60% Remedial Design Basis of Design Report

Appendix F
Geotechnical Design Analysis

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ABBREVIATIONS

ARCS	Assessment and Remediation of Contaminated Sediments
bgs	below ground surface
BODR	*Basis of Design Report*
CPT	cone penetrometer test
DER	*Pre-Design Investigation Data Evaluation Report for the Lower Duwamish Waterway – Middle Reach*
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	*Record of Decision*
SPT	standard penetration test
ST	structure number

USCS	Unified Soil Classification System
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 Intermediate (60%) 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 F2-1a through F2-1e. 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 bgs 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, and as correlated to standard penetration test (SPT) results in this unit (average 126 pcf, range 84 to 140 pcf). Grain size distribution tests (sieve and hydrometer) 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. SPT testing indicates a friction angle average near 33 degrees based on an average corrected blowcount $(N_1)_{60}$ of 18 (range 0 to >50).

Unified Soil Classification System (USCS) classifications of sample intervals from this unit include GM, SP, SM, and ML.

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. This is within the range of correlated SPT results (average 104 pcf, range 84 to 119 pcf). The geotechnical moisture content ranges 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. The plasticity index ranges from 10% to 21% and liquid limit

ranges from 45% to 63%. VST, FFP, and CPT testing indicate undrained shear strengths ranging as shown in Figure F2-2a. Grain size sieve and hydrometer 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%. SPT results indicate an average corrected blowcount $(N_1)_{60}$ of 4 (range 0 to 31).

USCS classifications of sample intervals from this unit include OL, OH, ML, MH, and SM.

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 sieve and hydrometer 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 (SPT correlated average of 126 pcf and range of 105 to 128 pcf), a laboratory-measured peak friction angle of 43 degrees. In situ SPT testing suggests a friction angle average near 32 degrees (range 0 to 30 from SPT testing) based on an average corrected blowcount $(N_1)_{60}$ of 16 (range 0 to >50). The measured geotechnical natural moisture content within this unit ranged from 9% to 69%, with an average of approximately 32%.

USCS classifications of sample intervals from this unit include SP, SP-SM, and SM. The alluvium unit was the deepest layer encountered during the geotechnical PDI, and because the bottom of this unit was not reached, the thickness of this unit was not determined. Based on geologic information presented in the feasibility study (AECOM 2012), it is inferred that a dense glacial or post-glacial unit of transitional silts underlies the alluvium.

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 F2-2a. 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 modeling parameters are presented in Table F2-2.

Table F2-2
Soil Parameters for Modeling Slope Stability and Consolidation Settlement

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 $CR = c_c/(1+e_0)$ (unitless)
Fill	125	N/A	50	30 to 33[3]	See Note 2
Recent sediments	100	75+32.5*Z; ≤400	0	32	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.
3. In general, a friction angle of 30 degrees was used for fill materials. However, in certain locations where the existing slope had a factor of safety less than 1 using this assumption, the fill friction angle was increased until a factor of safety greater than 1 was achieved.

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 is used for evaluating new loads placed on top of the surface, such as a cap being placed on top of sediments. Undrained strength evaluations represent the critical case for loading because the factor of safety increases over time due to consolidation (Ladd 1986).

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 F2-2a 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 represents the critical condition for unloading problems, such as excavation or dredging, because negative excess pore pressures temporarily increase sediment strength immediately after the load is removed (Ladd 1986). As these negative excess pore pressures equilibrate over time, the factor of safety decreases.

Drained shear strength also 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, consolidated drained direct shear tests and consolidated undrained triaxial compression 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. Figure F2-2b presents the results of consolidated undrained triaxial shear test results for sediment samples as compared to the design assumption used in modeling. See Table F2-2 for a summary of friction angles and cohesion 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). This drainage allows the void spaces in the soil/sediment to compress.

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 and also within the range reported for normally consolidated clays based on plasticity (DoD 2022).

3 Geotechnical Engineering Analysis

This section discusses the following geotechnical engineering analyses prepared in support of the Intermediate (60%) 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 [ratio]) 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.

For the slope stability modeling described in this section, upland groundwater elevations ranging from 8 feet to 11.3 feet MLLW were selected based on nearby borings, and models were run for both the high tide and low tide to evaluate sensitivity to surface water elevations so as to bracket the range of potential results. The lowest factor of safety from the two tide stages evaluated is reported in the summary table F3-1.

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

Location	Dredge Bottom Elevation[1] (feet MLLW)	Scenario	Target Factor of Safety	Side Slope	Minimum Factor of Safety[2]
RAL Exceedance Area 30 (STA 133+40)	-36	Short Term	1.3	2H:1V	1.3
		Long Term	1.5	2.5H:1V	1.6
		Seismic 100-year Seismic 475-year	1.0 to 1.15	2.5H:1V	0.9 0.6
RAL Exceedance Area 27A (STA 142+67)	3.5-foot-thick cut	Short Term	1.3	3H:1V	0.9[3]
		Long Term	1.5	3H:1V	1.1[3]
		Seismic 100-year Seismic 475-year	1.0 to 1.15	3H:1V	0.9 0.7
RAL Exceedance Area 22 (STA 149+45)	-29	Short Term	1.3	2H:1V	1.3
		Long Term	1.5	3H:1V	1.9
		Seismic 100-year Seismic 475-year	1.0 to 1.15	3H:1V	1.1 0.6
RAL Exceedance Area 20 (STA 153 to 154)	4-foot-thick cut	Short Term	1.3	2H:1V	1.0[3]
		Long Term	1.5	2.5H:1V	1.5
		Seismic 100-year Seismic 475-year	1.0 to 1.15	2.5H:1V	1.1 0.9
RAL Exceedance Area 11 (STA 166+05)	-30	Short Term	1.3	2H:1V	1.3
		Long Term	1.5	3H:1V	1.9
		Seismic 100-year Seismic 475-year	1.0 to 1.15	3H:1V	1.5 1.0

Notes:

1. Dredge bottom elevation or cut thickness includes required dredge elevation/thickness + 1 foot of allowable overdredge.
2. Minimum factor of safety reported for either the MHHW or MLLW river stage, whichever is lower.
3. The existing factor of safety for this slope is 1.1. The dredge cut and geology will be revisited during Pre-Final (90%) RD to evaluate potential model updates and measures such as slope offsets, if needed, to protect the slope.

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 F-20. Cross section locations are shown in Figures F2-1b to F2-1d. With the exception of the locations noted on the table, for 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 Intermediate (60%) 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 Pre-Final (90%) 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 Intermediate (60%) 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:

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

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

Equation F3-2

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

where:

$\mathrm{q_{all}}$	=	allowable bearing capacity (psf)
FOS	=	Factor of Safety = 1.5

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

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:

h	=	lift thickness
γ'	=	buoyant unit weight of cap material (pcf)
γ'	=	$\gamma - \gamma_w$
γ	=	total unit weight of cap material (pcf)
γ_w	=	unit weight of water (64 pcf)
γ'	=	110 pcf − 64 pcf = 46 pcf

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

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:

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

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

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. As such, sediments being loaded by the cap are assumed to be consolidating in virgin compression, and the pre-consolidation pressure is ignored in the calculation. 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, after which (during Pre-Final [90%] RD) site-specific analyses can be evaluated with precise sediment thicknesses. Table F3-2 provides a general subgrade consolidation evaluation with varying sediment thicknesses for the Intermediate (60%) 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 F3-3 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 F3-3, 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 Pre-Final (90%) 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 F3-4 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 Intermediate (60%) RD evaluation, the factor of safety for a 3H:1V backfill slope was computed using the following equation:

Equation F3-6

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

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.

Some dredge areas adjacent to the FNC may not be able to accommodate a 3H:1V backfill slope because the slope would encroach within the navigation channel above the authorized depth. In these cases, steeper backfill slopes will be used. Where steeper slopes are needed, armor rock will be used for the backfill material. Armor rock 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). In an infinite slope evaluation, assuming an armor rock friction angle of 38 degrees, slopes of 2H:1V have a factor of safety of 1.6. For armor rock friction angle of 42 degrees, slopes of 1.75H:1V have a factor of safety of 1.6. Both cases are greater than the target long-term factor of safety of 1.5. Thus, backfill could be placed on 2H:1V to 1.75H:1V slopes if angular armor rock is used.

The infinite slope evaluation for armor rock backfill was checked using limit equilibrium slope stability assuming an intermediate friction angle (40 degrees) for the armor rock, as presented in Table F2-2. Limit equilibrium slope stability evaluation confirms that the long-term factor of safety of a 2.5H:1V backfill placed on 2H:1V dredge cuts has a factor of safety greater than 1.5.

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 Intermediate (60%) 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 Intermediate (60%) 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 F2-1c). 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 F2-1c). 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 F2-1c. 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 Intermediate (60%) 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

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

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

	Reduction Factor Based on Side Slope			
Offset Distance	**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 Table F4-2, 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 Intermediate (60%) 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 F4-3 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:
ft^2: 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 Intermediate (60%) RD.

Some piles may need to be removed during construction. Pile removal best management practices were developed by the Washington Department of Natural Resources (DNR 2017) by adapting

protocols prepared by EPA Region 10. These protocols will be included in project specifications that govern demolition.

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. Typical target factors of safety for seismic slope stability range from 1.0 to 1.15 (Duncan and Wright 2005). For the 475-year earthquake, the resulting factor of safety was less

than 1.0, indicating that some movement of the capped slope can be expected during the earthquake.

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). Other methods of evaluation are available, including considering specific earthquake magnitude and distance combinations. However, in any case it is expected that regardless of the method selected and the earthquake magnitude and distance considered, some deformation would be predicted. Table F5-2 presents the estimated slope displacement for Container Properties under both earthquake scenarios based on the National Cooperative Highway Research Program.

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. Damage assessment and repairs would be addressed as part of the long-term monitoring and maintenance program.

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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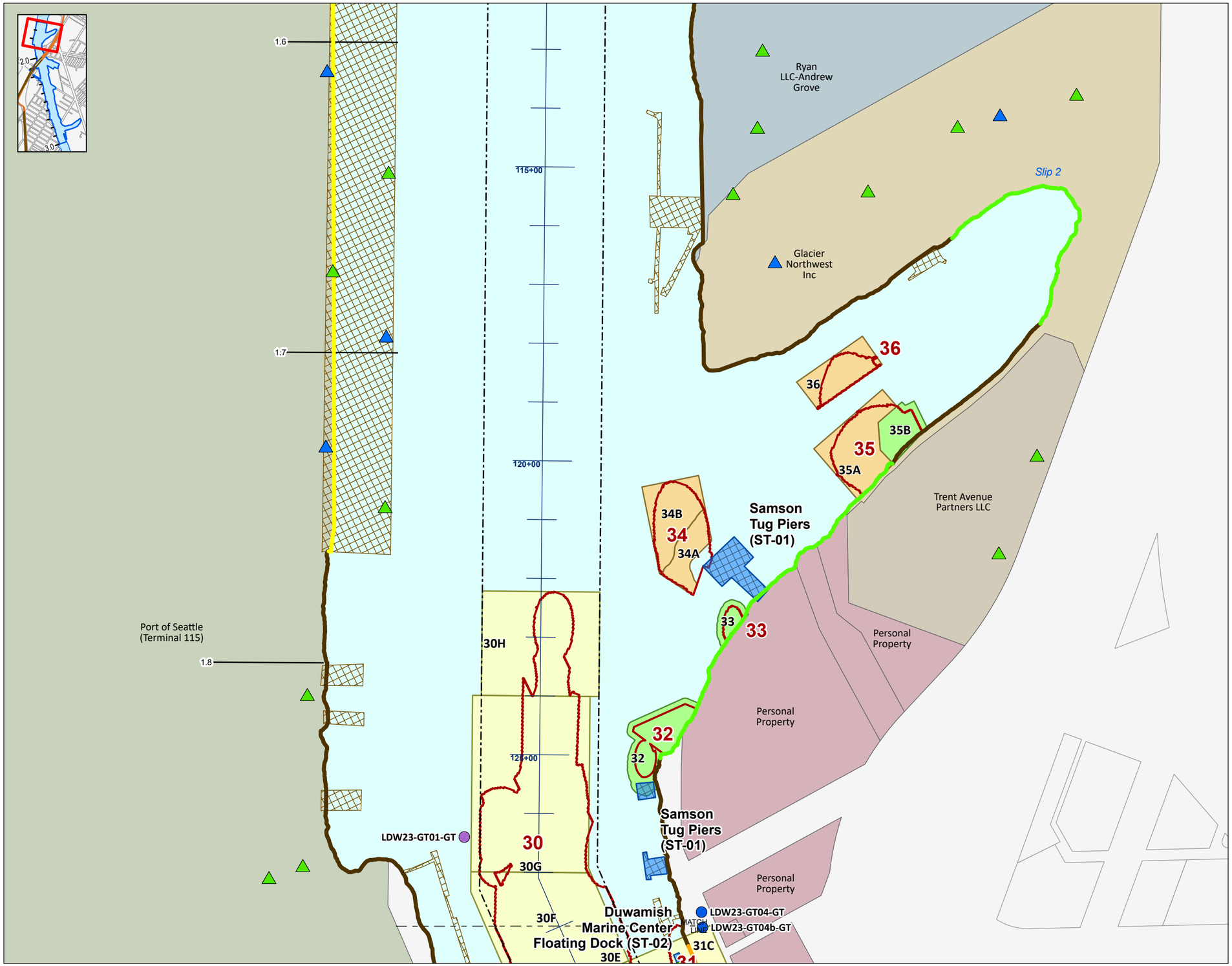
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Figures



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

Remedial action area technology assignments for 60% RD

- Dredge
- Partial dredge & cap
- ENR

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

N

0 100 200 Feet

0 25 50 Meters

Figure F2-1a. Middle Reach Geotechnical Data Locations, RM 1.6 to RM 1.85

APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH

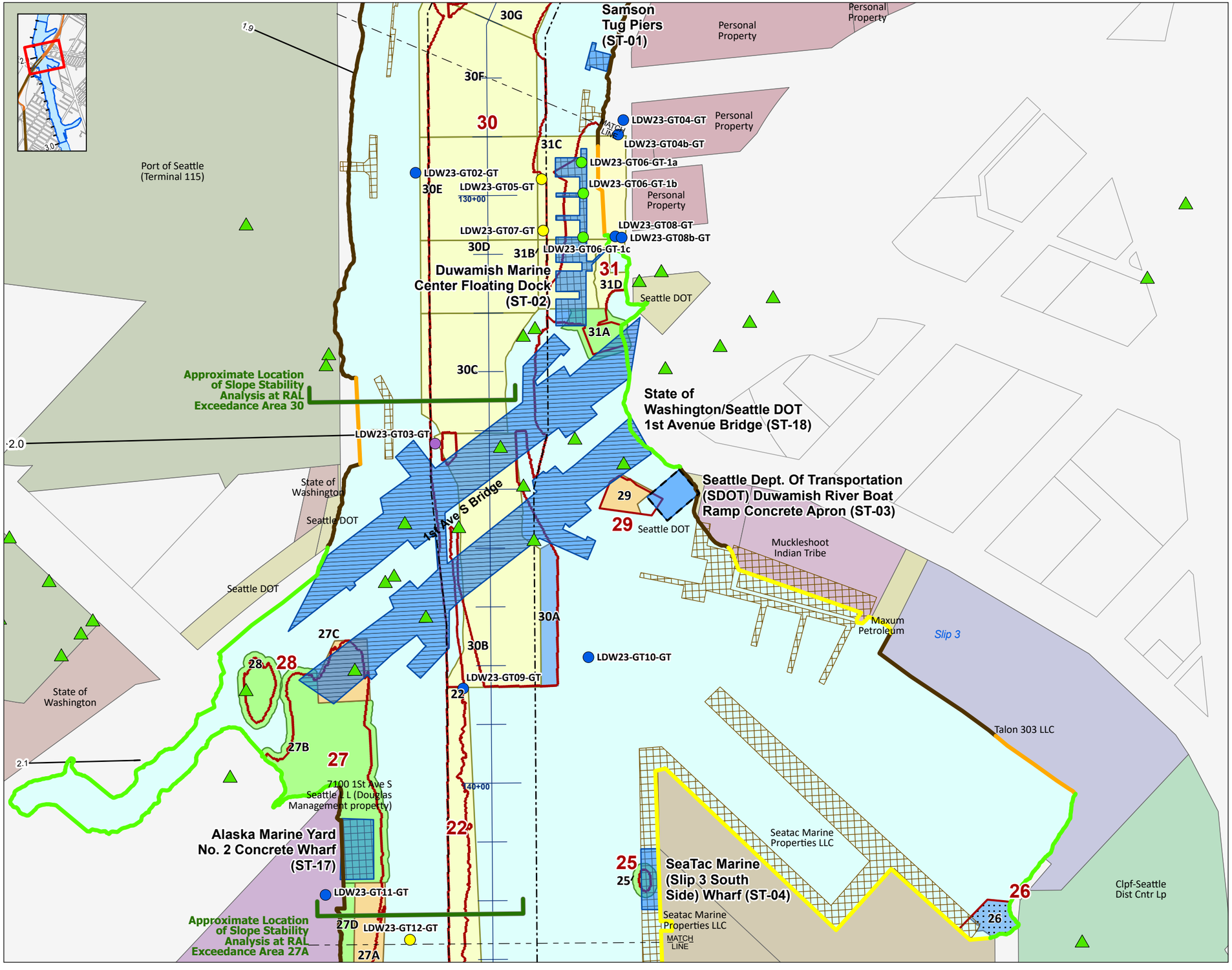
JULY 31, 2026

ANCHOR QEA

BARR

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
- Vane shear location
- Full-flow penetrometer location

Previous geotechnical studies by others

- Standard penetration test location
- 1 RAL exceedance area

Remedial action area technology assignments for 60% RD

- Dredge
- Partial dredge & cap
- Cap
- ENR
- Area-specific technology
- 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
- LDW Superfund Boundary
- LDW Superfund Boundary
- King Co tax parcel
- Federal Navigation Channel
- Federal Navigation Channel stations
- River mile

0 100 200 Feet
0 25 50 Meters

Figure F2-1b. Middle Reach Geotechnical Data Locations, RM 1.85 to RM 2.15

APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH

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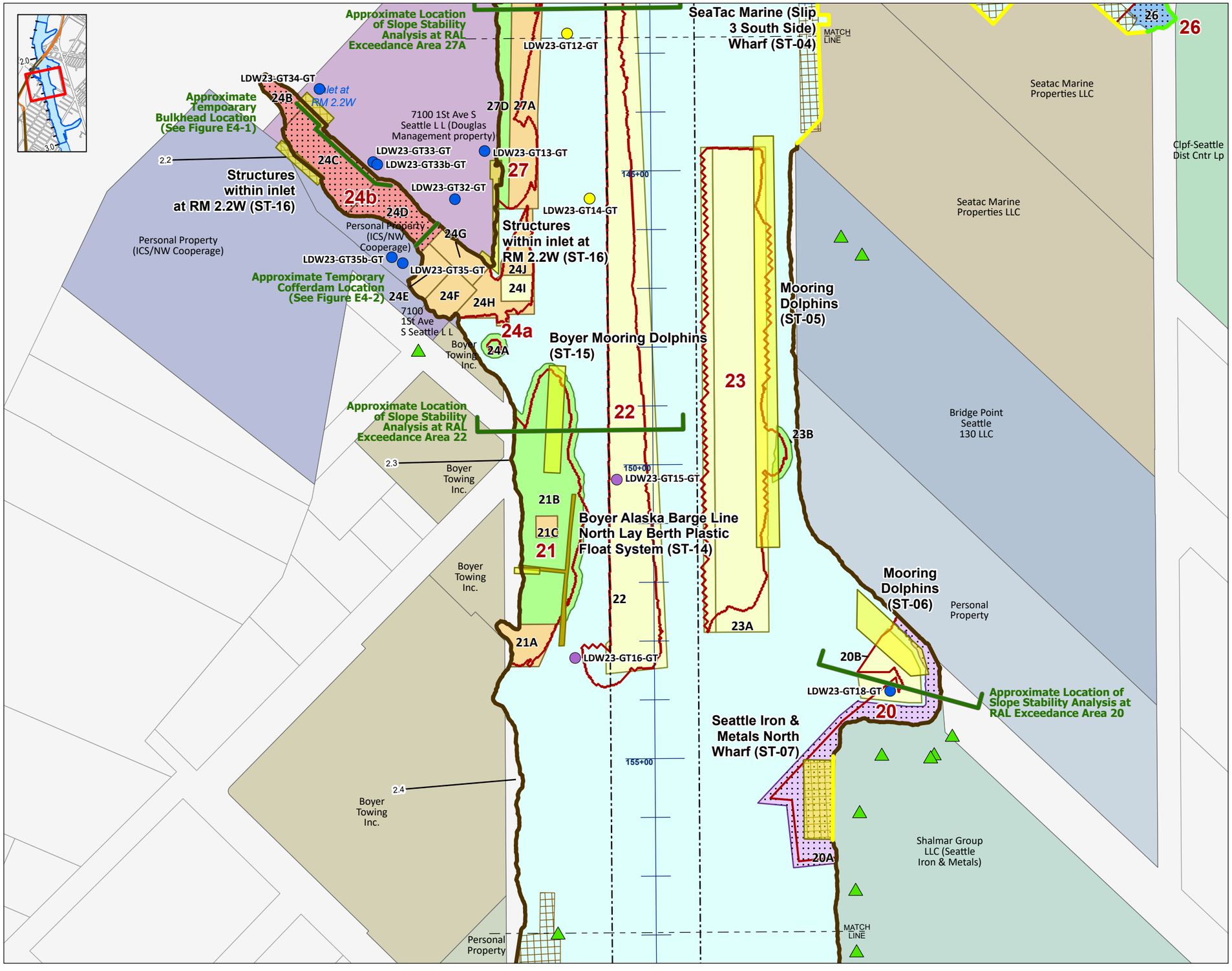


Figure F2-1c. Middle Reach Geotechnical Data Locations, RM 2.15 to RM 2.45

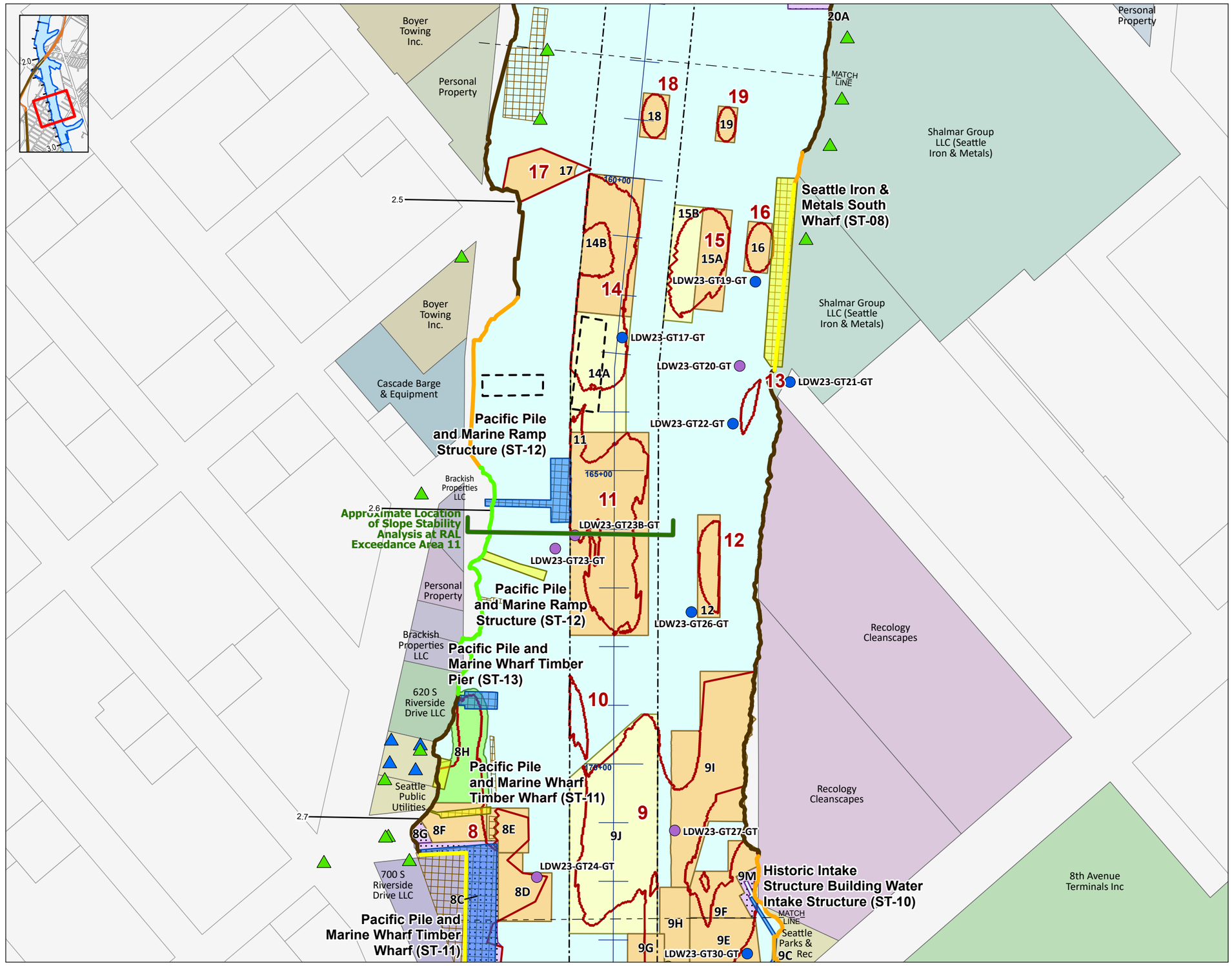
APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH

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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

Remedial action area technology assignments for 60% RD
- Dredge
- Partial dredge & cap
- Amended ENR
- ENR
- Area-specific technology
- 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

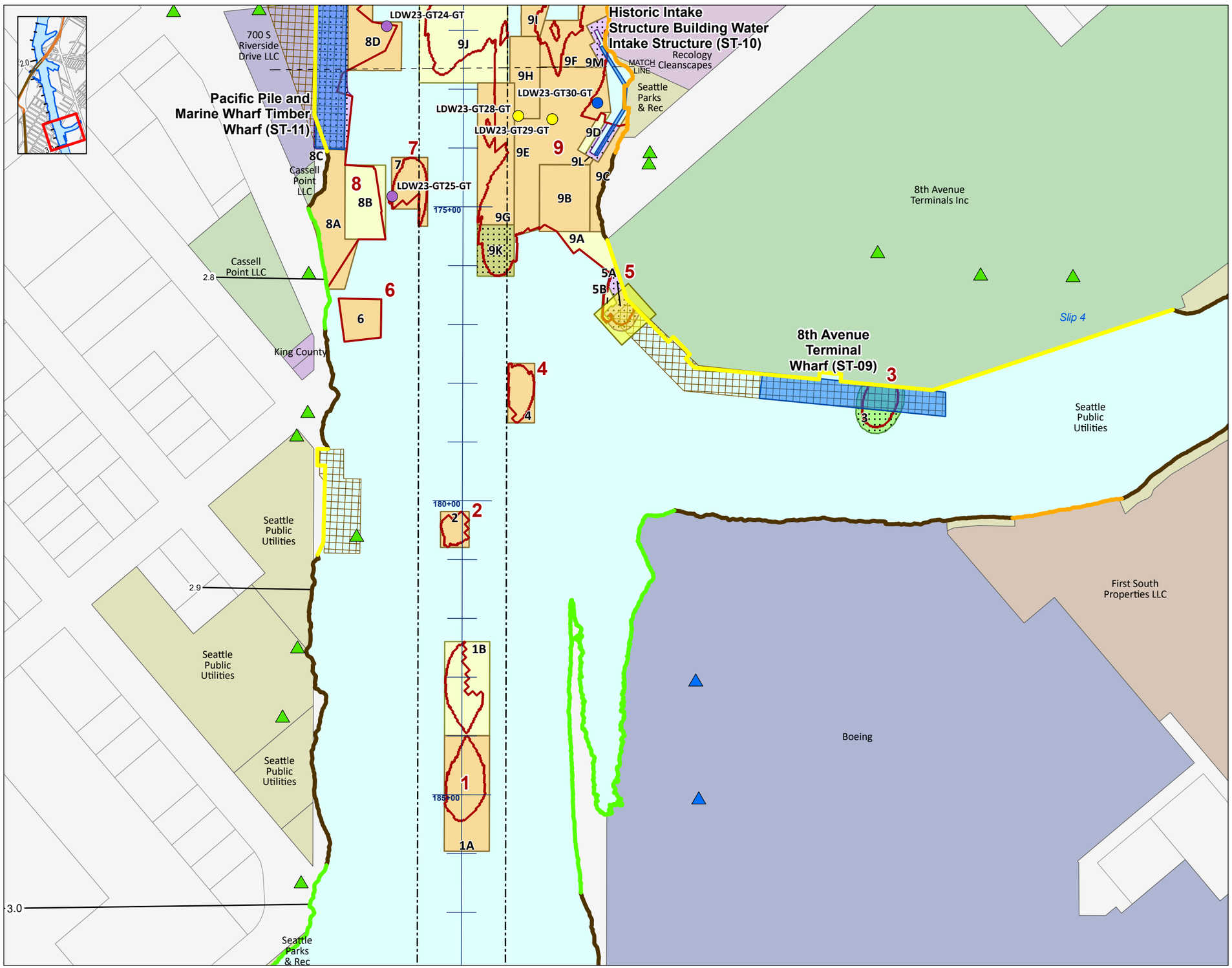
0 100 200 Feet
0 25 50 Meters

Figure F2-1d. Middle Reach Geotechnical Data Locations, RM 2.45 to RM 2.75

APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
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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

Remedial action area technology assignments for 60% RD

- Dredge
- Partial dredge & cap
- Amended ENR
- ENR
- Utility crossing cover
- Area-specific technology

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

0 100 200 Feet
0 25 50 Meters

Figure F2-1e. Middle Reach Geotechnical Data Locations, RM 2.75 to RM 3.0

APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH

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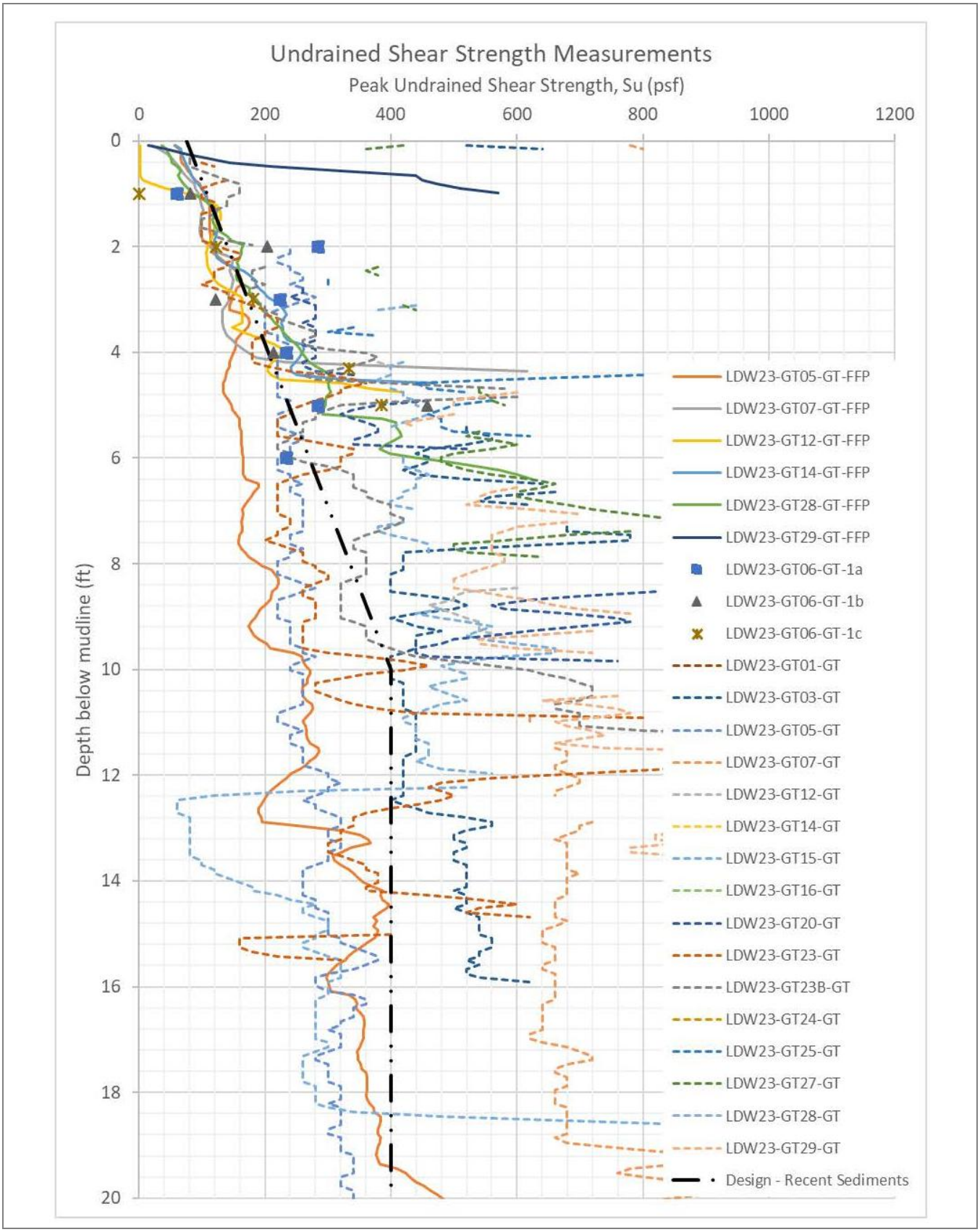


Figure F2-2a
Sediment Undrained Shear Strength Test Results and Design Assumptions

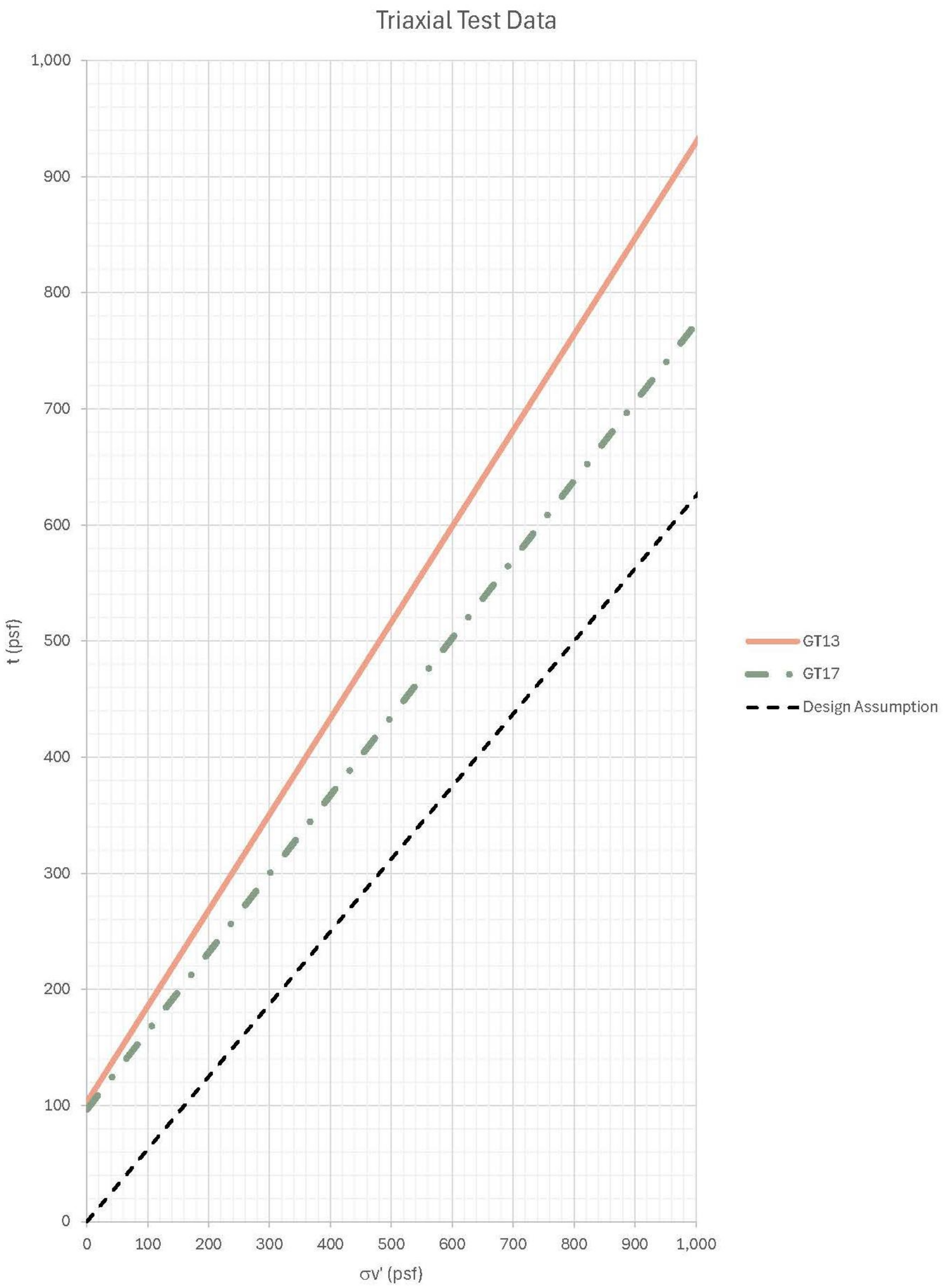
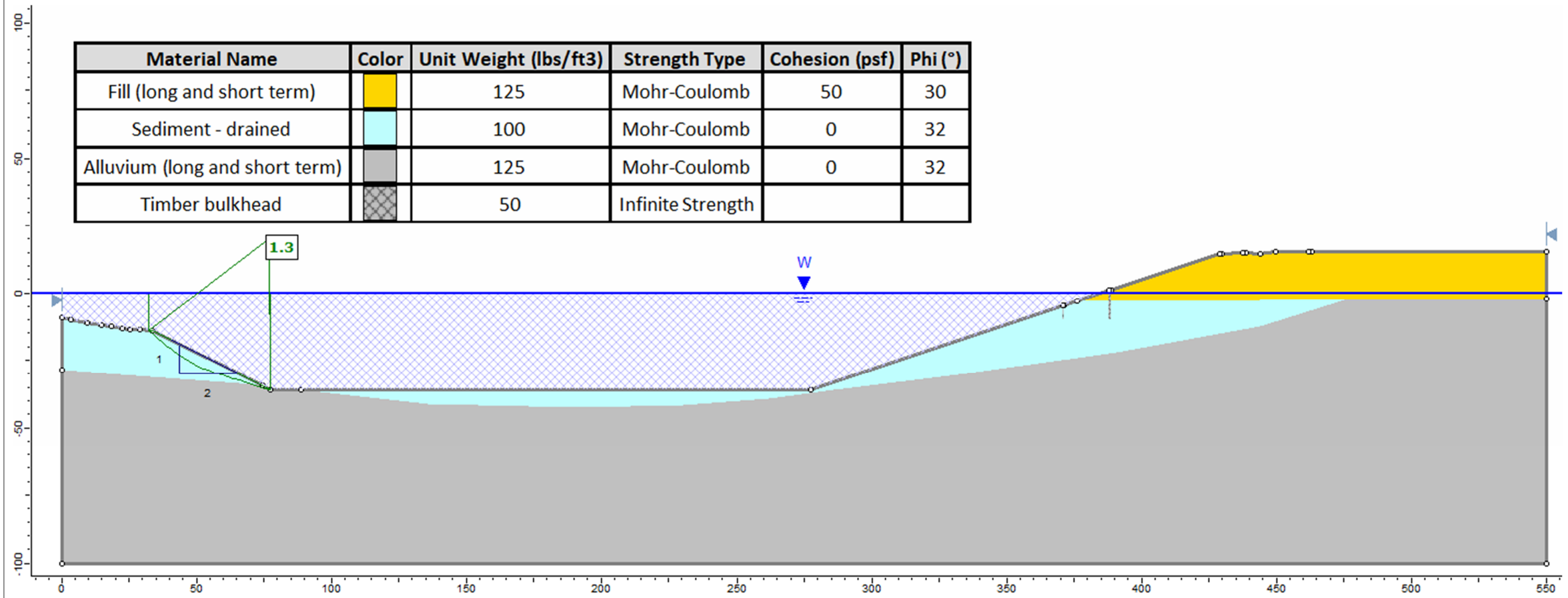


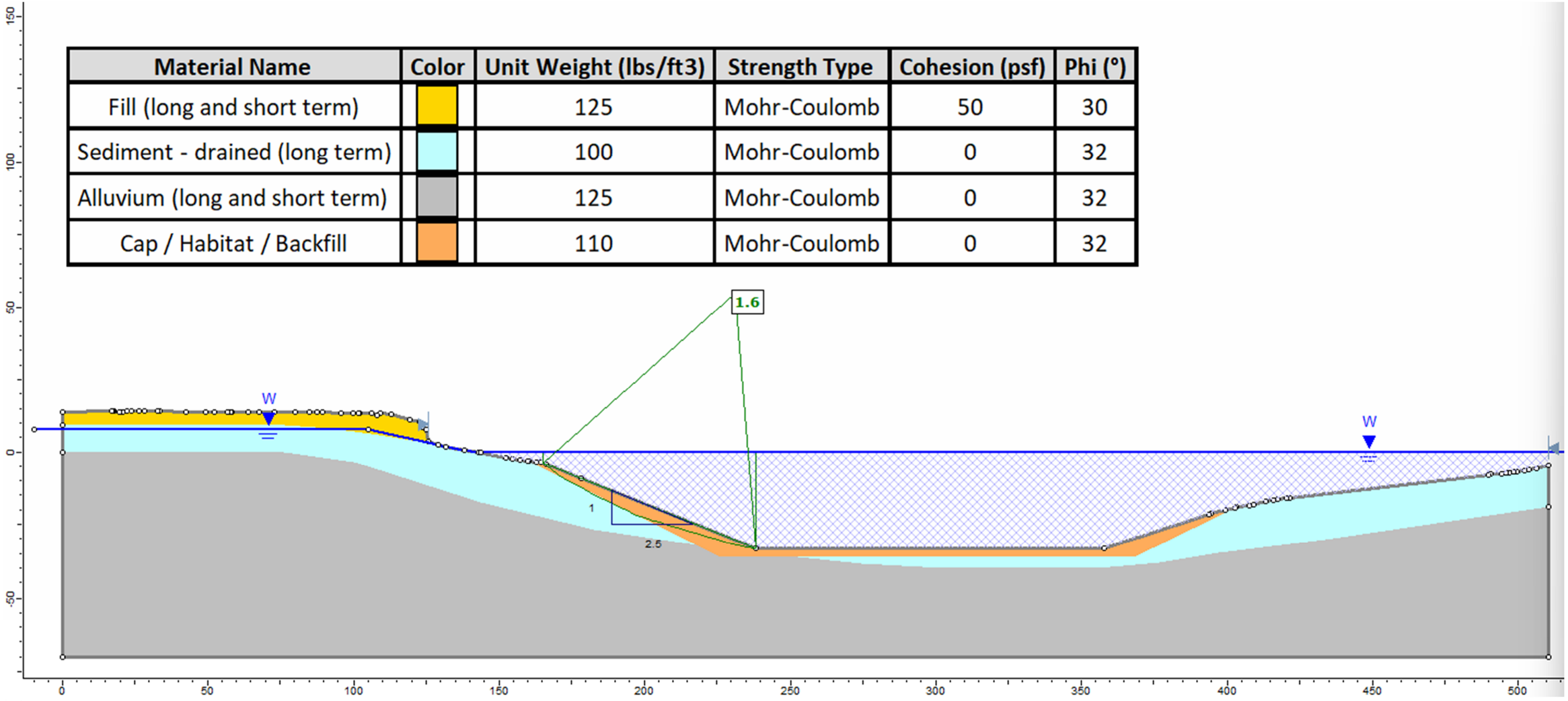
Figure F2-2b
CU Triaxial Test Results and Drained Shear Strength Design Assumptions for Sediment

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill (long and short term)		125	Mohr-Coulomb	50	30
Sediment - drained		100	Mohr-Coulomb	0	32
Alluvium (long and short term)		125	Mohr-Coulomb	0	32
Timber bulkhead		50	Infinite Strength		



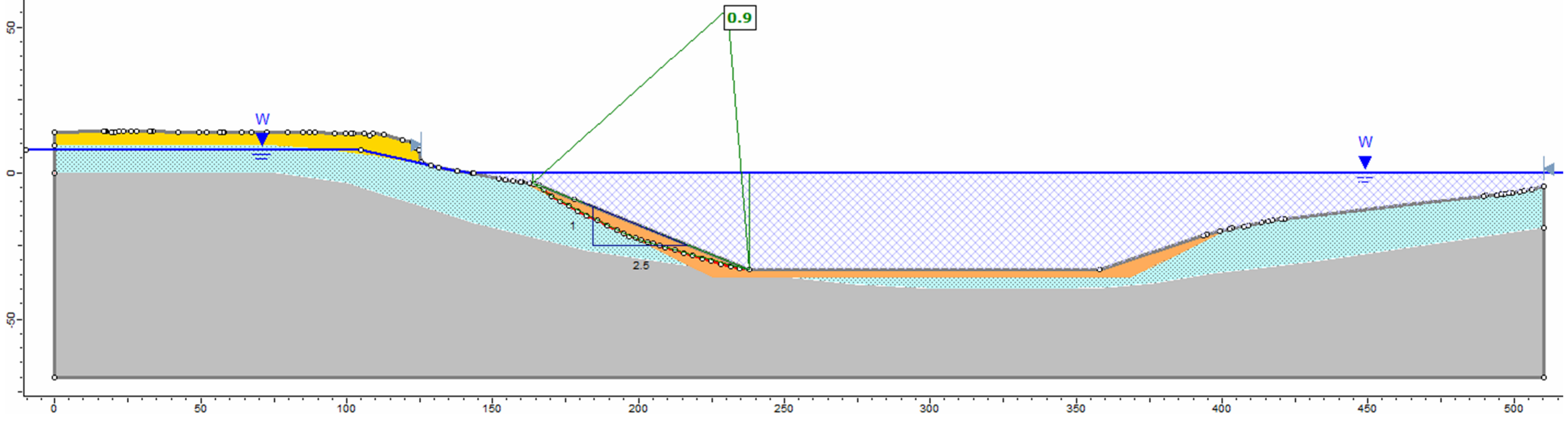
Notes:
The green number and line are the computed factor of safety and failure plane.
H:V: horizontal to vertical
lbs/ft^3: pounds per cubic foot
psf: pound per square foot
RAL: remedial action level

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill (long and short term)		125	Mohr-Coulomb	50	30
Sediment - drained (long term)		100	Mohr-Coulomb	0	32
Alluvium (long and short term)		125	Mohr-Coulomb	0	32
Cap / Habitat / Backfill		110	Mohr-Coulomb	0	32



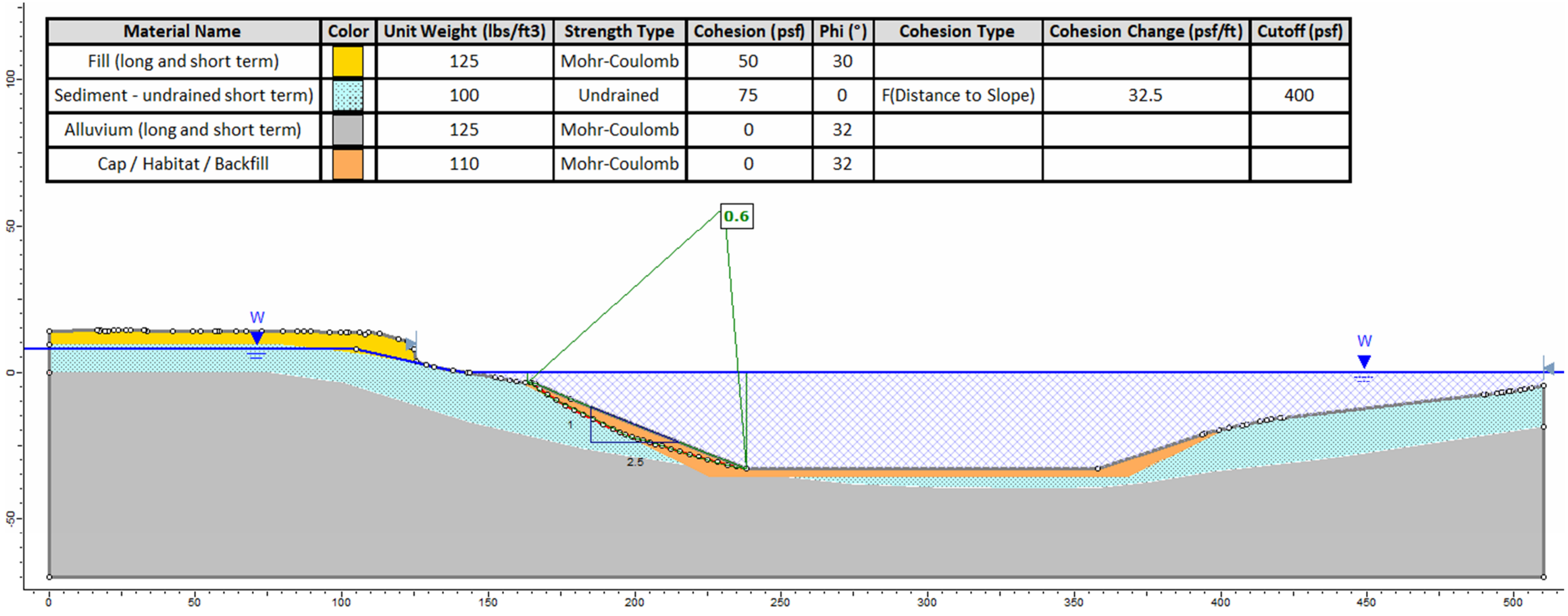
Notes:
The green number and line are the computed factor of safety and failure plane.
H:V: horizontal to vertical
lbs/ft^3: pounds per cubic foot
psf: pound per square foot
RAL: remedial action level

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Cohesion Type	Cohesion Change (psf/ft)	Cutoff (psf)
Fill (long and short term)		125	Mohr-Coulomb	50	30			
Sediment - undrained short term)		100	Undrained	75	0	F(Distance to Slope)	32.5	400
Alluvium (long and short term)		125	Mohr-Coulomb	0	32			
Cap / Habitat / Backfill		110	Mohr-Coulomb	0	32			

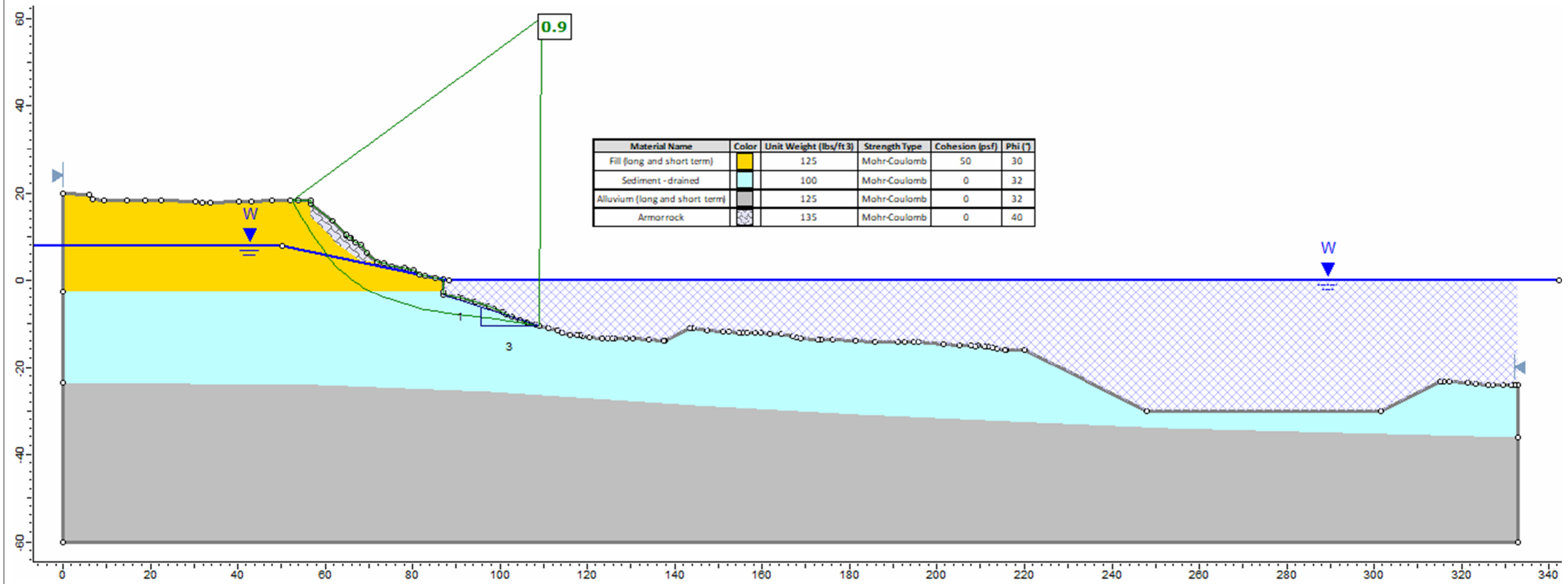


Notes:
The green number and line are the computed factor of safety and failure plane.
H:V: horizontal to vertical
lbs/ft^3: pounds per cubic foot
psf: pound per square foot
RAL: remedial action level

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Cohesion Type	Cohesion Change (psf/ft)	Cutoff (psf)
Fill (long and short term)		125	Mohr-Coulomb	50	30			
Sediment - undrained short term)		100	Undrained	75	0	F(Distance to Slope)	32.5	400
Alluvium (long and short term)		125	Mohr-Coulomb	0	32			
Cap / Habitat / Backfill		110	Mohr-Coulomb	0	32			

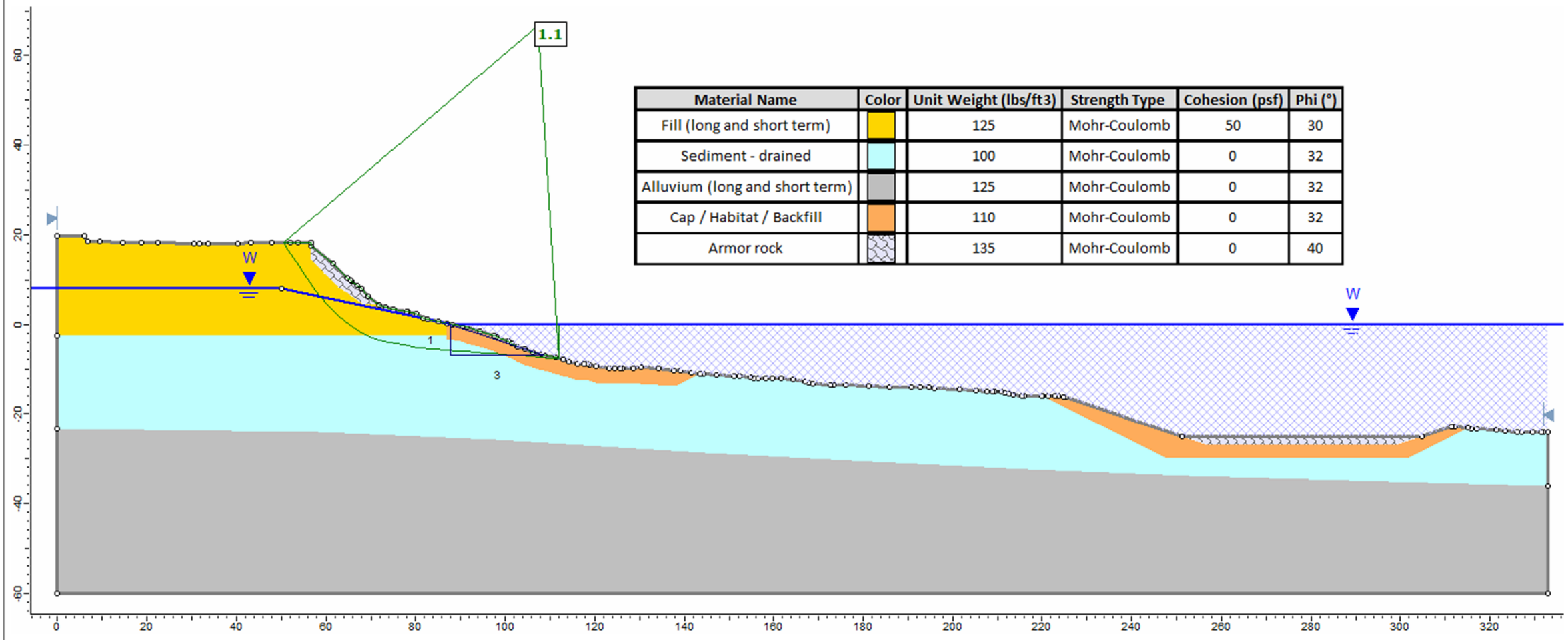


Notes:
The green number and line are the computed factor of safety and failure plane.
H:V: horizontal to vertical
lbs/ft^3: pounds per cubic foot
psf: pound per square foot
RAL: remedial action level



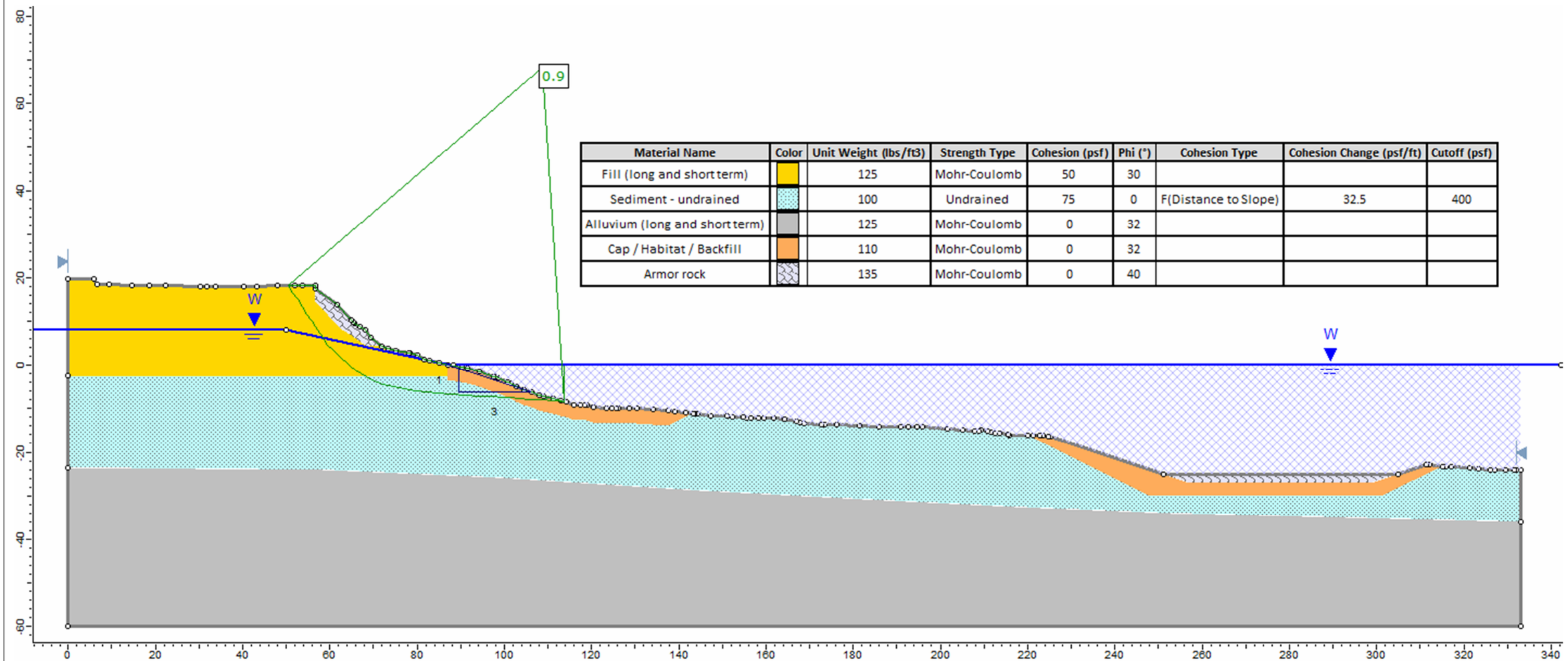
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill (long and short term)		125	Mohr-Coulomb	50	30
Sediment - drained		100	Mohr-Coulomb	0	32
Alluvium (long and short term)		125	Mohr-Coulomb	0	32
Armor rock		135	Mohr-Coulomb	0	40

Notes:
The green number and line are the computed factor of safety and failure plane.
H:V: horizontal to vertical
lbs/ft^3: pounds per cubic foot
psf: pound per square foot
RAL: remedial action level



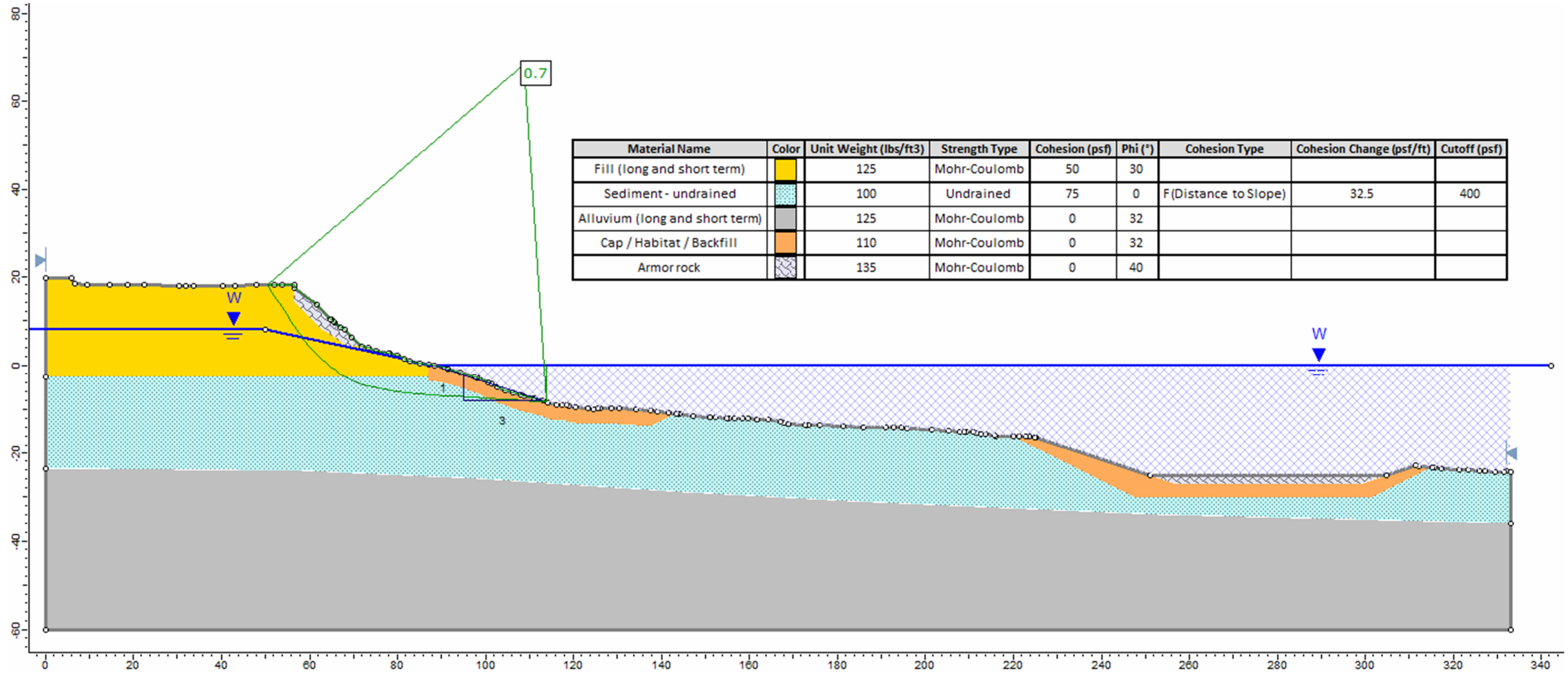
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill (long and short term)		125	Mohr-Coulomb	50	30
Sediment - drained		100	Mohr-Coulomb	0	32
Alluvium (long and short term)		125	Mohr-Coulomb	0	32
Cap / Habitat / Backfill		110	Mohr-Coulomb	0	32
Armor rock		135	Mohr-Coulomb	0	40

Notes:
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H:V: horizontal to vertical
lbs/ft^3: pounds per cubic foot
psf: pound per square foot
RAL: remedial action level



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Cohesion Type	Cohesion Change (psf/ft)	Cutoff (psf)
Fill (long and short term)		125	Mohr-Coulomb	50	30			
Sediment - undrained		100	Undrained	75	0	F(Distance to Slope)	32.5	400
Alluvium (long and short term)		125	Mohr-Coulomb	0	32			
Cap / Habitat / Backfill		110	Mohr-Coulomb	0	32			
Armor rock		135	Mohr-Coulomb	0	40			

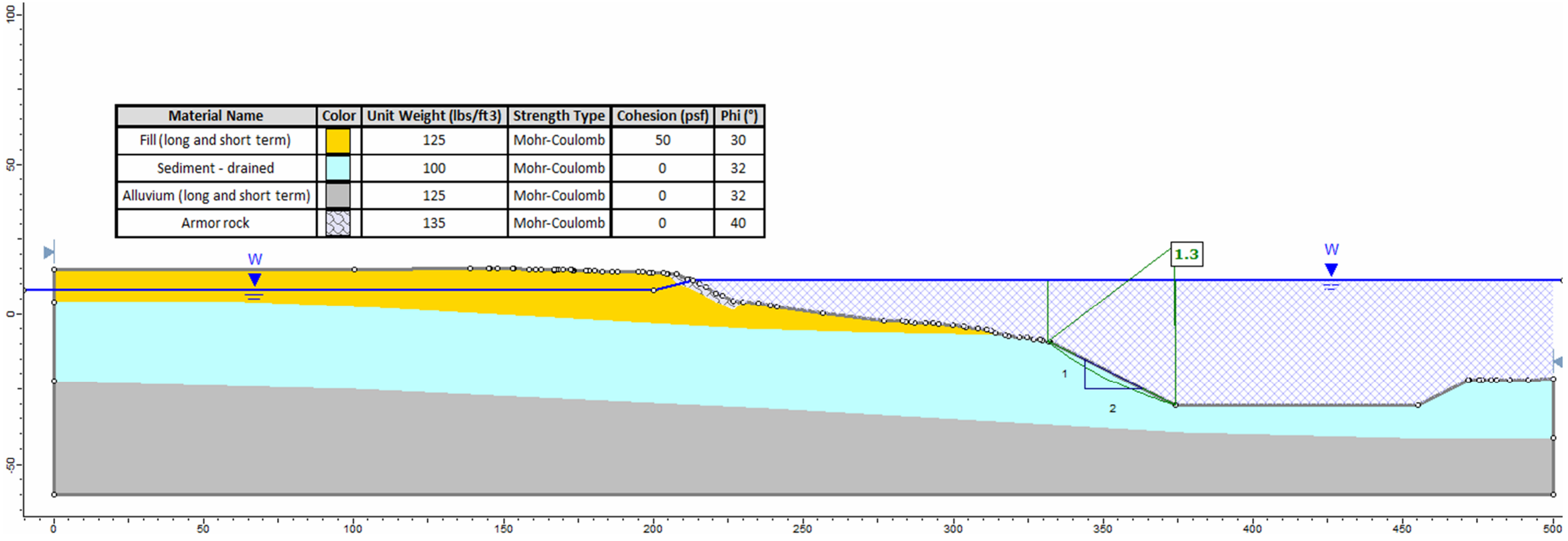
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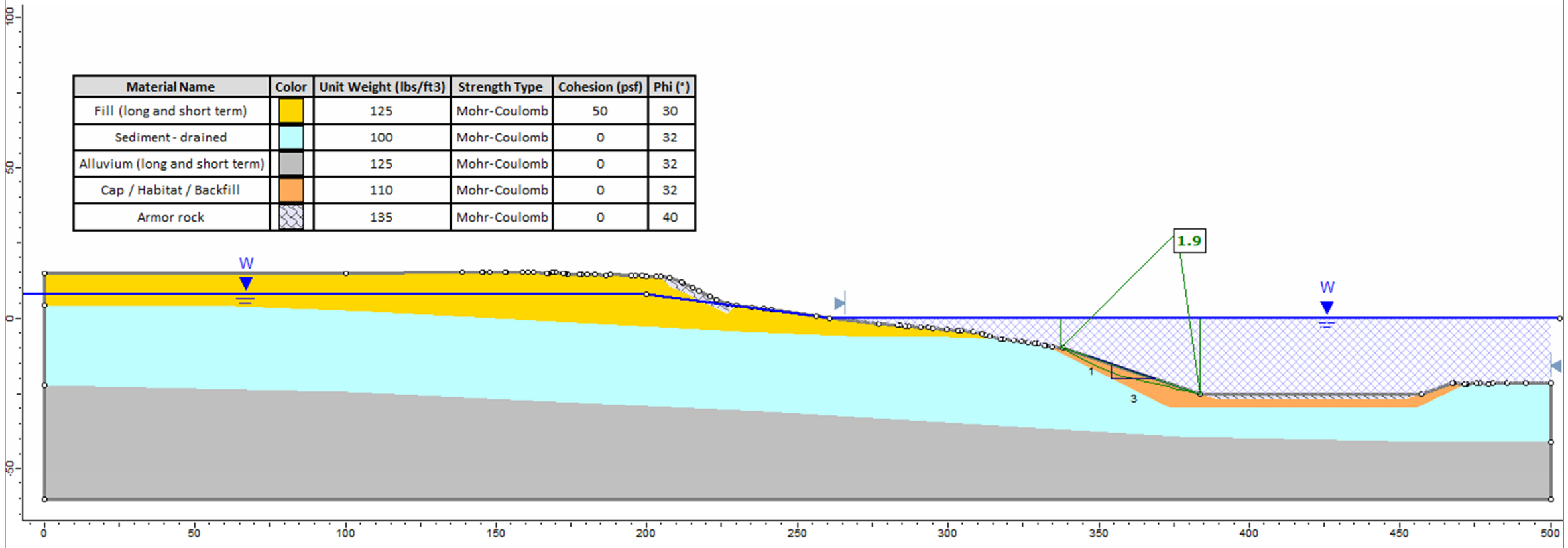
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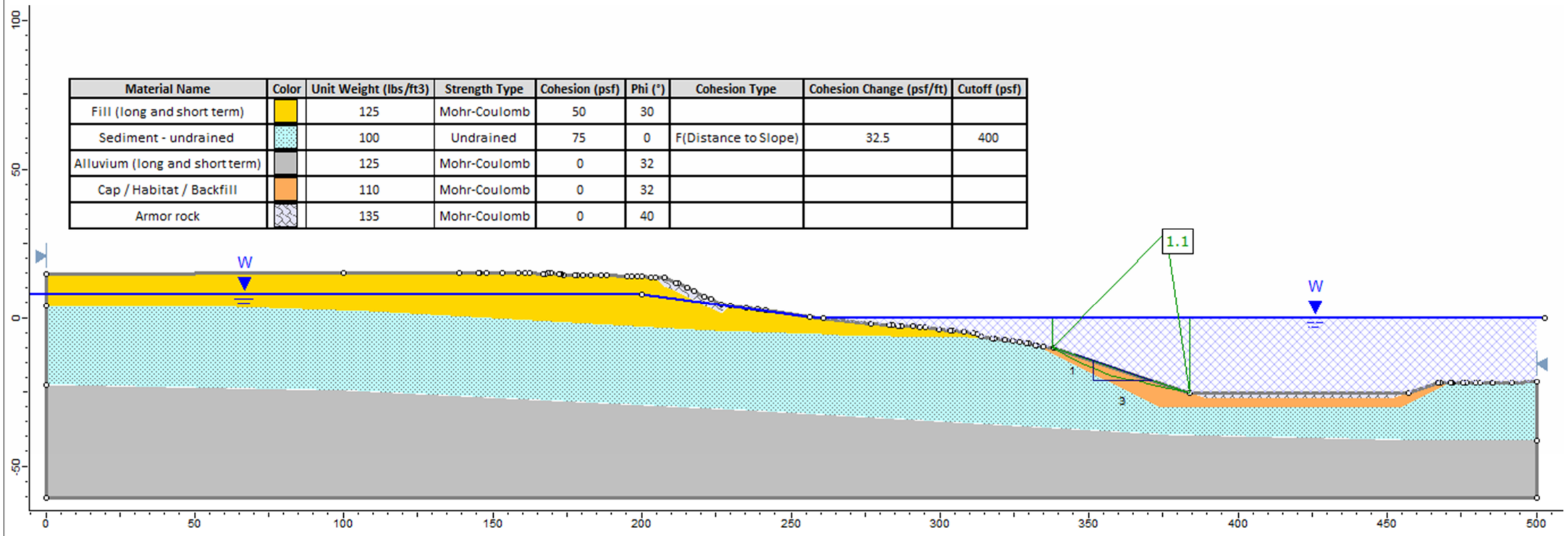
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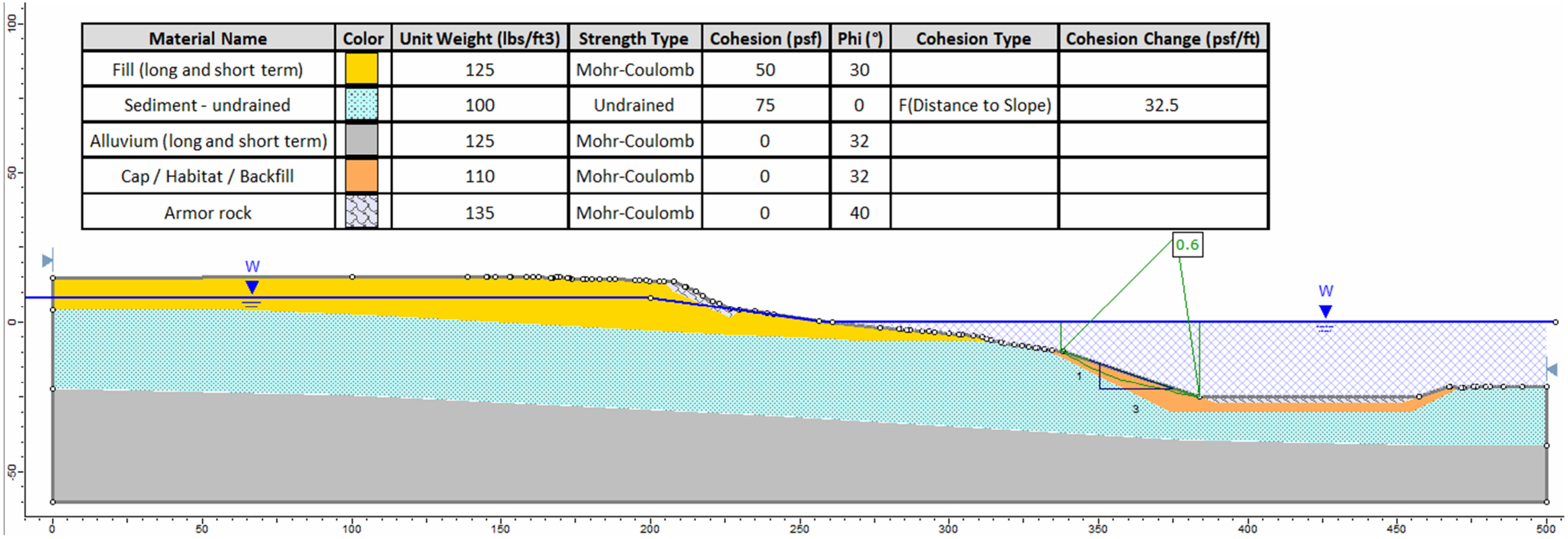
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Sediment - undrained		100	Undrained	75	0	F(Distance to Slope)	32.5	400
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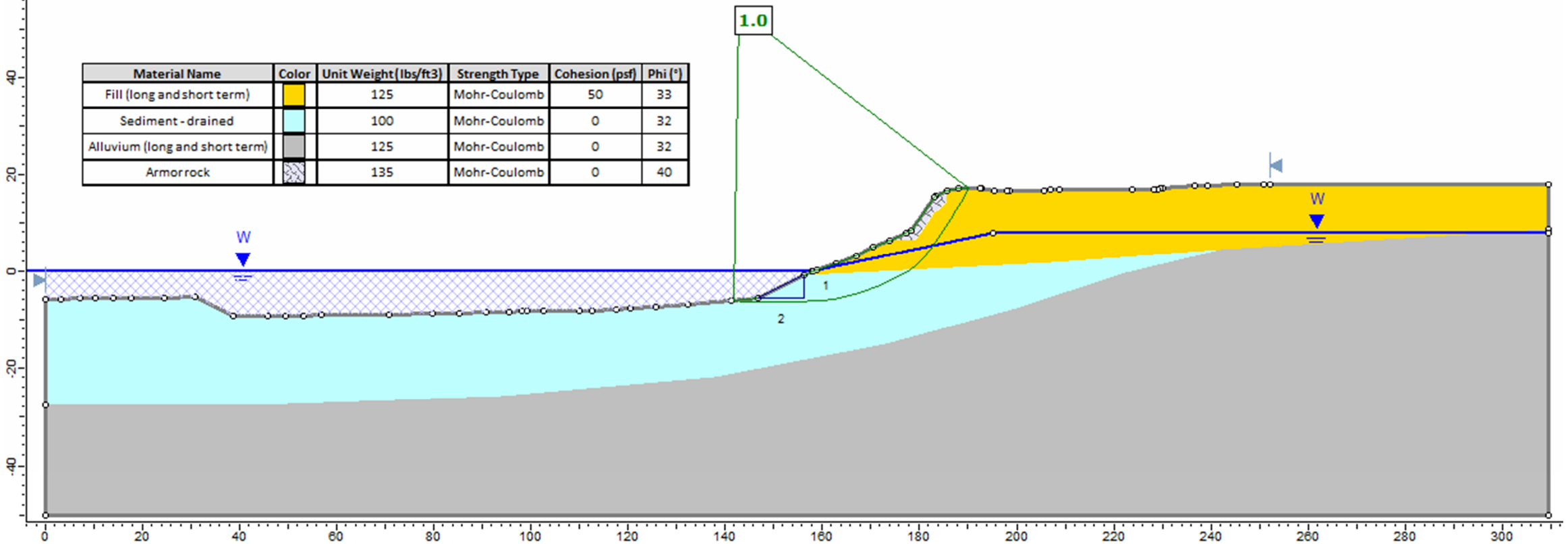
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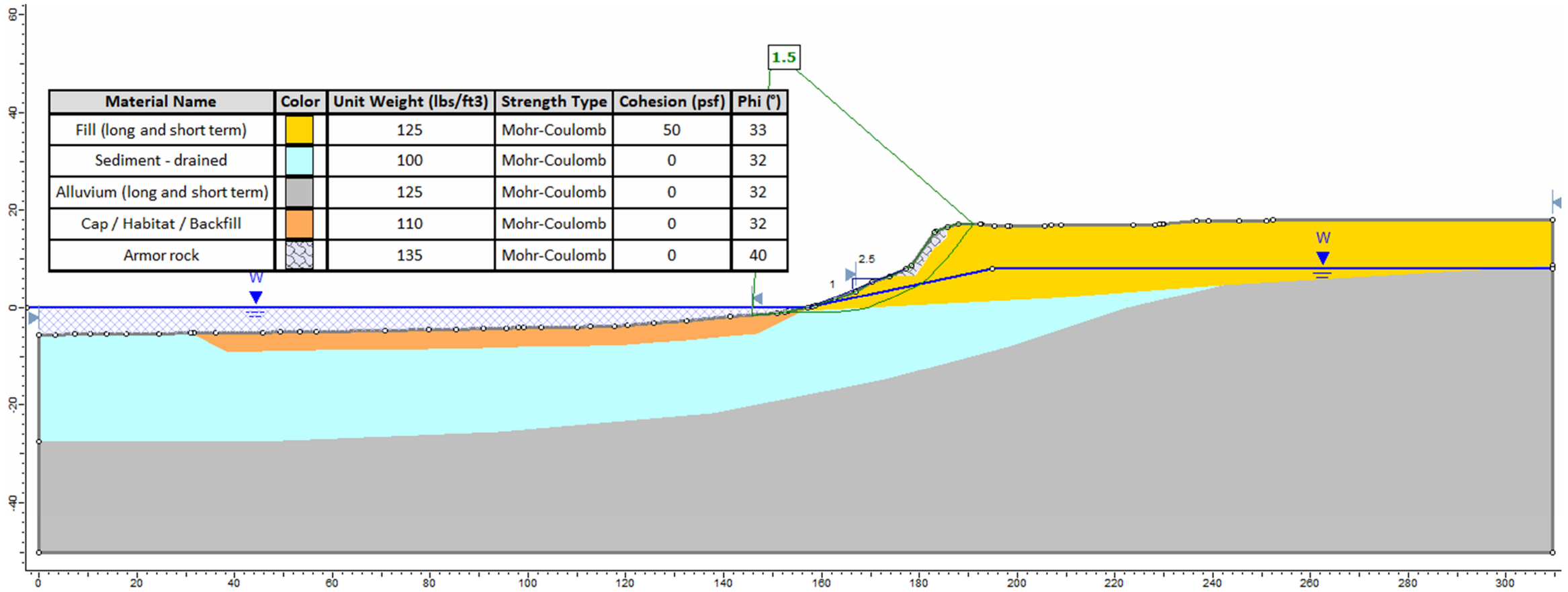
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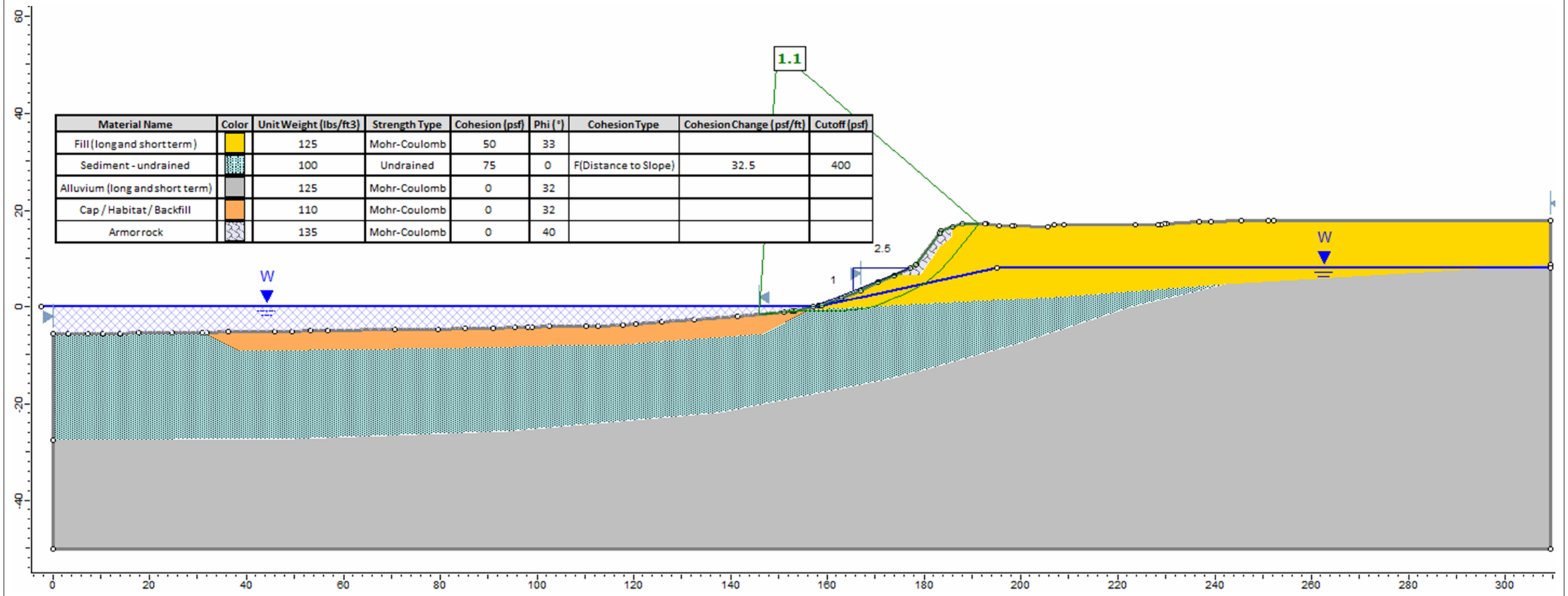
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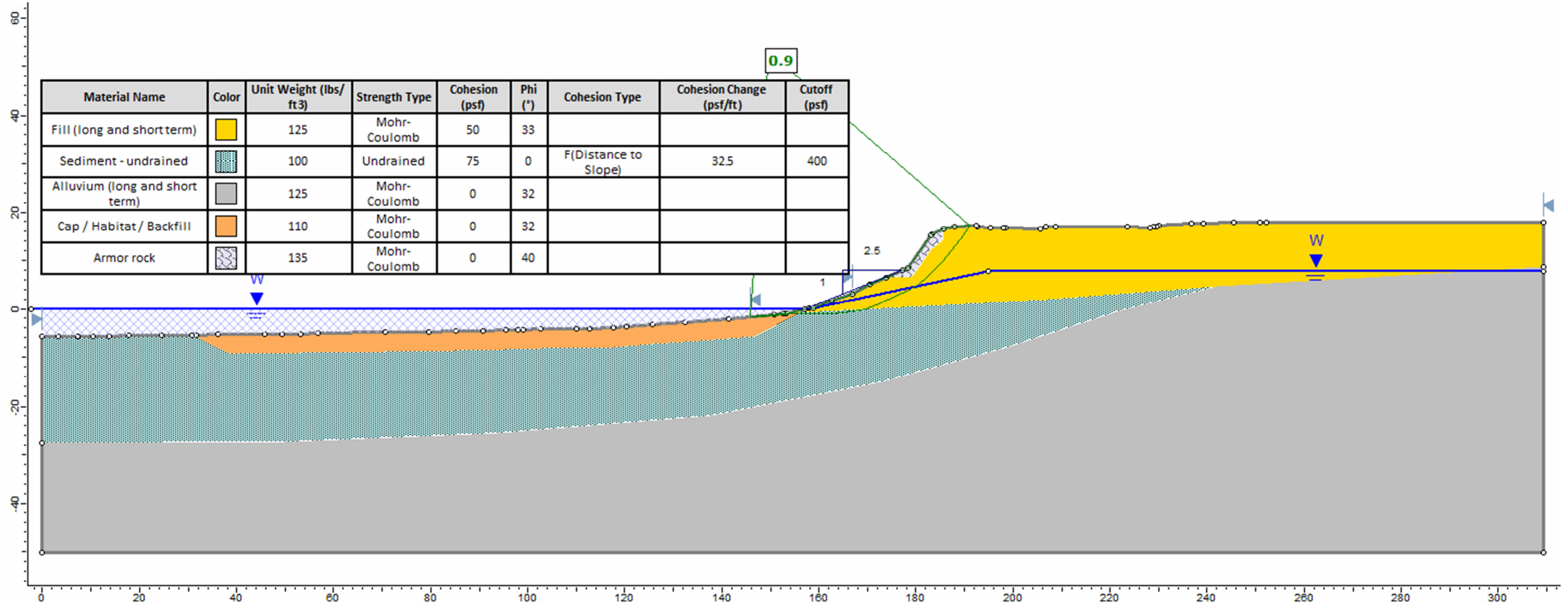
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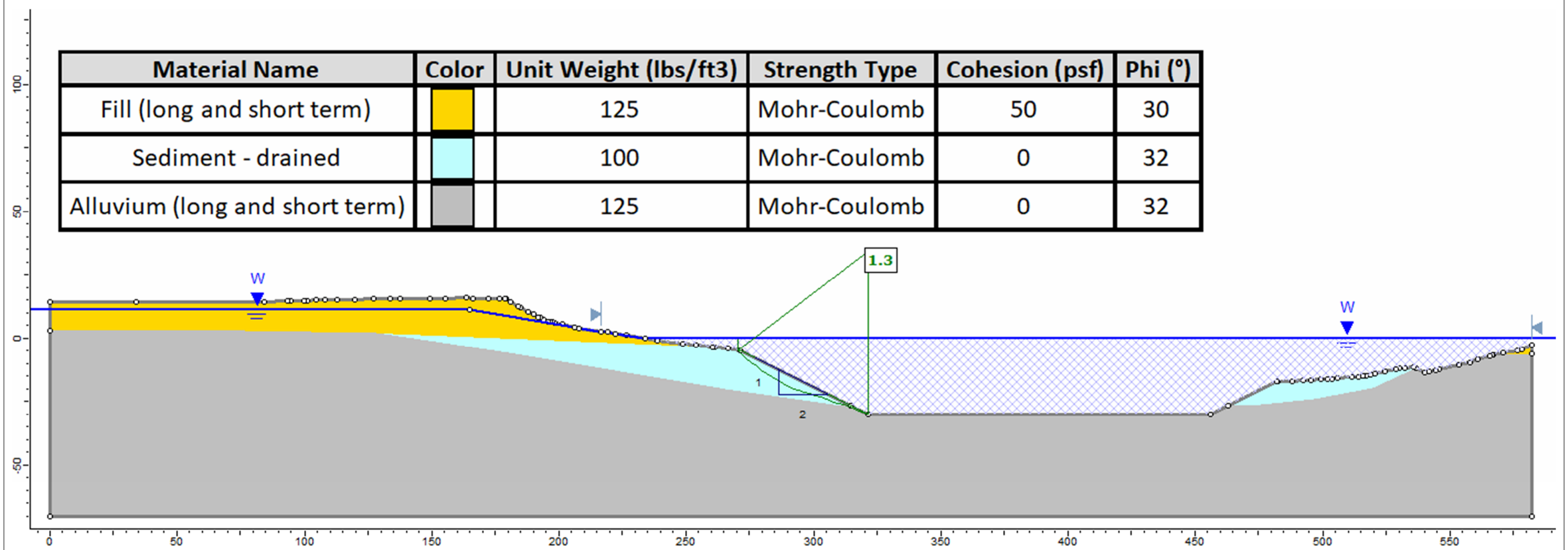
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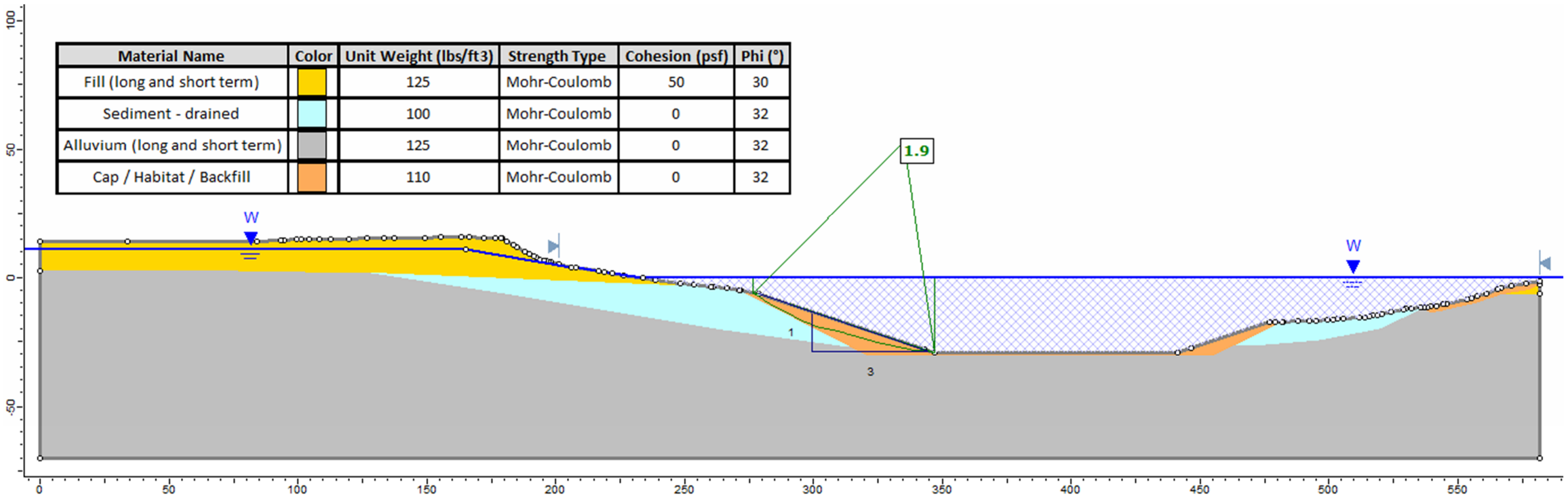
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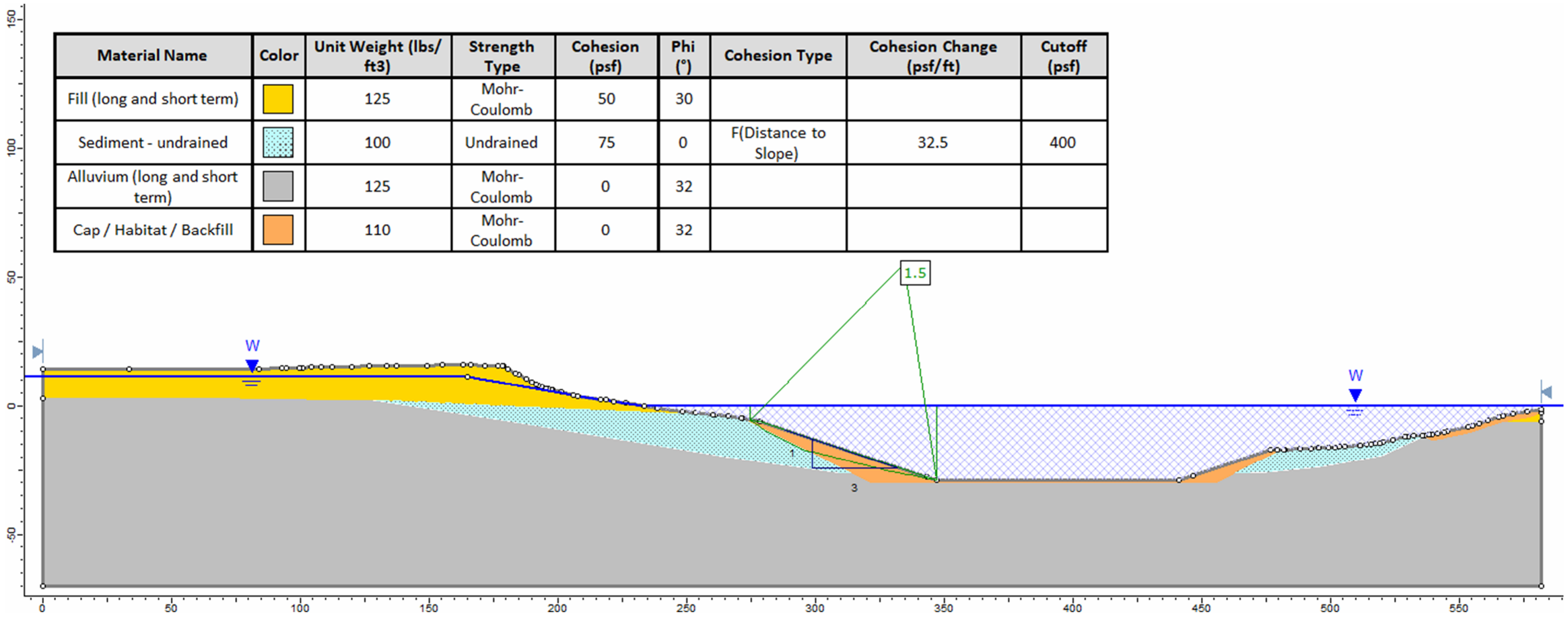
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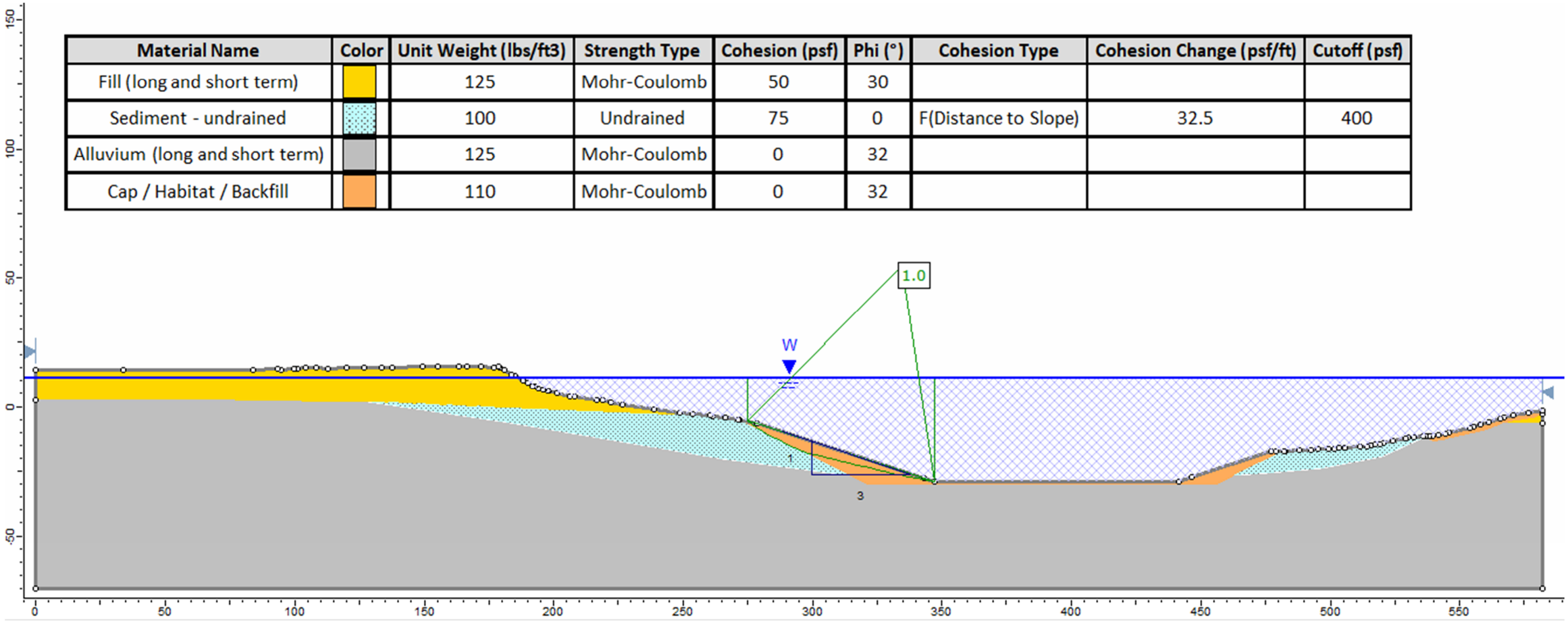
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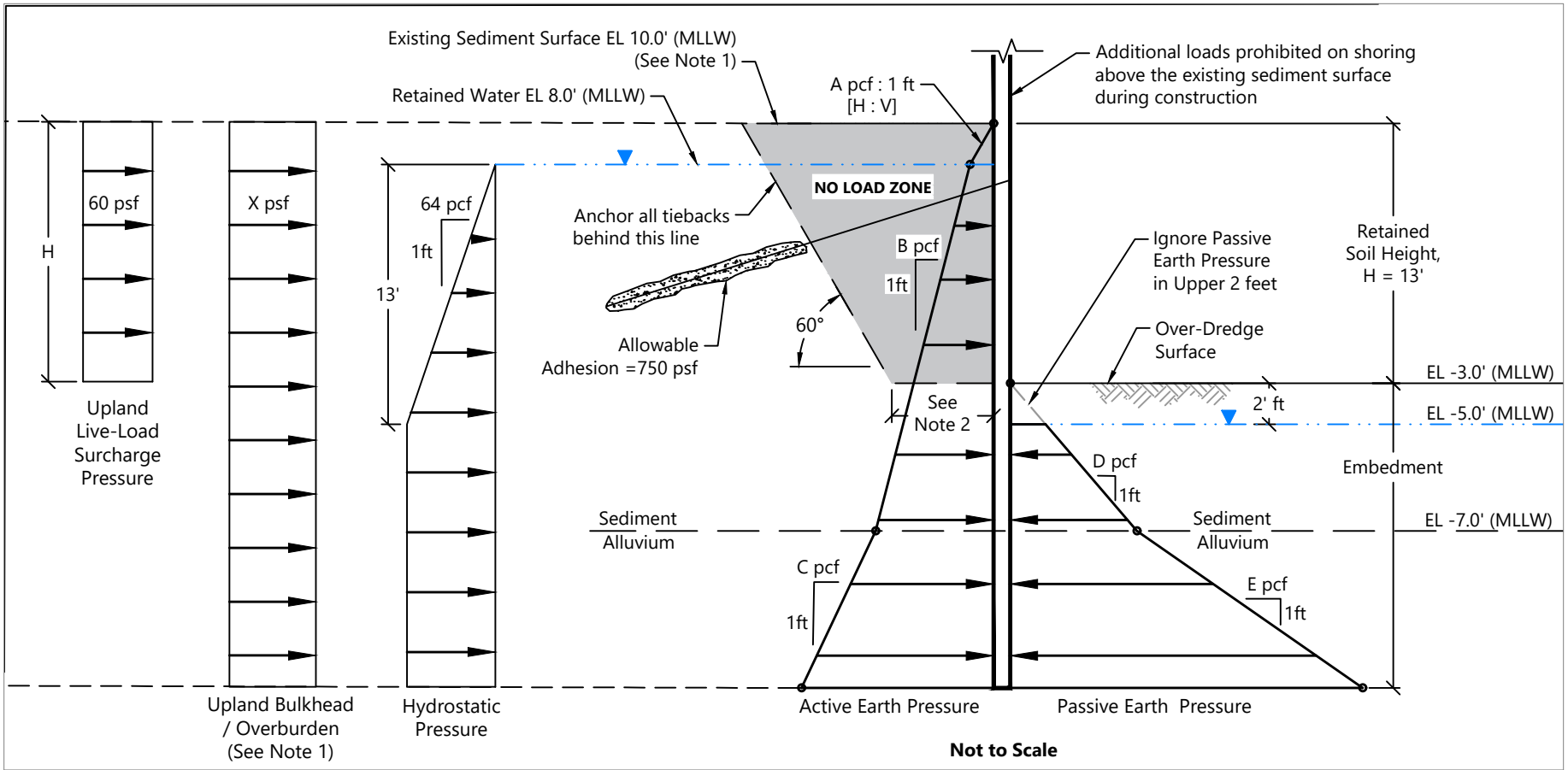


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NOTES:

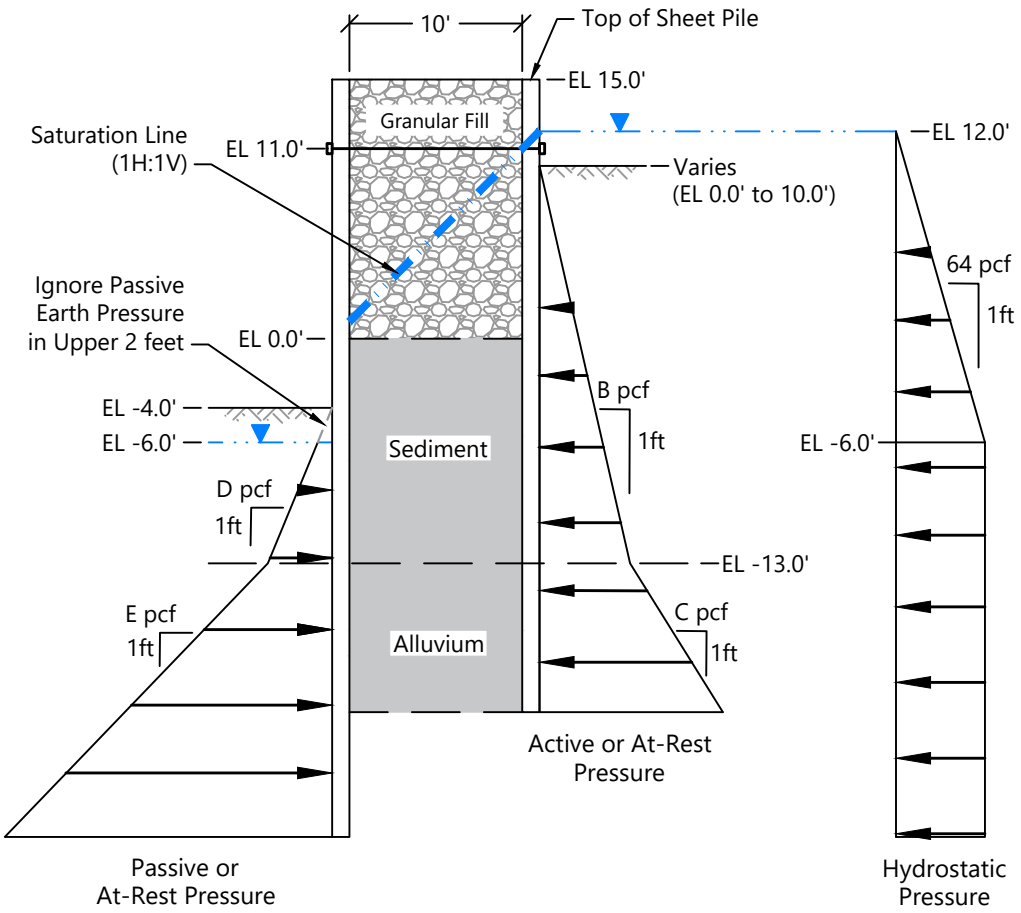
1. The lateral earth pressure diagram assumes the temporary bulkhead is installed at the toe of an existing ecology block wall, which retains roughly 11 feet of soil above the proposed temporary bulkhead. The upland bulkhead/overburden pressure accommodates for the additional pressures induced by the 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



NOTES:

1. All materials between cell walls use an active earth pressure coefficient of K_A = 0.4 per USACE UFC DM 7.2, Foundation and Earth Structures.
2. 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.
3. Non-yielding walls use at rest earth pressure coefficients.
4. 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.
5. Ignore the contribution of the upper 2 feet of soil at the base of the wall when computing passive pressures.
6. Passive Pressure acts over 3 pile diameters.

Exterior Cofferdam System Parameters			
Variable	**Unit**	**Yielding Walls**	**Non-Yielding Walls**
B	pcf	14	20
C	pcf	19	29
D	pcf	95	
E	pcf	198	

Interior Cofferdam System Parameters (Between Sheet Pile Walls)			
Soil Layer	**Unit Weight (pcf)**	**Active Earth Pressure Coefficient, Ka**	**Active Equivalent Fluid Pressure (pcf)**
Granular Fill - Moist	120	0.40	48
Granular Fill - Buoyant	56	0.40	22
Sediment - Buoyant	36	0.40	14
Sediment - Buoyant	61	0.40	24

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

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

$S_U = \alpha \times Scale$

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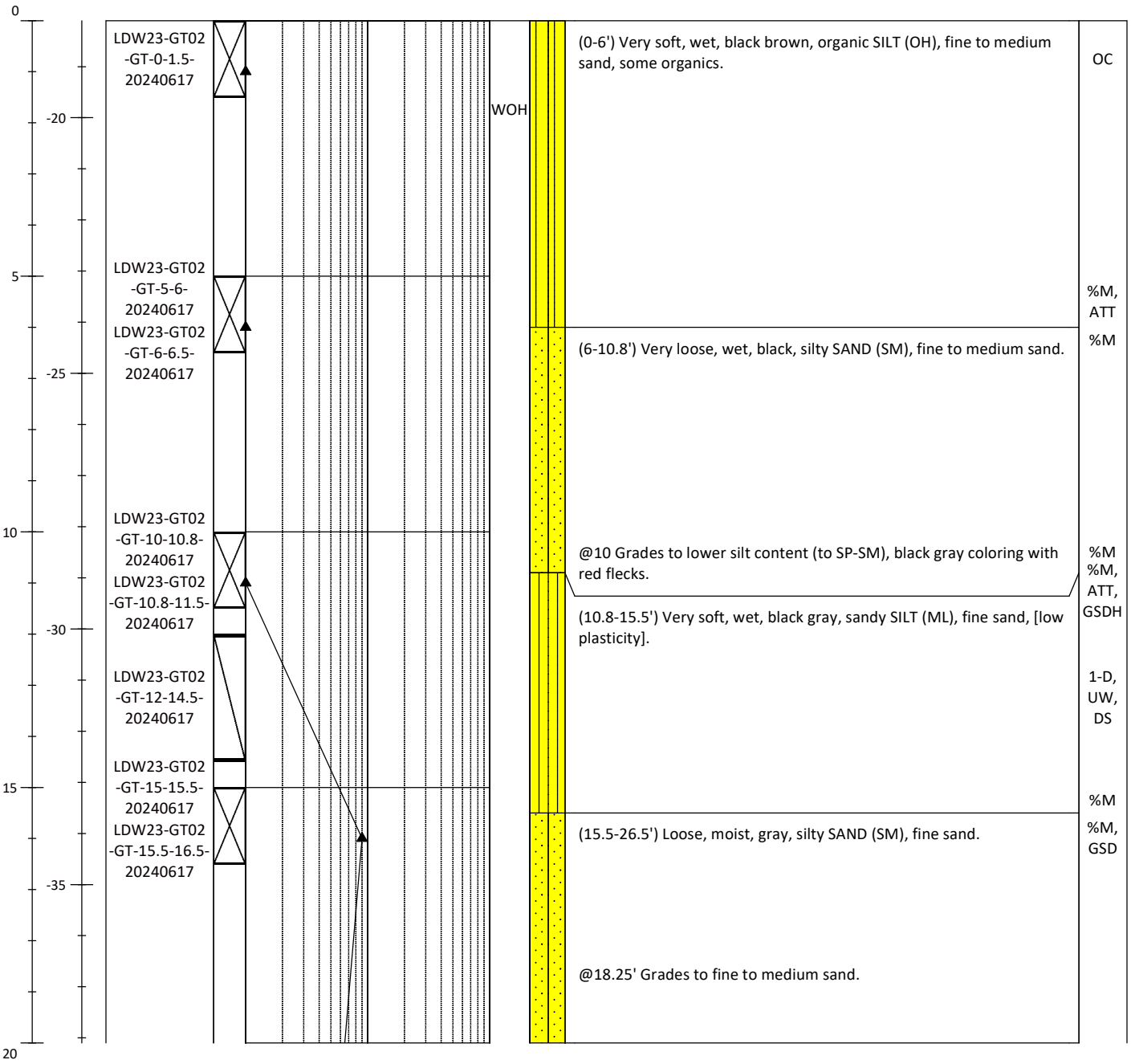
Test Location ID	Coordinates		Test Time	Water Depth in feet	Test Depth below Mudline in feet	Dummy Vane Scale Reading (kPa)	Vane Diameter in mm	Vane Constant	Peak Undrained Shear Strength			Remolded Shear Strength			Sample Description
	Easting	Northing							Vane Scale Reading in kPa	kPa	lbs/ft^2	Vane 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	
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	organic debris felt at 3.5 feet
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	
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	--	--	--	--	--	--	--	--	--	Refusal noted on sand
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	
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	
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	Strong resistance, debris suspected
VST-1b	1269434.630	201907.797	--	--	7	--	--	--	--	--	--	--	--	--	Refusal noted on sand
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	
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	Sand lens ~2.5-2.8 ft
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	
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	Pushed through sand lense to 4.3 ft
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	
VST-1c	1269484.321	201852.102	--	--	6.8	--	--	--	--	--	--	--	--	--	Refusal noted on sand

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

Soil Boring Log

LDW23-GT02-GT

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**	



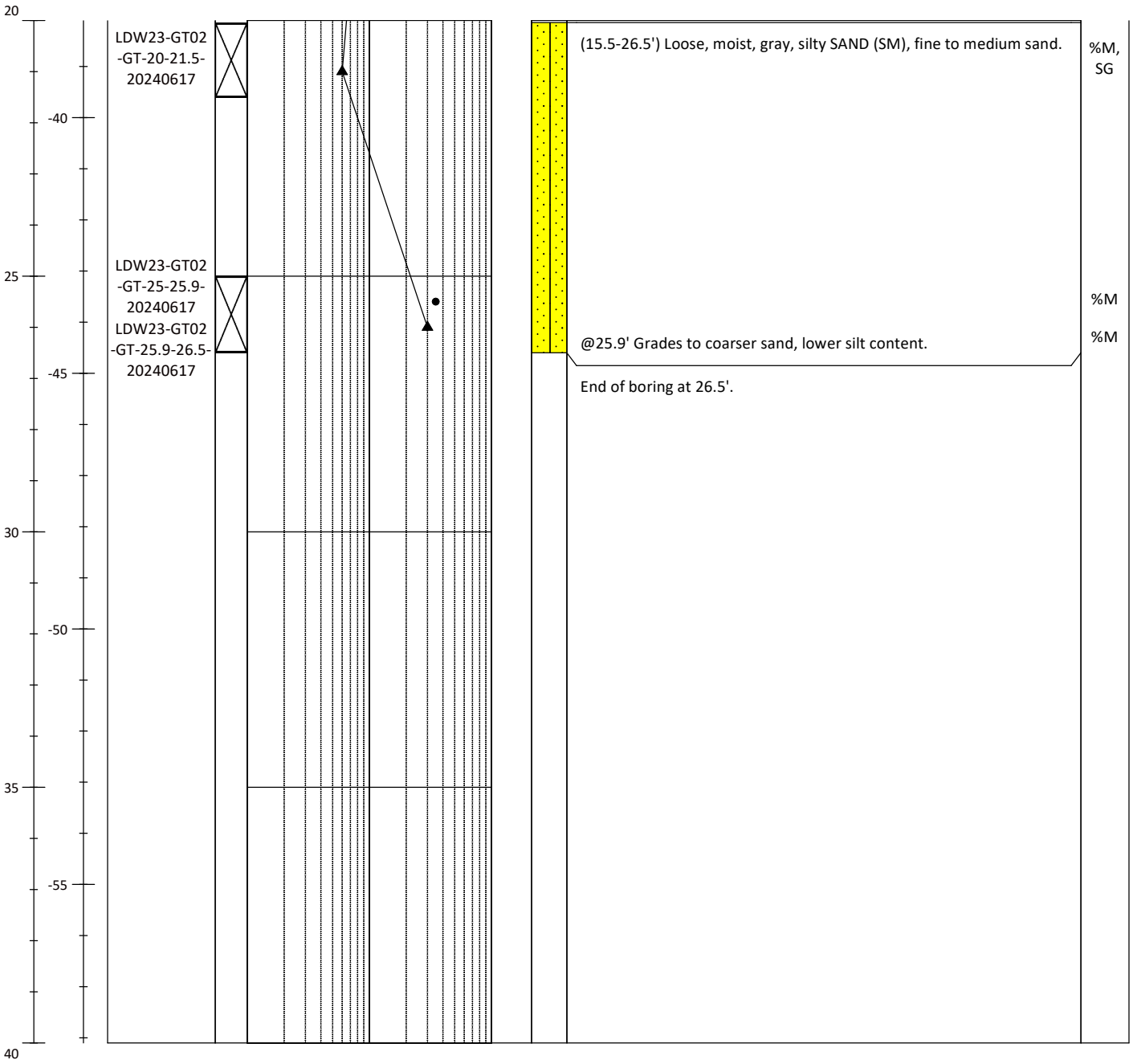
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1201 Third Avenue
Suite 2600 Seattle, WA 98101

- 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

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**	



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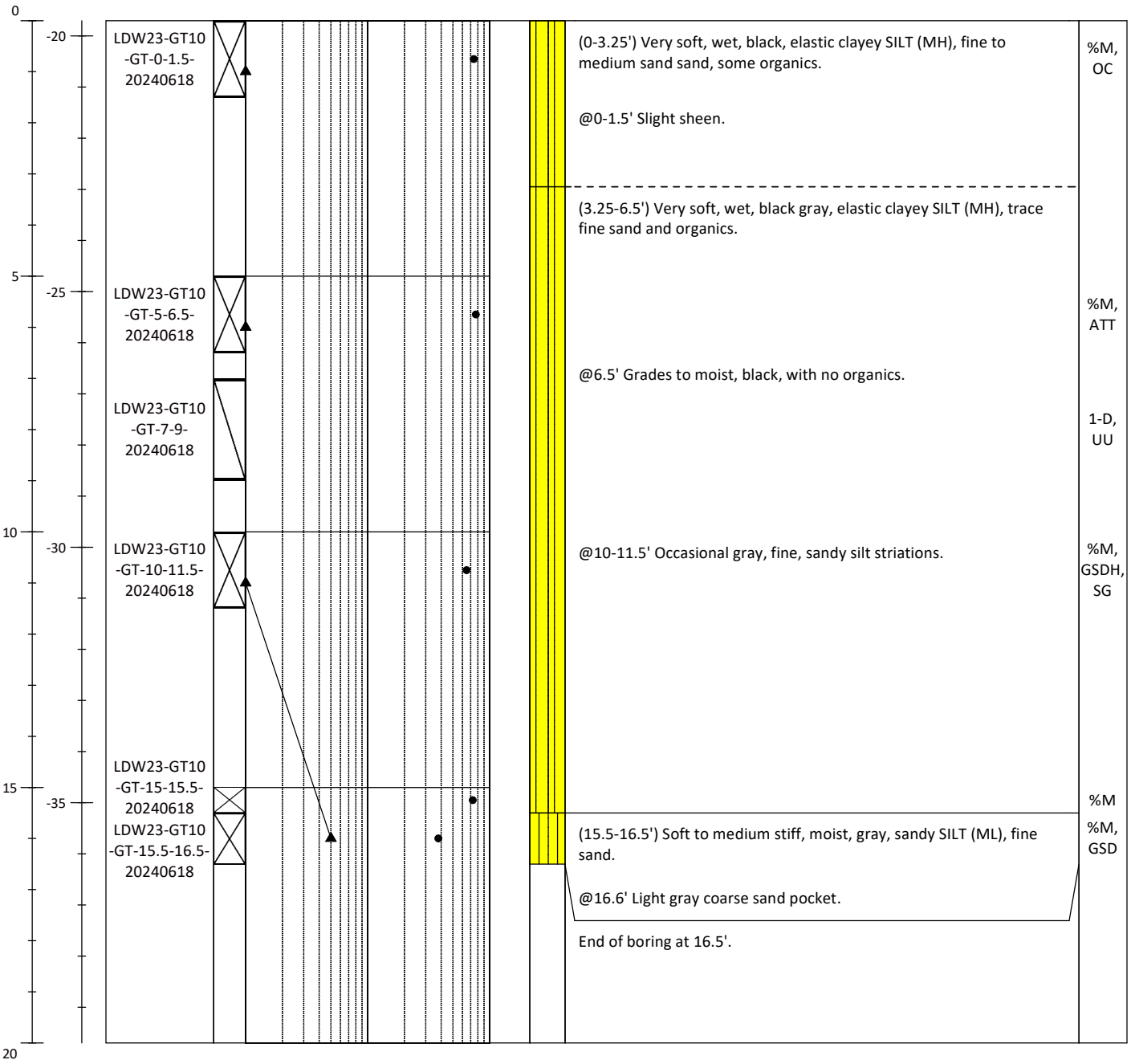
△ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
☒ Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log

LDW23-GT10-GT

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**	



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- 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) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description	Lab Test
0	-20	LDW23-GT09-GT-0-1.5-20240618					(0-6.2') Very soft, wet, black gray, organic clayey SILT with sand (OH), fine sand. @1.2-1.4' Shell hash and twigs.	%M, ATT, OC
5	-25	LDW23-GT09-GT-5-6.2-20240618 LDW23-GT09-GT-6.2-6.5-20240618					(6.2-13.25') Very soft, moist, gray, sandy SILT (ML), fine sand, trace organics.	%M, ATT, SG %M
10	-30	LDW23-GT09-GT-10-11.5-20240618					@10' Grades to black gray with no organics.	%M, GSD
15	-35	LDW23-GT09-GT-15-16.5-20240618					(13.25-16.5') Very soft, moist, black gray, clayey SILT with sand (ML), fine sand. @15.4-15.9' Gray silty sand lens, striated. End of boring at 16.5'.	%M, ATT, GSDH
20								

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△ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
☒ Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT19-GT

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 (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description	Lab Test
0	-10	LDW23-GT19-GT-0-1.5-20240619					(0-3.25') Very soft, wet, black brown, organic SILT with sand (OH), fine sand, twigs thoughout.	%M, OC
							(3.25-8.25') Very soft, moist, black gray, elastic SILT with sand (MH), fine sand, medium plasticity.	
5	-15	LDW23-GT19-GT-5-6.5-20240619						%M, ATT
							(8.25-20.8') Loose, moist, black gray, poorly graded SAND with silt (SP-SM), fine to medium sand, some coarse sand.	
10	-20	LDW23-GT19-GT-10-11.5-20240619						%M, GSD
15	-25	LDW23-GT19-GT-15-16.5-20240619						%M
20								

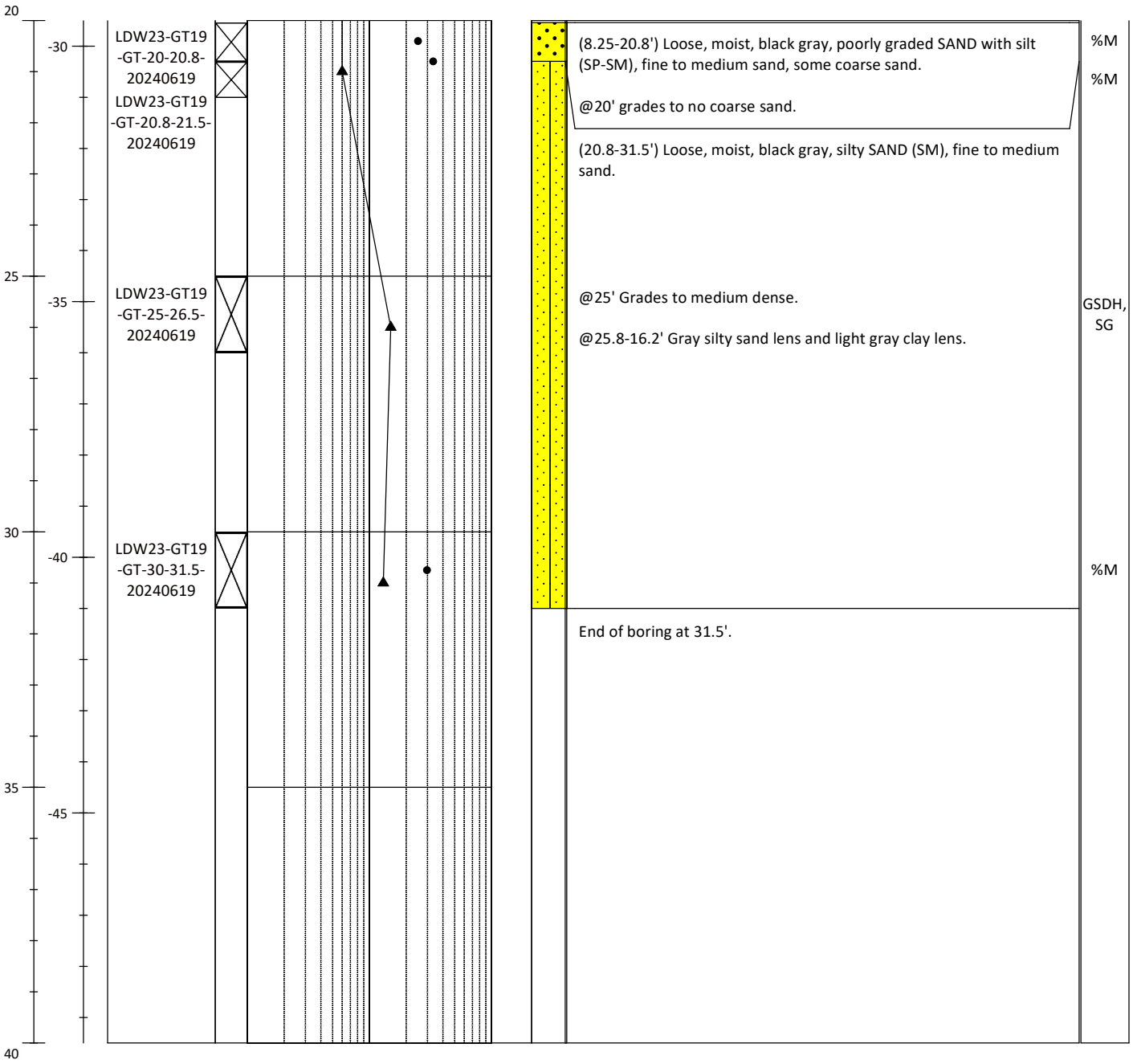
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△ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
☒ Split Spoon/Grab

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

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**	



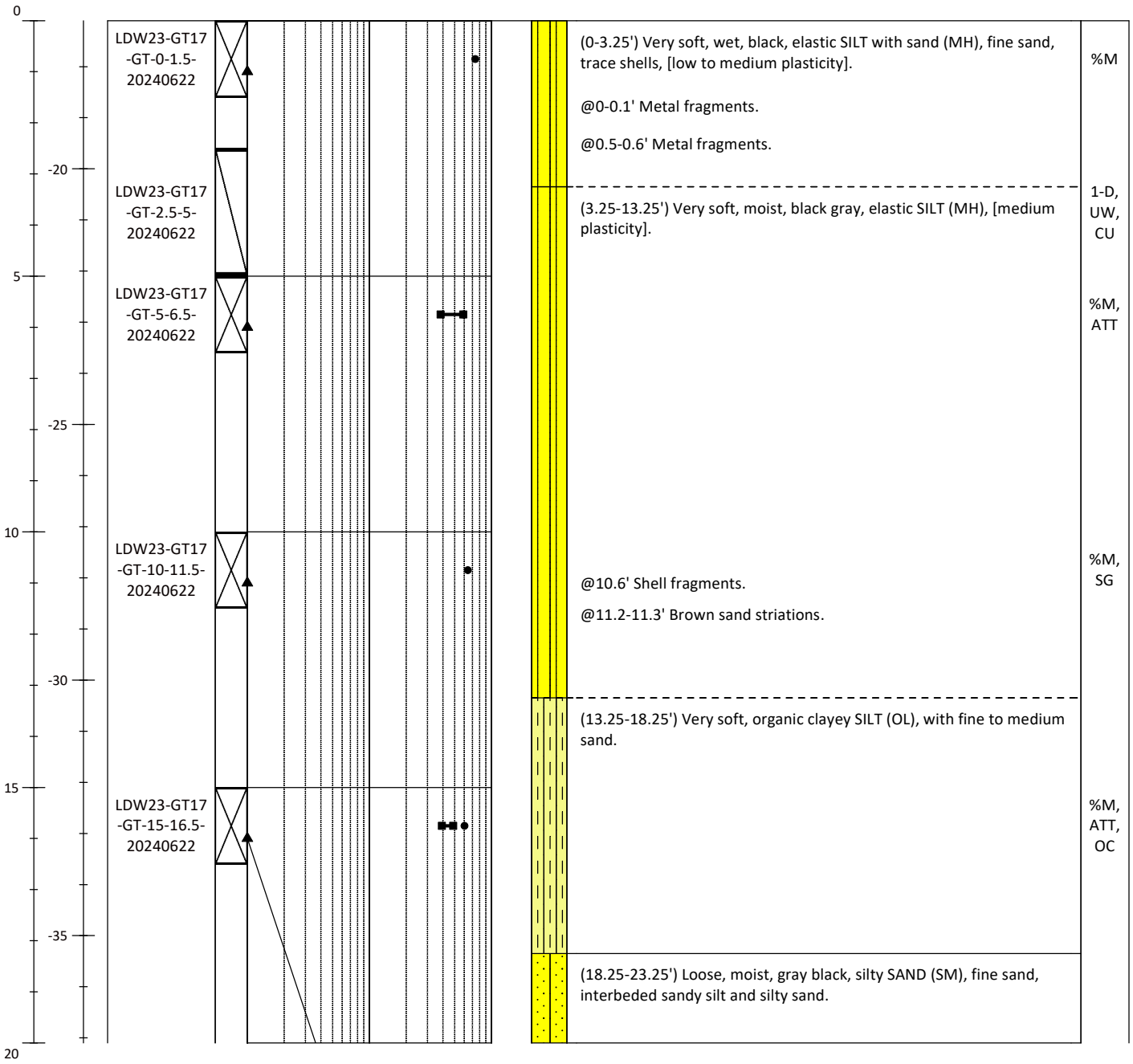
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT17-GT

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**	



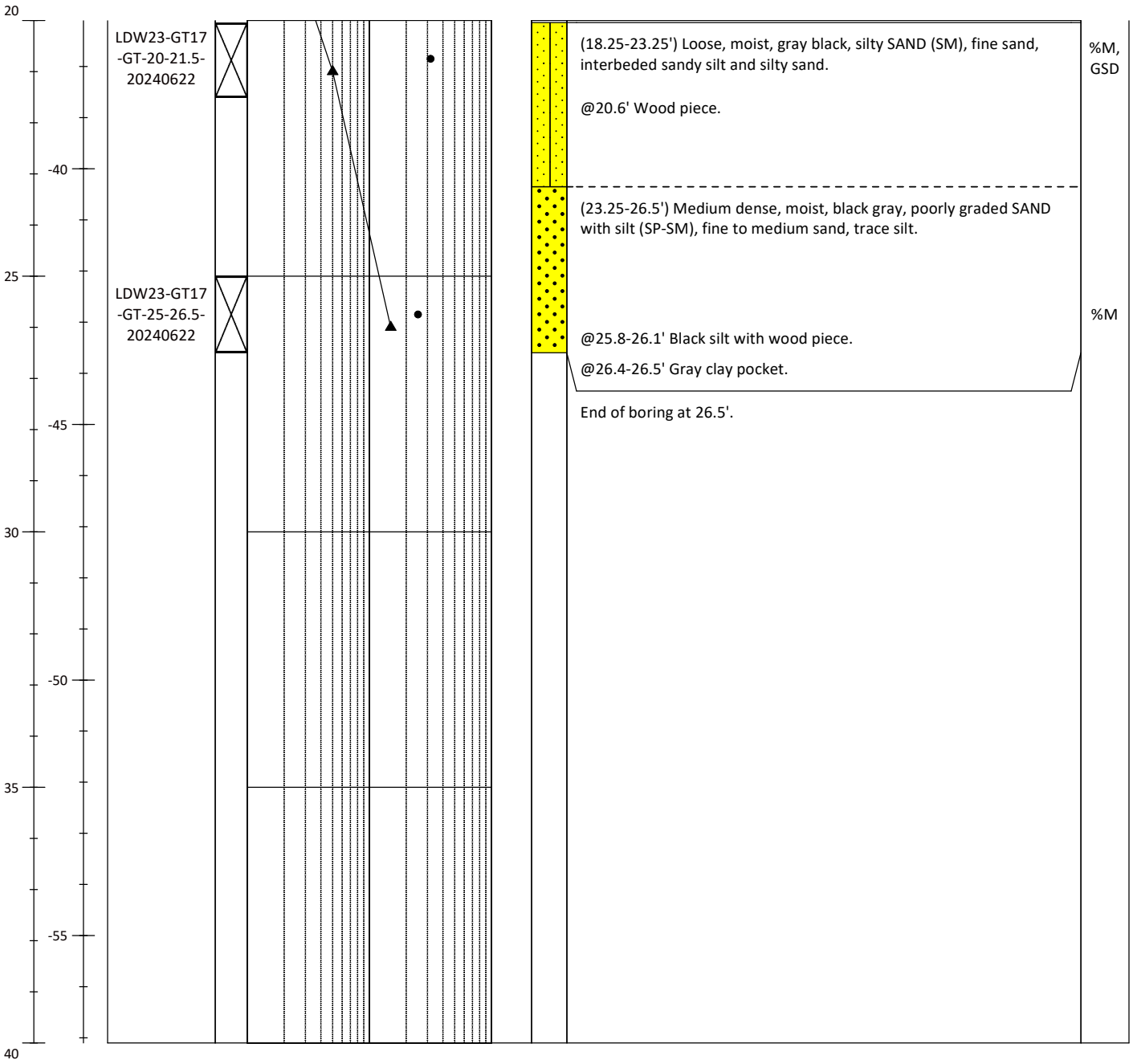
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SPT N-Value
Moisture Content (%)
Atterberg Limits
Shelby Tube
Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT17-GT

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**	



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

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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log

LDW23-GT18-GT

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) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0		LDW23-GT18-GT-0-1.5-20240619			M% 107.3		(0-8.25') Very soft, wet, black gray, clayey SILT (MH), trace fine sand. @0.4' Stick. @0-1.5' Light gray streaking thoughout.	%M
5	-10	LDW23-GT18-GT-5-6.5-20240619			M% 102.5		@10' Grades to soft.	%M, GSDH
10	-15	LDW23-GT18-GT-10-11.5-20240619					@10.8' Metal scraps with rope or twig connected. @11.4-11.5' Light gray sand with silt, shell fragments thoughout.	%M, ATT
15	-20	LDW23-GT18-GT-15-16.5-20240619					@15' Grades to very soft. @15-15.1' Light gray sand with gravel piece. @16.1-16.3' Light gray banding.	%M, ATT, SG
20	-25						(18.25-31.5') Medium dense, wet, gray, poorly graded SAND with silt (SP-SM), fine to medium sand, small clay pockets thoughout.	

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△ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
⊠ Split Spoon/Grab

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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT18-GT

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) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description	Lab Test
20	-25						(18.25-31.5') Medium dense, wet, gray, poorly graded SAND with silt (SP-SM), fine to medium sand, small clay pockets thoughout.	
							@21.1-21.3' Silt lens.	
							@21.3-21.5' Dark gray silty sand, no red flecks, catcher bent backwards.	
25	-30	LDW23-GT18-GT-25-26.5-20240619						%M, GSD
30	-35	LDW23-GT18-GT-30-31.5-20240619						%M
							@31.4 ft: Blue plastic thread.	
							End of boring at 31.5'.	
35	-40							
40	-45							

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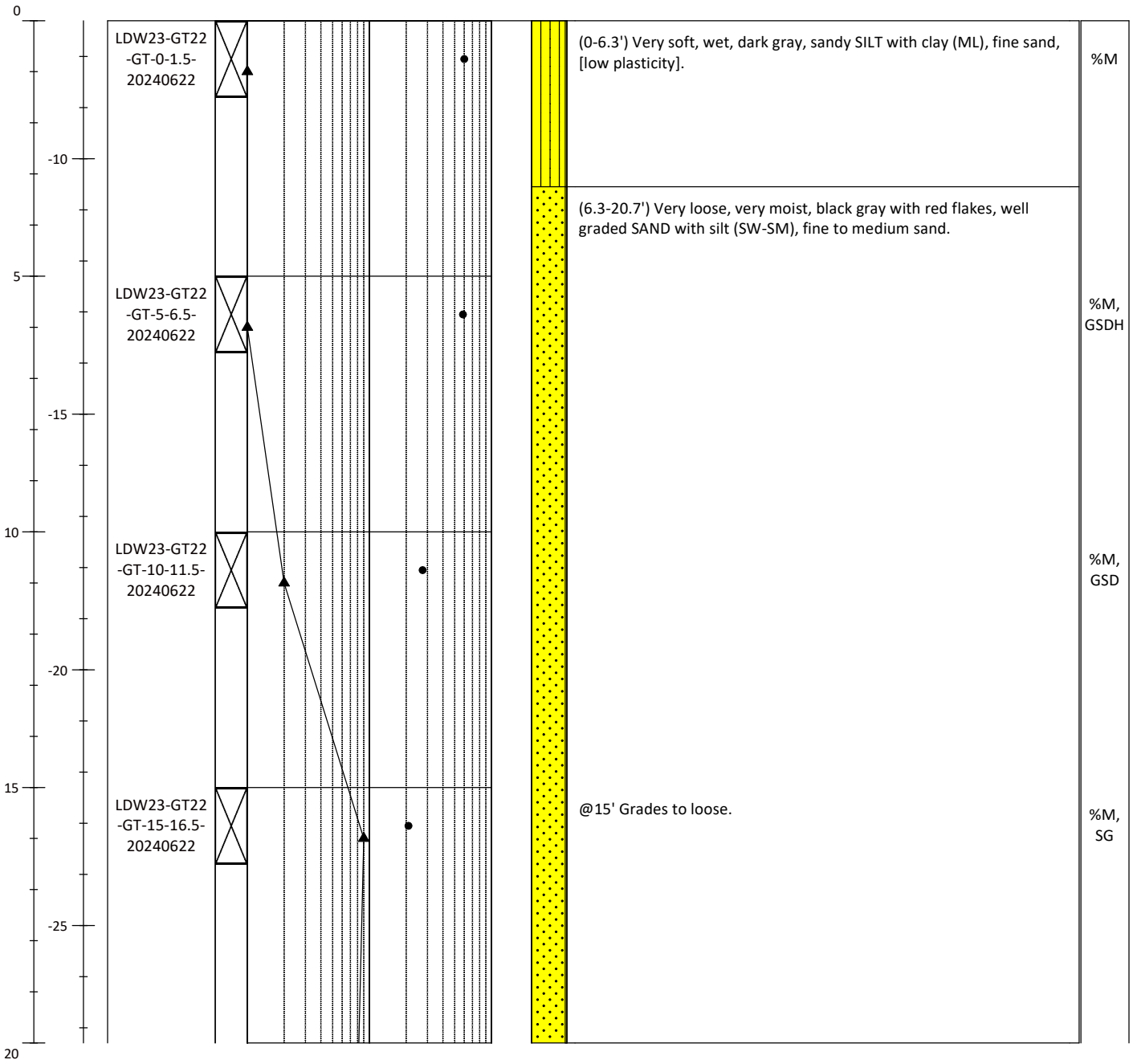
△ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
⊠ Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log

LDW23-GT22-GT

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**	



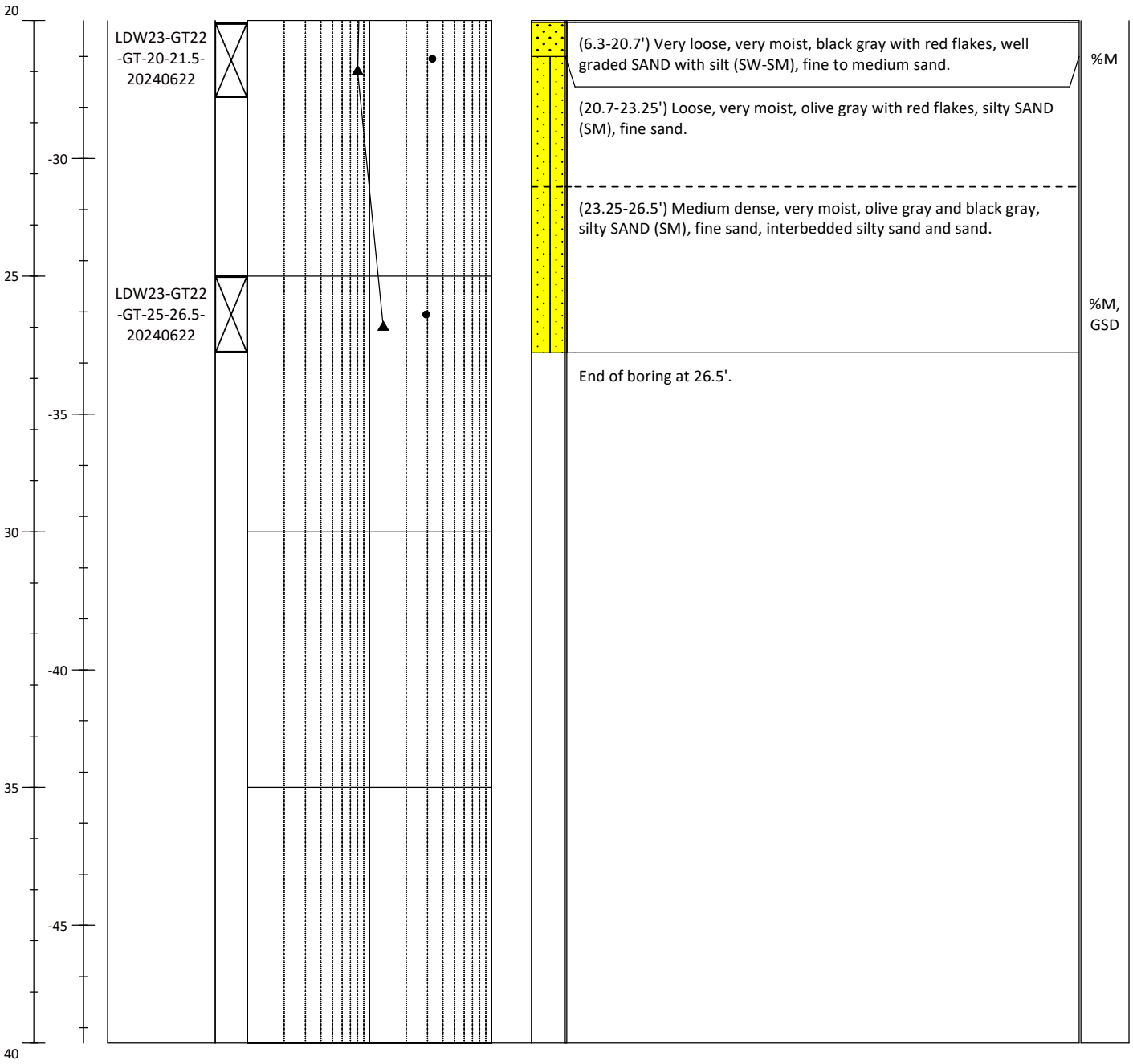
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT22-GT

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**	



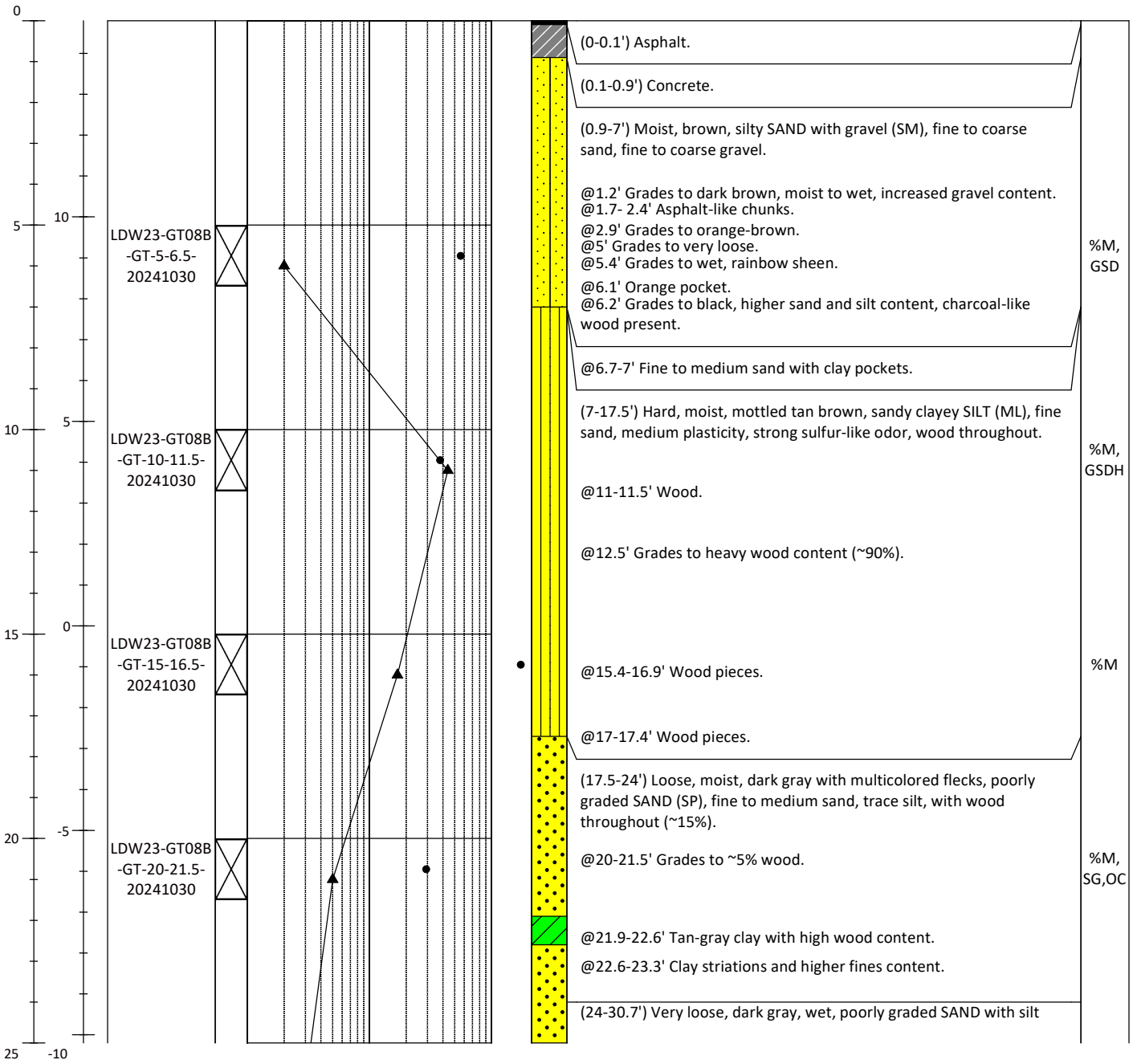
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT08B-GT

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**	



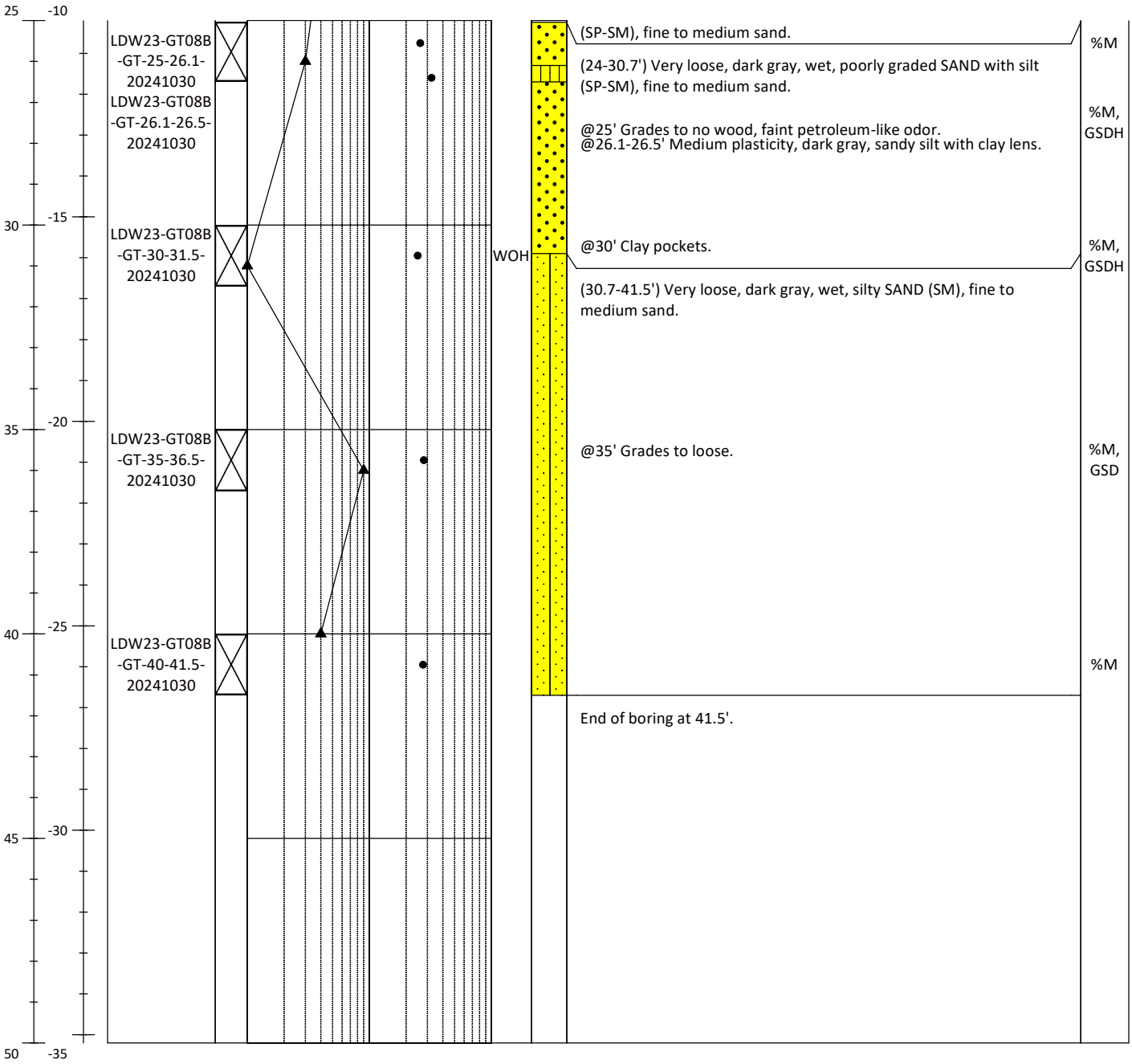
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT08B-GT

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**	



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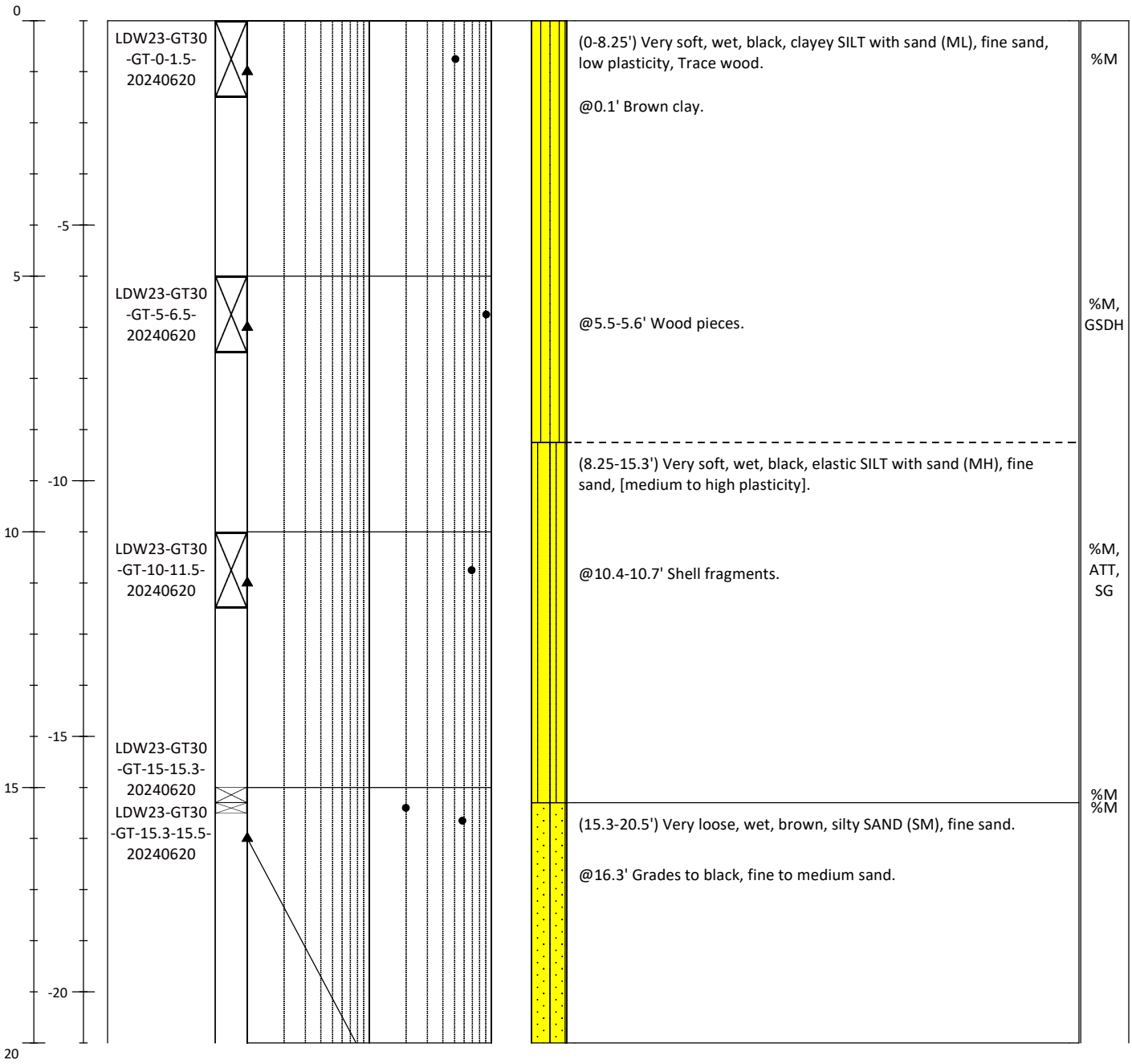
SPT N-Value
Moisture Content (%)
Atterberg Limits
Shelby Tube
Split Spoon/Grab

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

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**	



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- 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

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) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description	Lab Test
20								
	-25	LDW23-GT30-GT-20-21.5-20240620					(16.3-20.5') Very loose, wet, black, silty SAND (SM), fine to medium sand. @20' Grades to medium dense.	%M, GSD
							(20.5-20.9') Stiff, moist, black, fat CLAY with fine sand (CH), trace organics.	
25							(20.9-23.25') Medium dense, wet, black, silty SAND (SM), fine to medium sand.	
		LDW23-GT30-GT-25-26.5-20240620					(23.25-26.5') Medium dense, wet, black gray, with red flecks, poorly graded SAND with silt (SP-SM), fine to medium sand. @26.4-26.5' Silty sand.	%M
	-30						End of boring at 26.5'.	
30								
	-35							
35								
	-40							
40								

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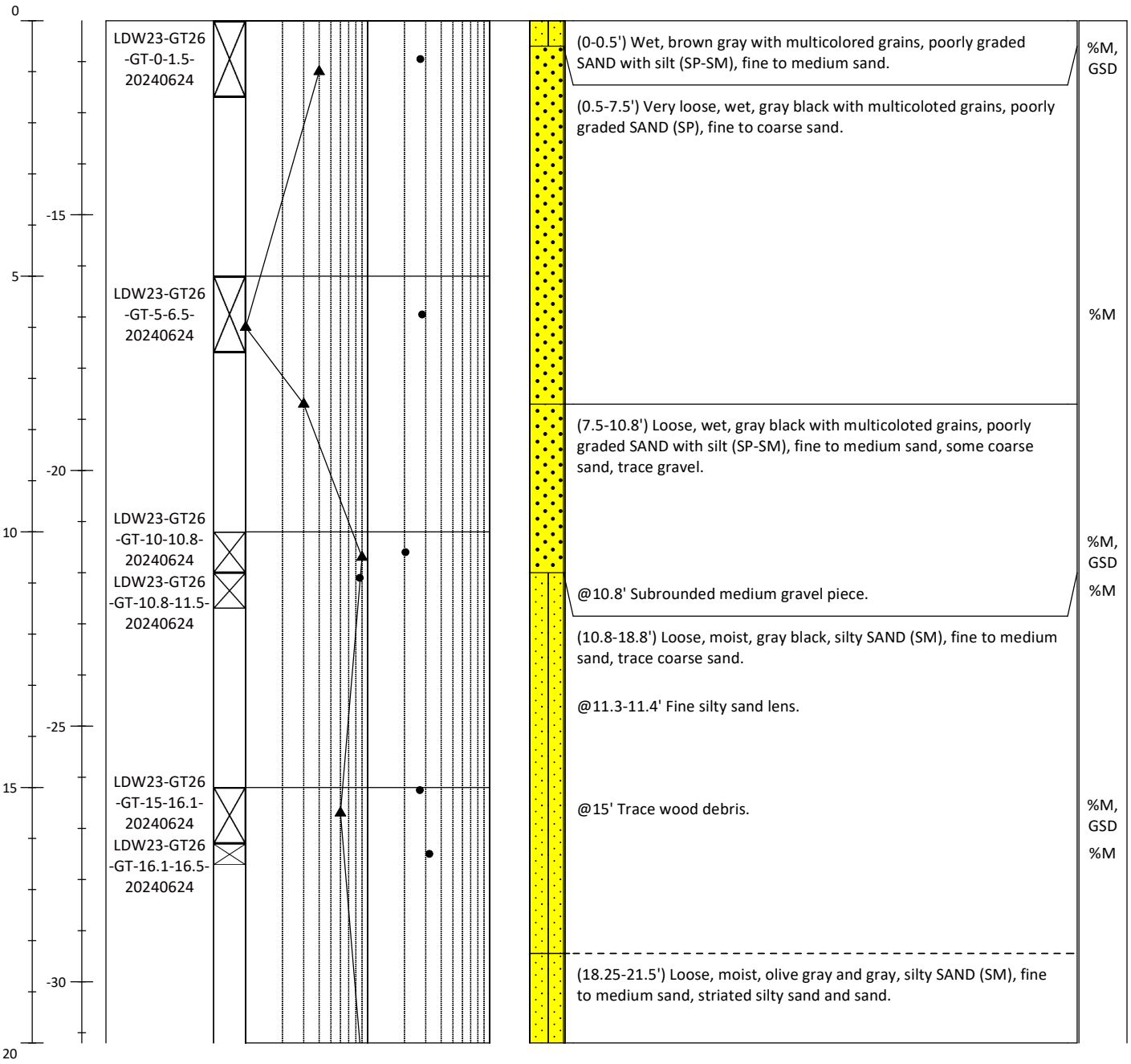
△ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
☒ Split Spoon/Grab

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

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**	



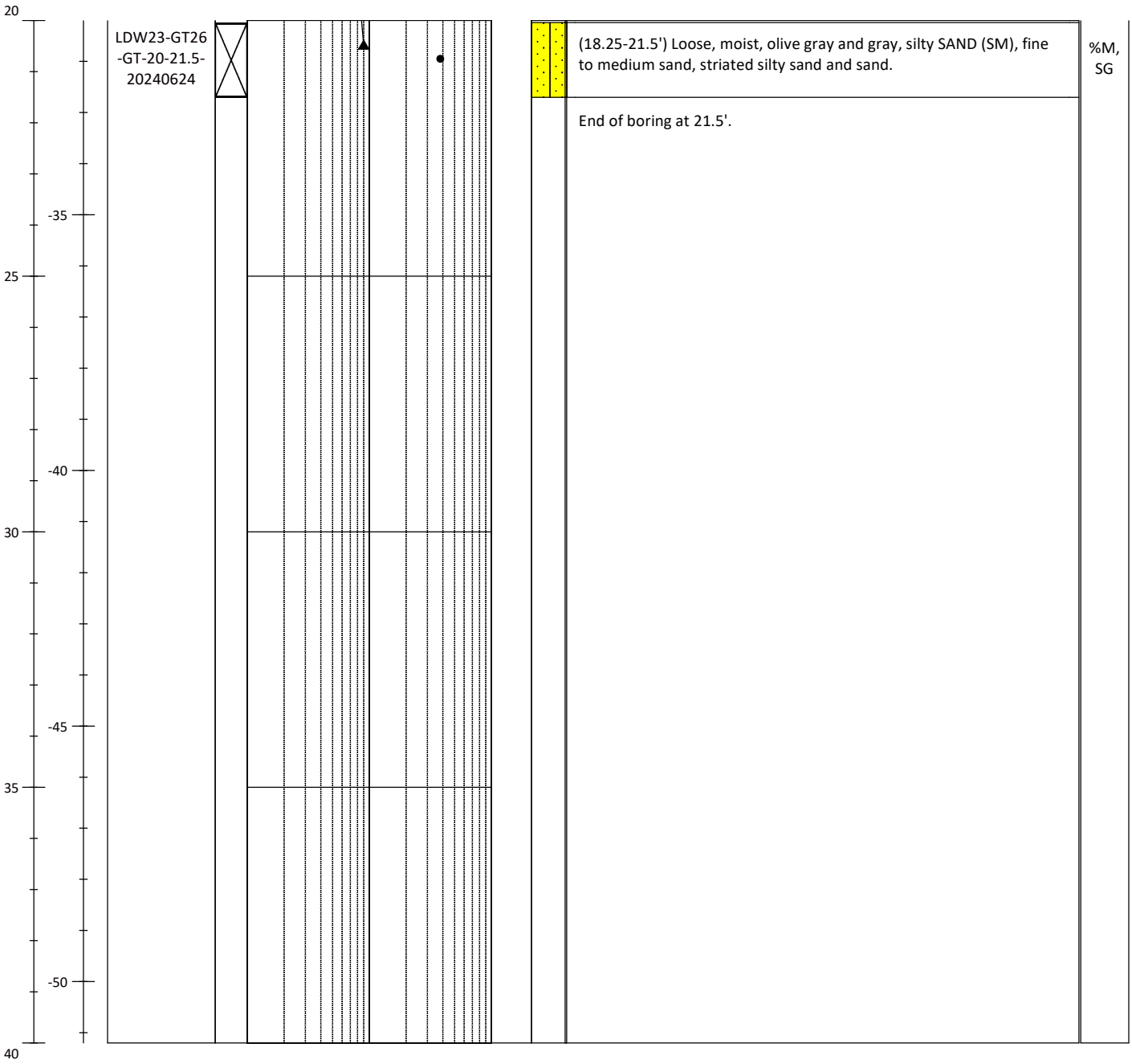
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

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

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**	



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△ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
⊠ Split Spoon/Grab

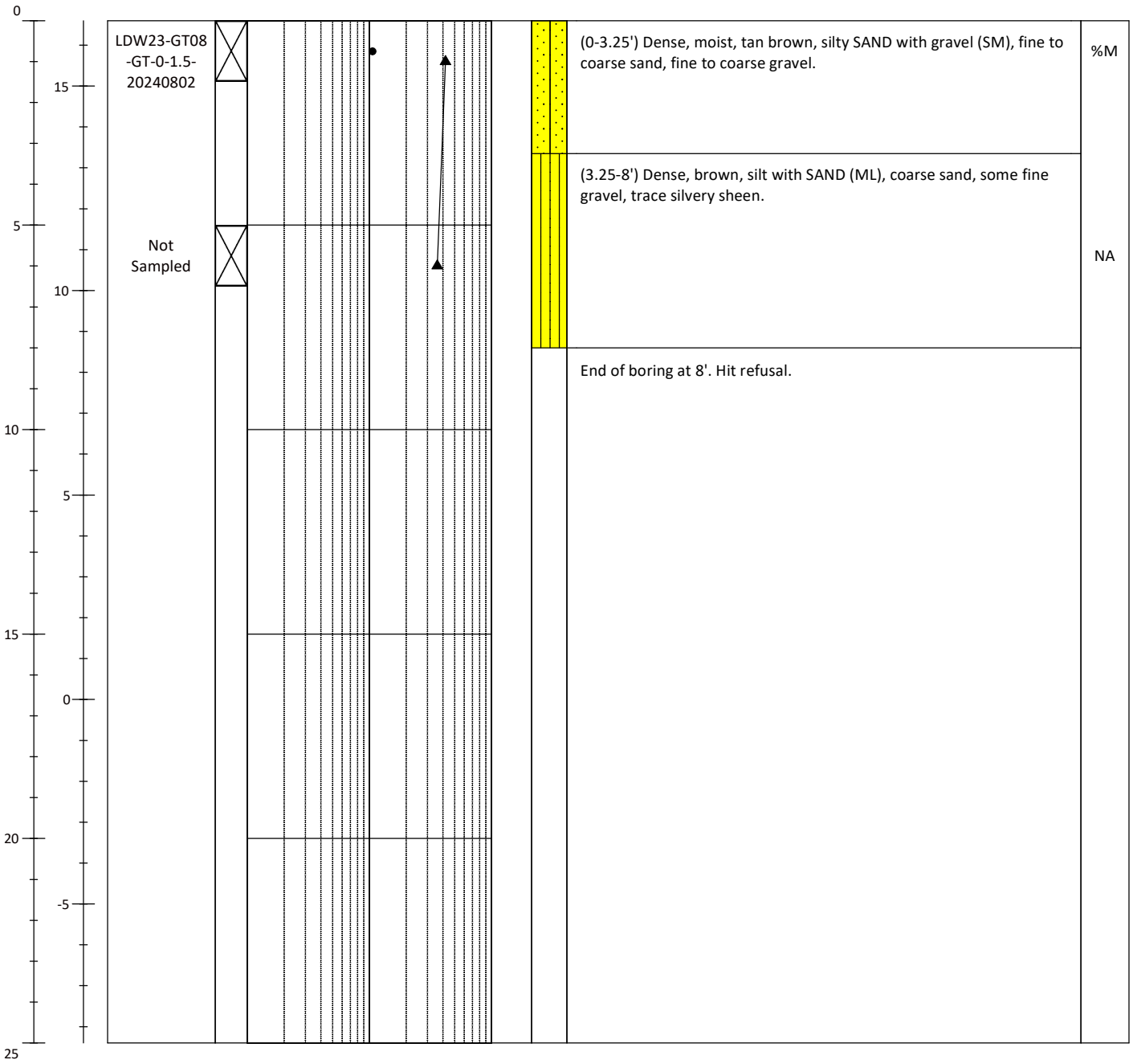
Notes:
%M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct 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-GT04-GT

Sheet 1 of 1

Project #: **210075-01.03**	Project: **Middle Reach of Lower Duwamish Waterway**	Method: **Mud Rotary**
Location: **Seattle, WA**	N/LAT: **202046.12** E/LONG: **1269401.67**	Total Depth (ft): **8**
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: **8/02/2024**		
Contractor: **HOLT**	Vert. Datum: **MLLW**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **RP**	Sampler(s): **Split Spoon**	



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- 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-GT33-GT

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 (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0	15	LDW23-GT33-GT-0.5-2-20240730		50/2			(0-6') Medium dense, moist, tan, silty SAND with gravel (SM), fine to medium sand, fine to coarse gravel.	%M
5	10						@5' Drilled through rubble then dropped to 4" void.	
10	5						Refusal at 6 ft. Refusal due to concrete.	
15	0							
20	-5							
25								

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

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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log

LDW23-GT08-GT

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) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0	10						(0-0.5') Concrete. Refusal hit due to drilling fluid transport through cracks in concrete.	NA
5	5							
10	0							
15	-5							
20	-10							
25								

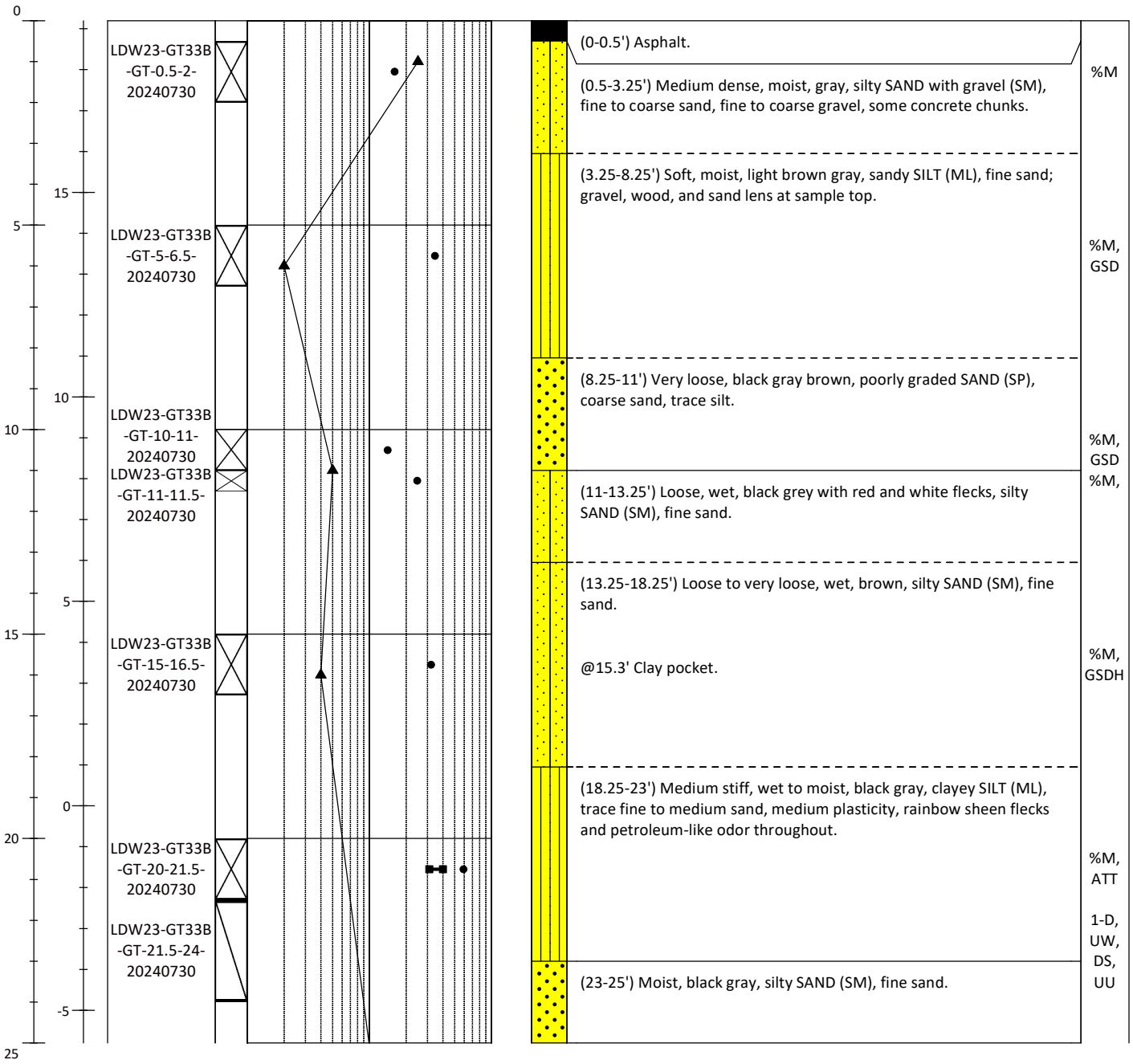
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SPT N-Value
Moisture Content (%)
Atterberg Limits
Shelby Tube
Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT33B-GT

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**	



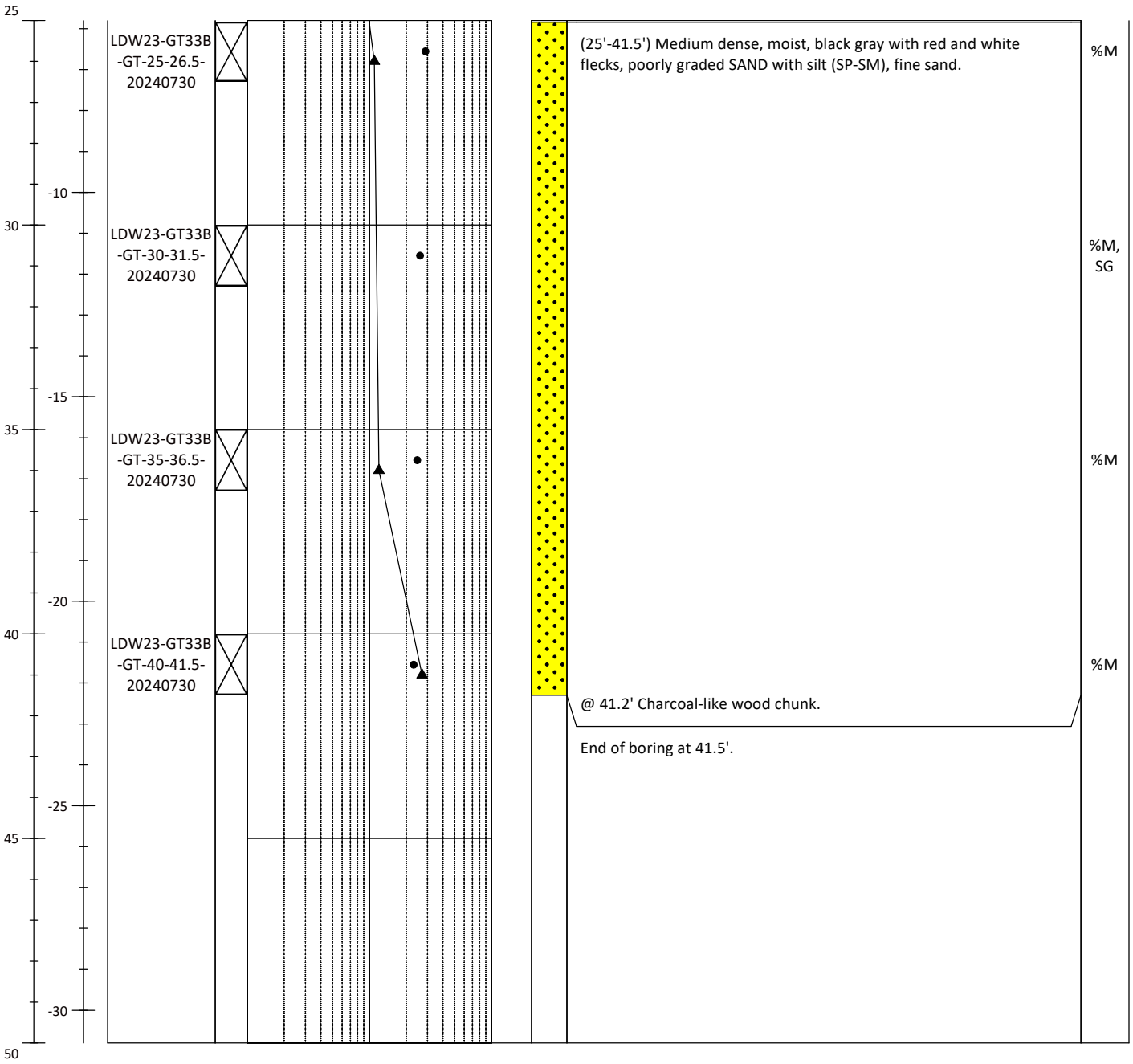
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SPT N-Value
Moisture Content (%)
Atterberg Limits
Shelby Tube
Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT33B-GT

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**	



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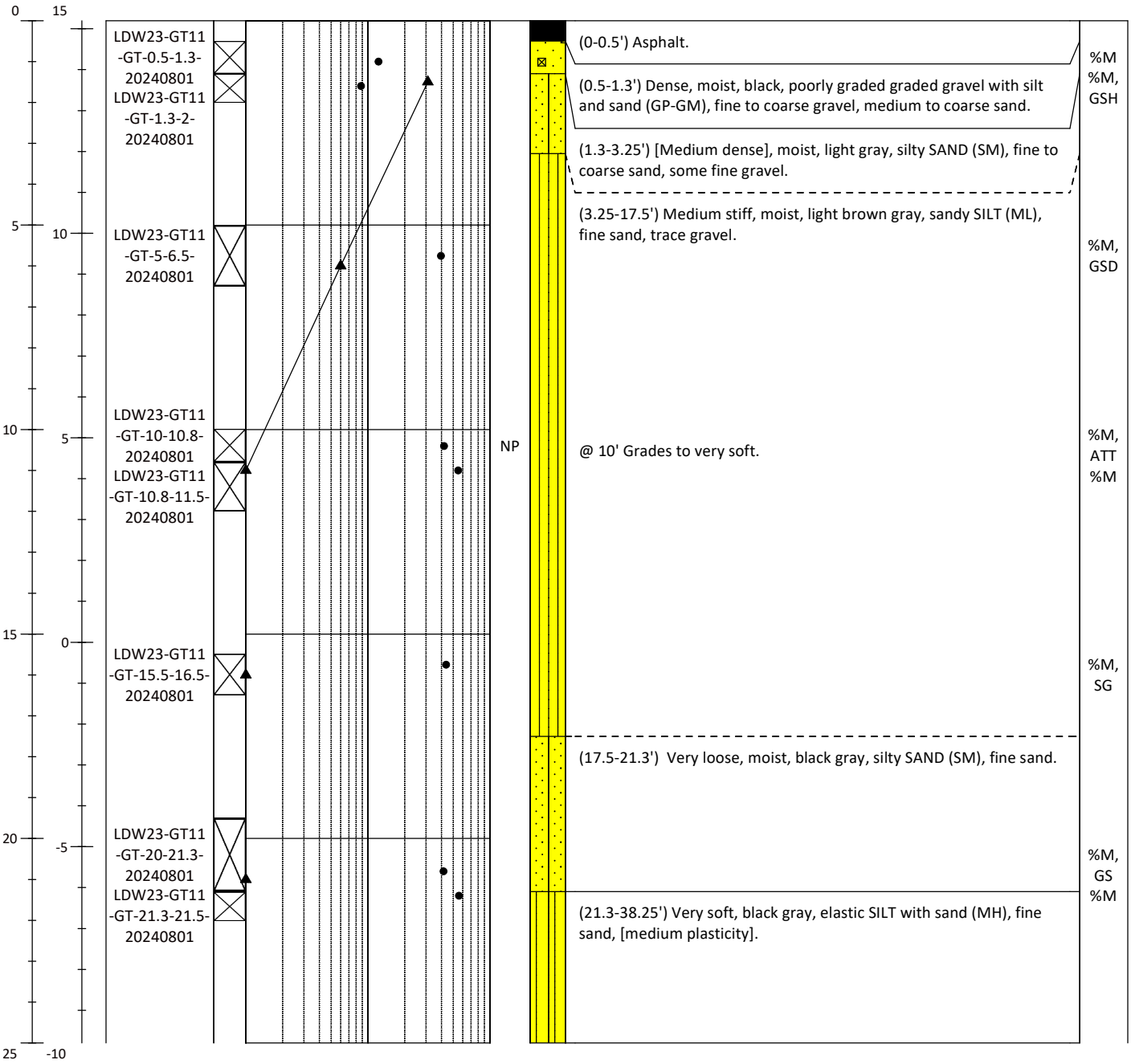
- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log

LDW23-GT11-GT

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**	



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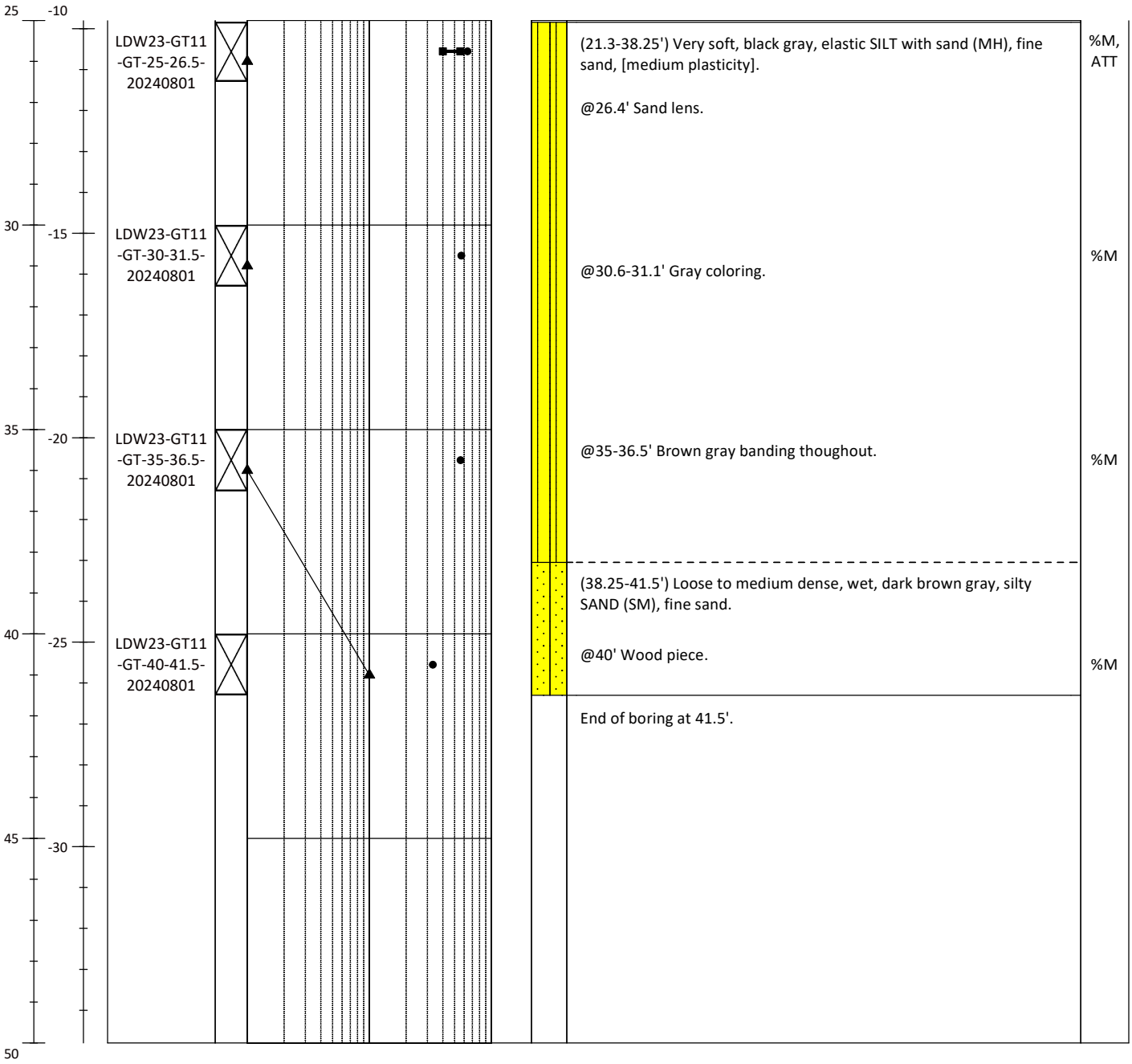
▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
☒ Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log

LDW23-GT11-GT

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**	



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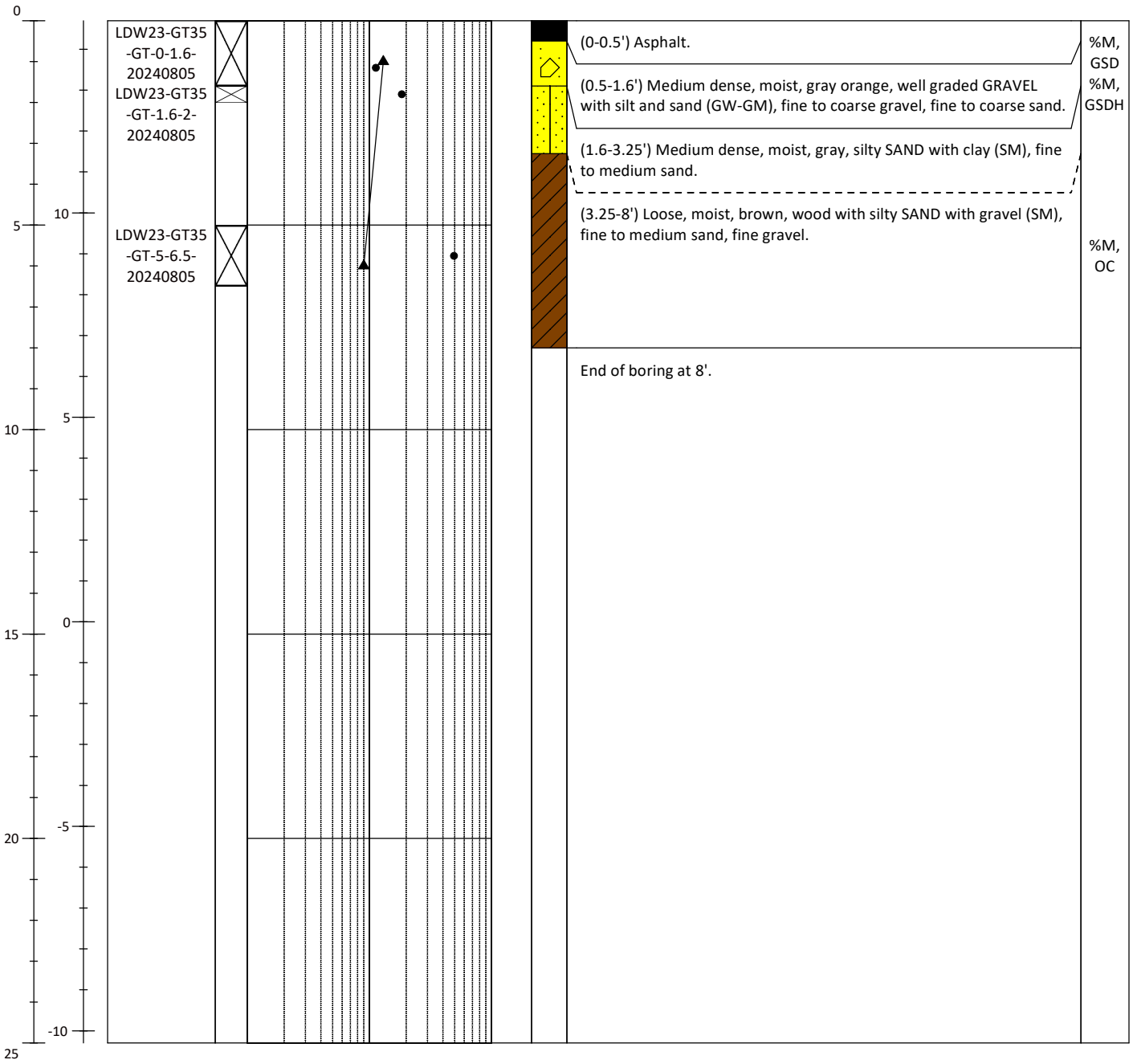
- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

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**	



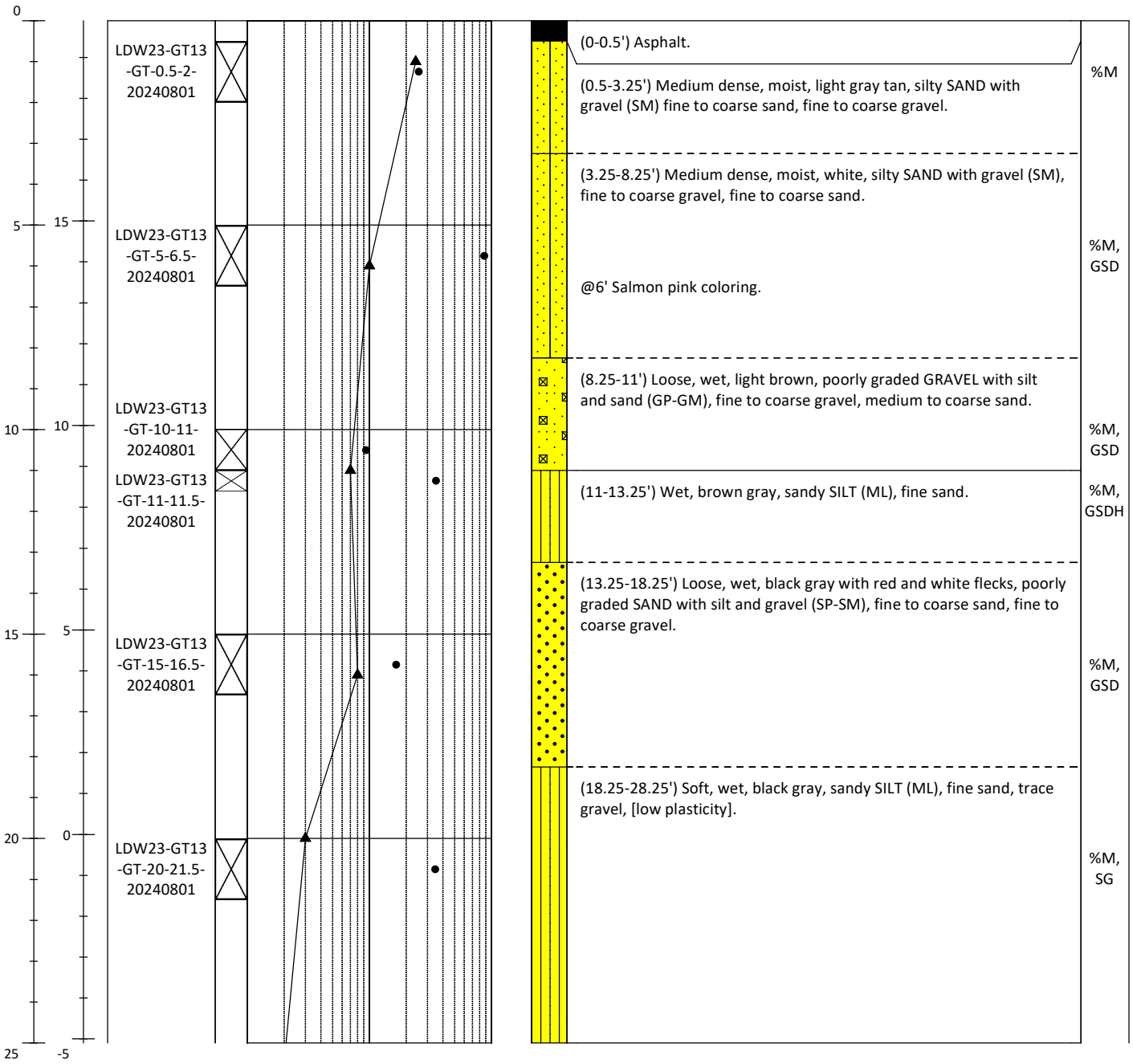
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▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
⊠ Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT13-GT

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**	



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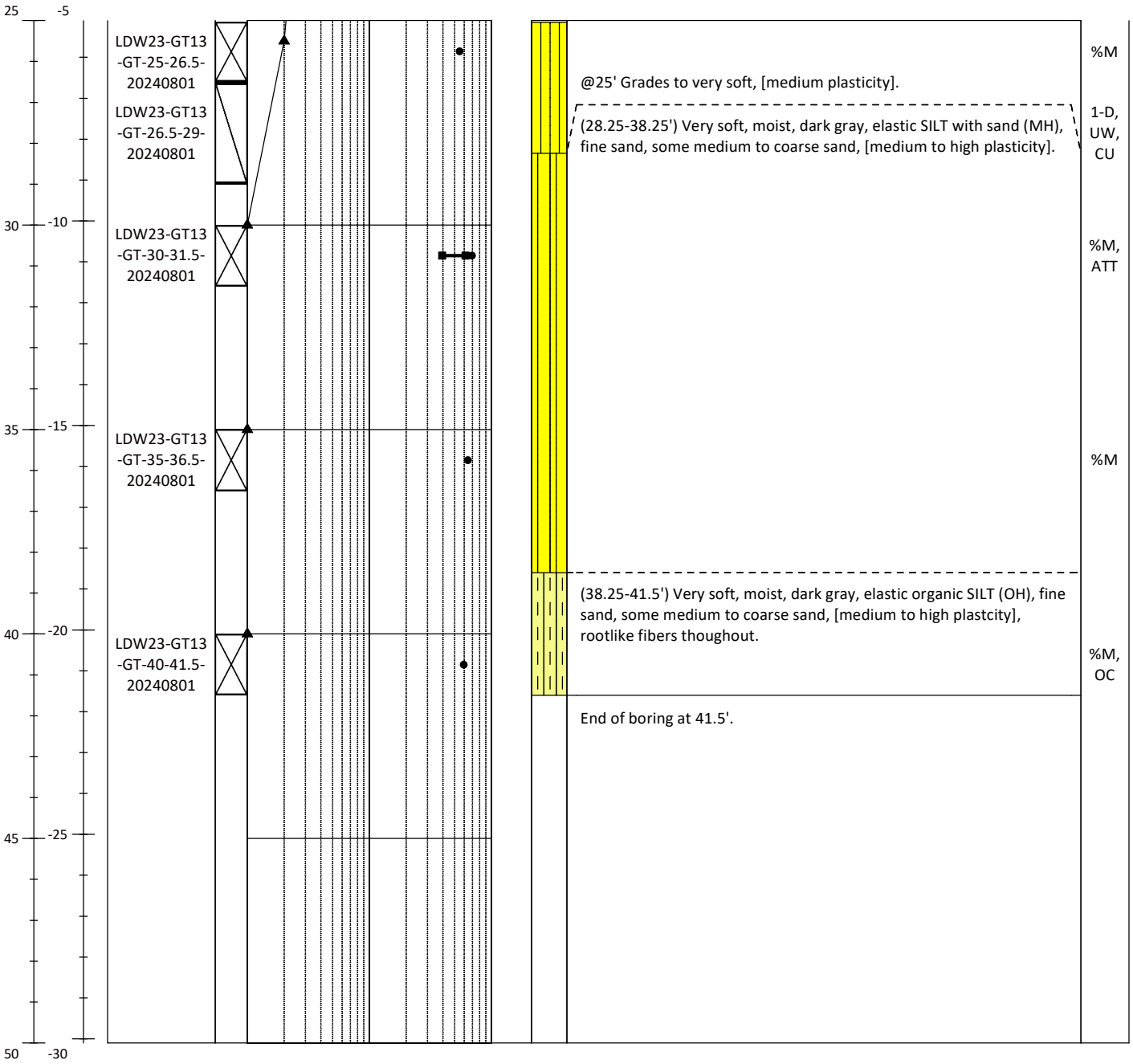
- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log

LDW23-GT13-GT

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**	



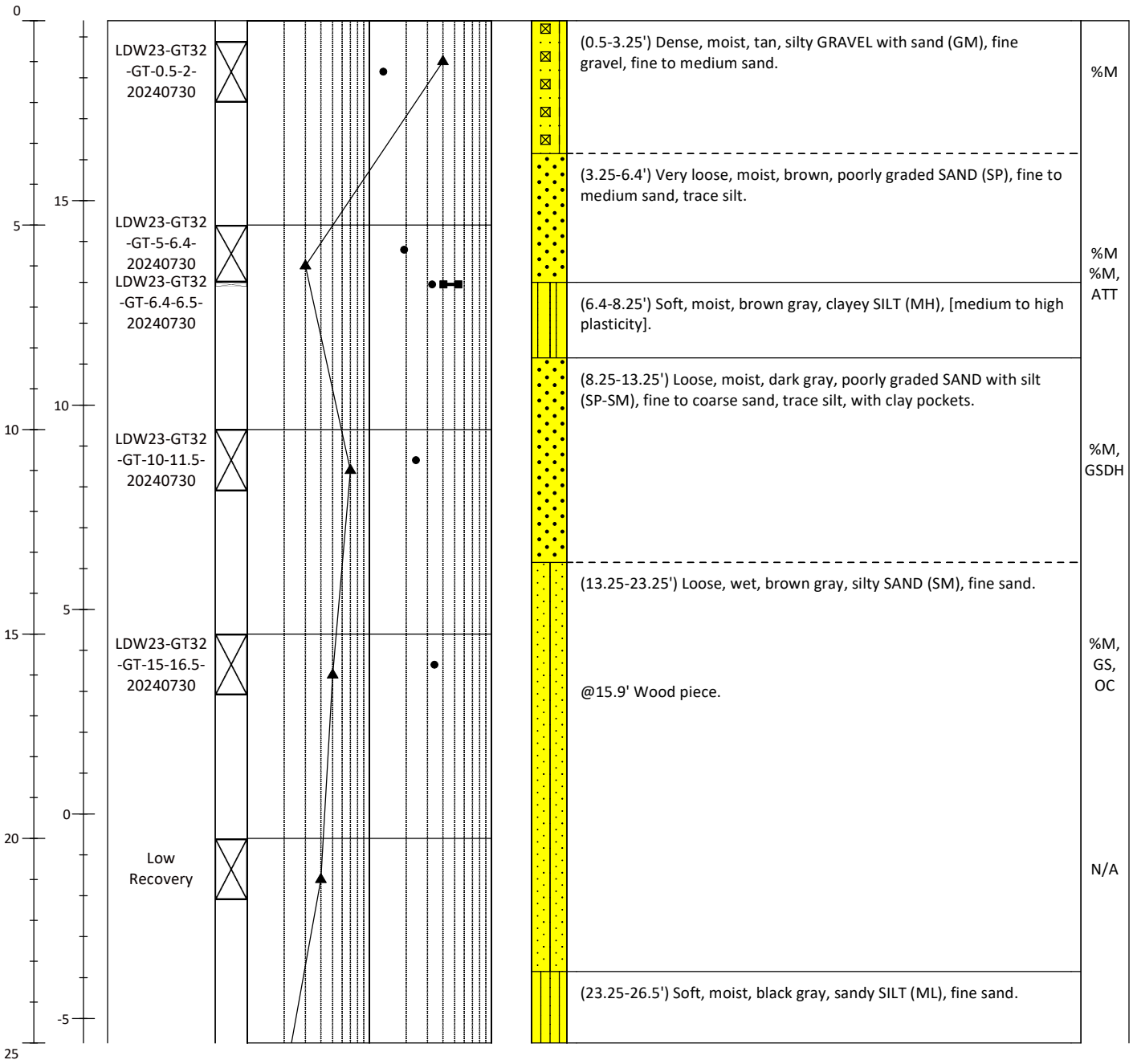
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

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

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**	



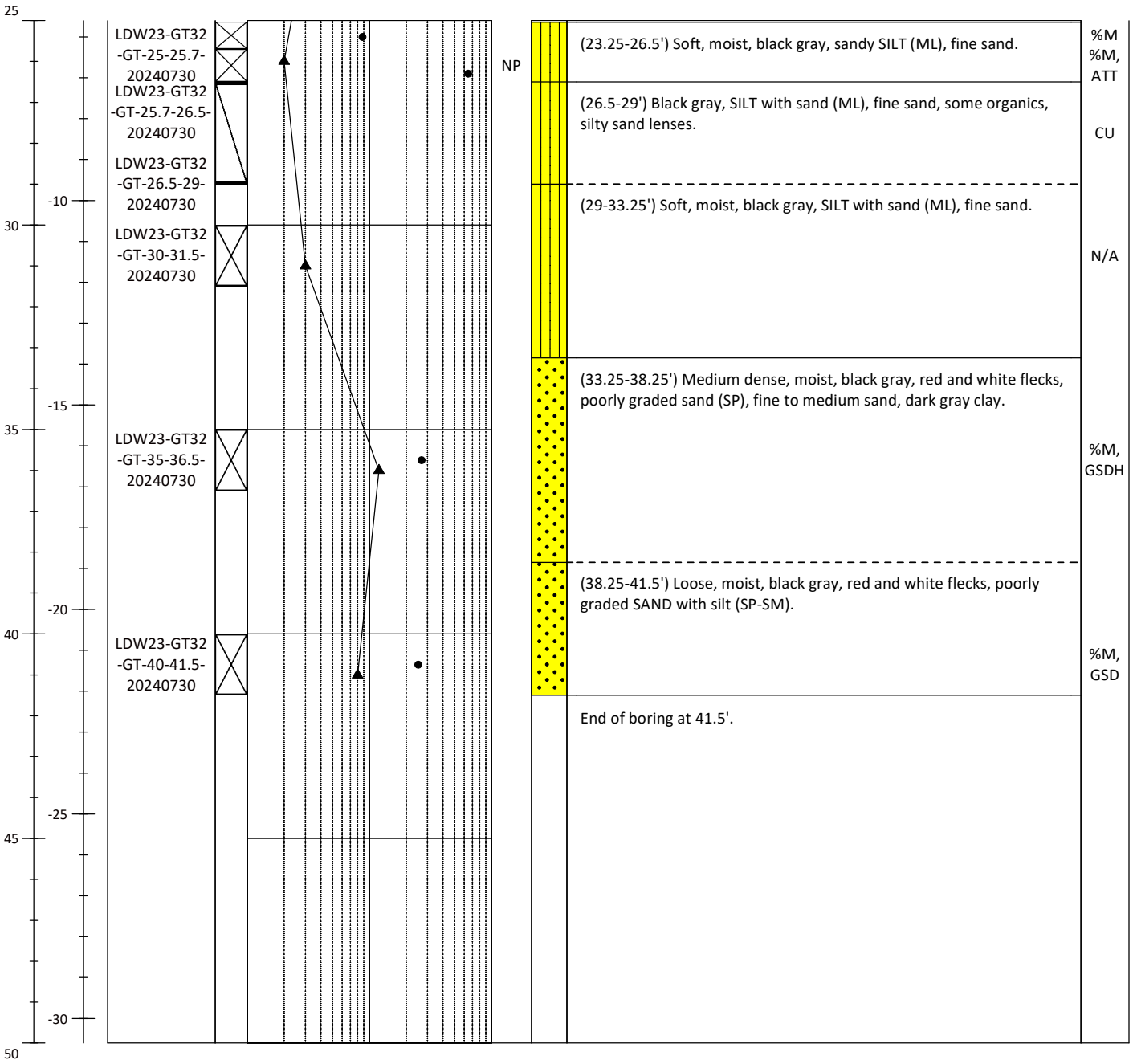
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Suite 2600 Seattle, WA 98101

- 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

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**	



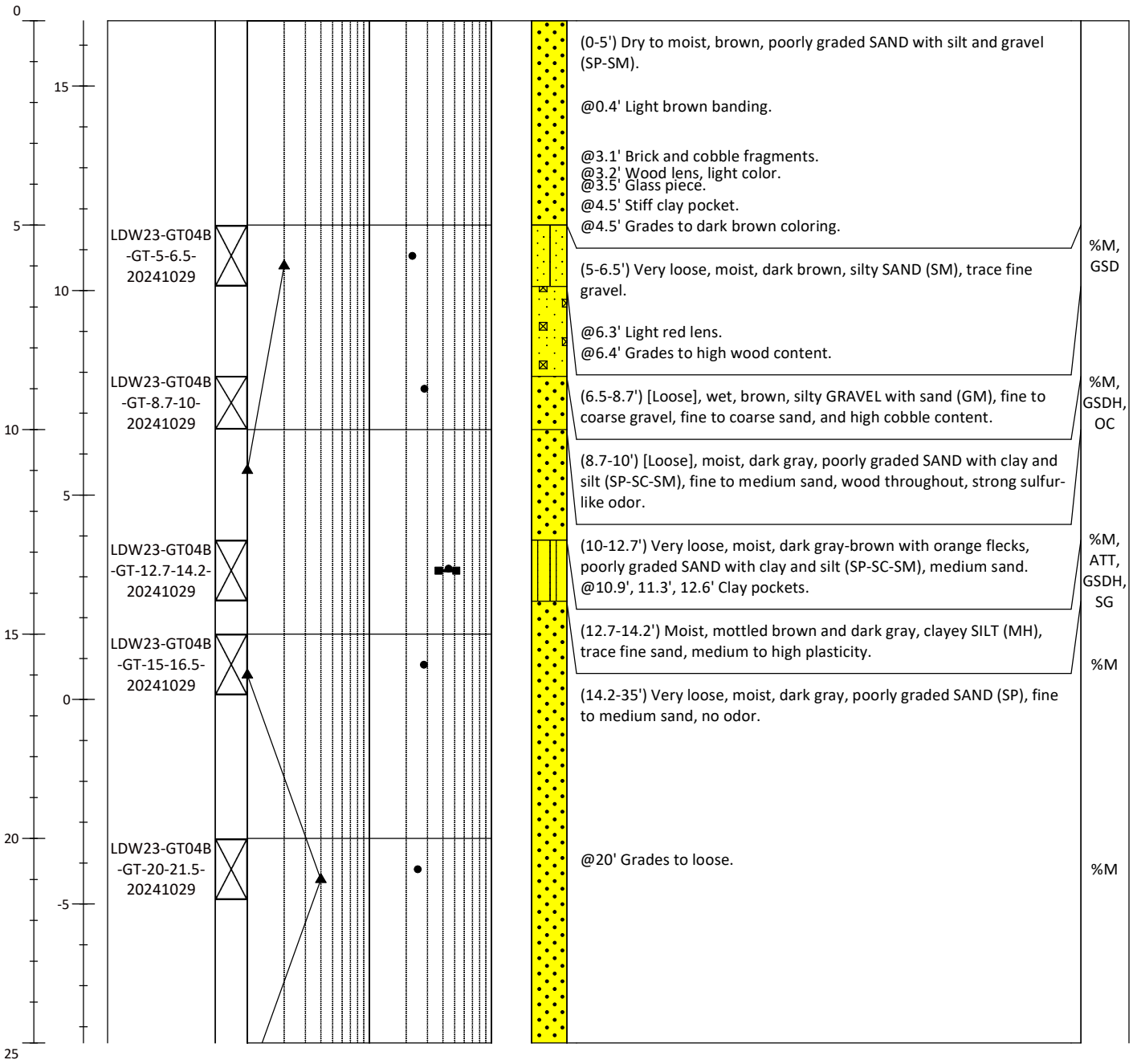
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△ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
⊠ Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT04B-GT

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**	



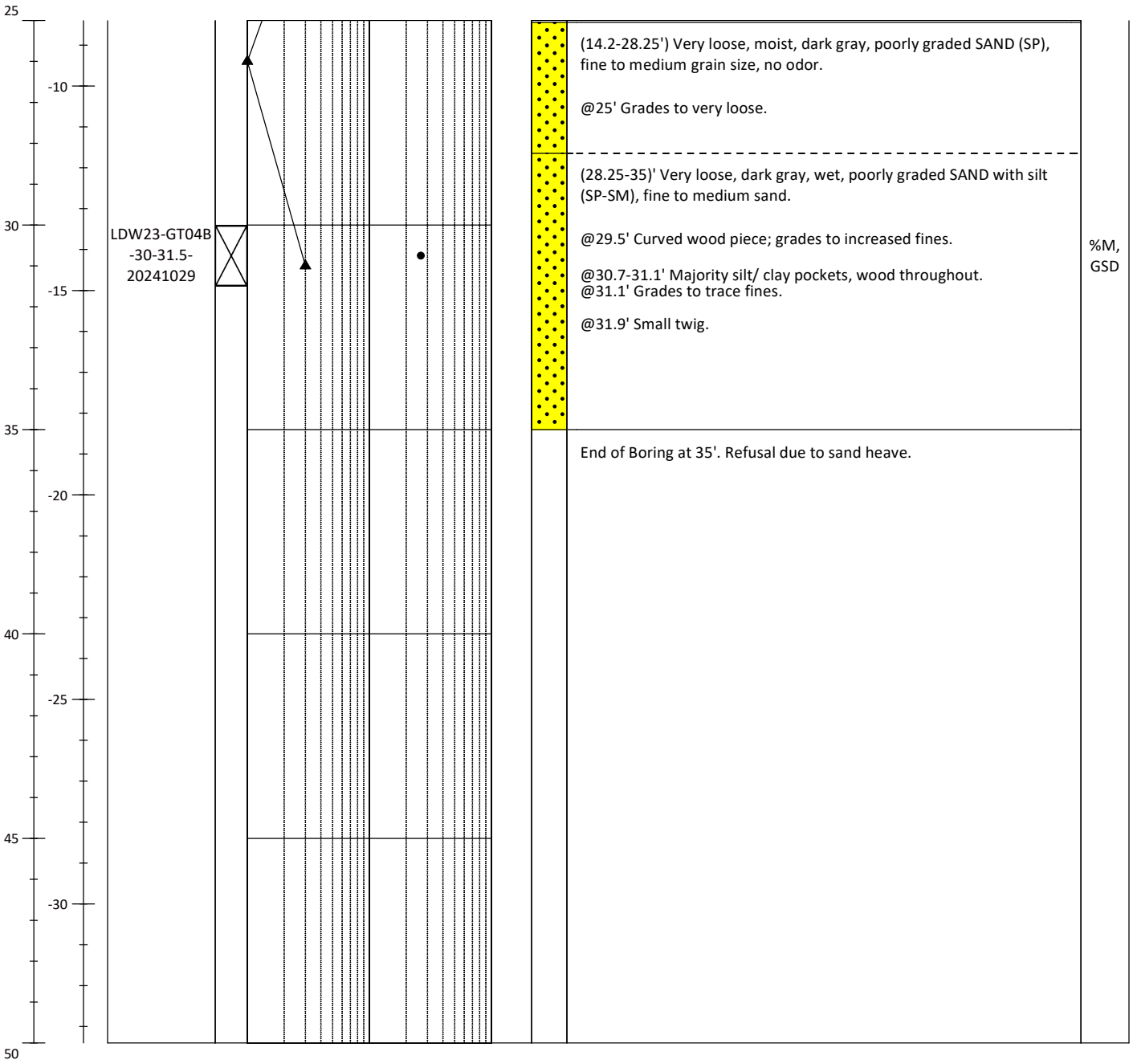
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

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

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**	



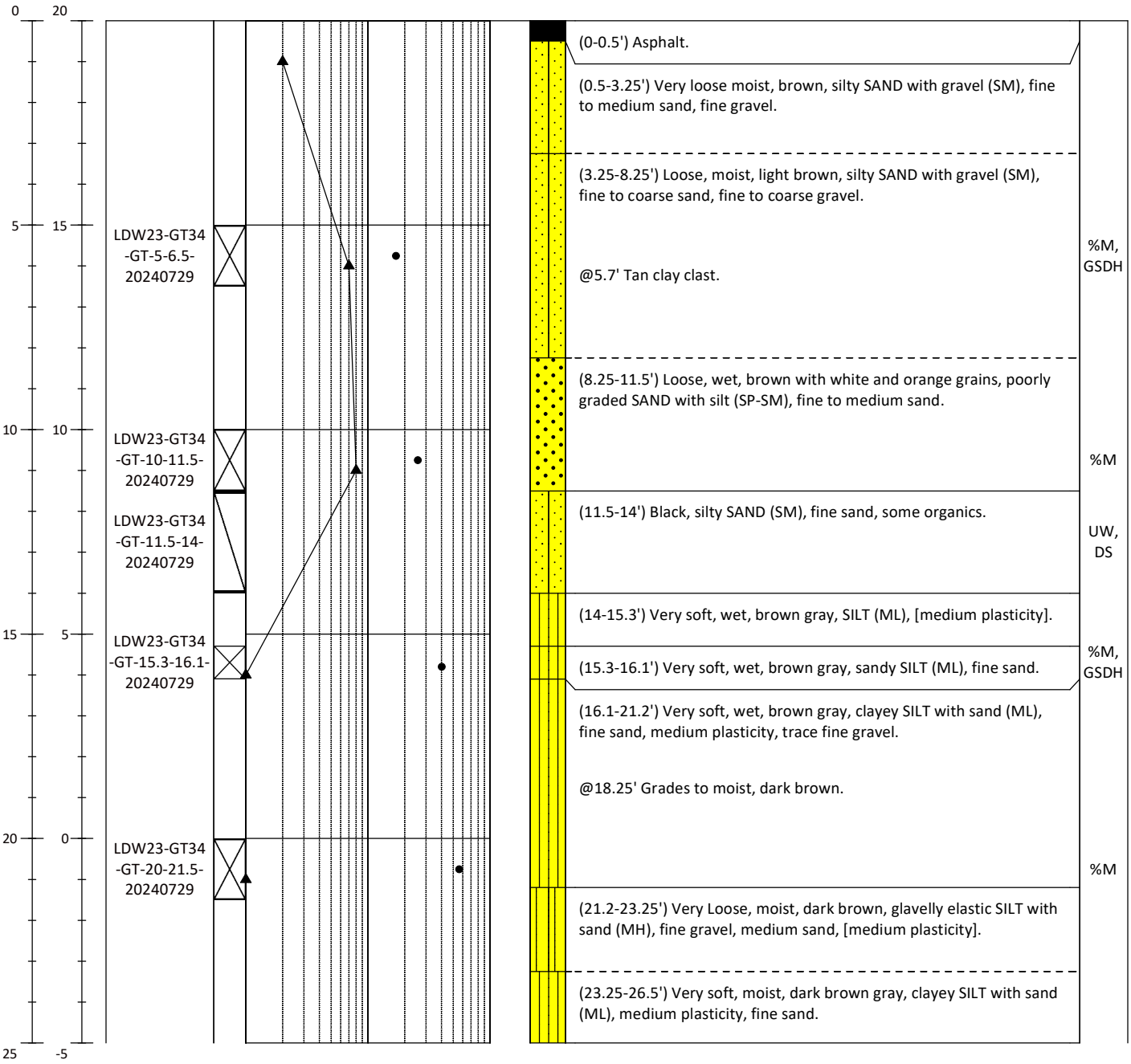
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

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

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**	



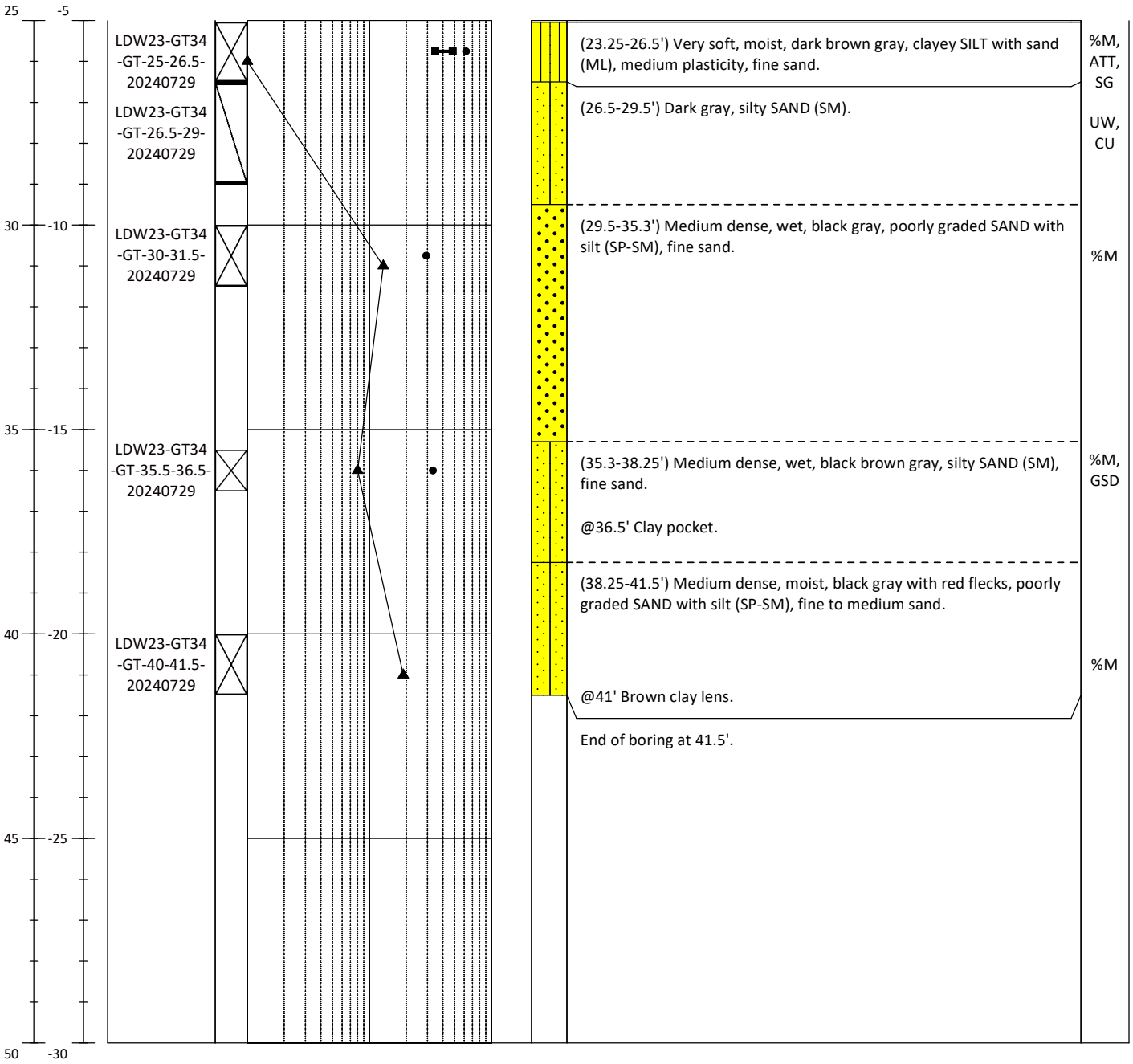
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

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

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**	



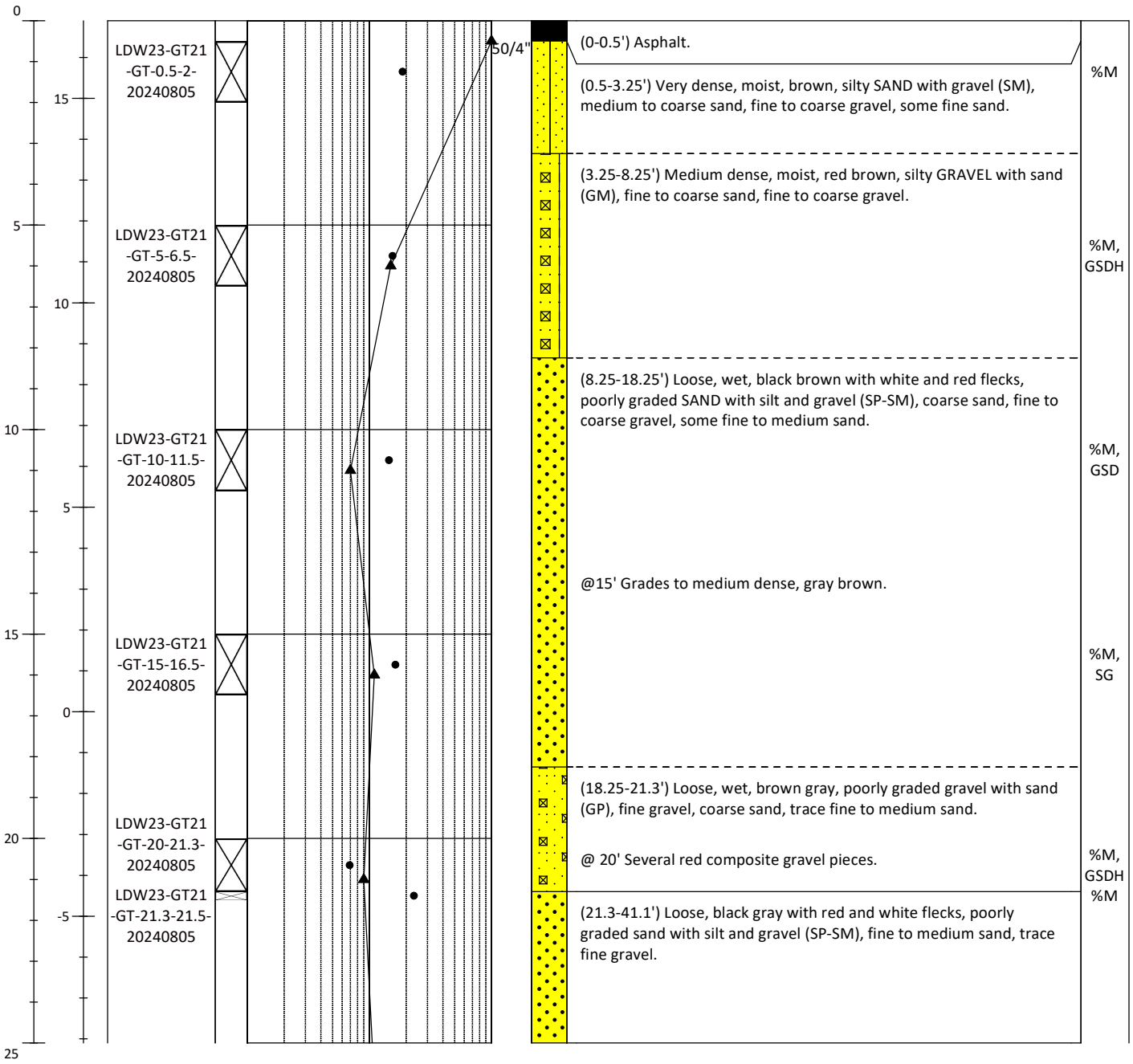
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▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
☒ Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT21-GT

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**	



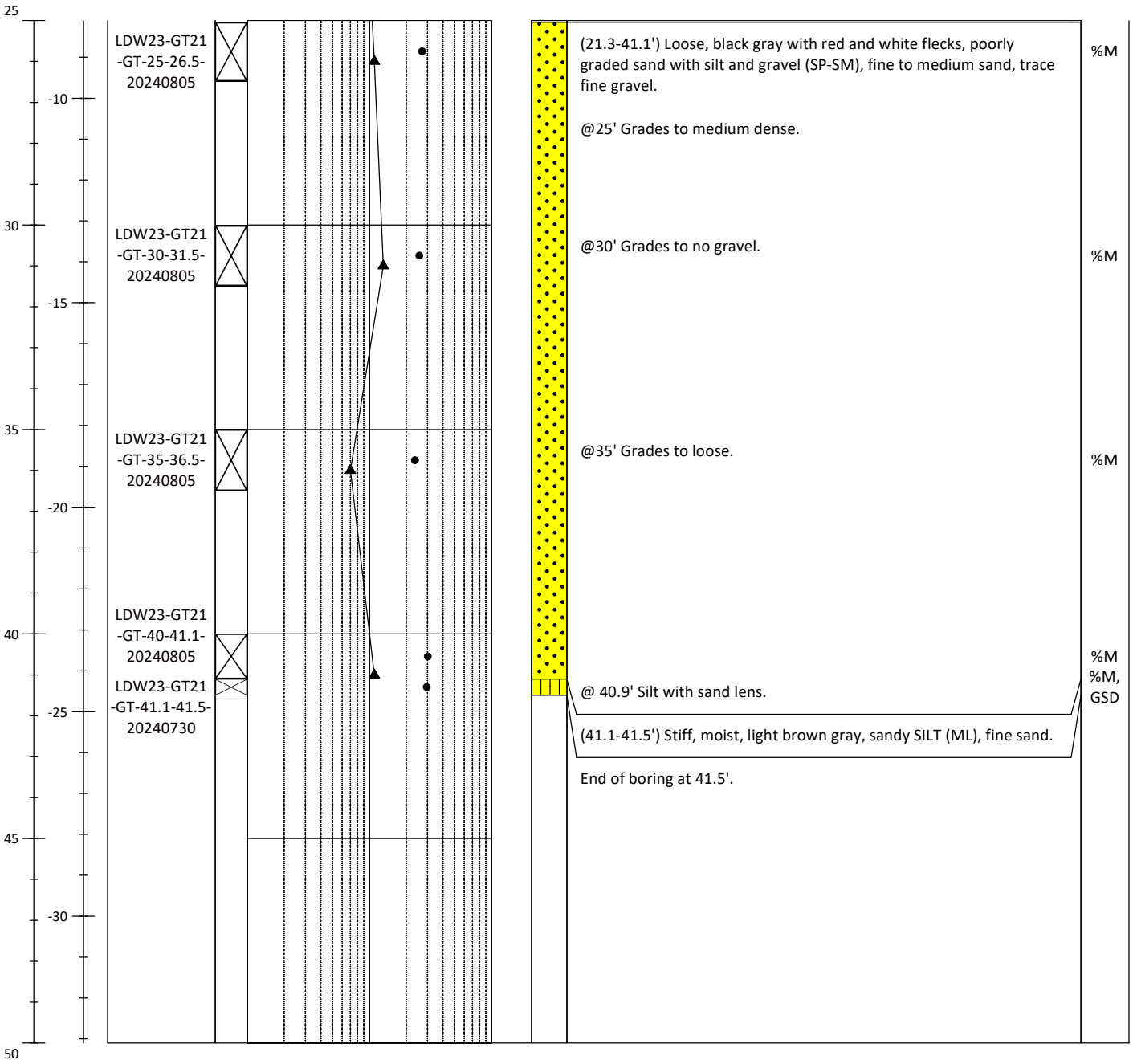
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log
LDW23-GT21-GT

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**	



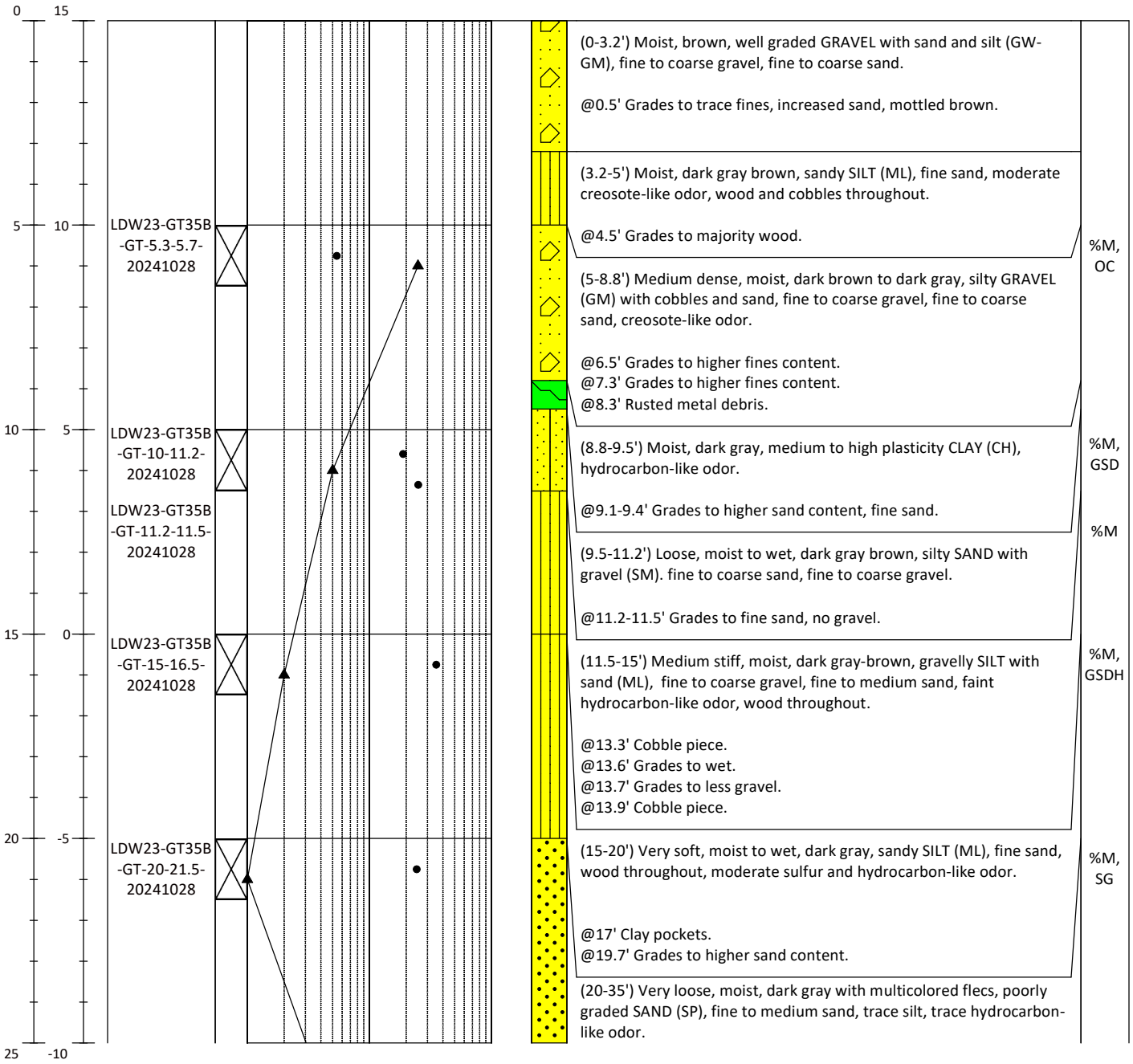
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- SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- Split Spoon/Grab

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**	



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

Notes:
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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 (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
25	-10	LDW23-GT35B-GT-25-26.5-20241028					(20-35') Very loose, moist, dark gray with multicolored flecs, poorly graded SAND (SP), fine to medium sand, trace silt, trace hydrocarbon-like odor.	%M, GSD
							@21.6' Grades to no odor.	
							@26' Clay lens (0.1').	
30	-15							
							@30' Grades to faint to medium hydrocarbon-like odor.	
							@32.3-33.4' Tan clay pockets (up to 3").	
35	-20						End of Boring at 35'. Refusal due to sand heave.	
40	-25							
45	-30							
50	-35							

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△ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
▯ Shelby Tube
☒ Split Spoon/Grab

Notes:
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Mudline elevations determined from leadline measurements and Site tide gage levels.

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

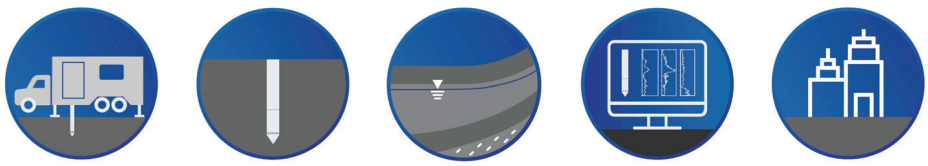
Report Prepared by:

ConeTec, Inc.

1237 S Director Street, Seattle, WA 98108

Tel: (253) 397-4861

ConeTecWA@conetec.com
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www.conetecdataservices.com



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CONETEC

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.

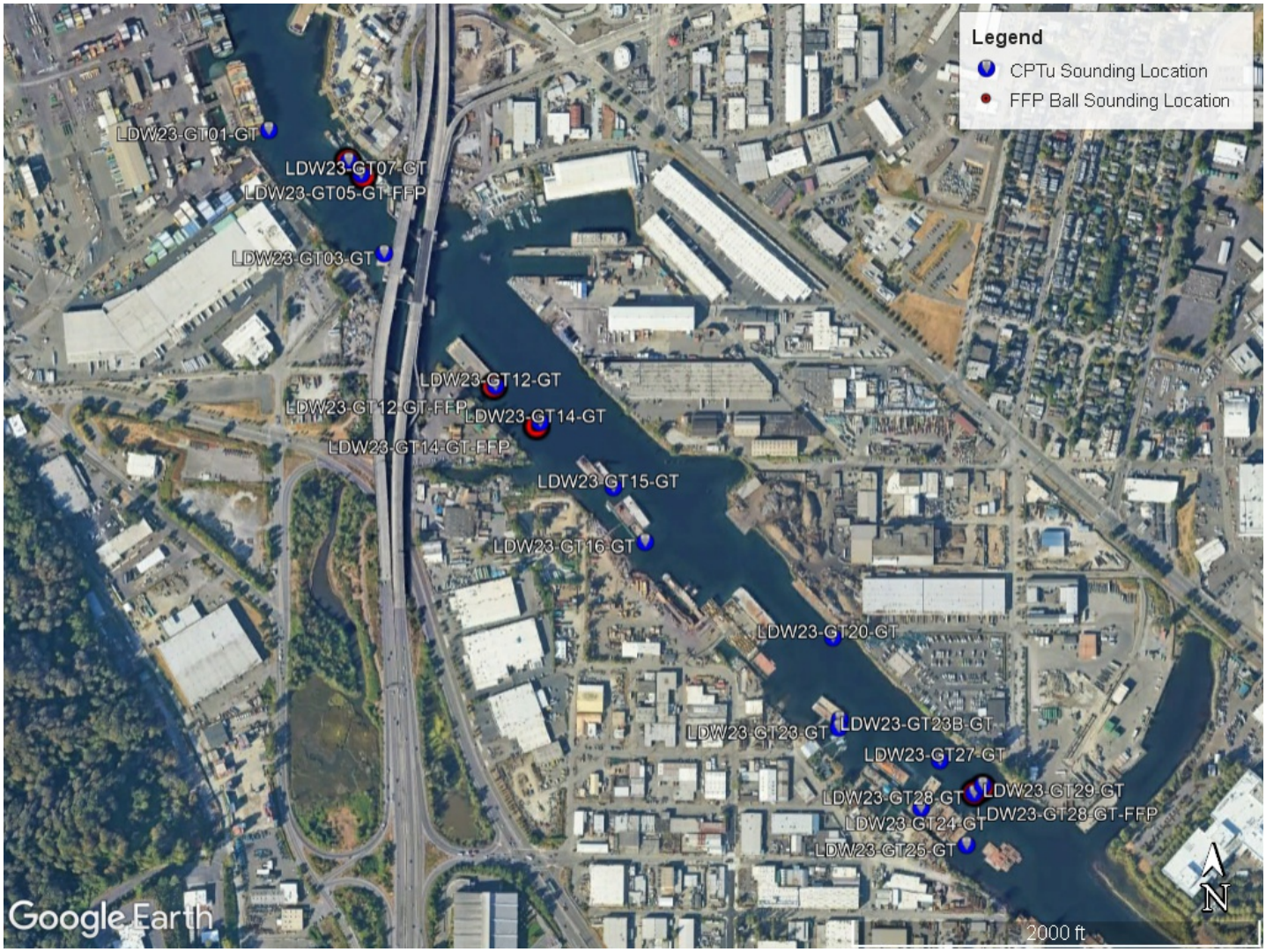
Project	
Client	Anchor QEA
Project	Lower Duwamish Waterway Middle Reach
ConeTec Project Number	24-59-27874
Test Types	CPTu, BCPT
Additional Comments	BCPT Cycling was performed at selected locations and depths.

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/m3) and the soil (17.5 kN/m3) were assumed and applied to calculations for specific depth layers, otherwise defined by Qtn (SBT Qtn) (Robertson, 2009). An assumed unit weight profile summary is included in the appendices.

Calculated Geotechnical Parameters	
Additional information	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). 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. 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).

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/m3) and the soil (17.5 kN/m3) 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

CONETEC

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 measuered 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

CPTu 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	

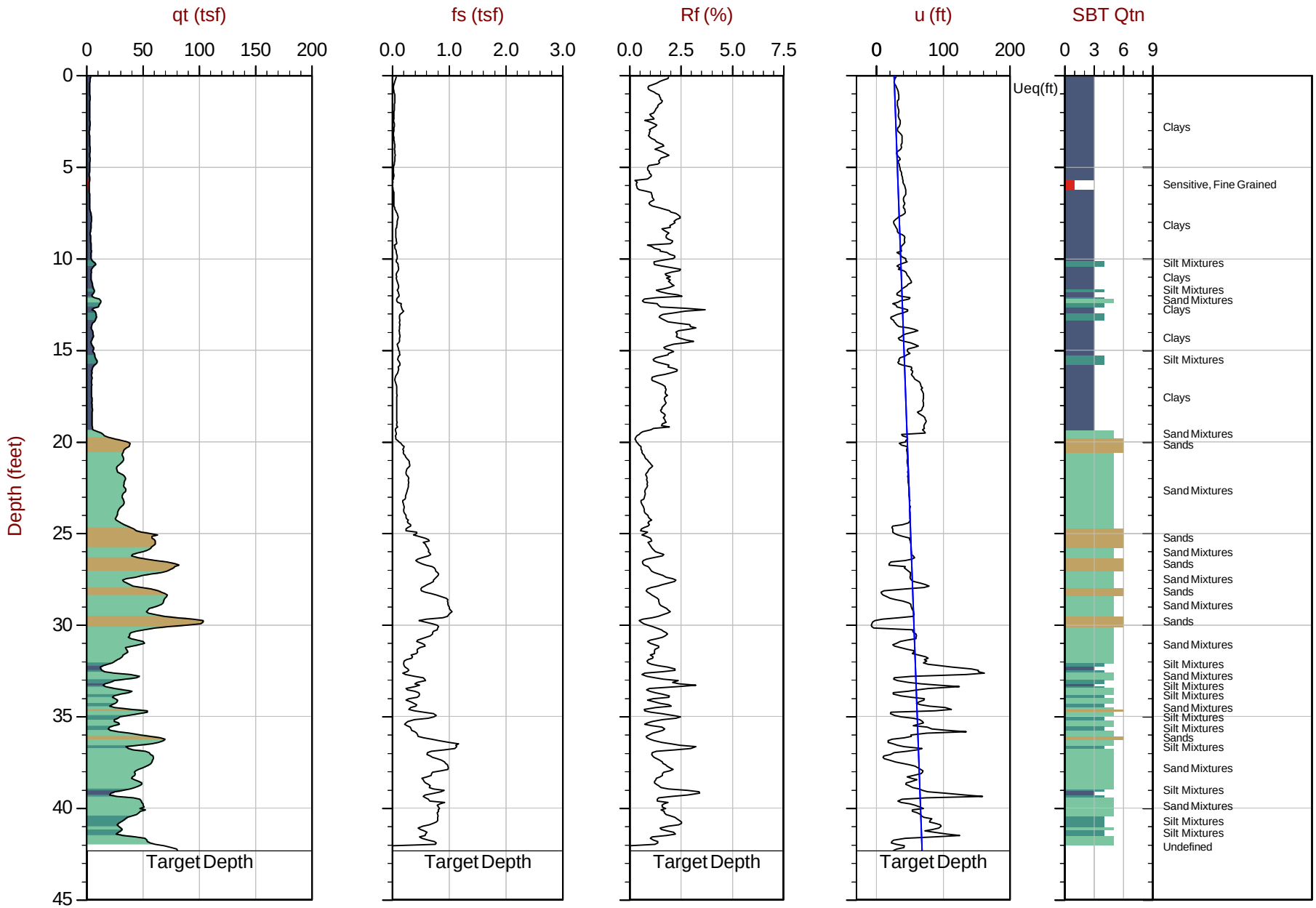
1. A unit weight of 9.81 kN/m^3 was assumed for data above the mudline, within the water layer. A unit weight of 17.50 kN/m3 was assumed for data below the mudline. For all other depth ranges, unit weights were based on SBT Qtn zones.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-12 11:45
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT01-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_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

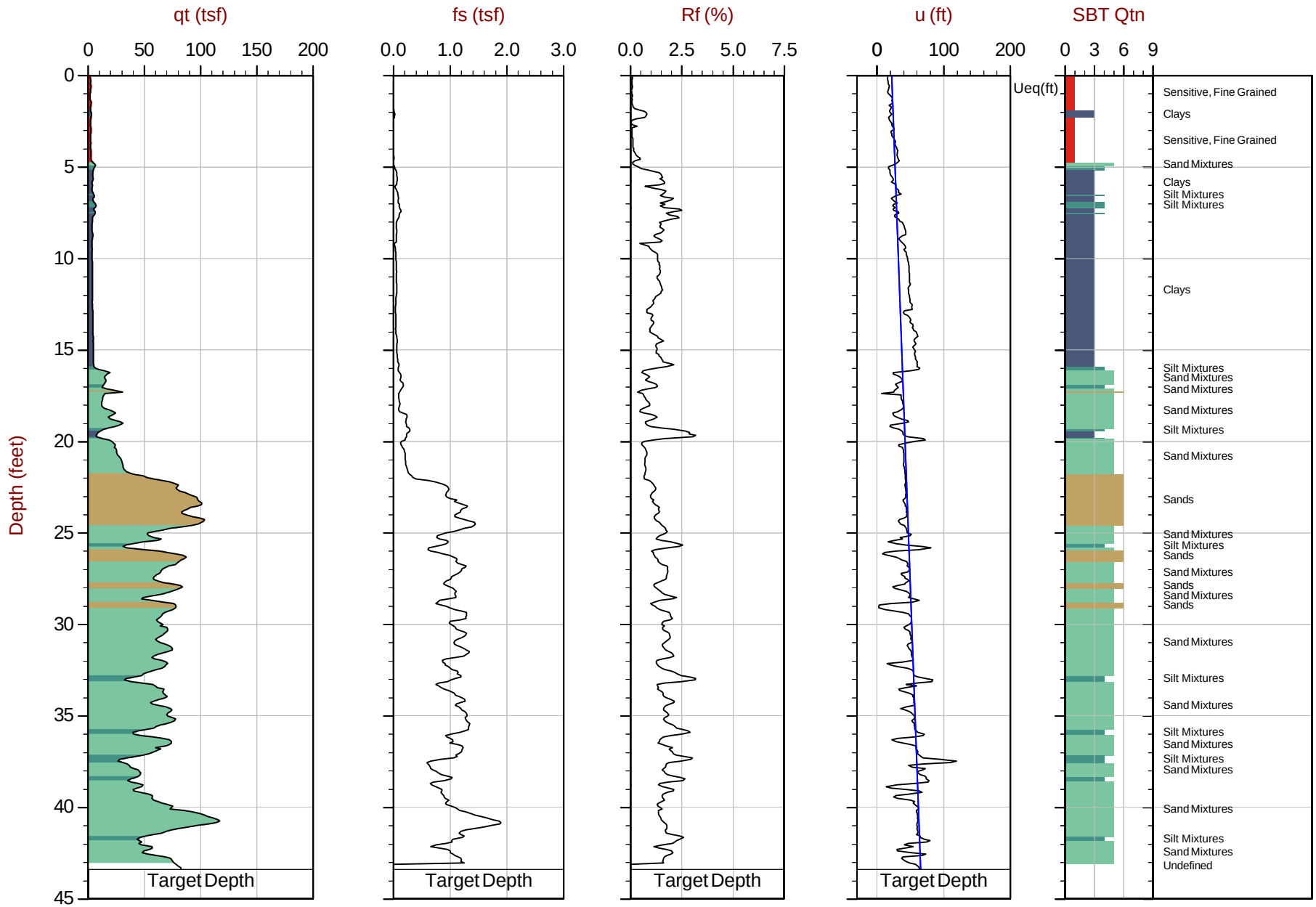
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-12 15:12
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT03-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

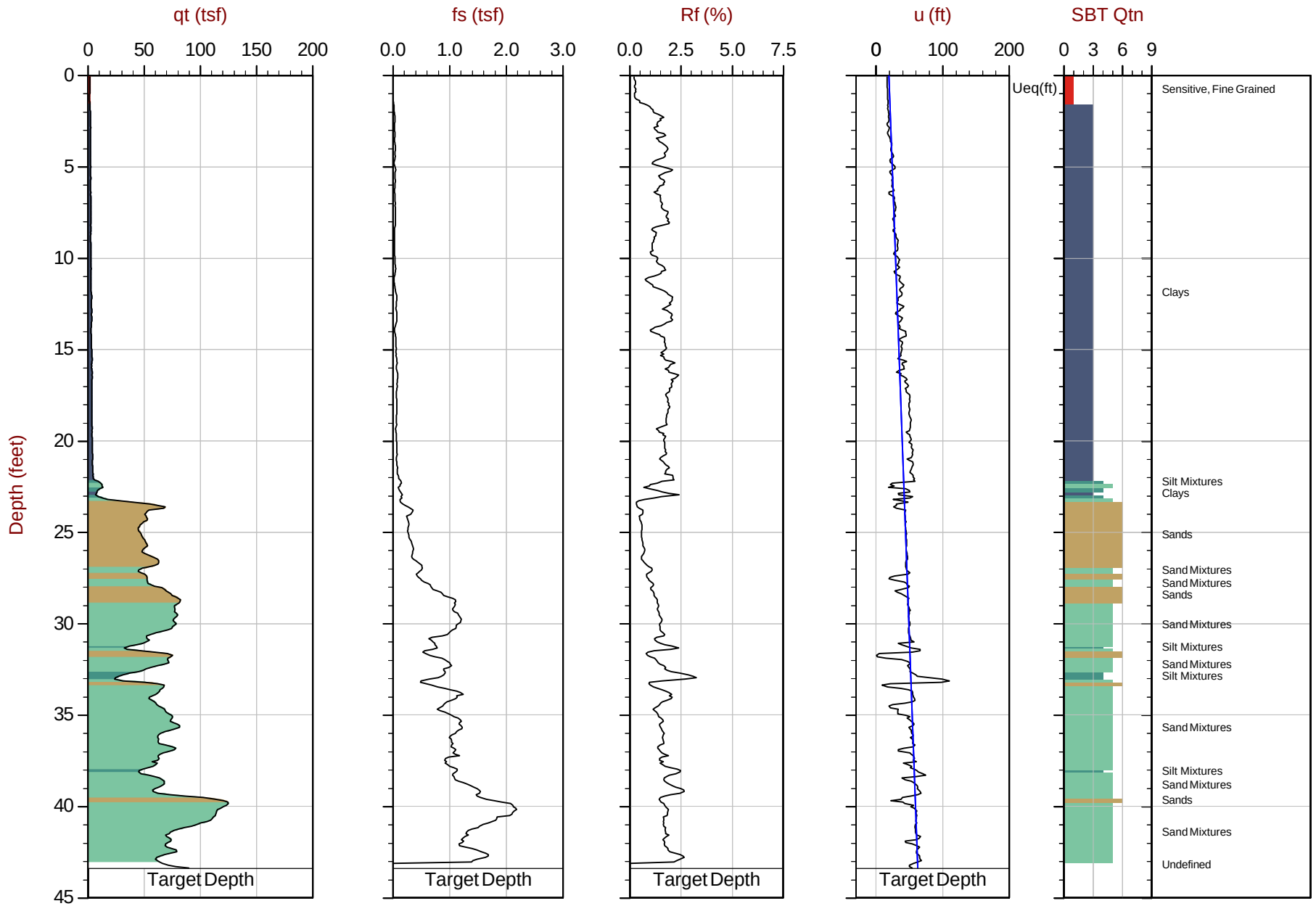
Overplot Item: Ueq | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Dissipation, Ueq assumed | Hydrostatic Line

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

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-13 07:54
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT05-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

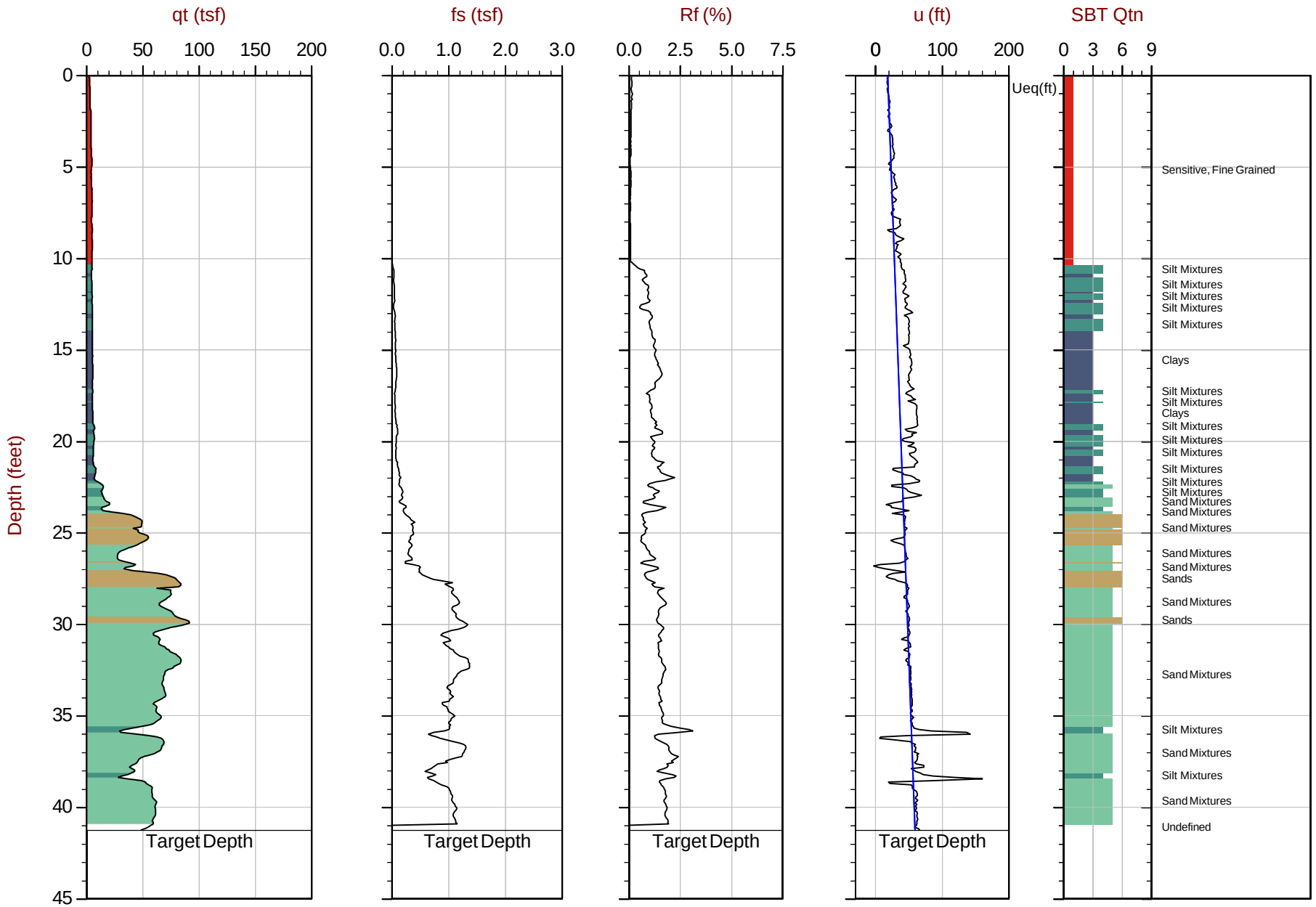
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-13 13:25
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT07-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

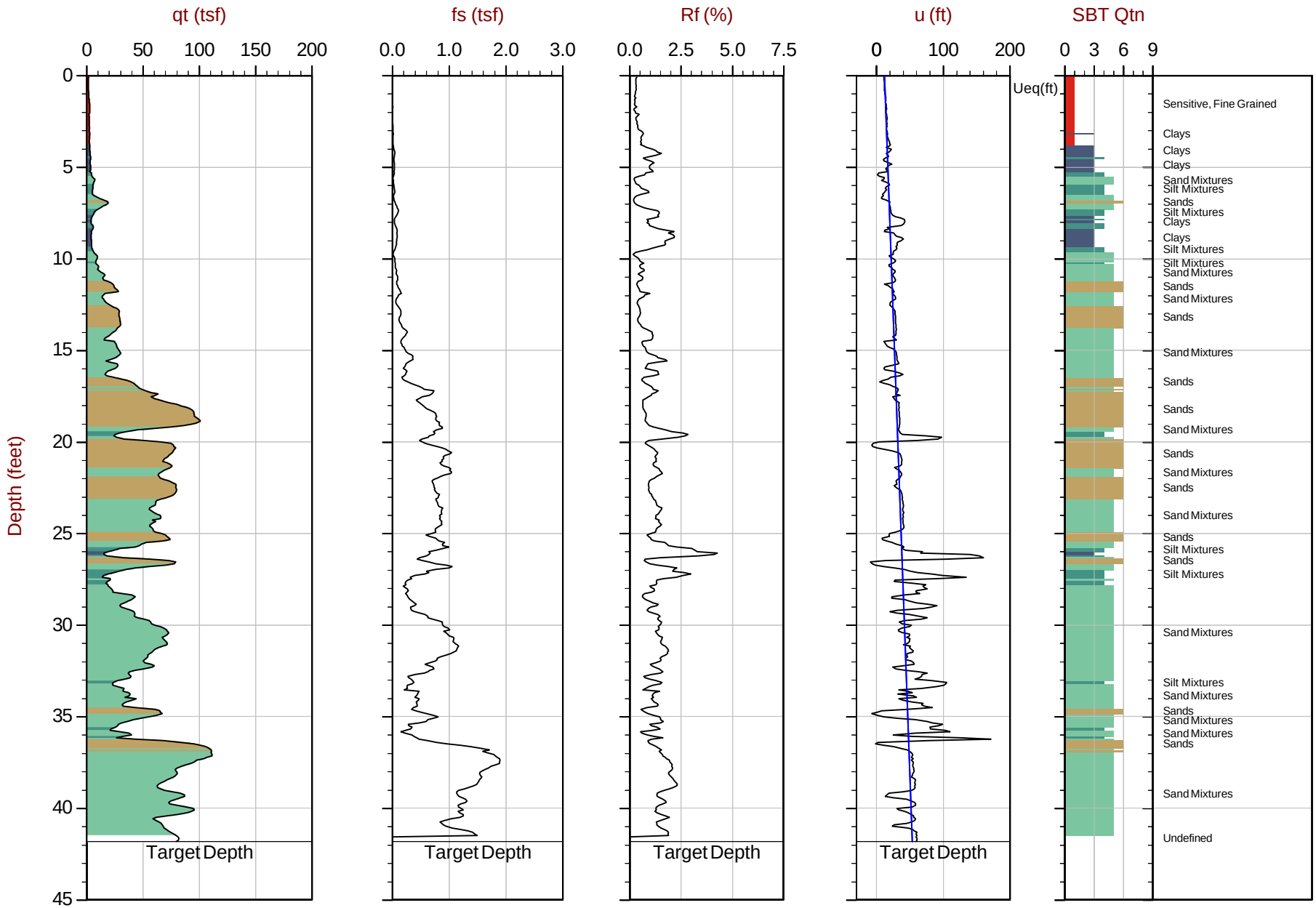
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

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

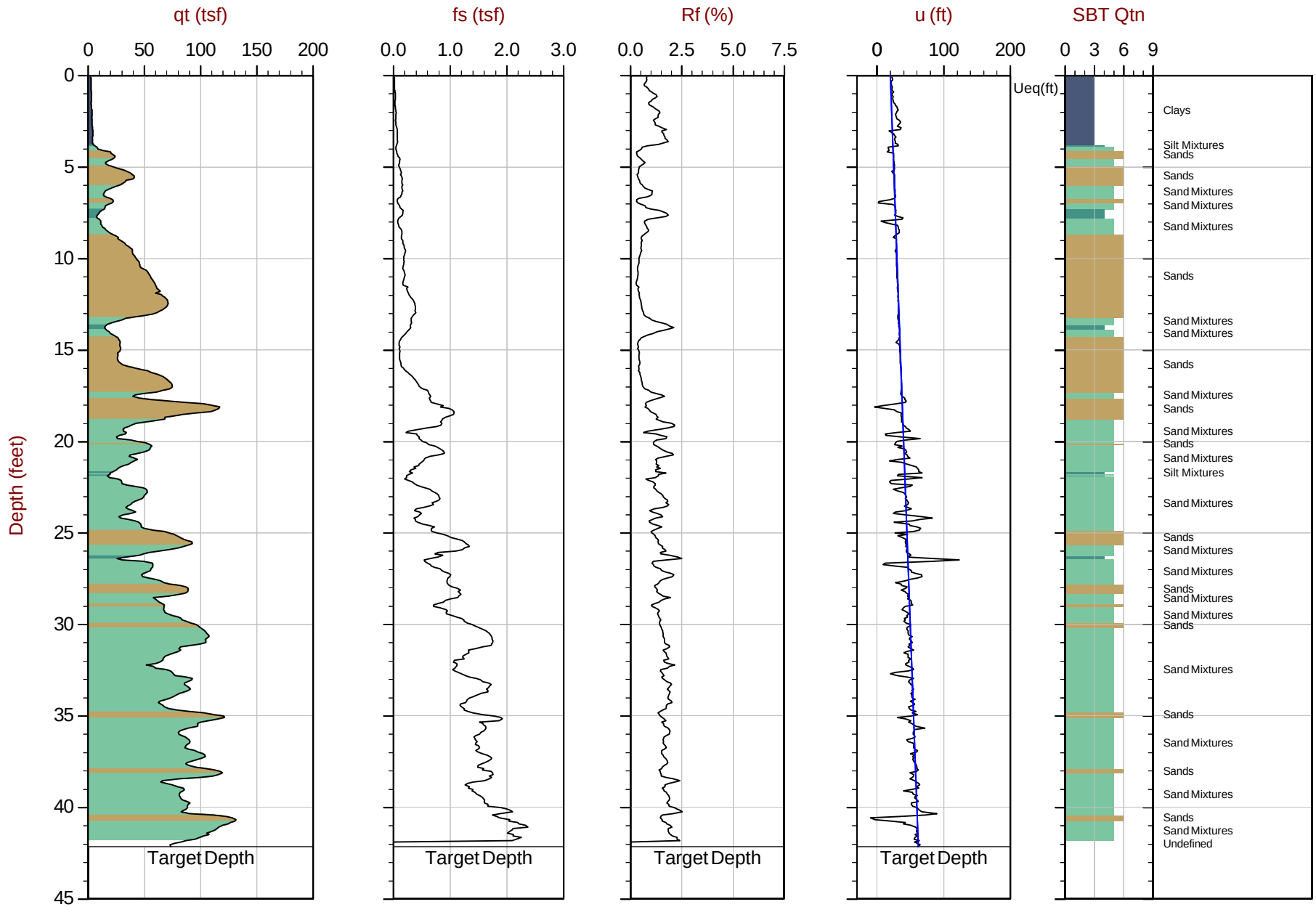
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-08 08:31
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT14-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

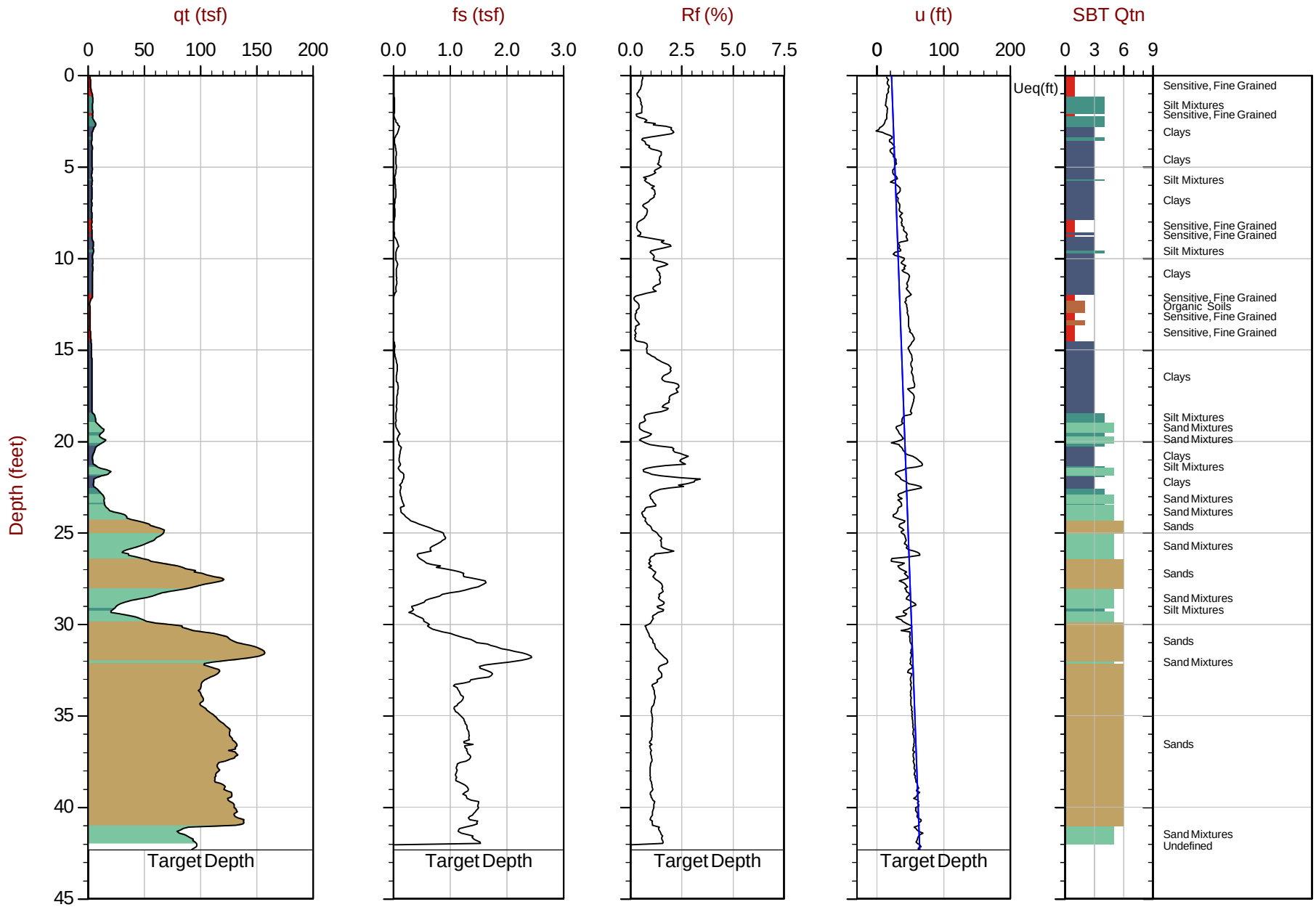
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

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

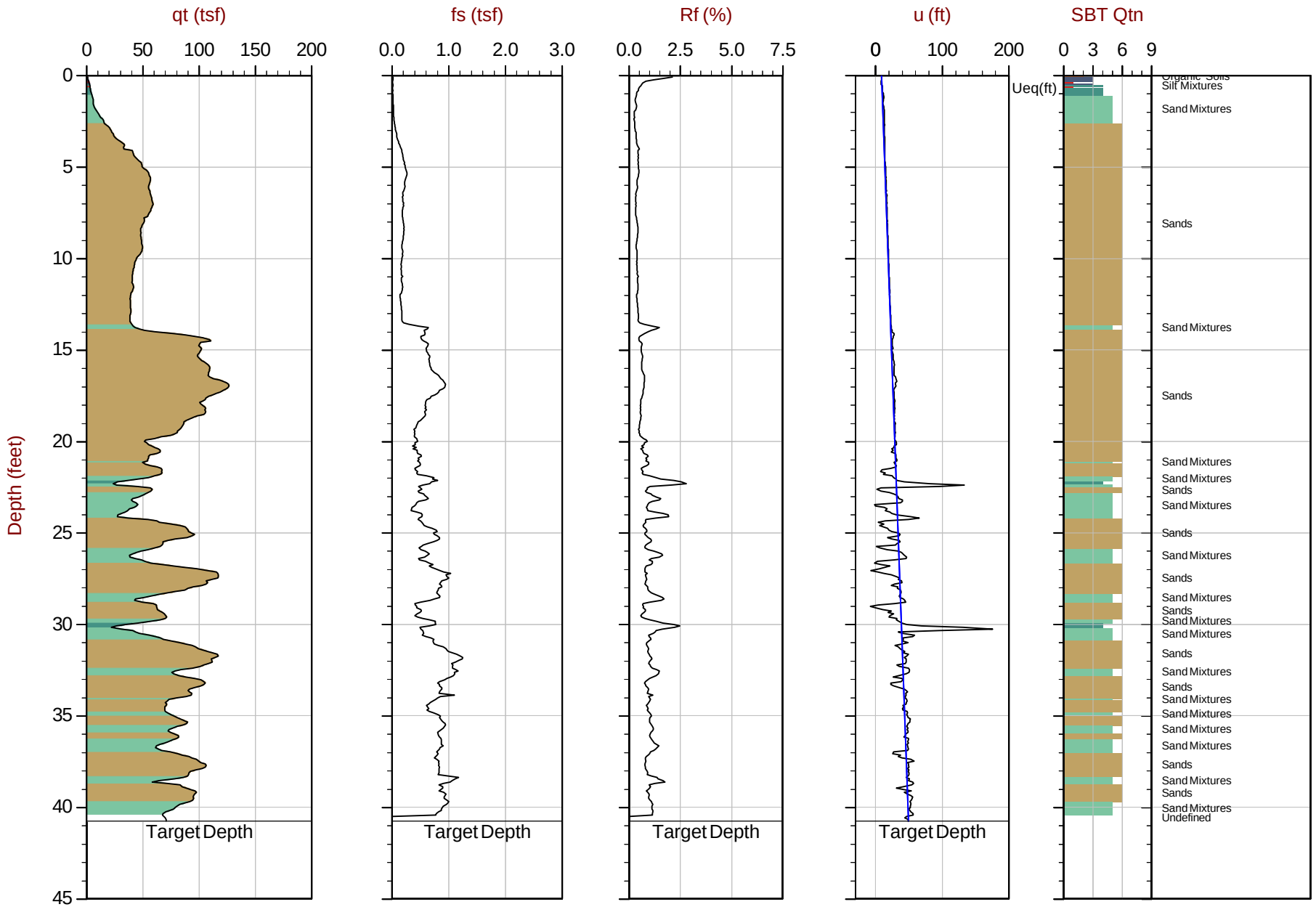
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-11 13:11
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT16-GT
Cone: 681:T375F10U35 Area=15 cm²



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

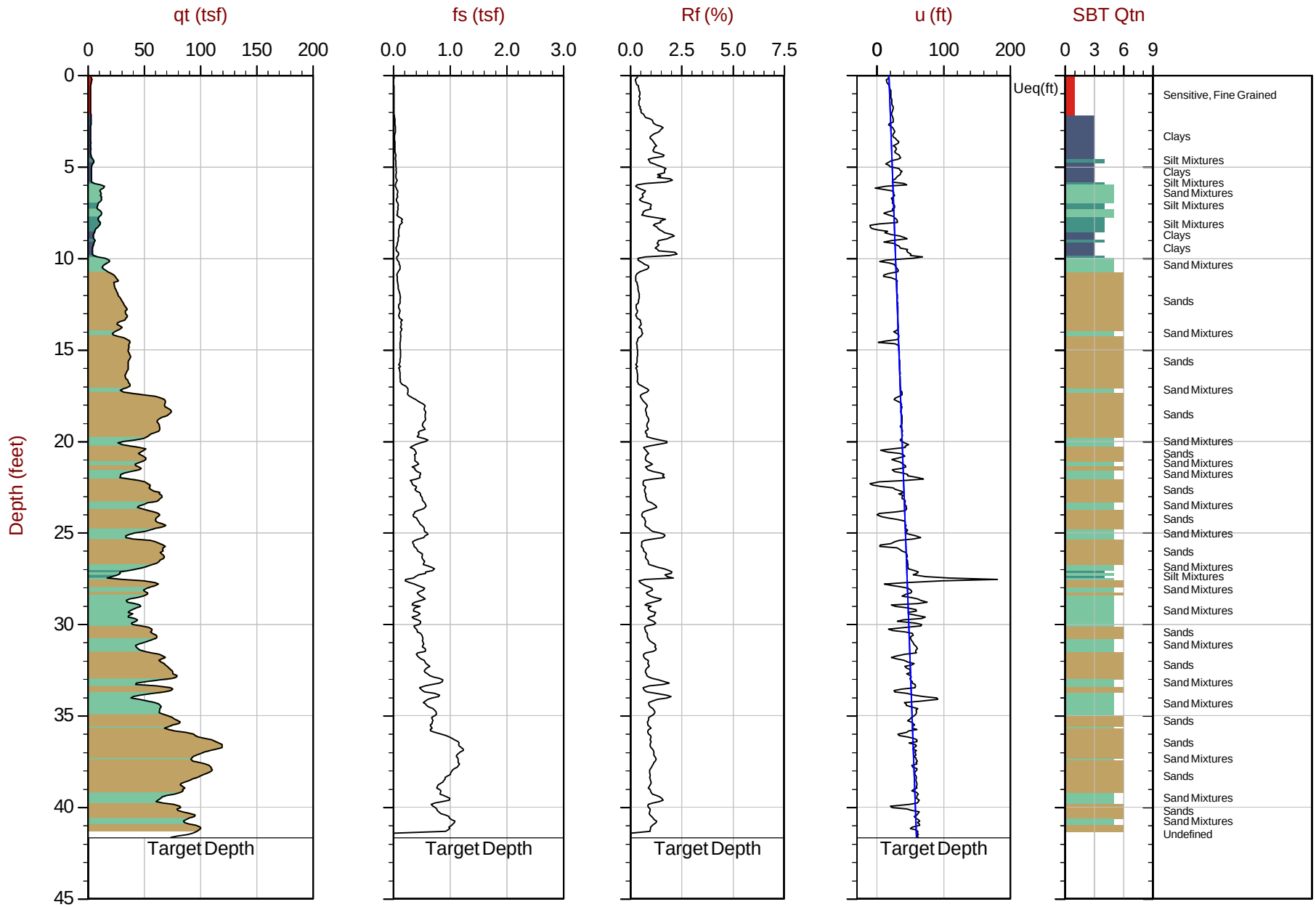
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

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

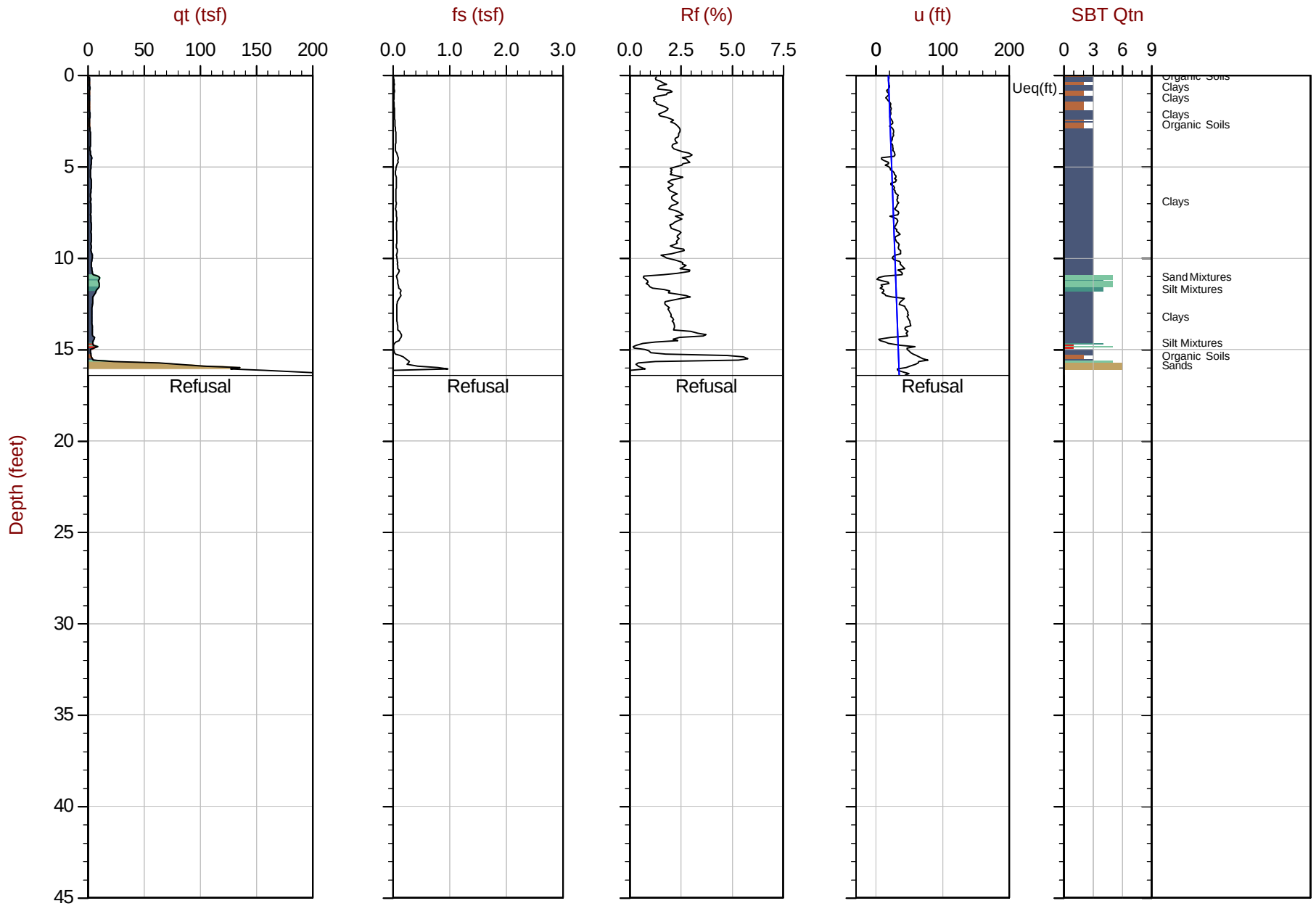
Overplot Item: Ueq | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Dissipation, Ueq assumed | Hydrostatic Line

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

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-10 08:15
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT23-GT
Cone: 681:T375F10U35 Area=15 cm²



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

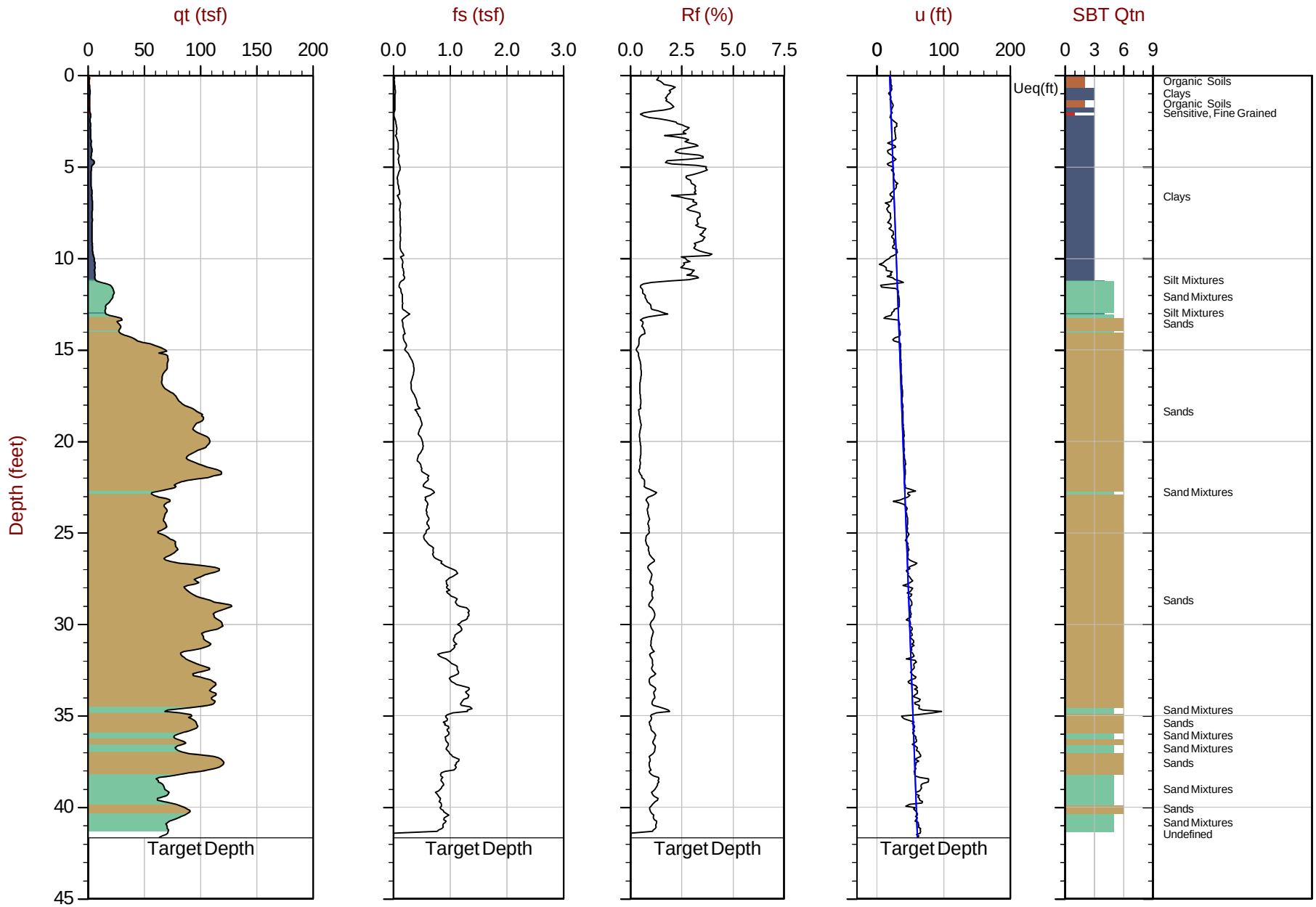
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-10 10:53
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT23B-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_CP23B.COR
Unit Wt: SBTQtn (PKR2009)

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

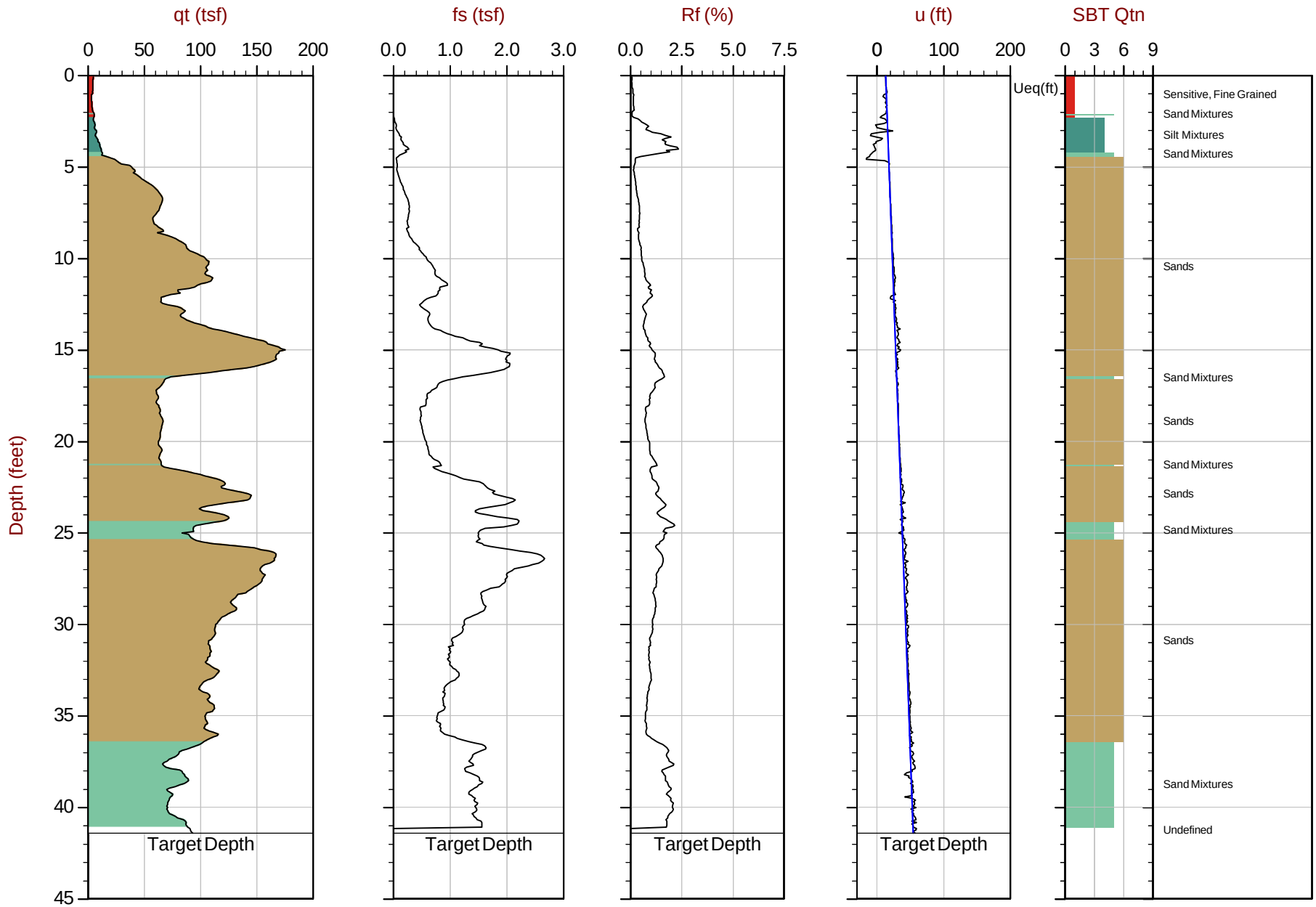
Overplot Item: Ueq | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Dissipation, Ueq assumed | Hydrostatic Line

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

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-09 11:24
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT24-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

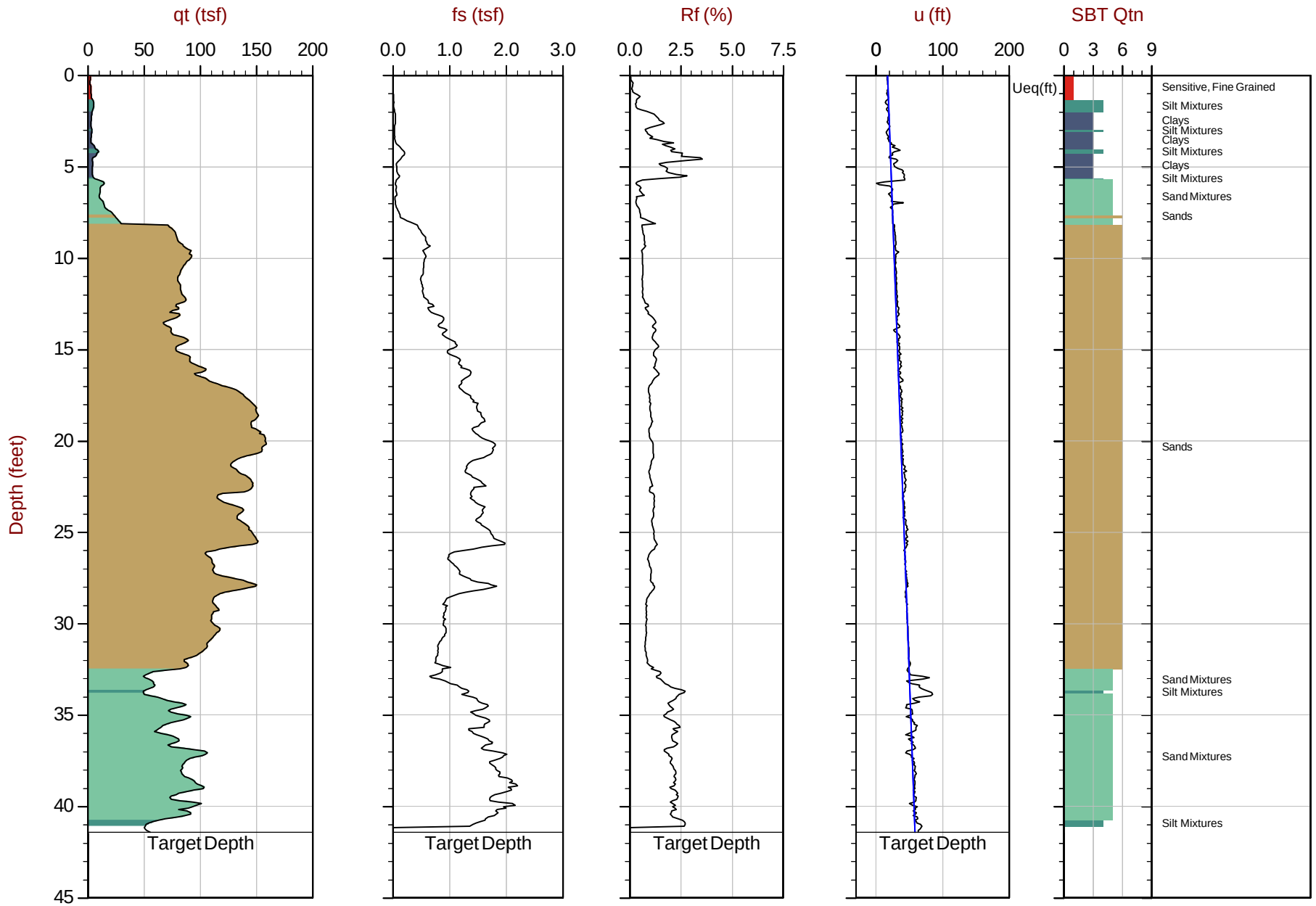
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-09 07:59
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT25-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

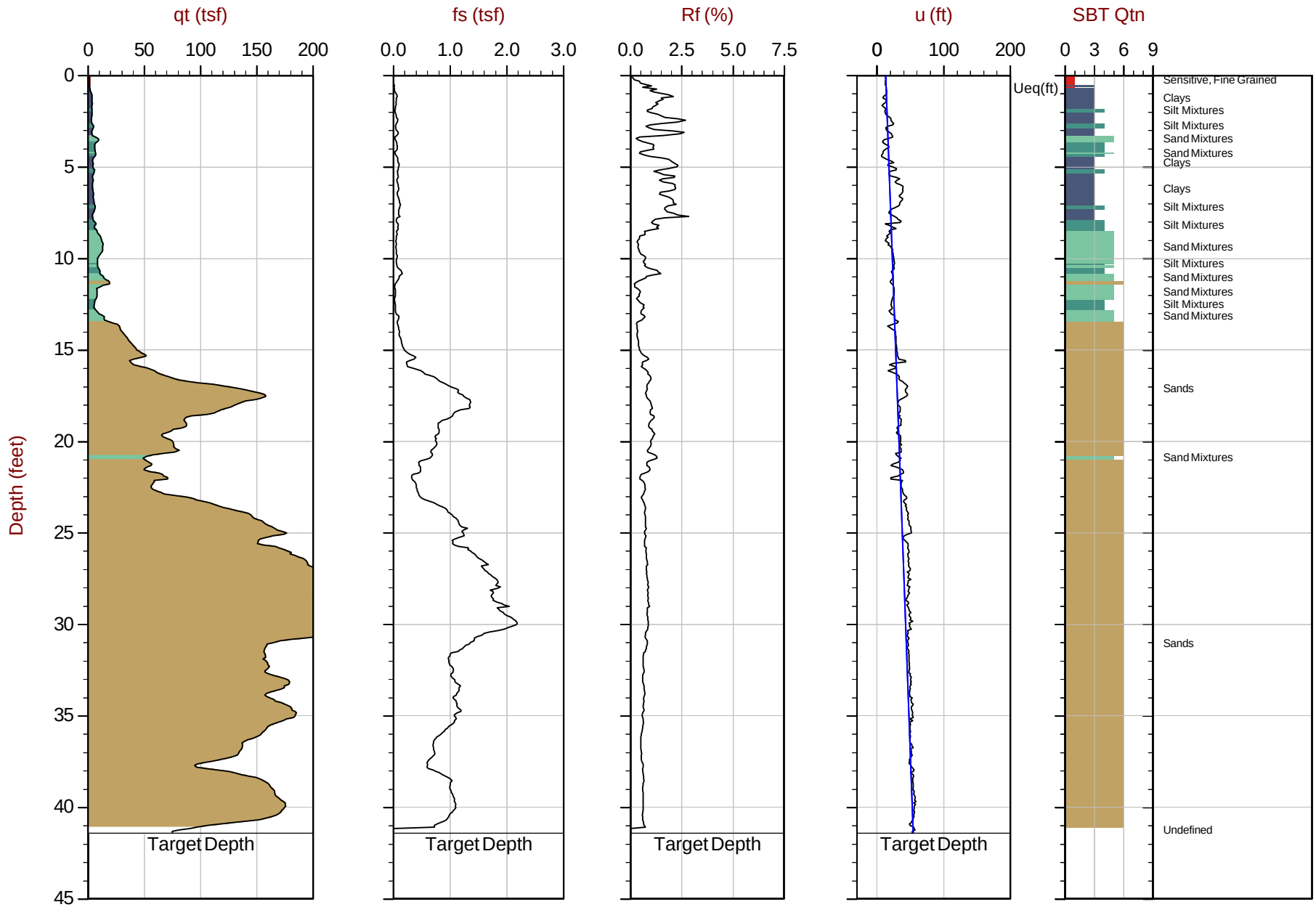
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-10 14:31
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT27-GT
Cone: 681:T375F10U35 Area=15 cm²



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

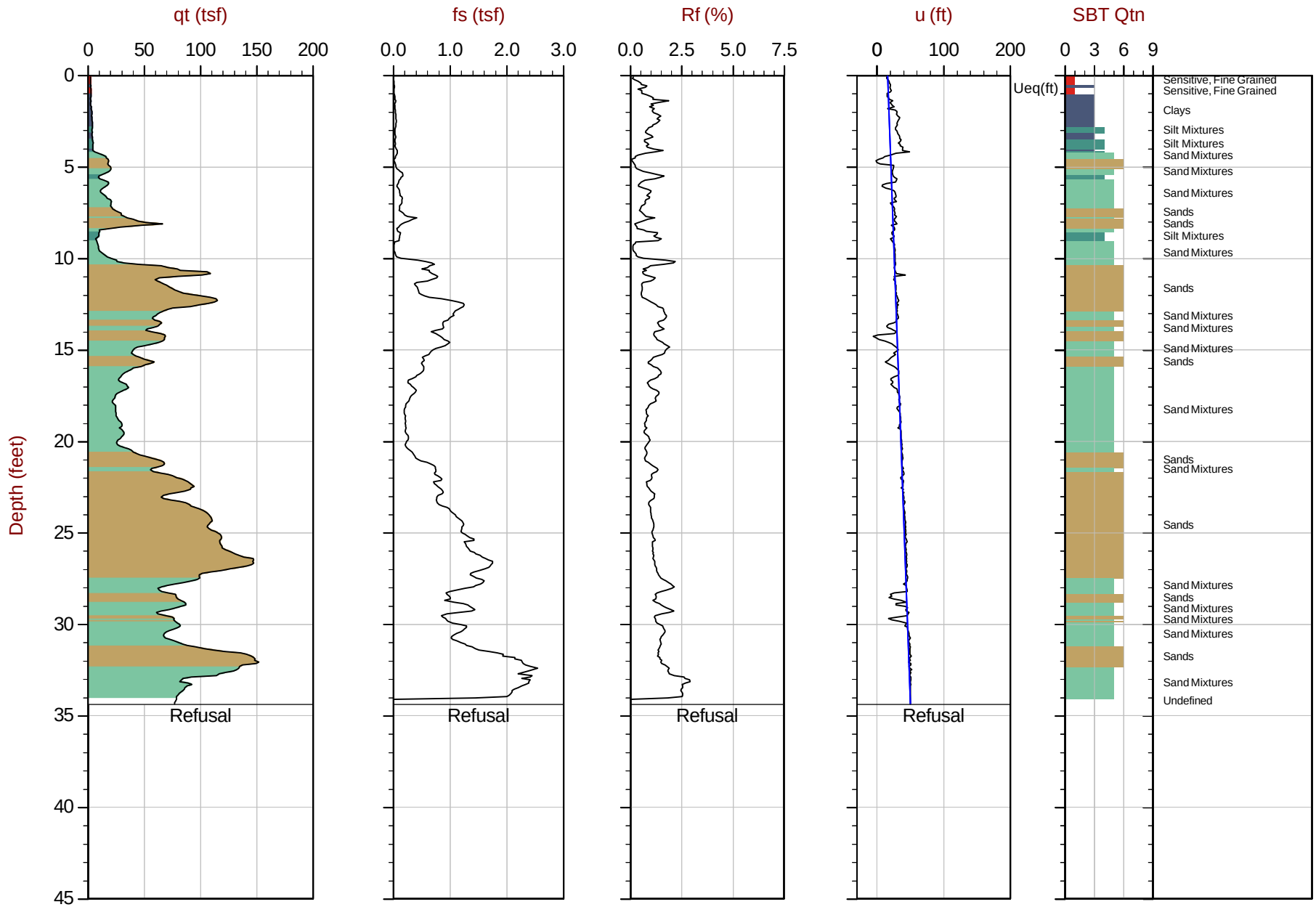
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-14 07:19
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT28-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

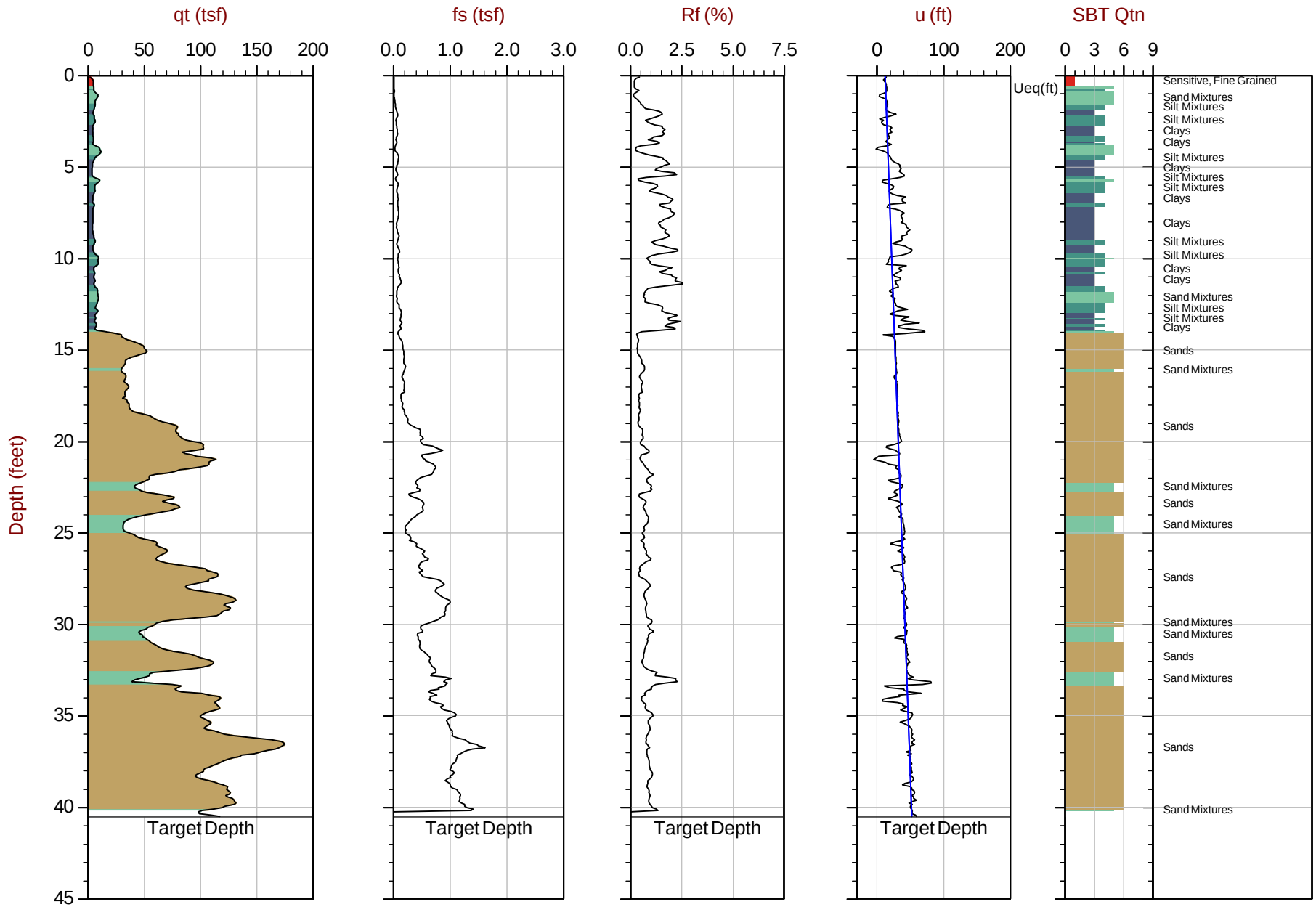
Overplot Item: Ueq | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Dissipation, Ueq assumed | Hydrostatic Line

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

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-12 07:16
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT29-GT
Cone: 681:T375F10U35 Area=15 cm²



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

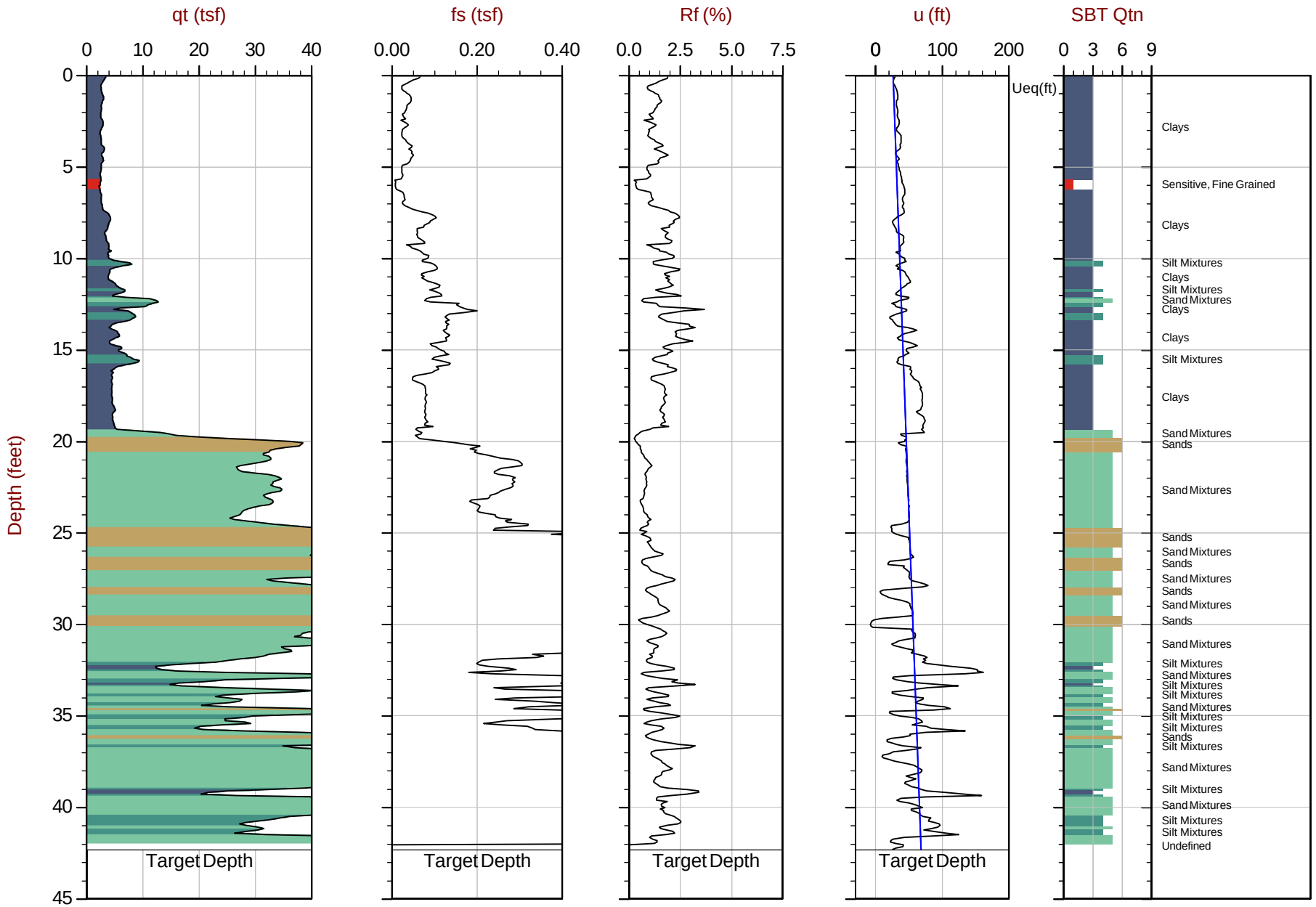
CONETEC

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-12 11:45
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT01-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_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

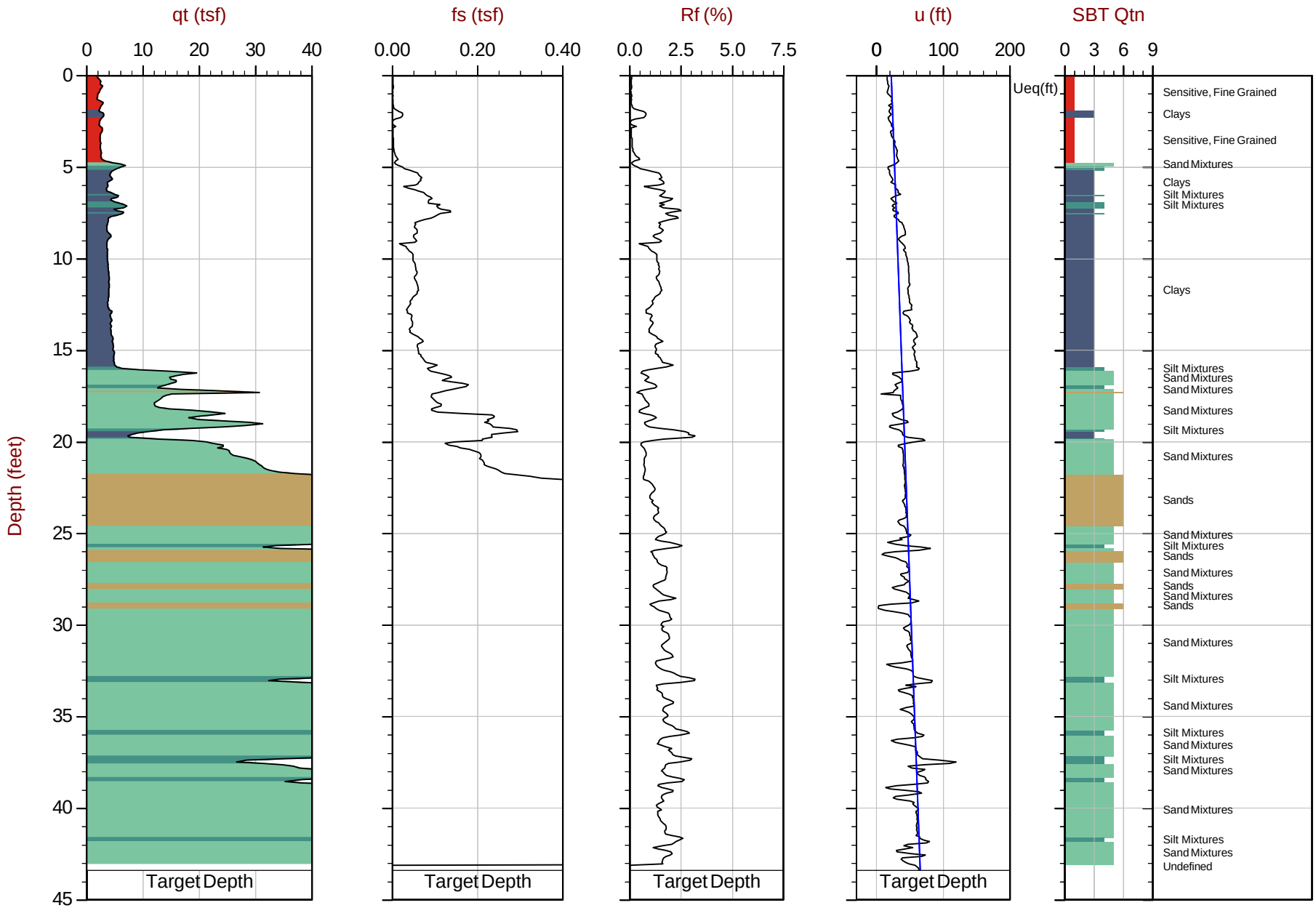
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-12 15:12
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT03-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

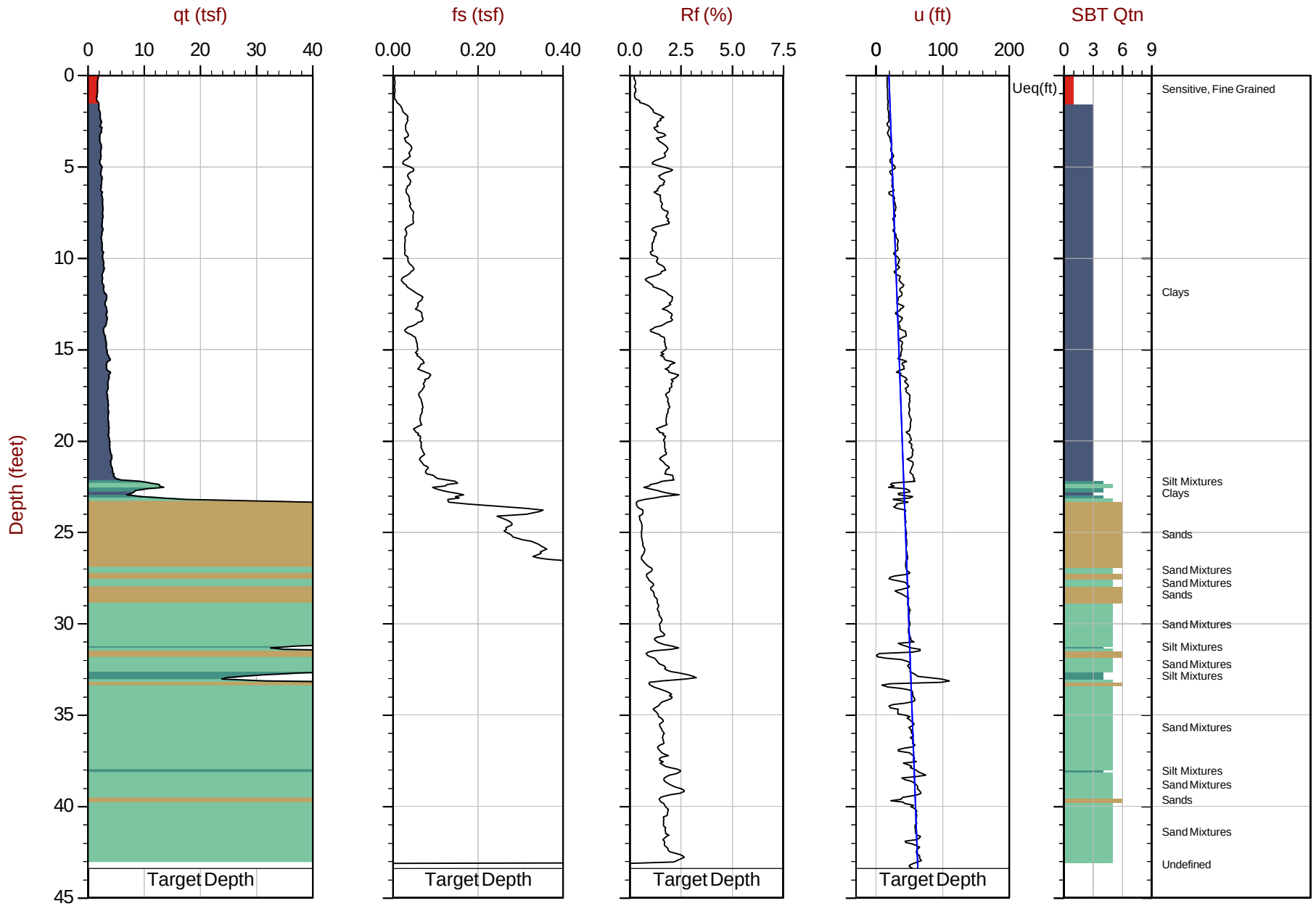
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-13 07:54
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT05-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

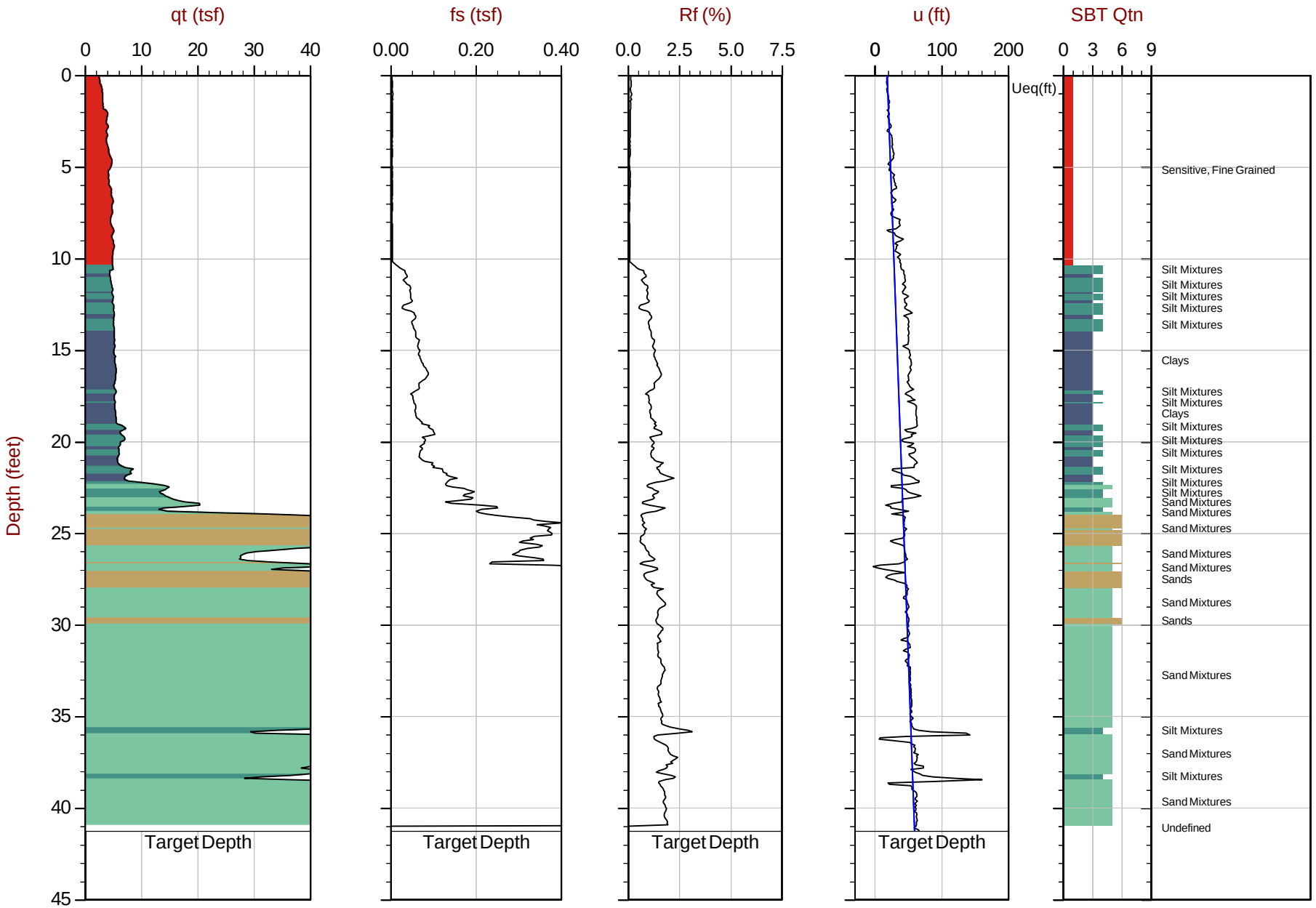
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-13 13:25
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT07-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

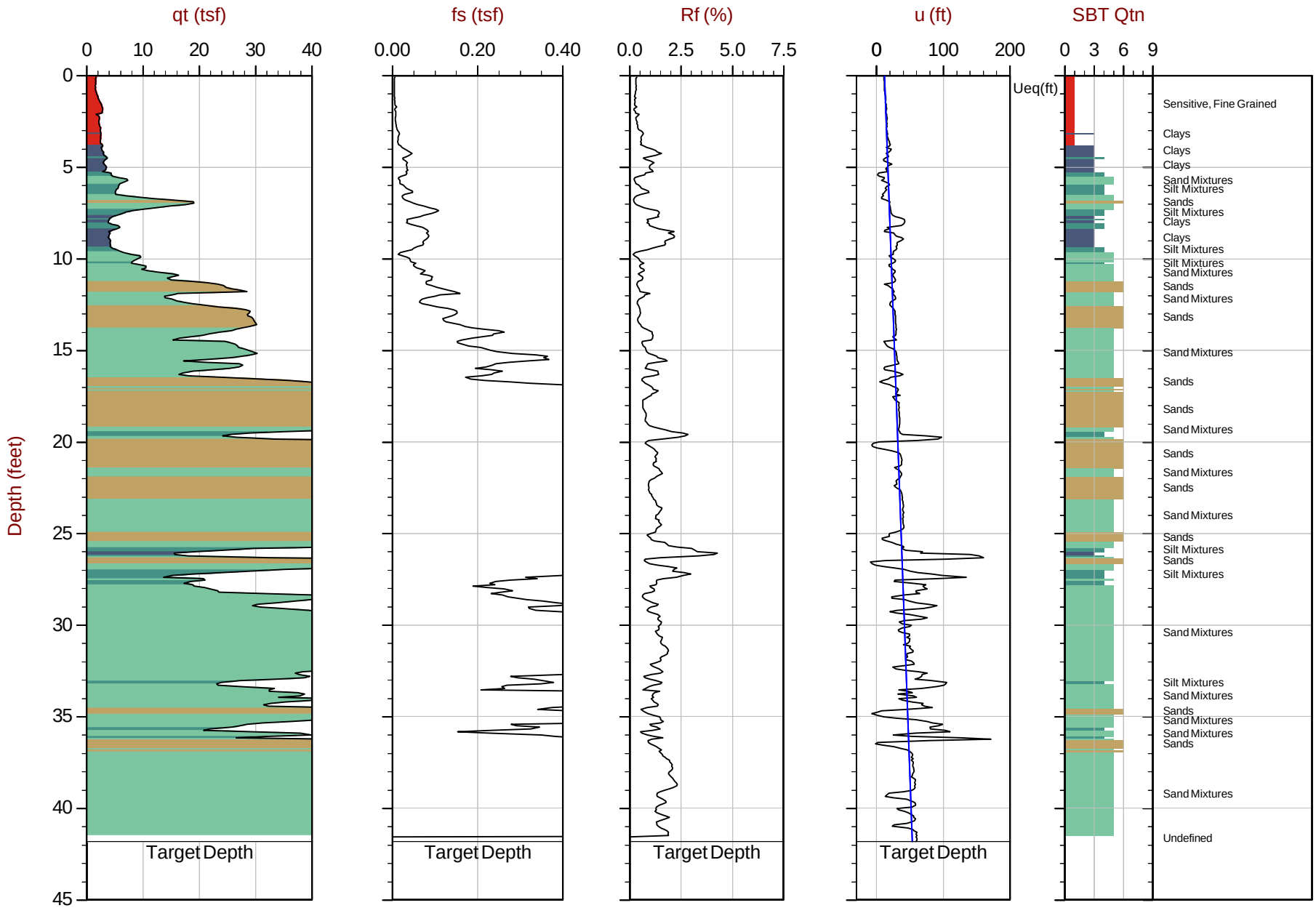
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

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

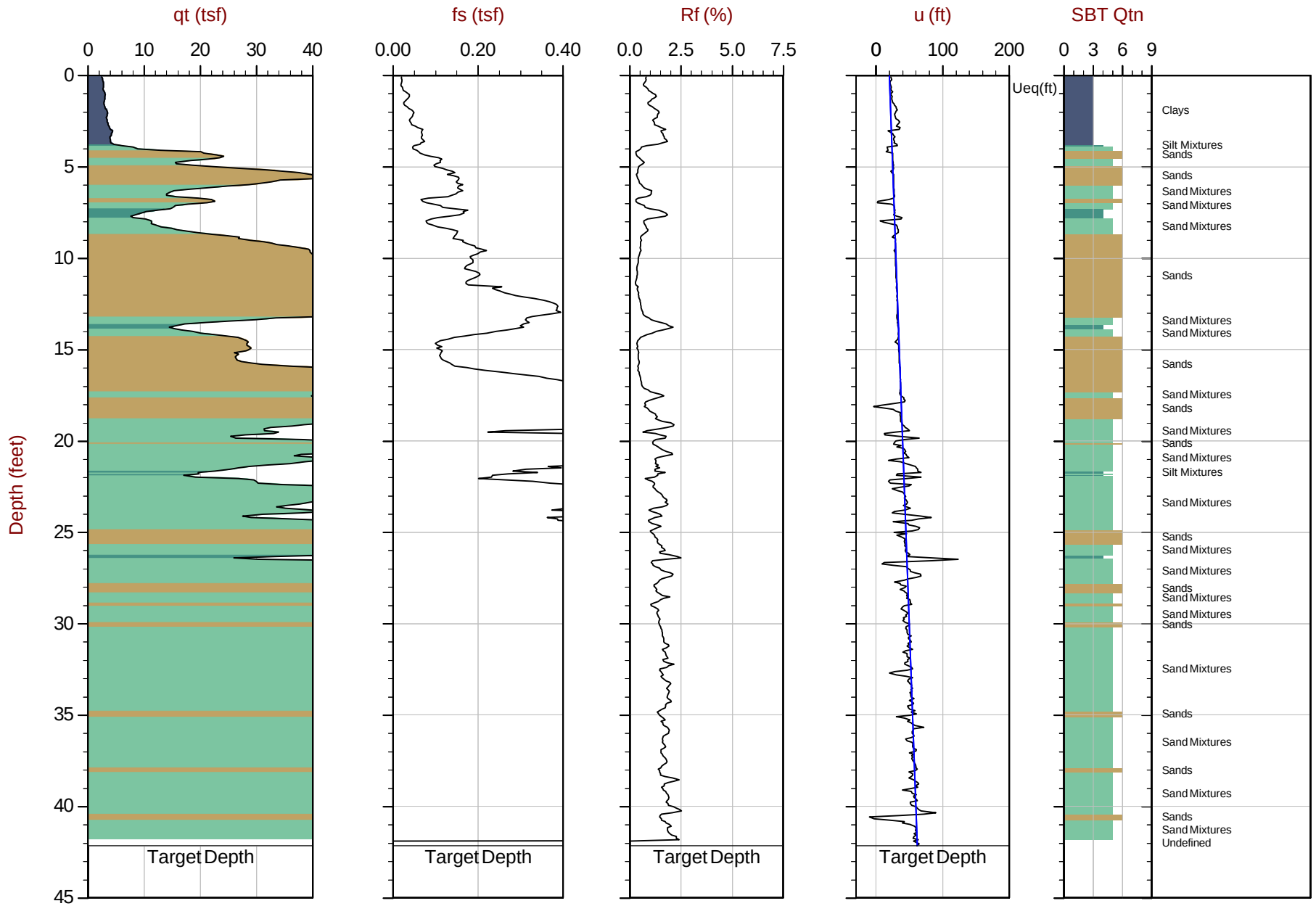
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-08 08:31
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT14-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

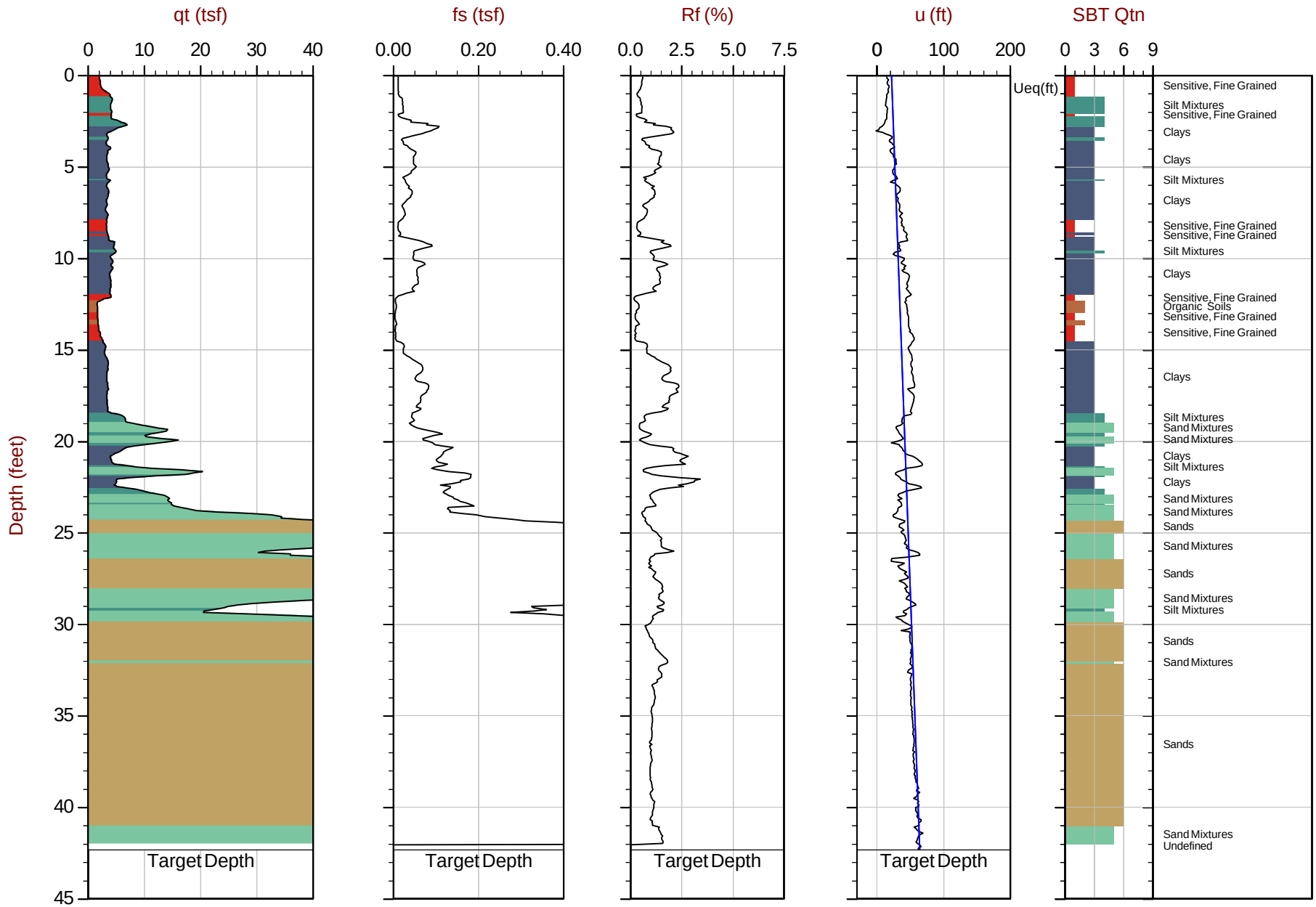
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

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

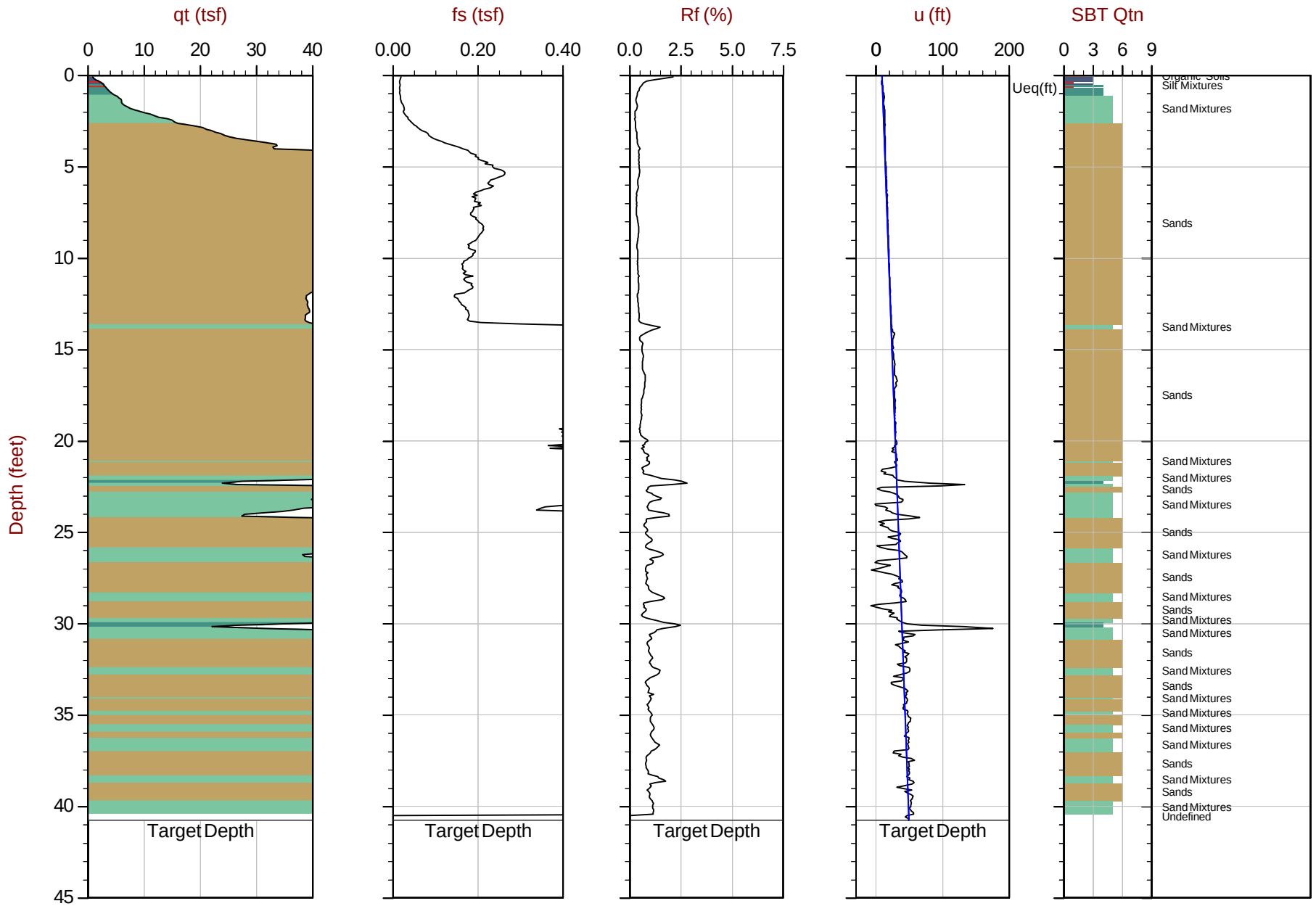
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-11 13:11
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT16-GT
Cone: 681:T375F10U35 Area=15 cm²



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

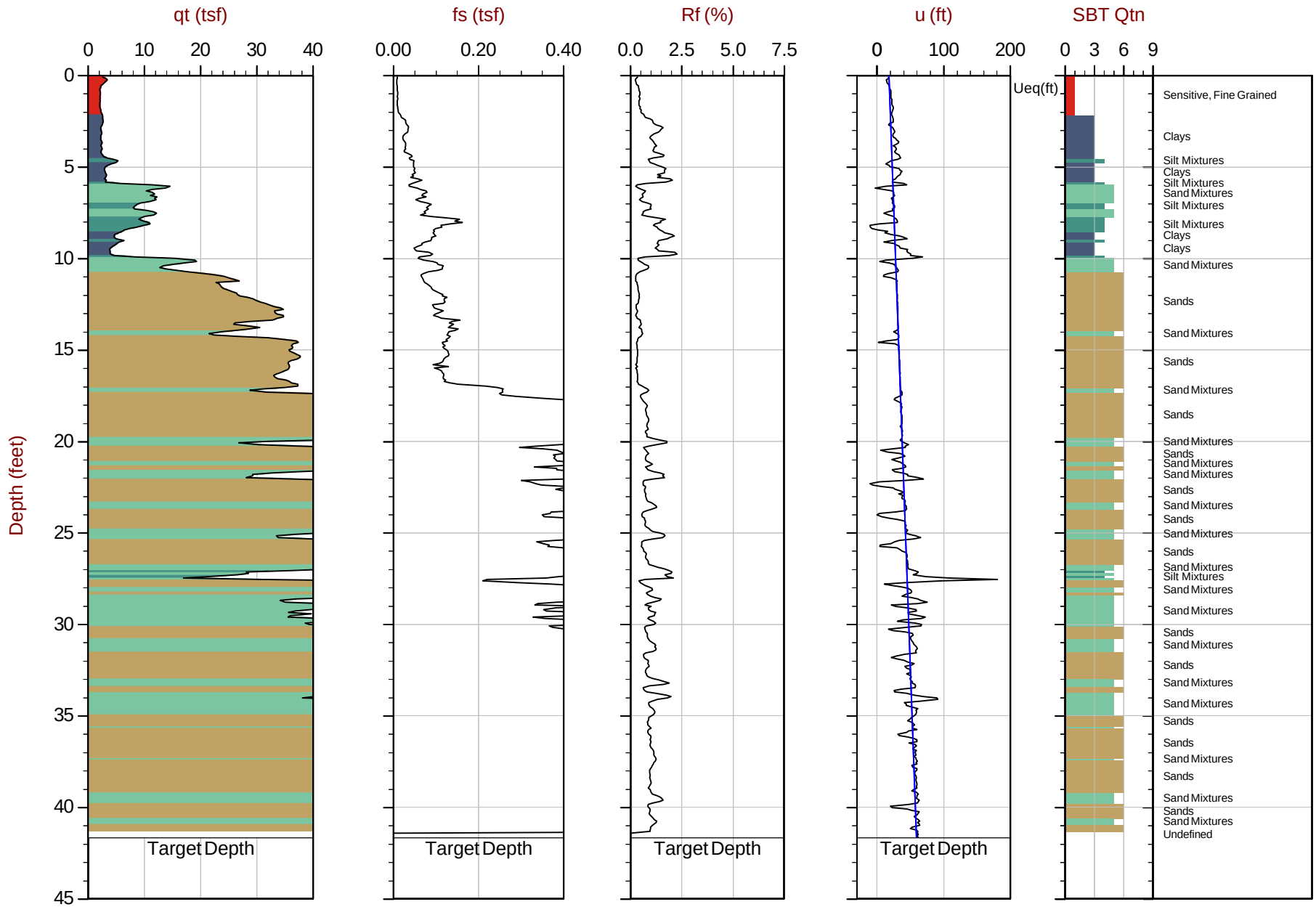
Overplot Item: Ueq | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Dissipation, Ueq assumed | Hydrostatic Line

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

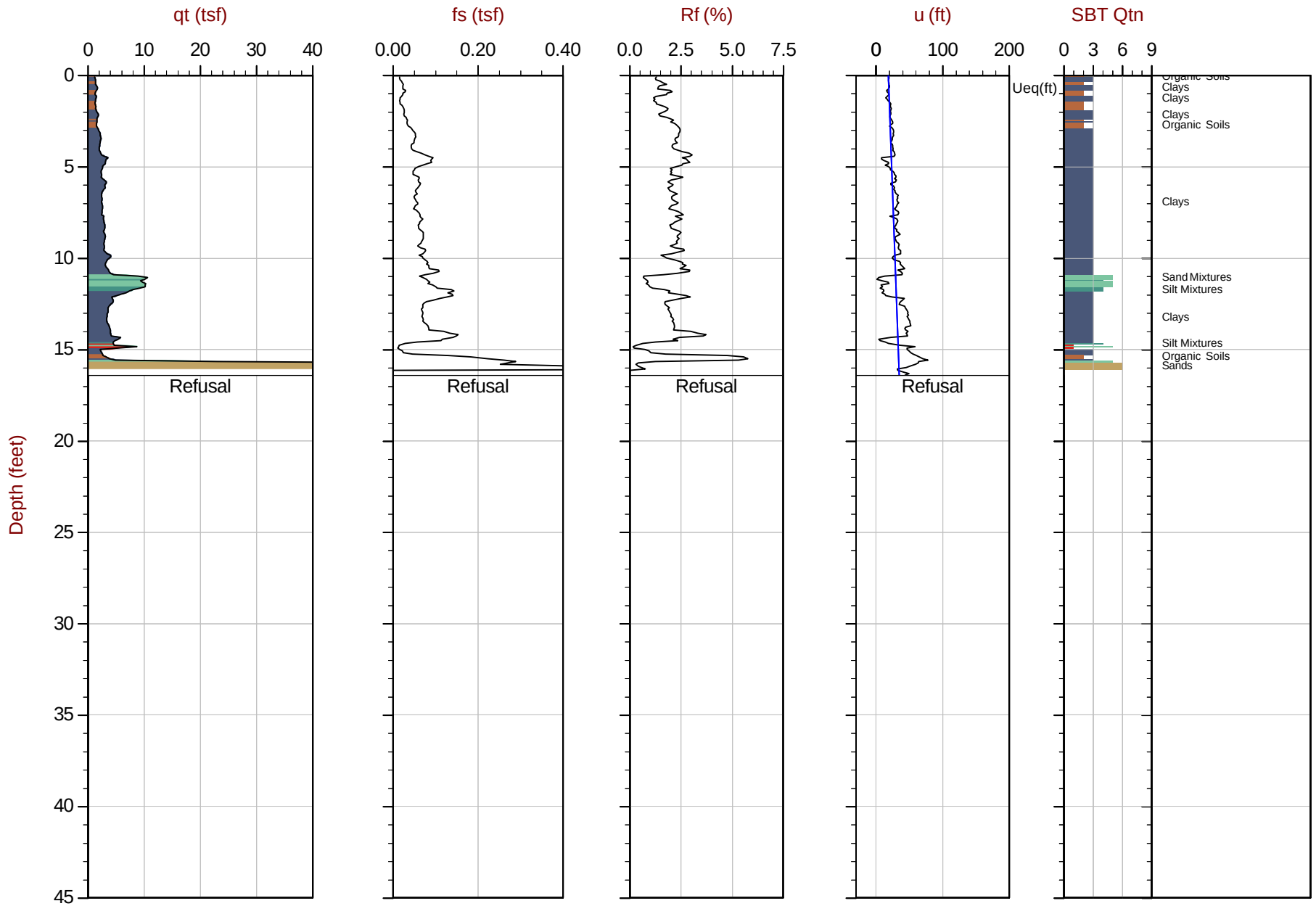
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-10 08:15
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT23-GT
Cone: 681:T375F10U35 Area=15 cm²



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

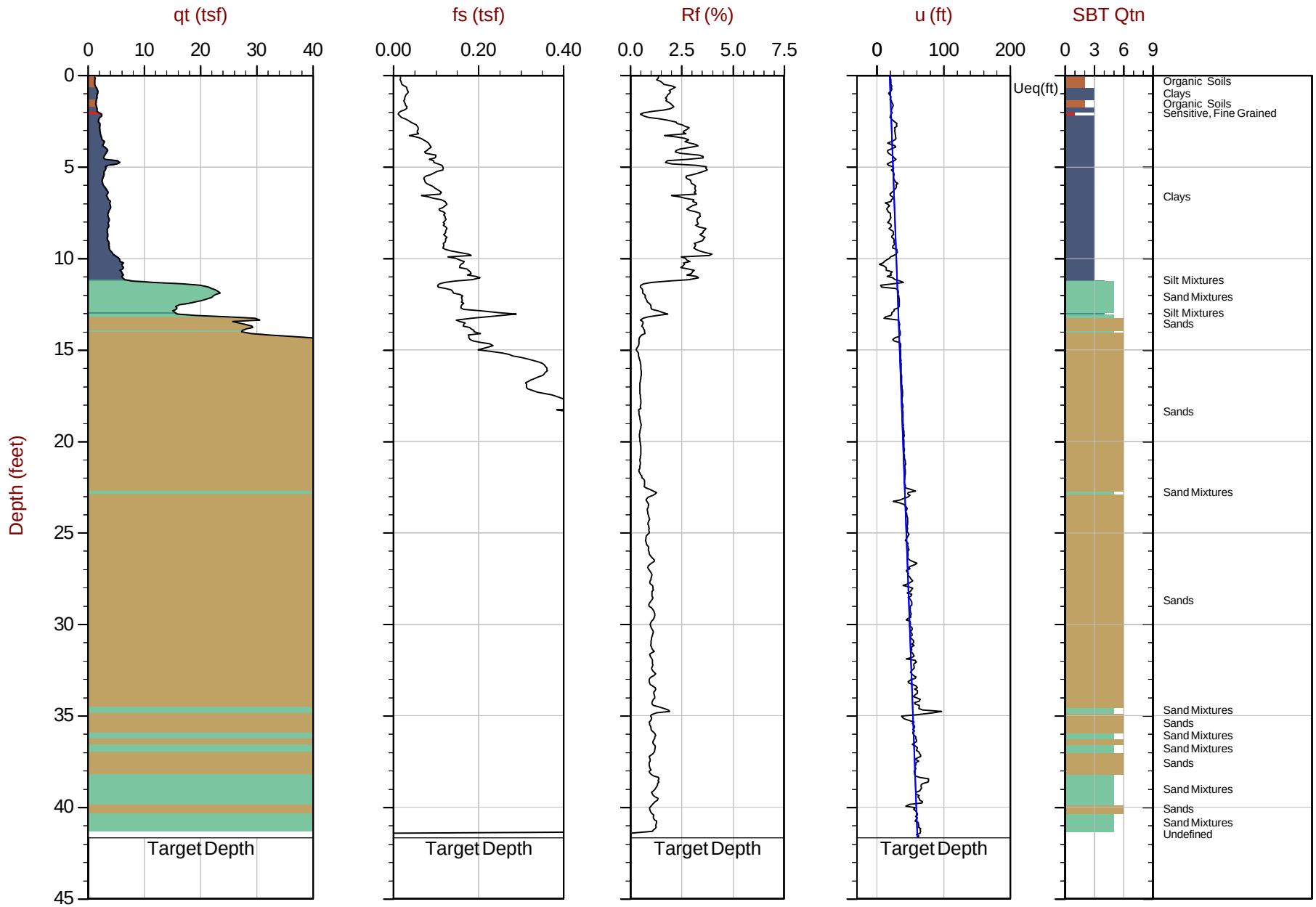
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-10 10:53
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT23B-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_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

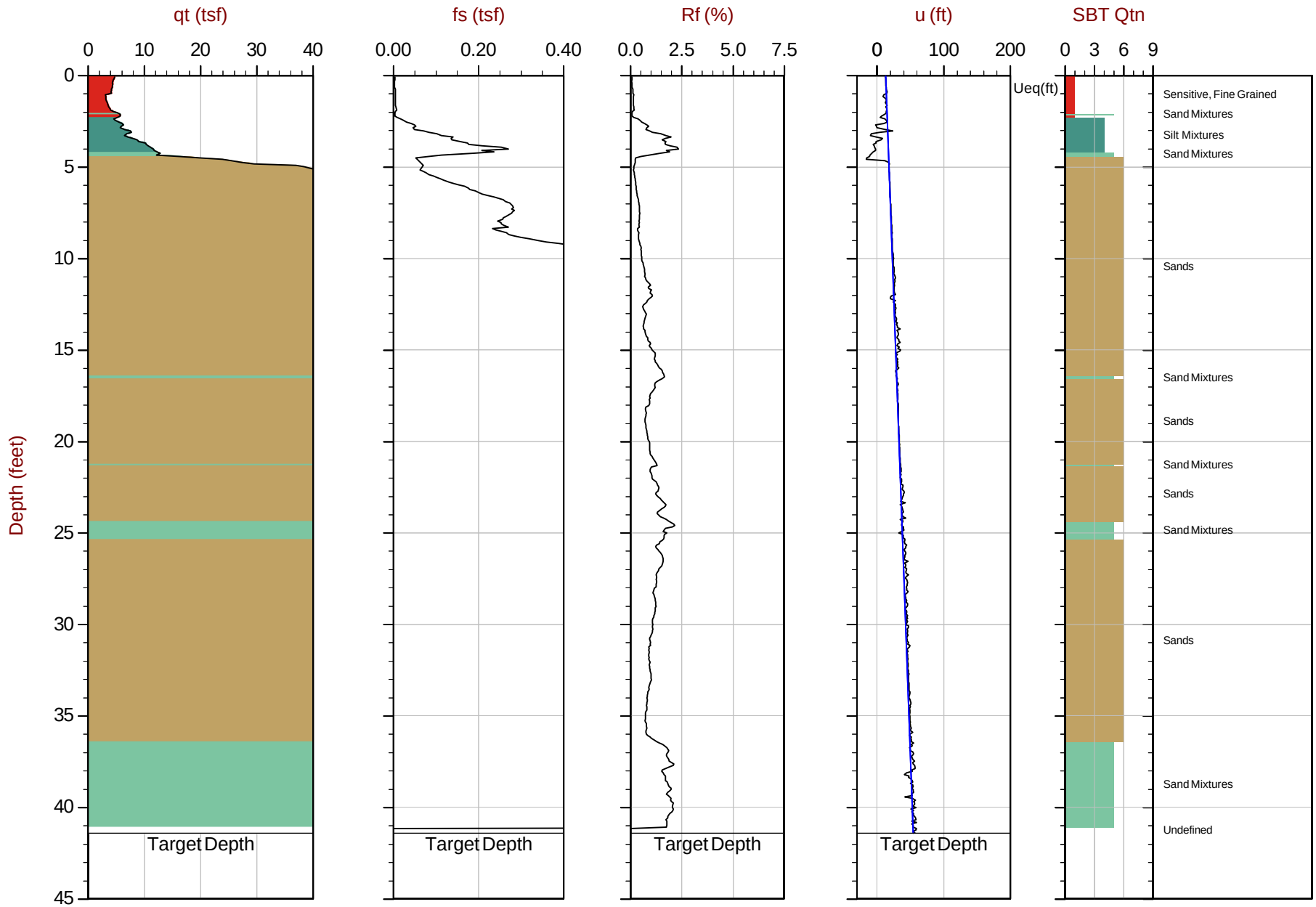
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-09 11:24
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT24-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

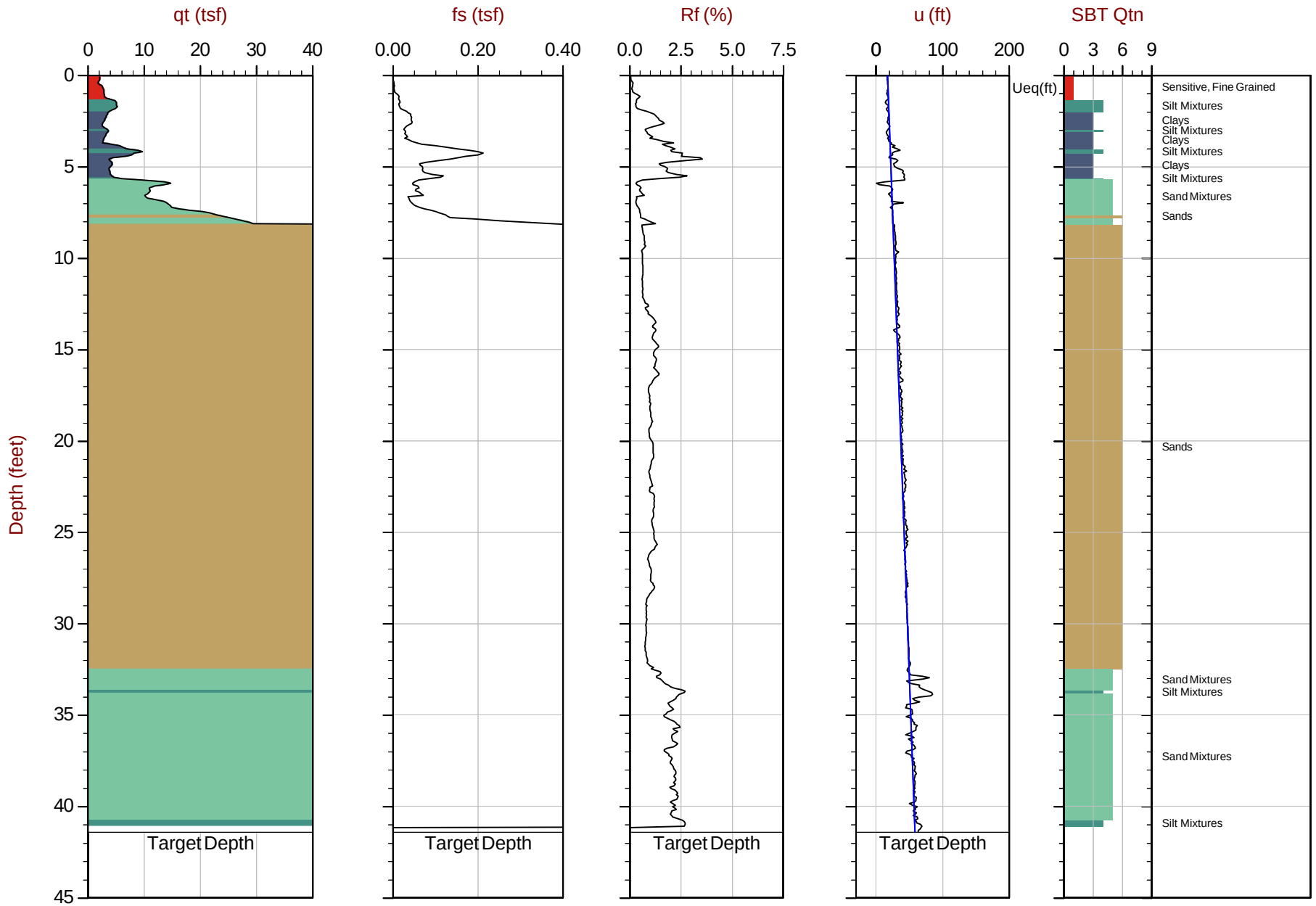
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-09 07:59
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT25-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

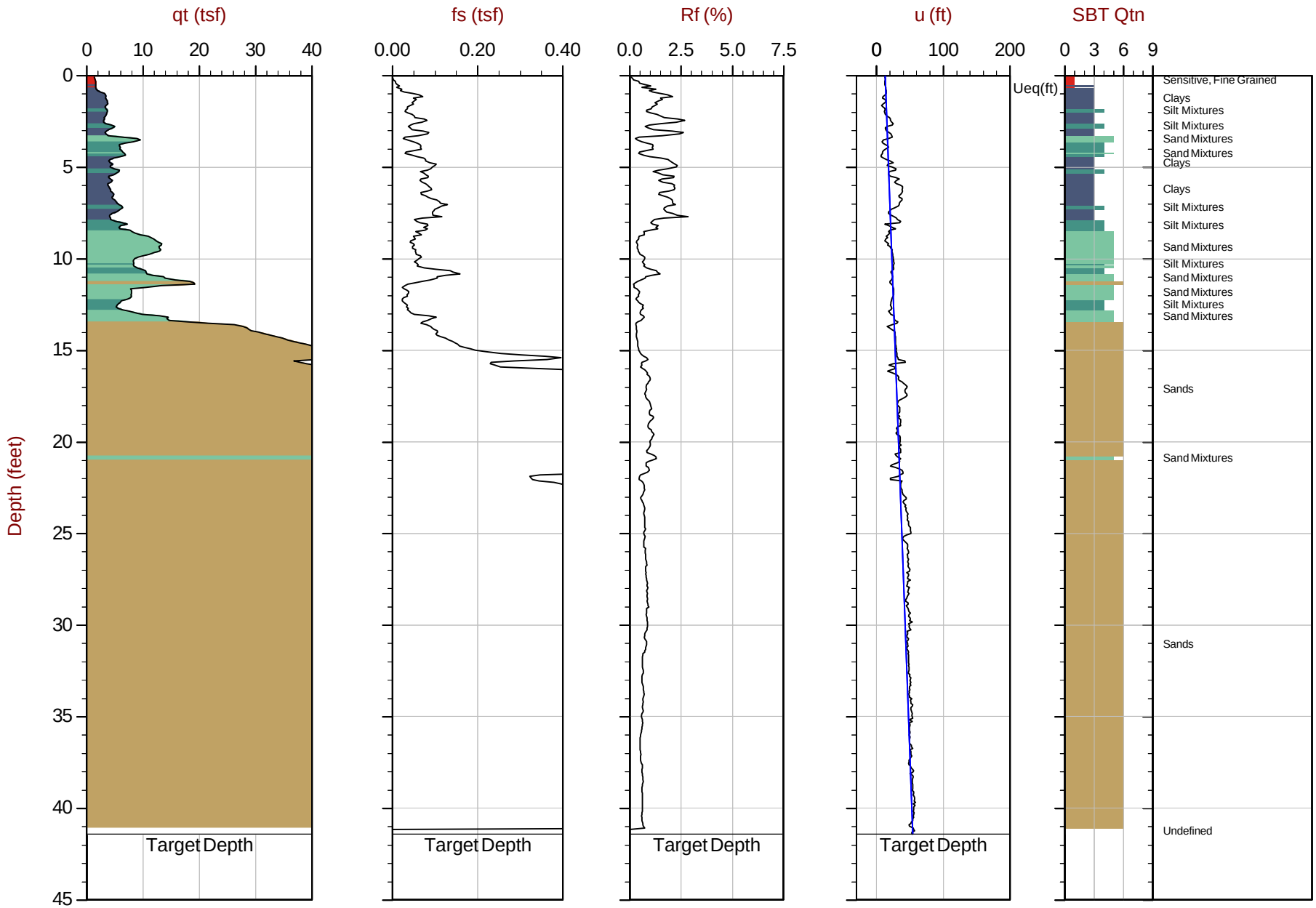
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-10 14:31
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT27-GT
Cone: 681:T375F10U35 Area=15 cm²



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

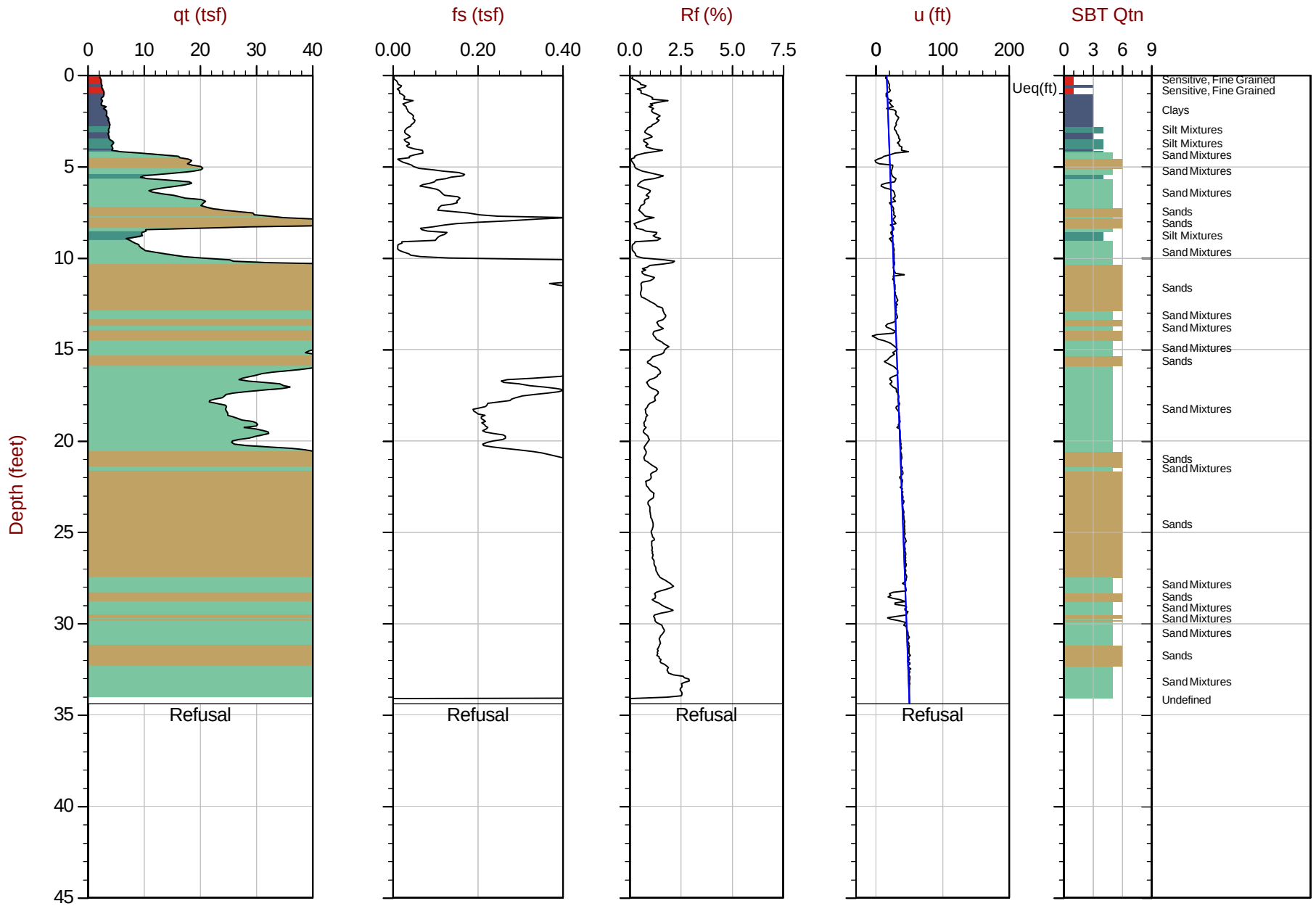
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-14 07:19
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT28-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

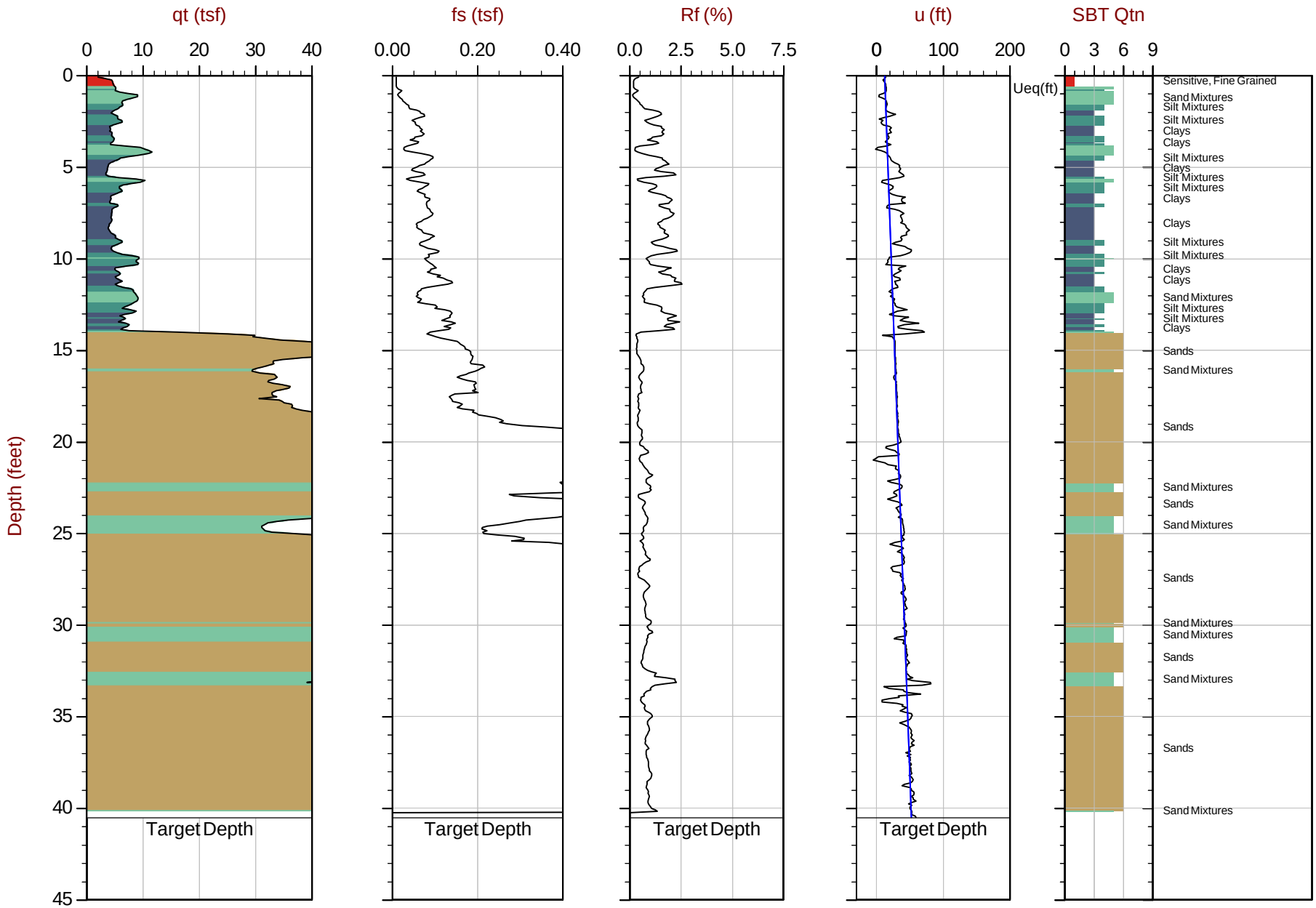
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-12 07:16
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT29-GT
Cone: 681:T375F10U35 Area=15 cm²



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 Ic, Su(Nkt), Phi, and N1(60)Ic

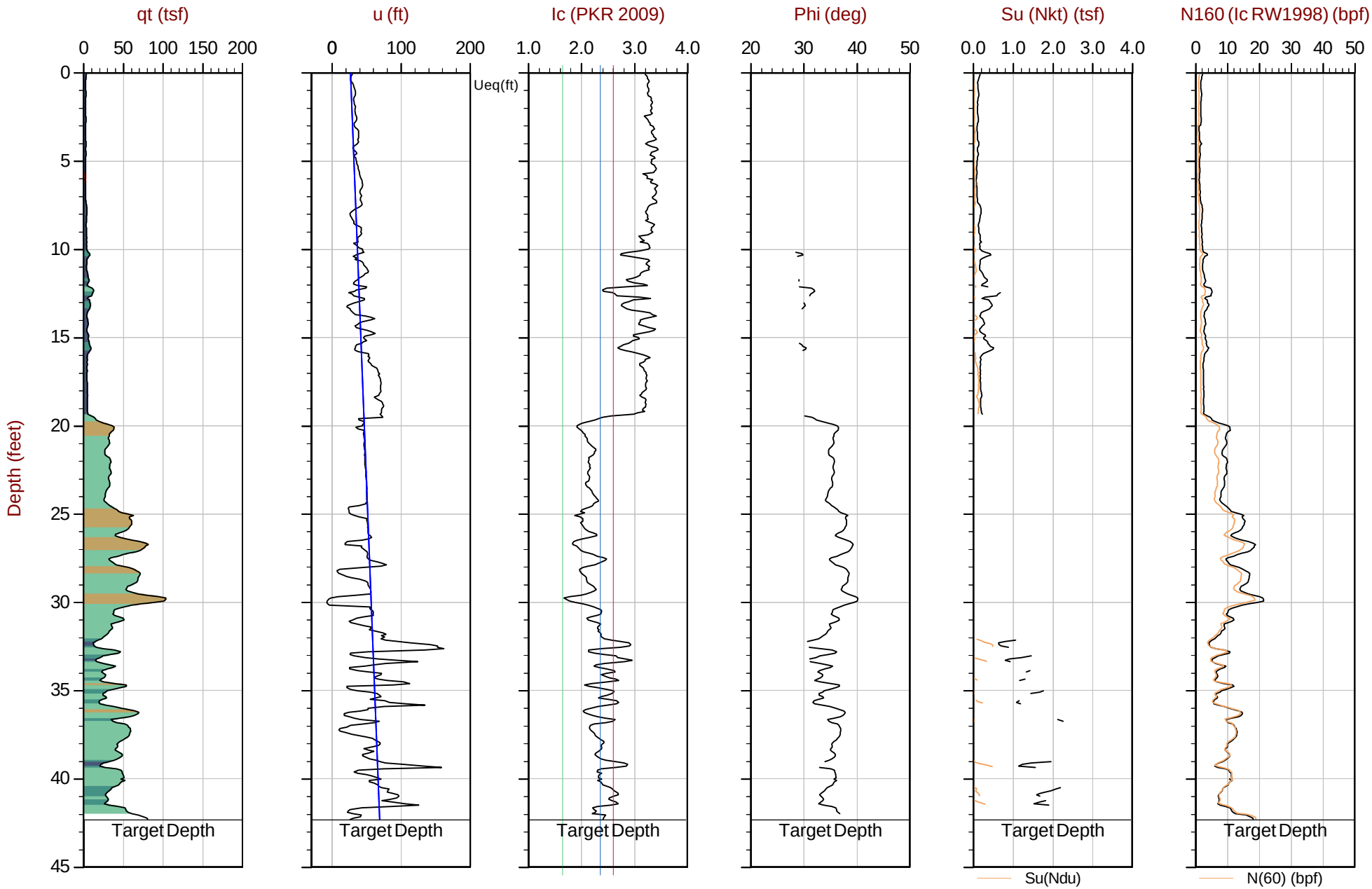
CONETEC

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-12 11:45
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT01-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_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

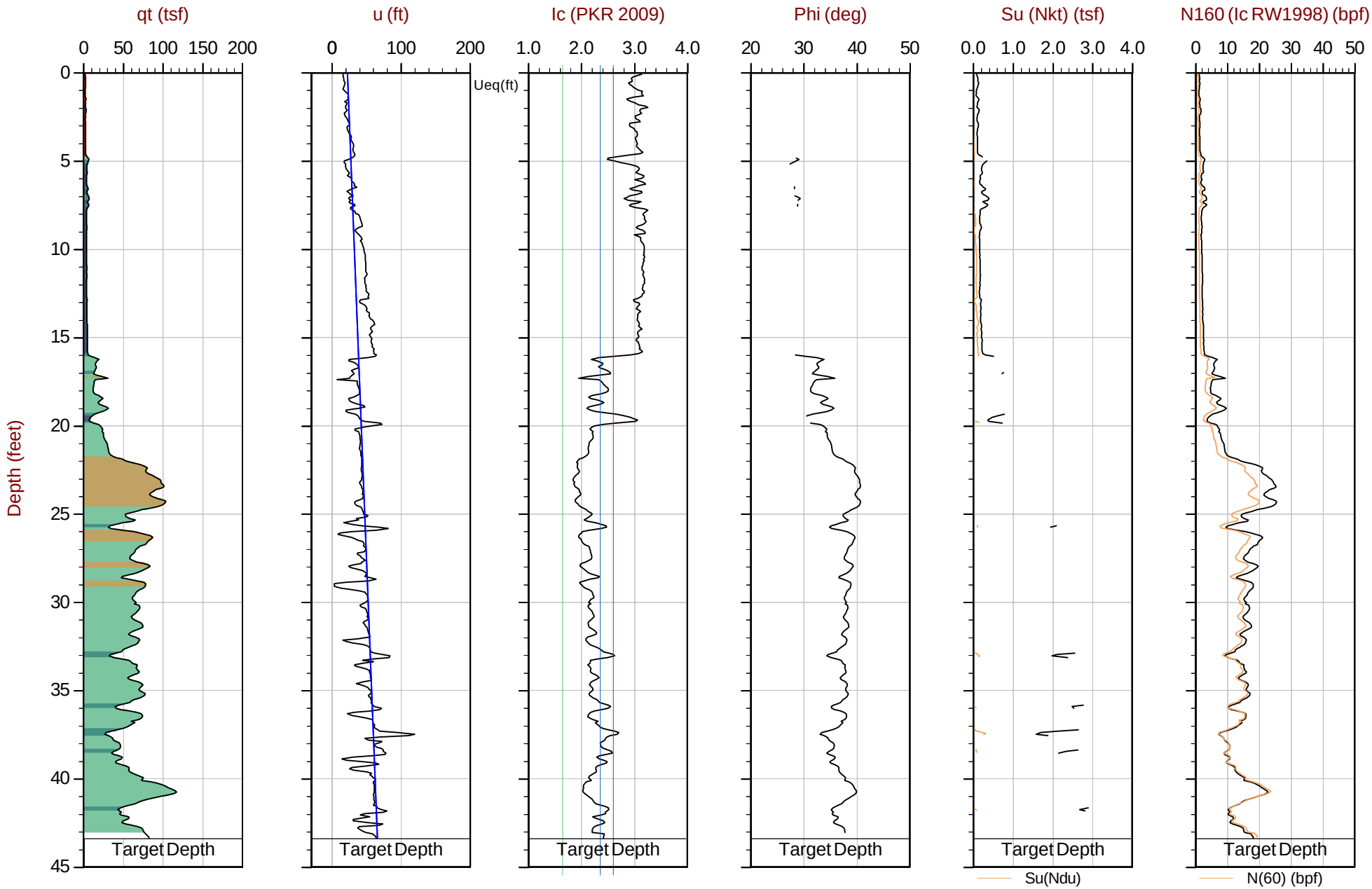
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-12 15:12
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT03-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

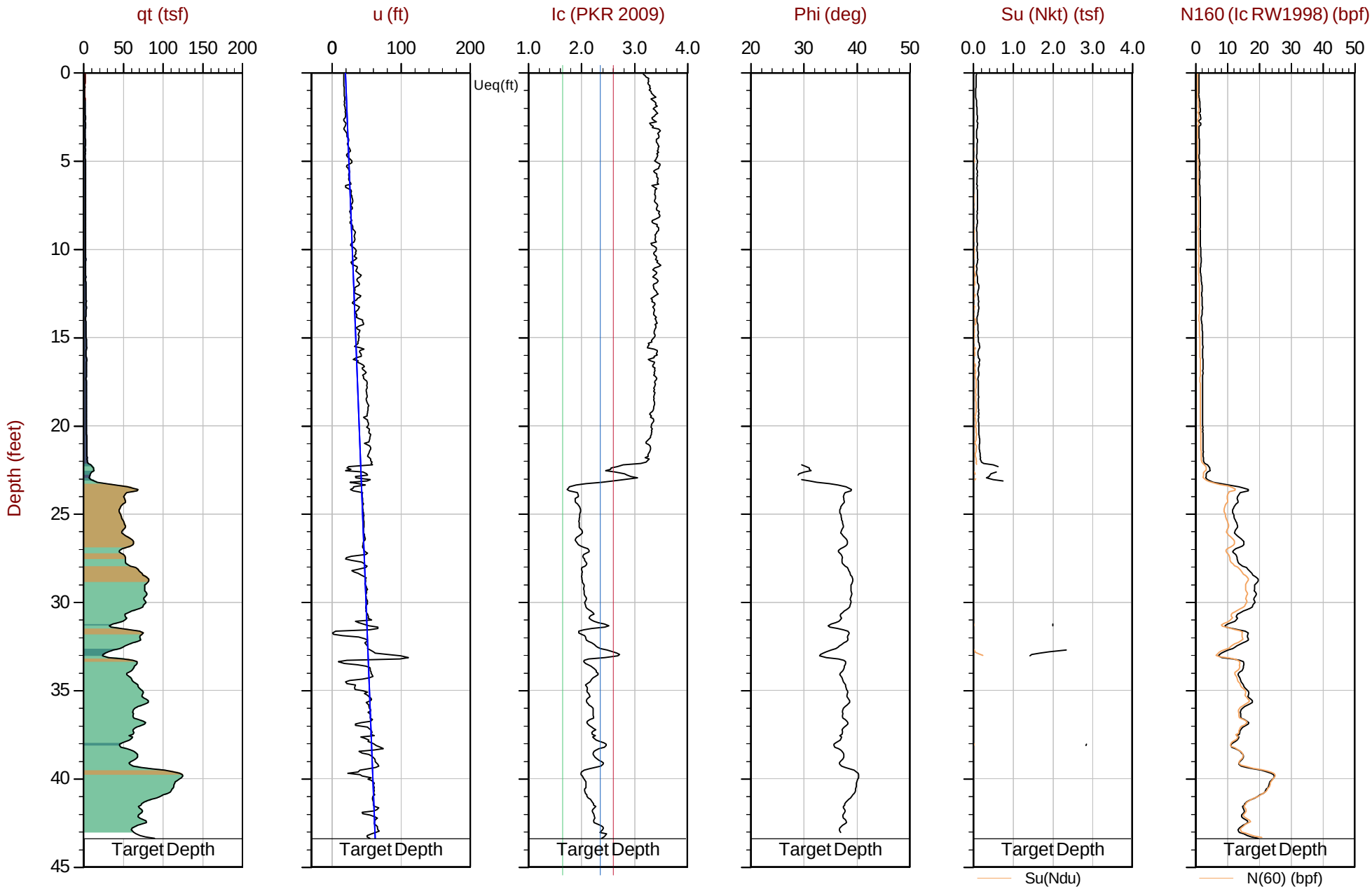
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-13 07:54
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT05-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

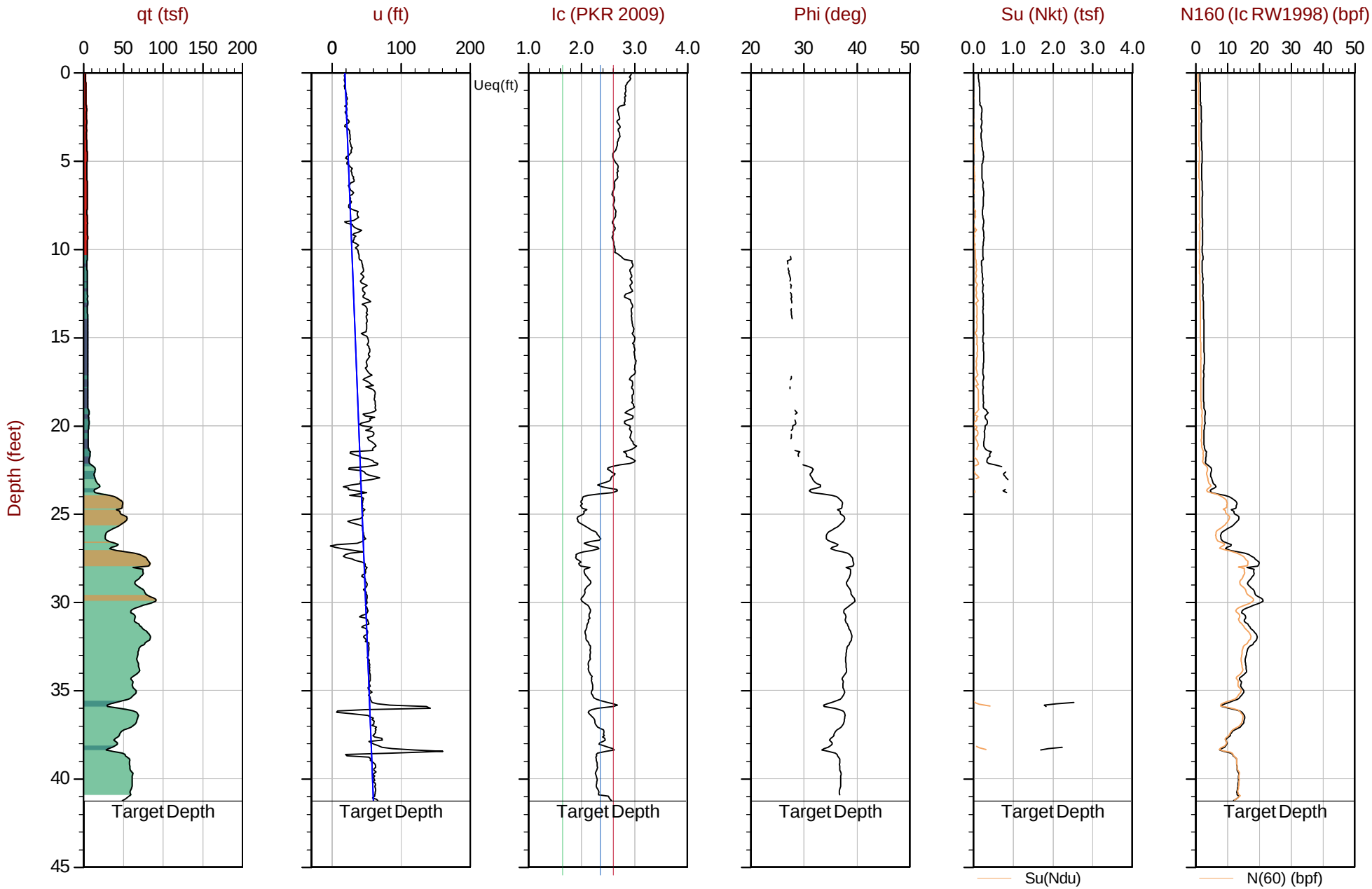
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-13 13:25
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT07-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

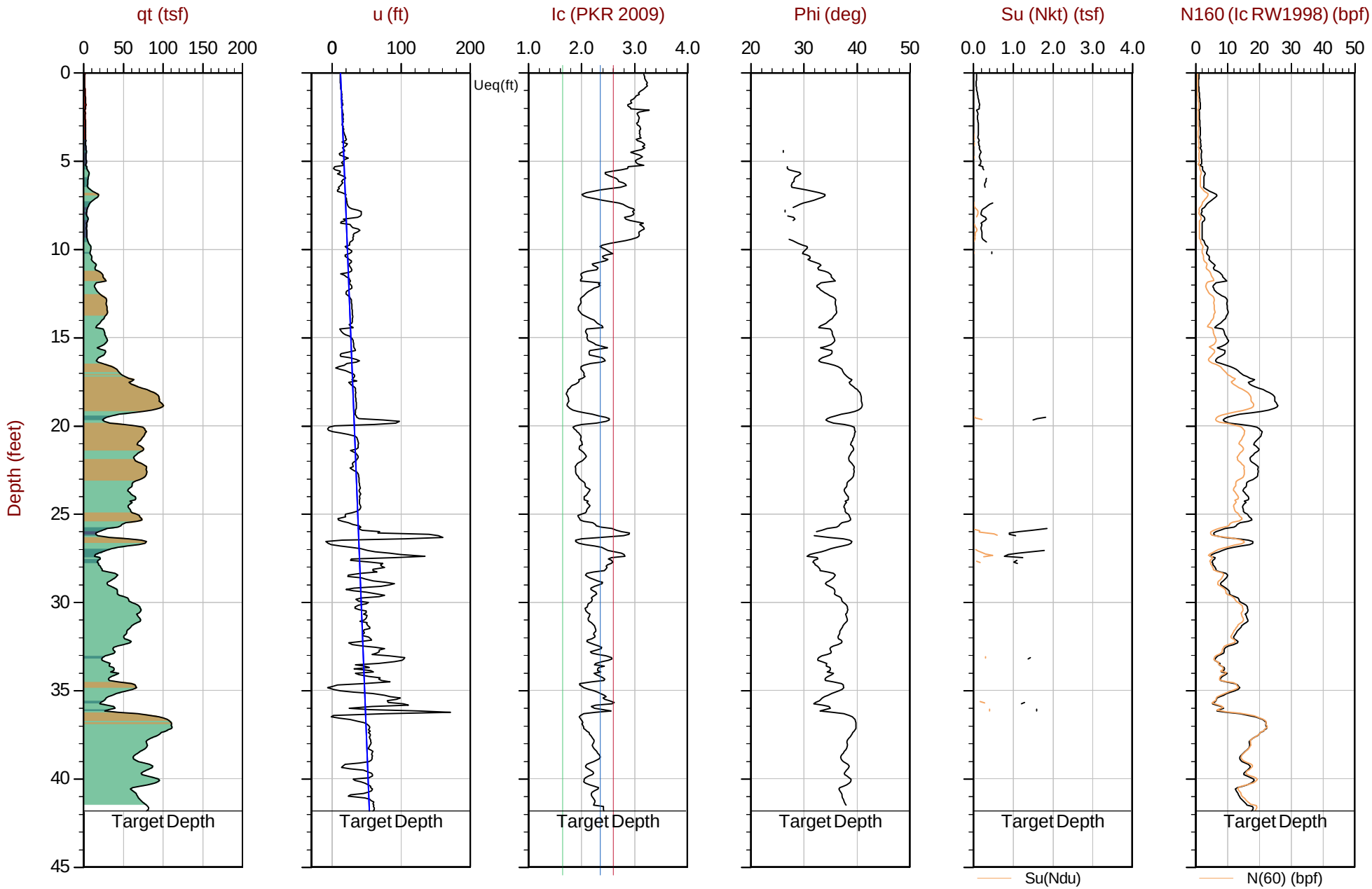
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

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
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

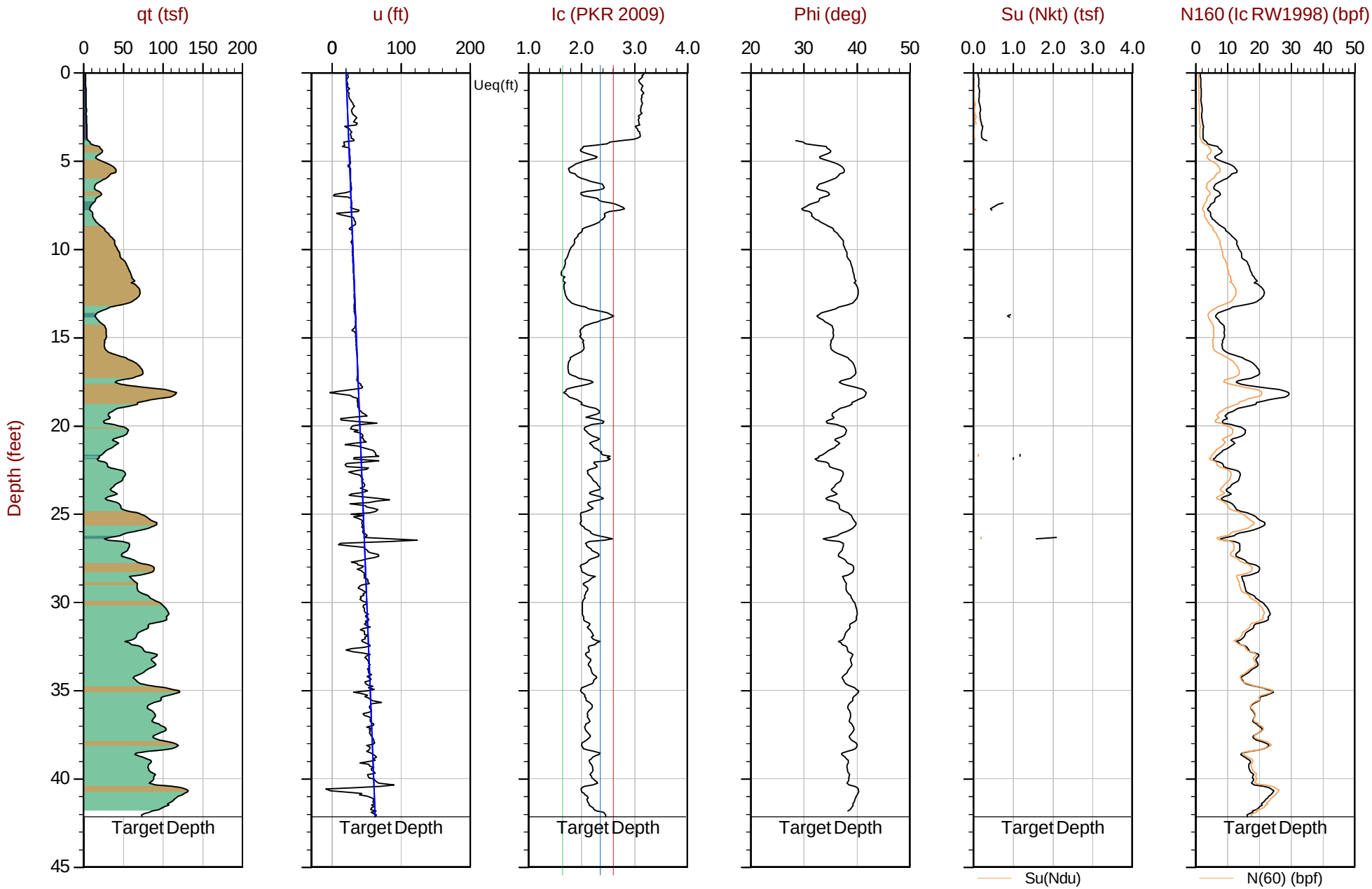
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-08 08:31
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT14-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

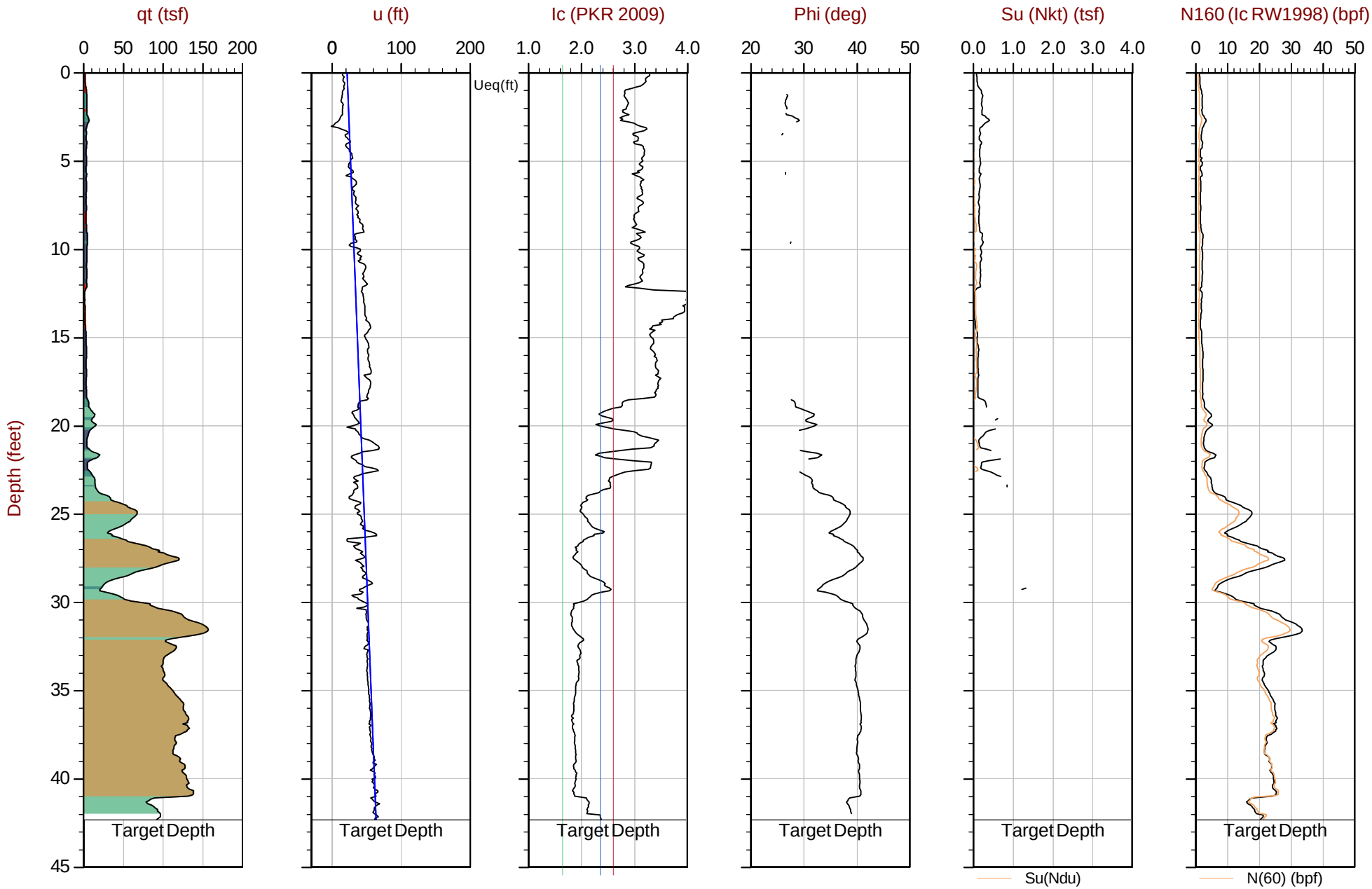
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

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)
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

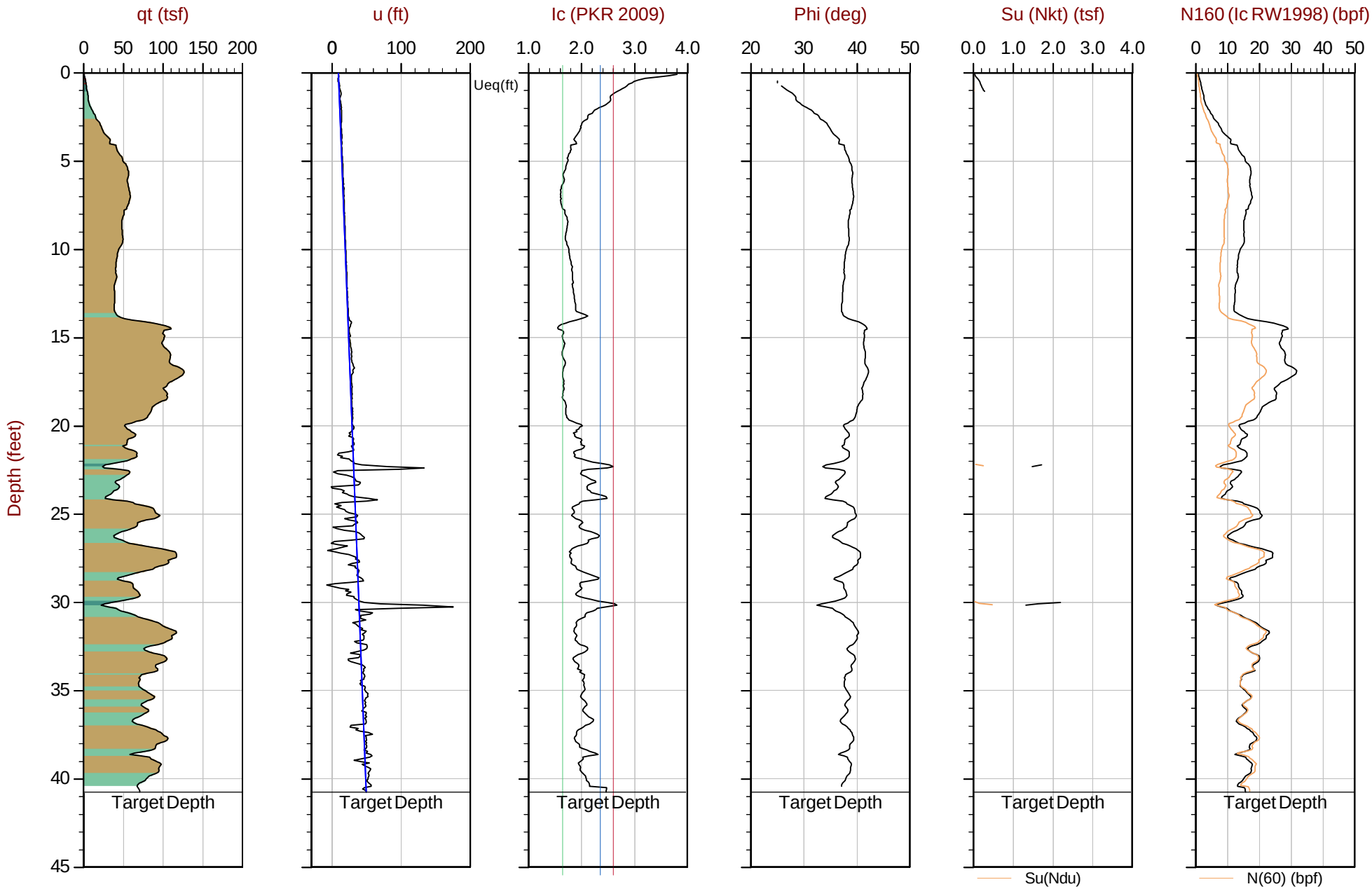
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-11 13:11
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT16-GT
Cone: 681:T375F10U35 Area=15 cm²



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

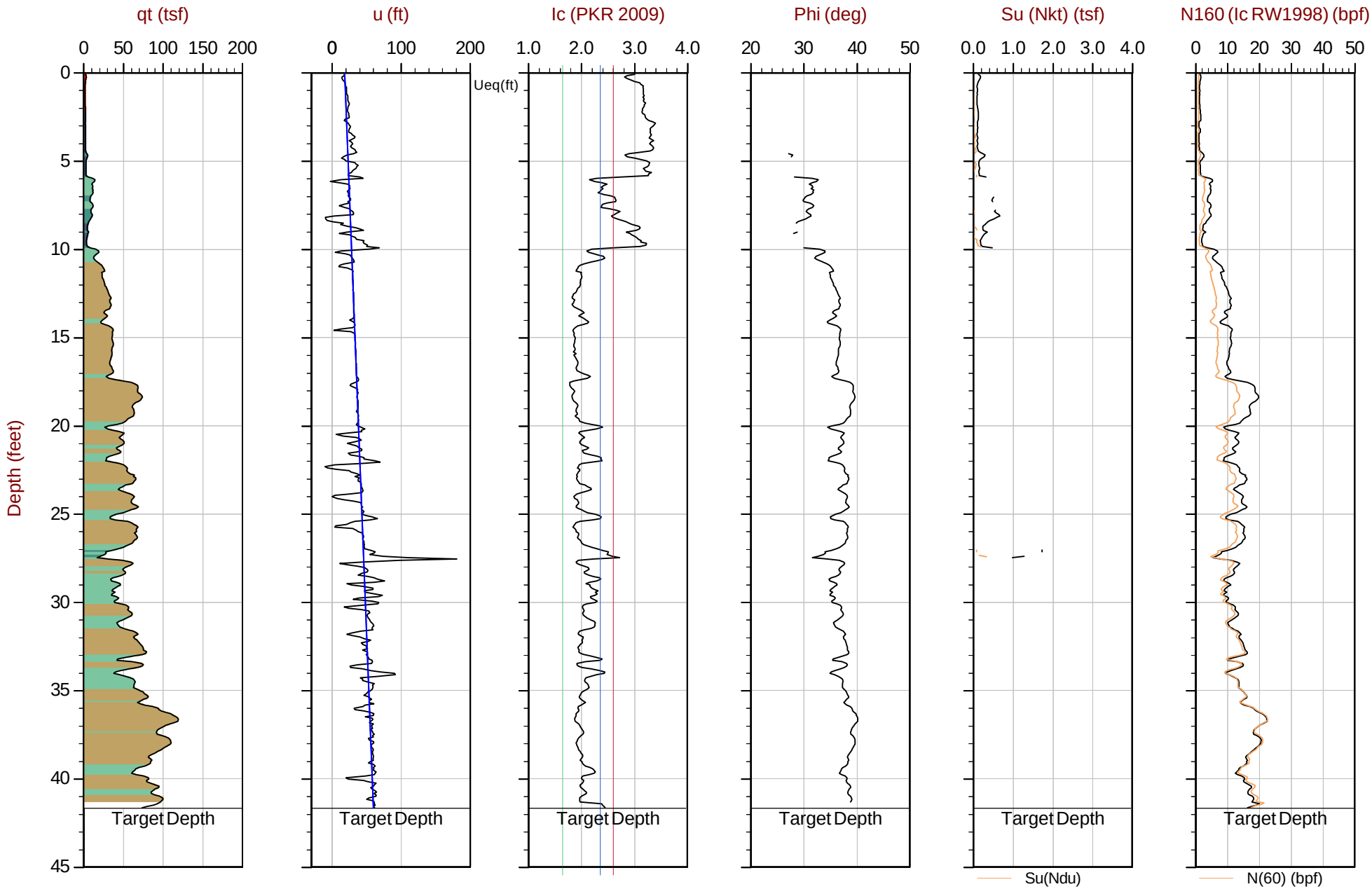
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

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)
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

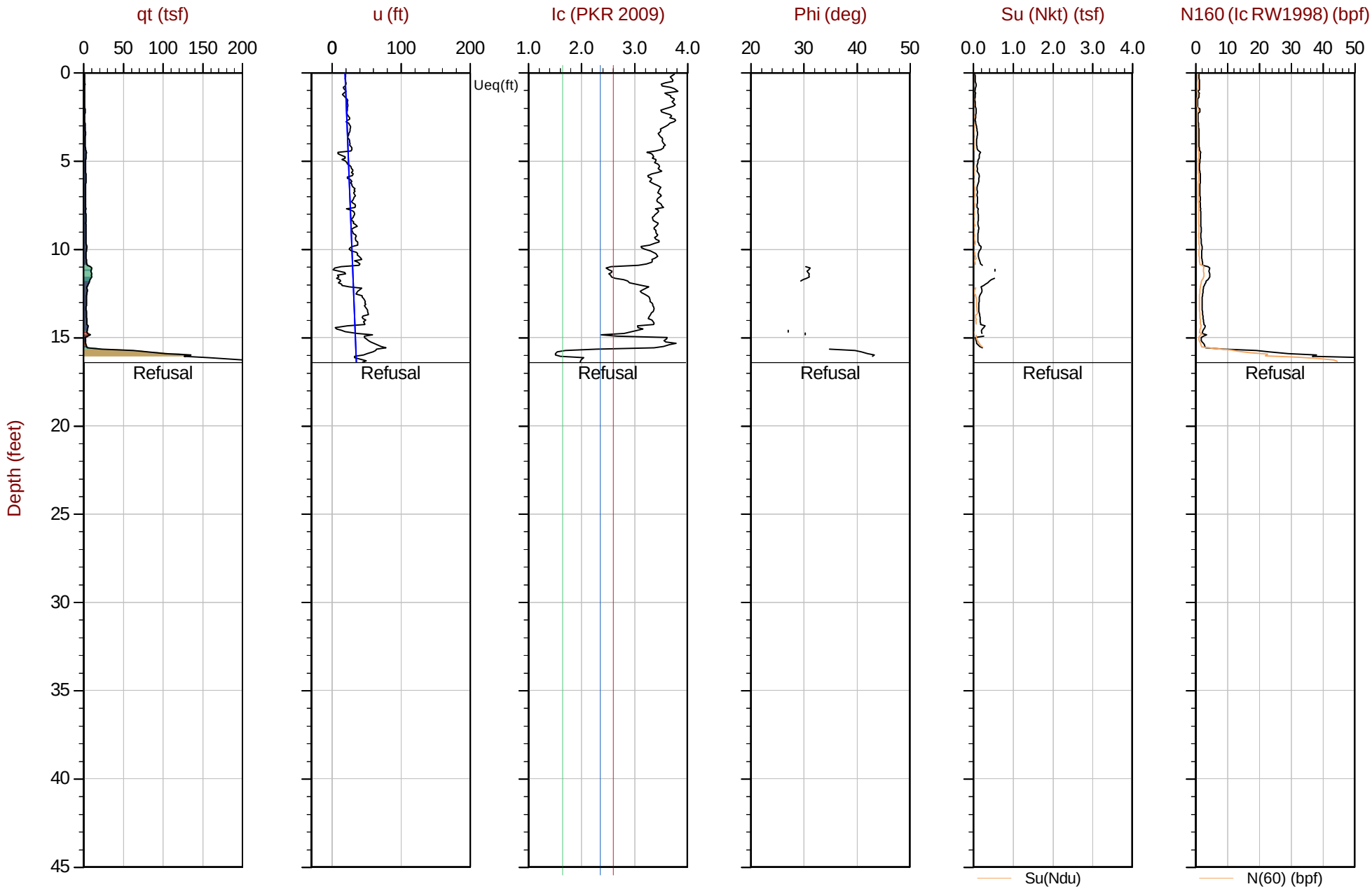
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-10 08:15
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT23-GT
Cone: 681:T375F10U35 Area=15 cm²



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

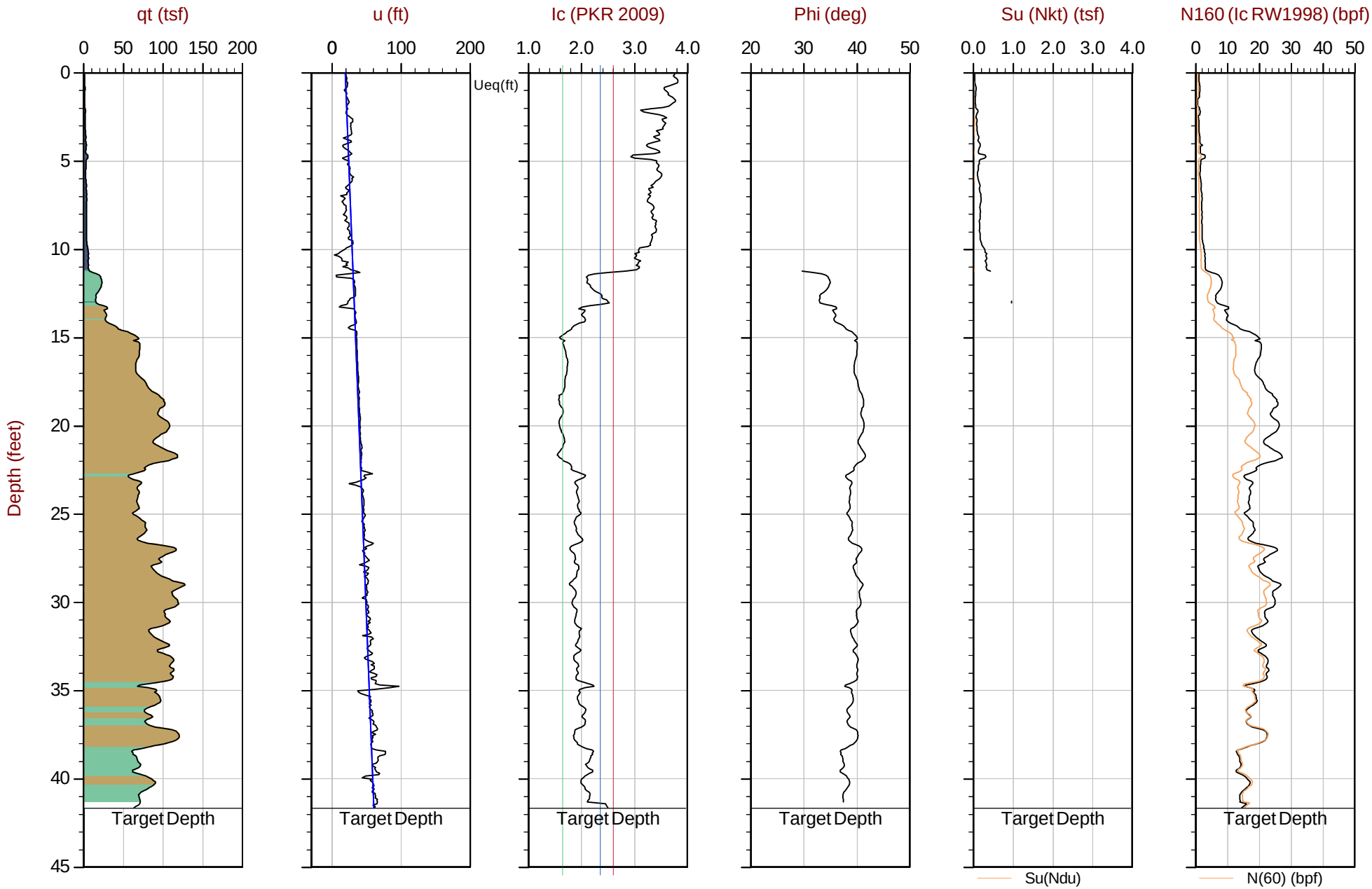
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-10 10:53
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT23B-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_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

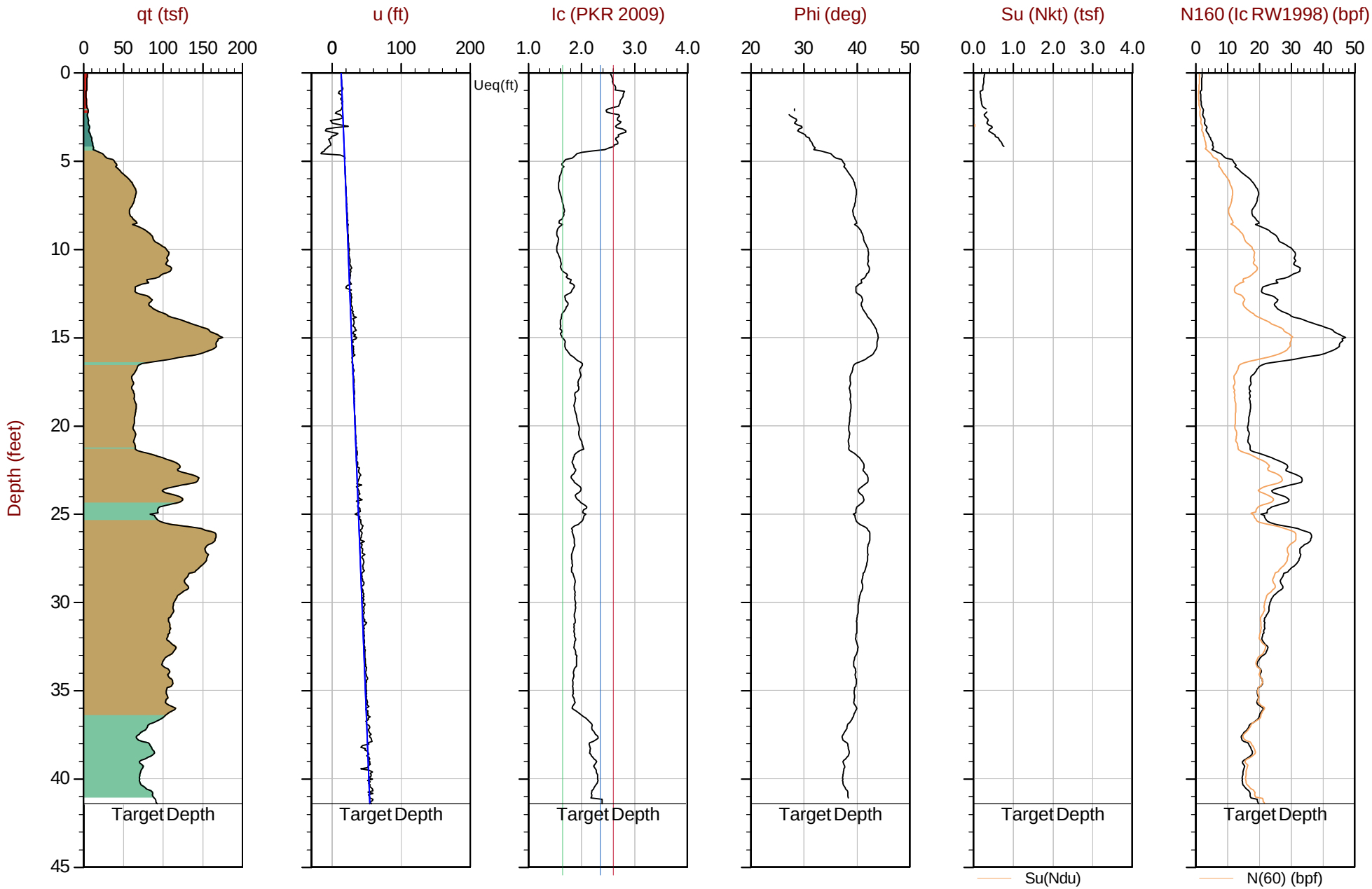
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-09 11:24
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT24-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

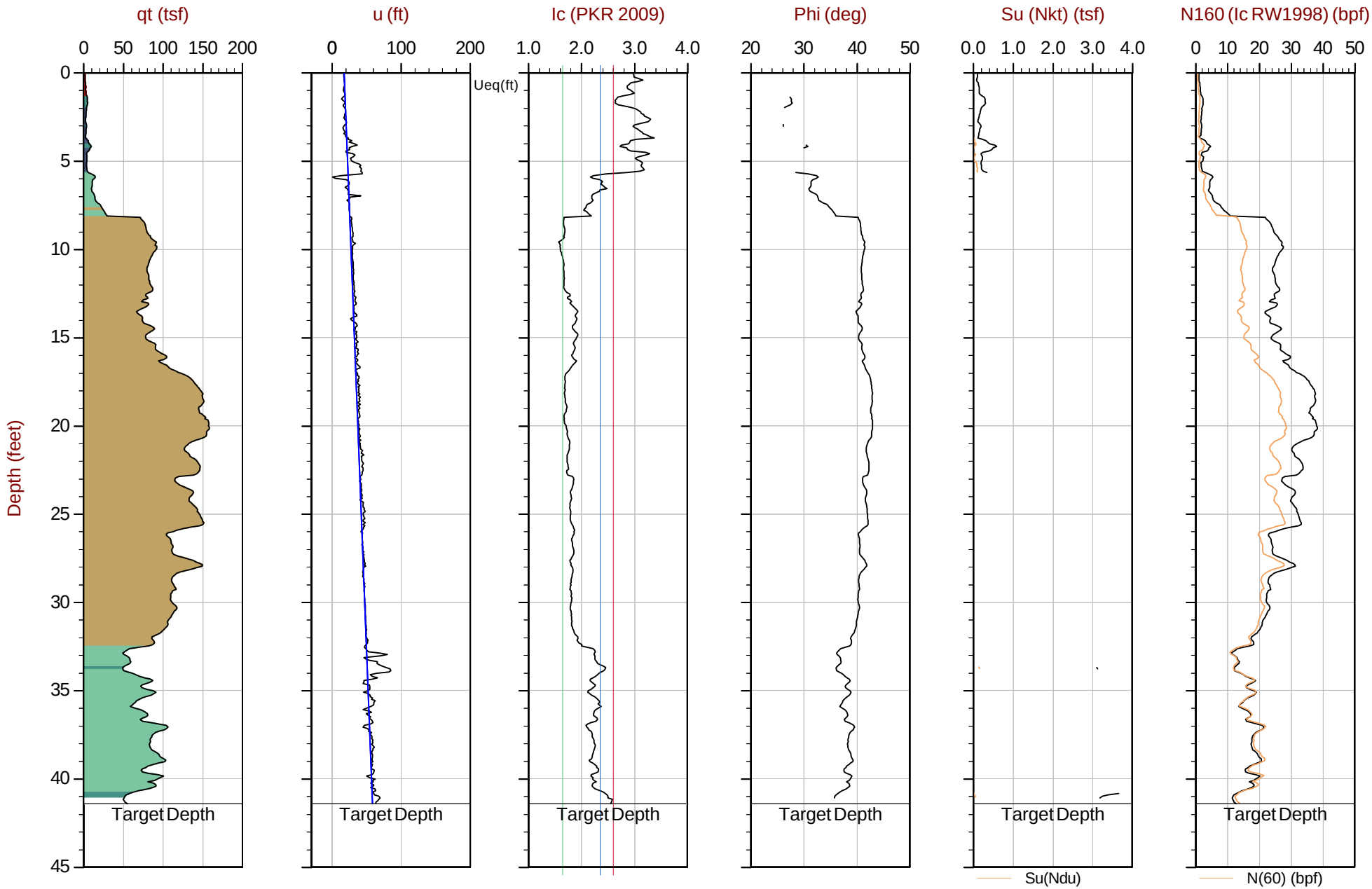
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-09 07:59
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT25-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

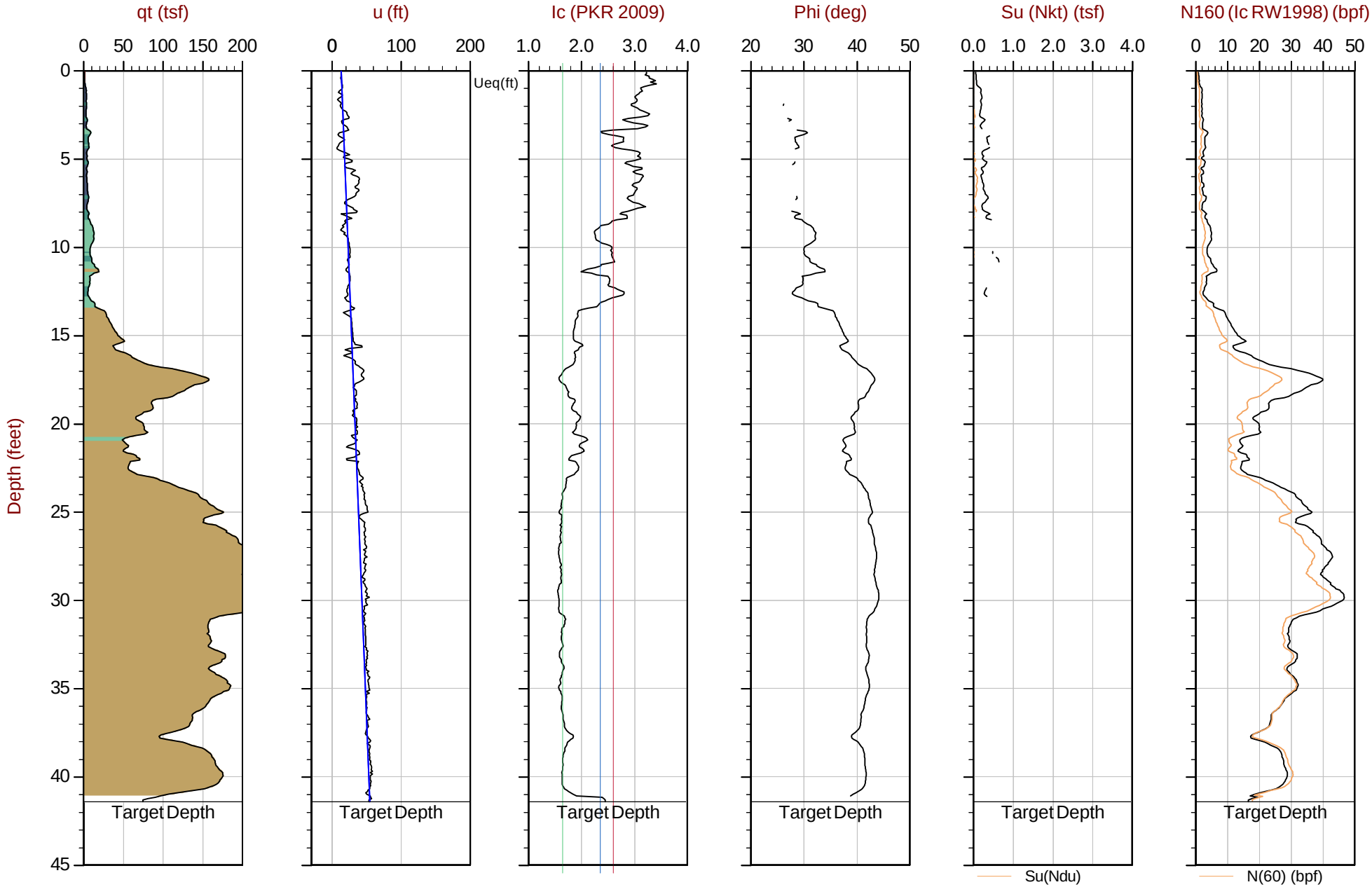
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-10 14:31
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT27-GT
Cone: 681:T375F10U35 Area=15 cm²



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

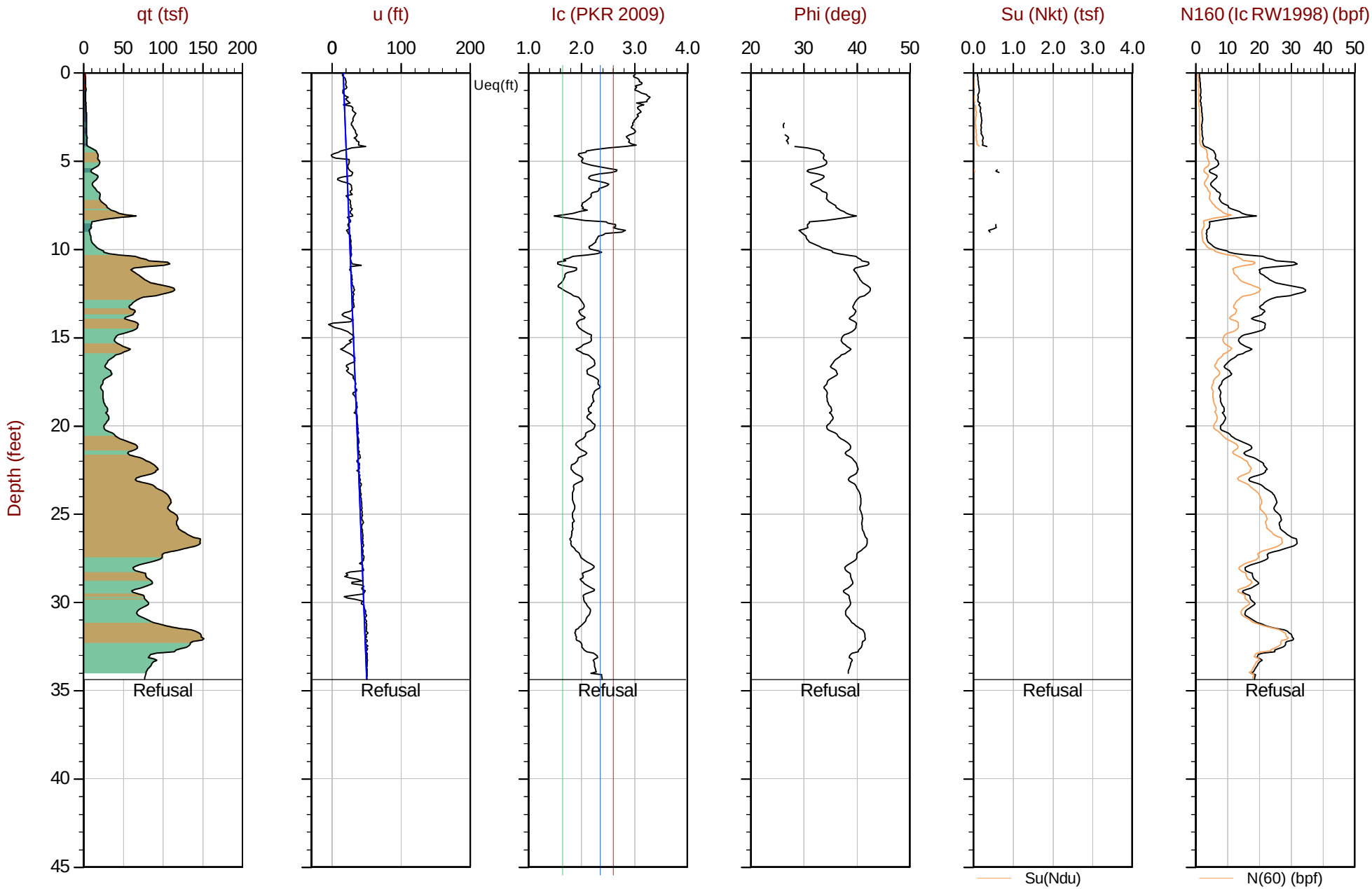
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-14 07:19
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT28-GT
Cone: 1007:T1500F15U35 Area=15 cm²



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

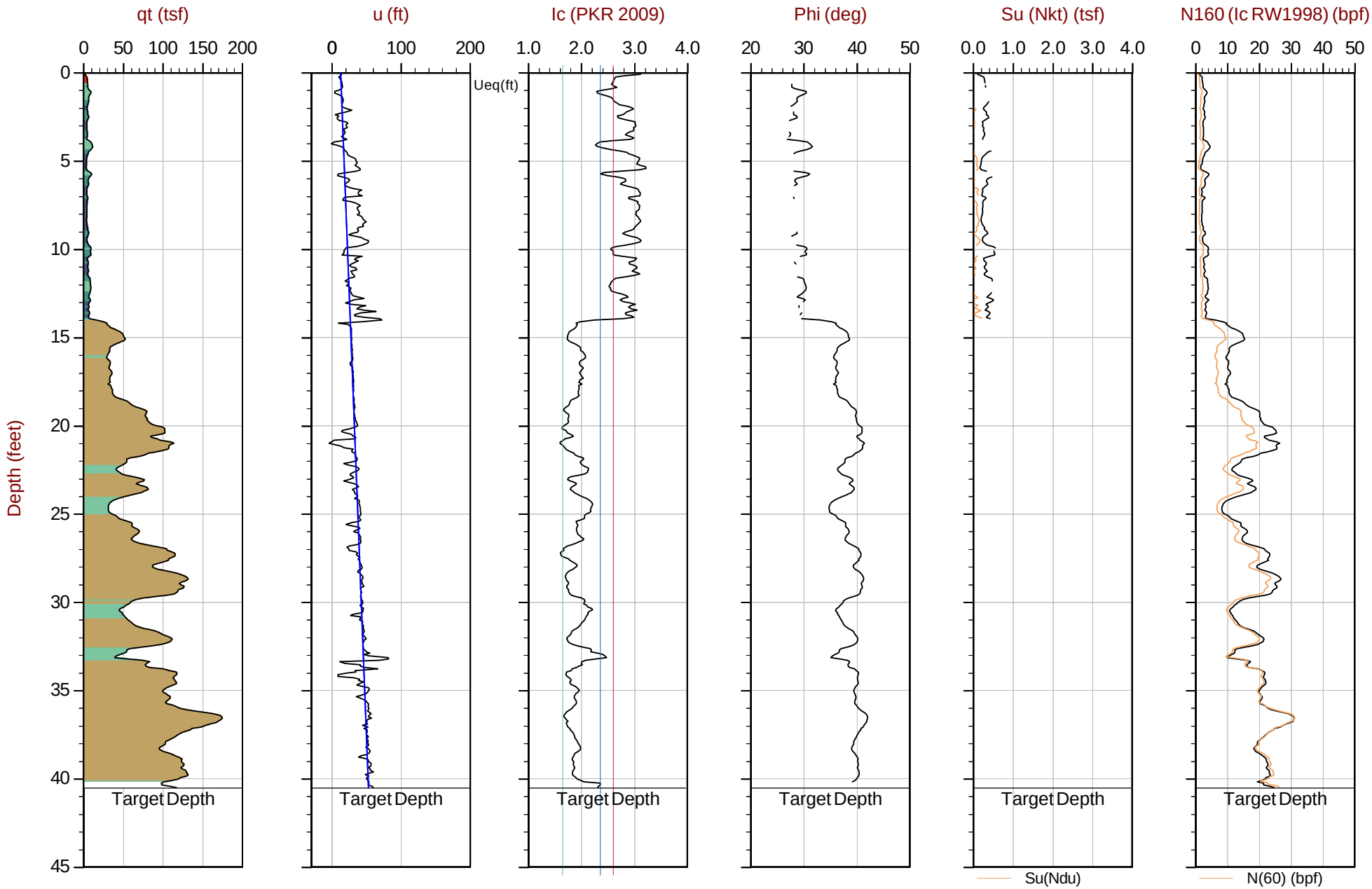
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 24-59-27874
Date: 2024-07-12 07:16
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT29-GT
Cone: 681:T375F10U35 Area=15 cm²



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

CONETEC

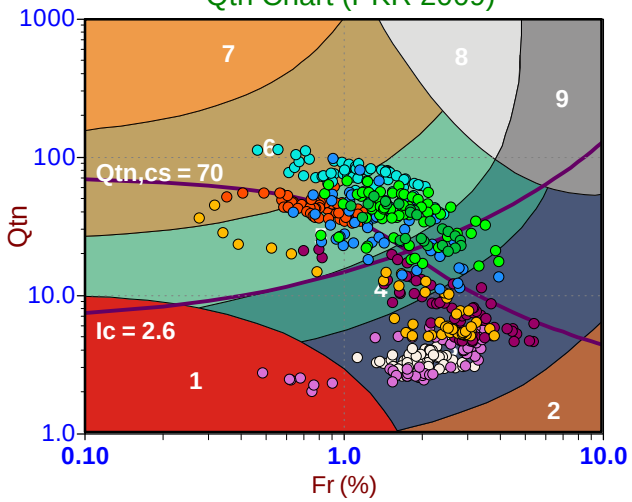
CONETEC

Anchor QEA

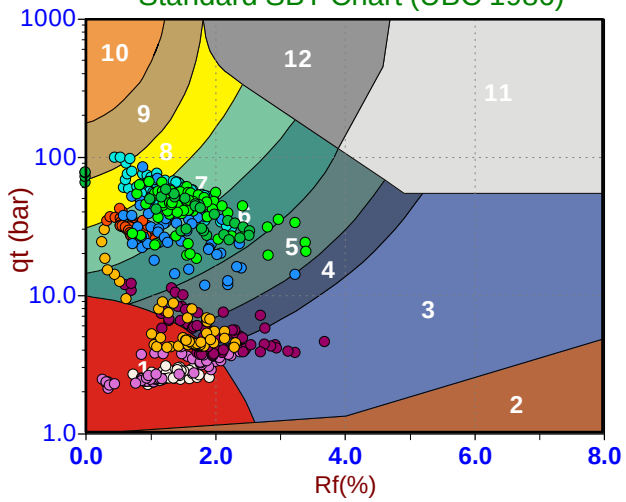
Job No: 24-59-27874
Date: 2024-07-12 11:45
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT01-GT
Cone: 1007:T1500F15U35 Area=15 cm²

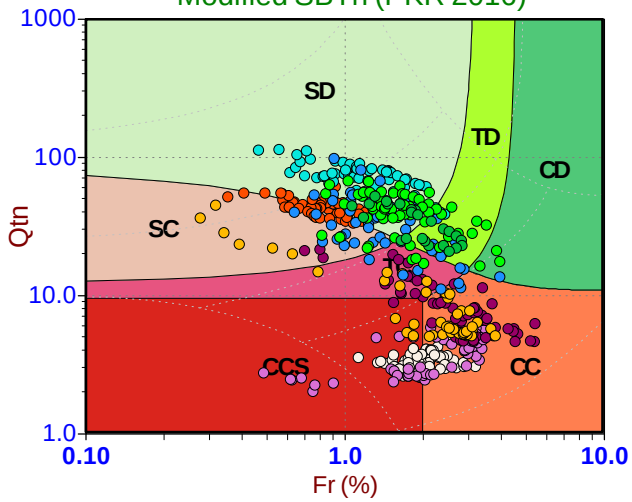
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

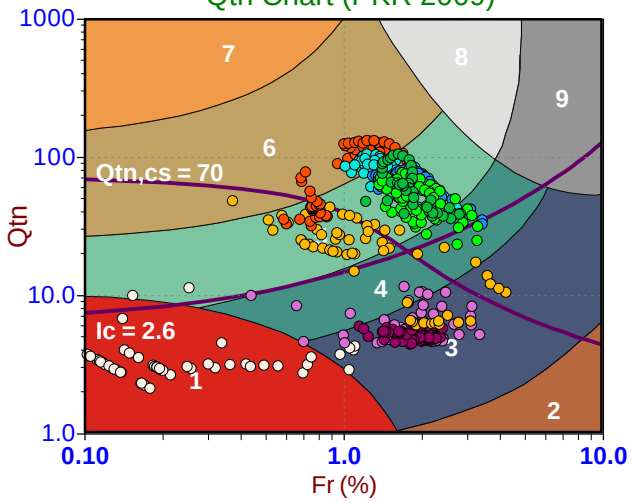
CONETEC

Anchor QEA

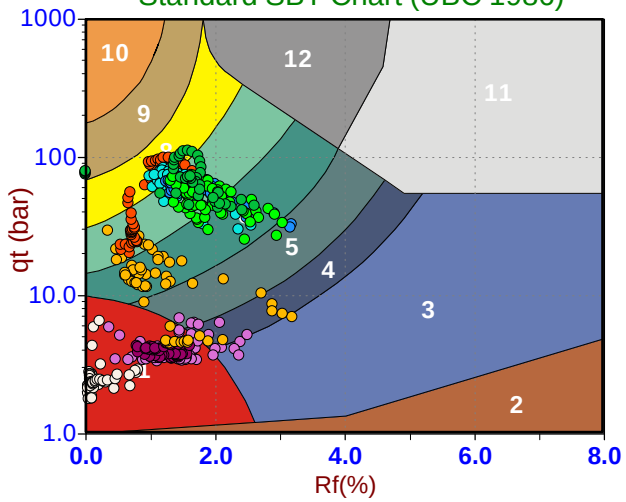
Job No: 24-59-27874
Date: 2024-07-12 15:12
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT03-GT
Cone: 1007:T1500F15U35 Area=15 cm²

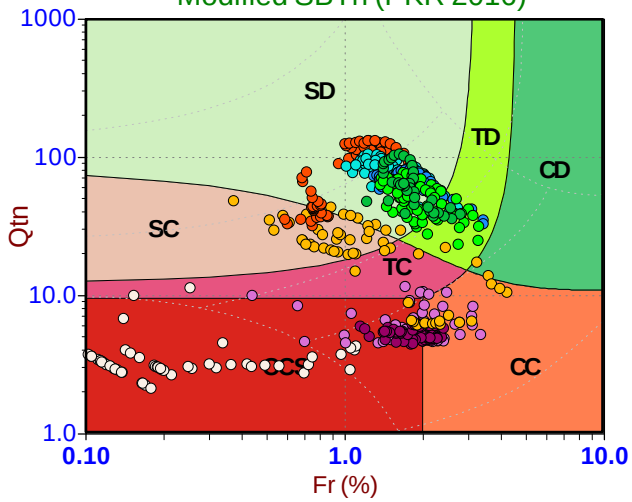
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

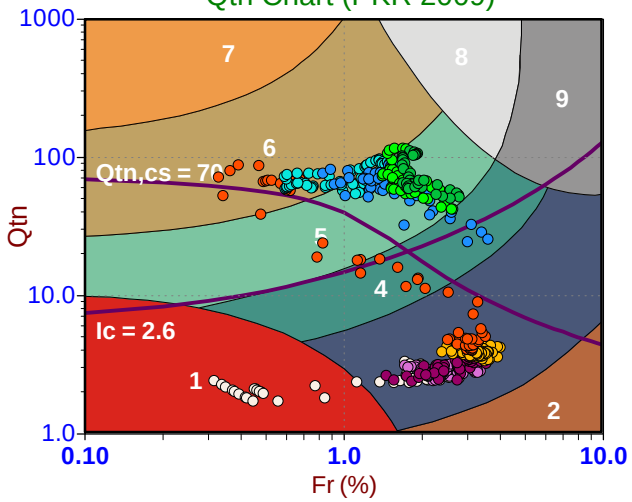
CONETEC

Anchor QEA

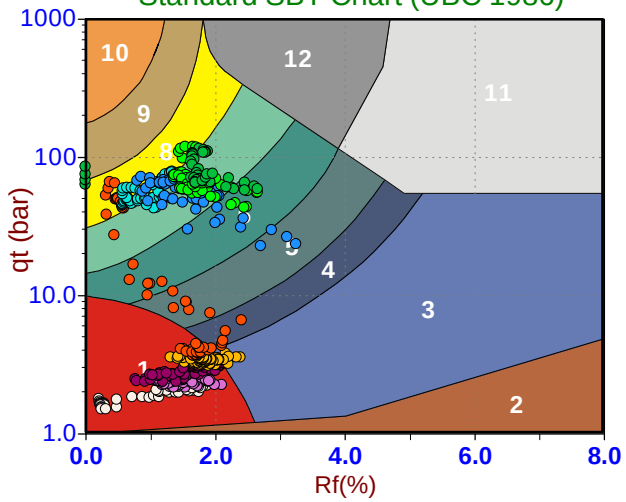
Job No: 24-59-27874
Date: 2024-07-13 07:54
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT05-GT
Cone: 1007:T1500F15U35 Area=15 cm²

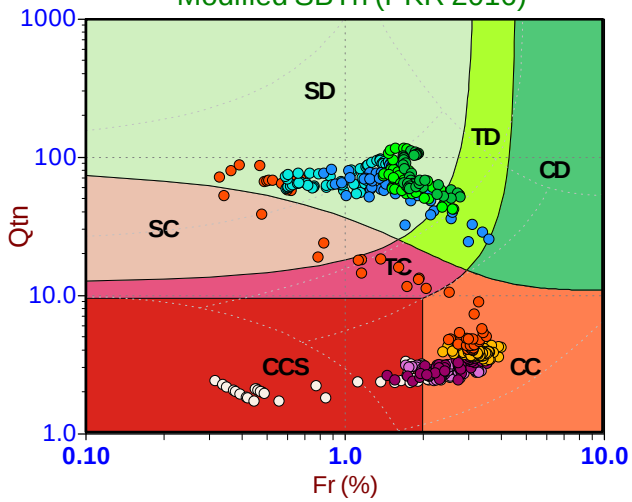
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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

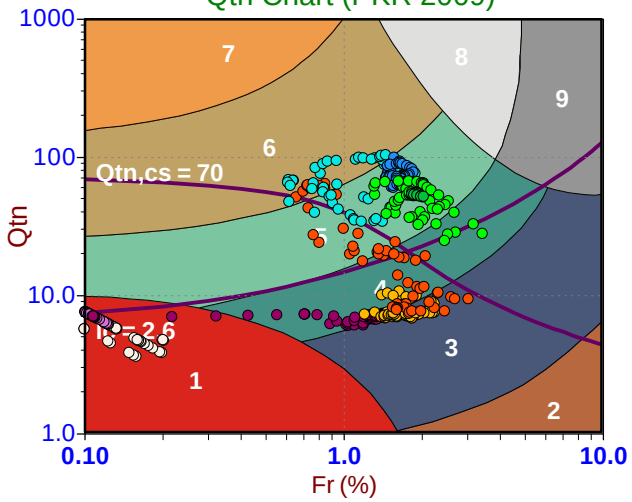
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Anchor QEA

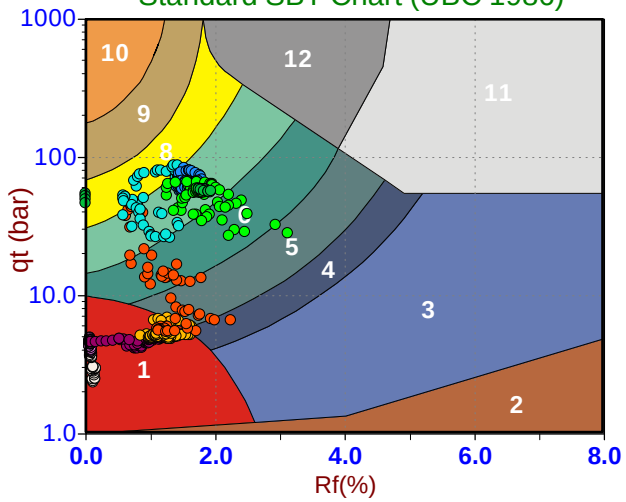
Job No: 24-59-27874
Date: 2024-07-13 13:25
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT07-GT
Cone: 1007:T1500F15U35 Area=15 cm²

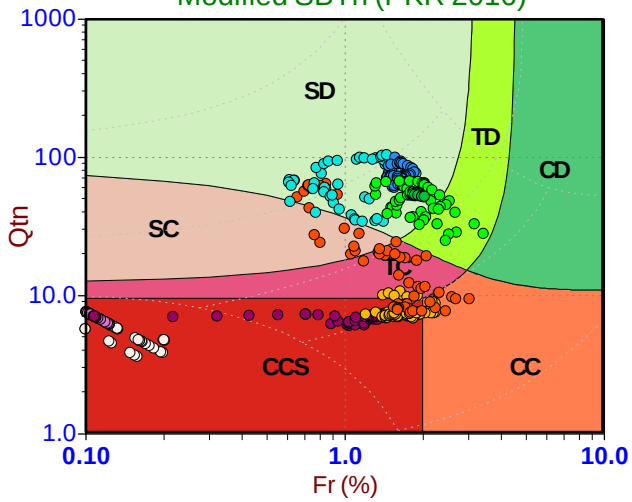
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

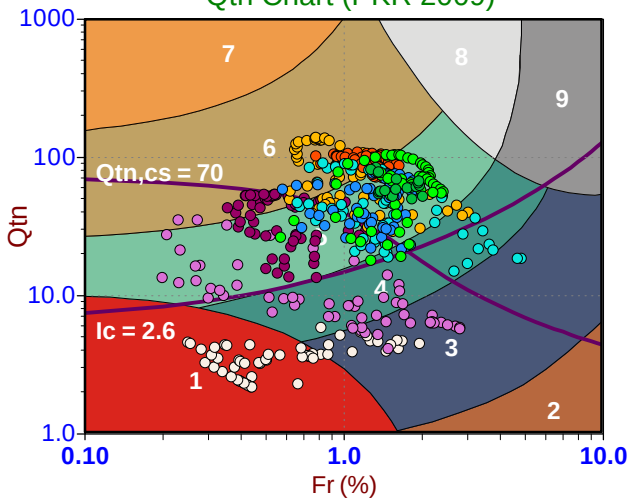
CONETEC

Anchor QEA

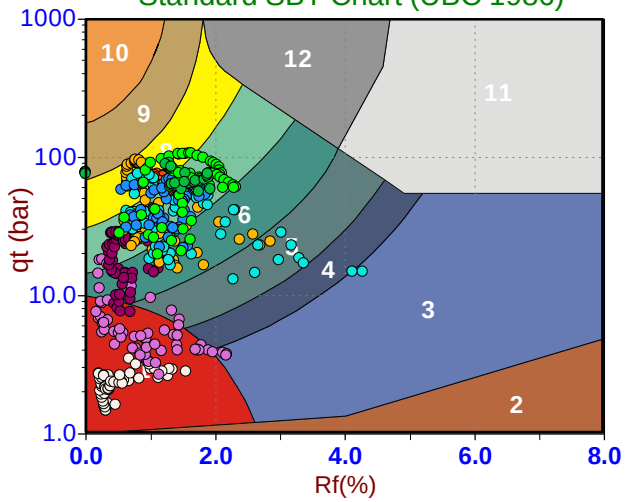
Job No: 24-59-27874
Date: 2024-07-08 13:08
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT12-GT
Cone: 1007:T1500F15U35 Area=15 cm²

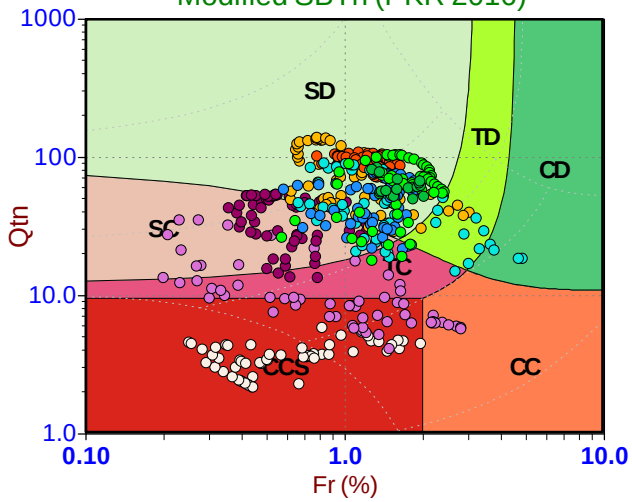
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

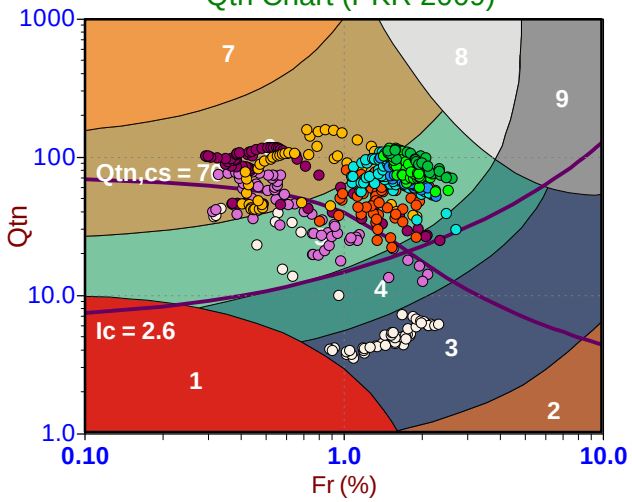
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Anchor QEA

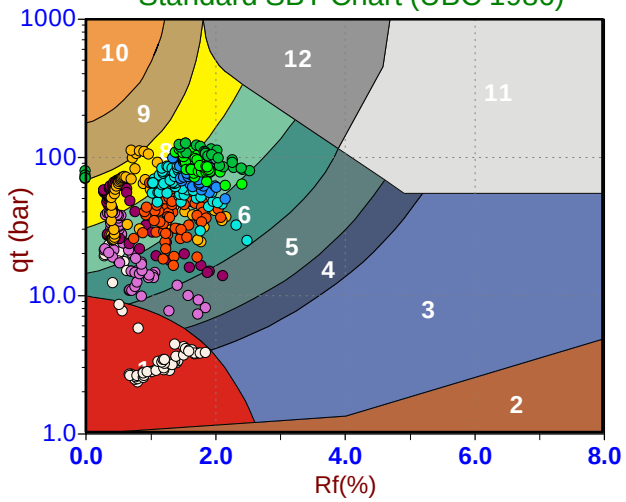
Job No: 24-59-27874
Date: 2024-07-08 08:31
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT14-GT
Cone: 1007:T1500F15U35 Area=15 cm²

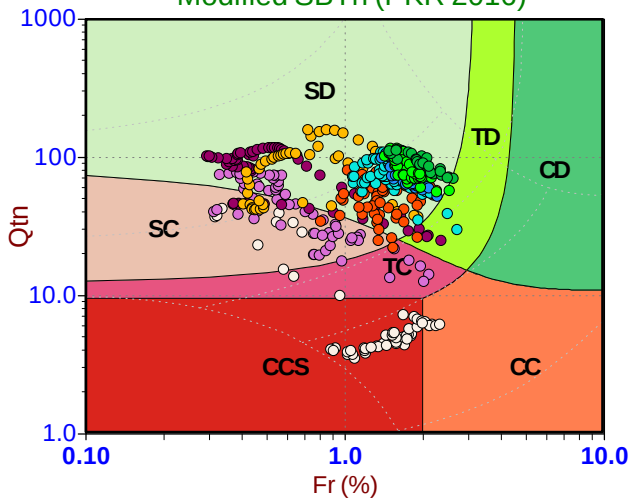
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

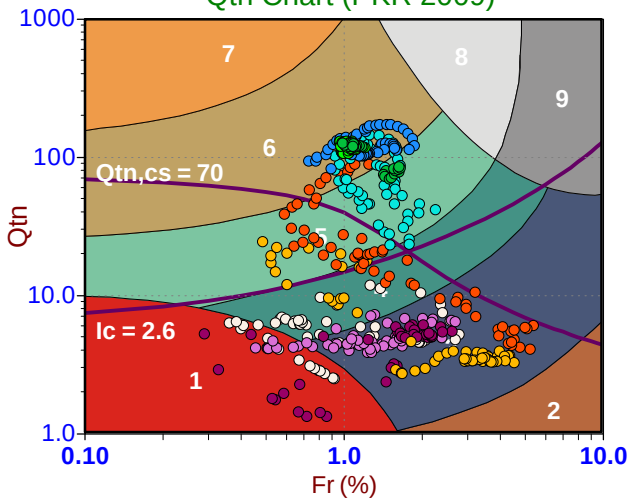
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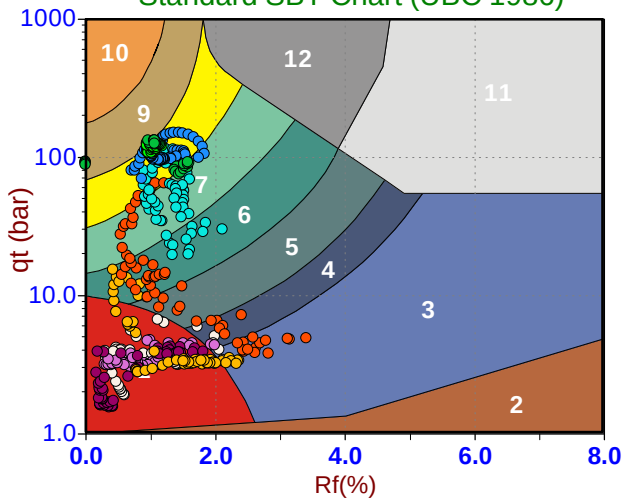
Job No: 24-59-27874
Date: 2024-07-13 16:21
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT15-GT
Cone: 1007:T1500F15U35 Area=15 cm²

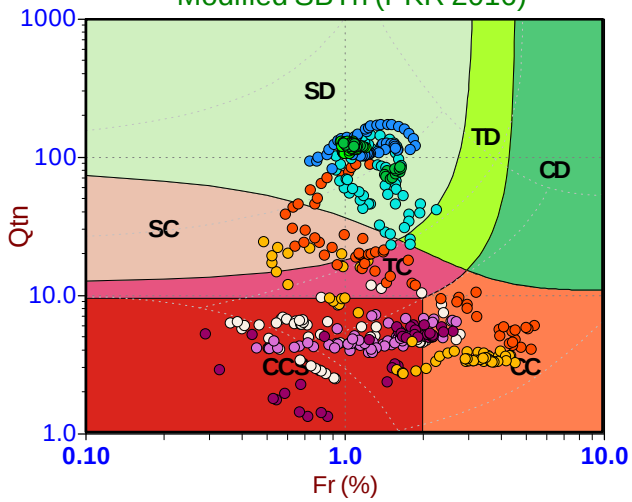
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

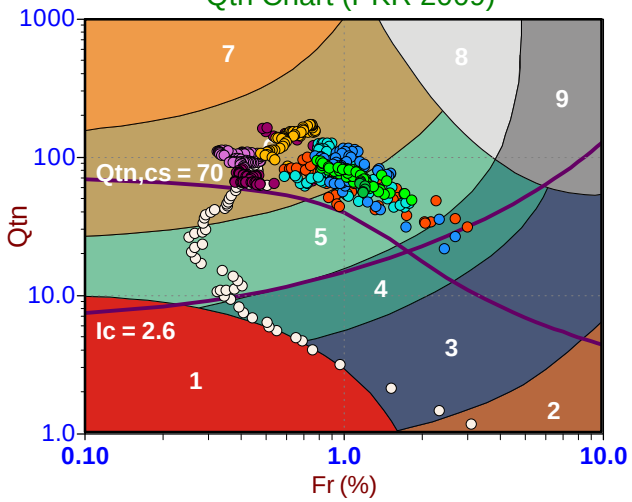
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Anchor QEA

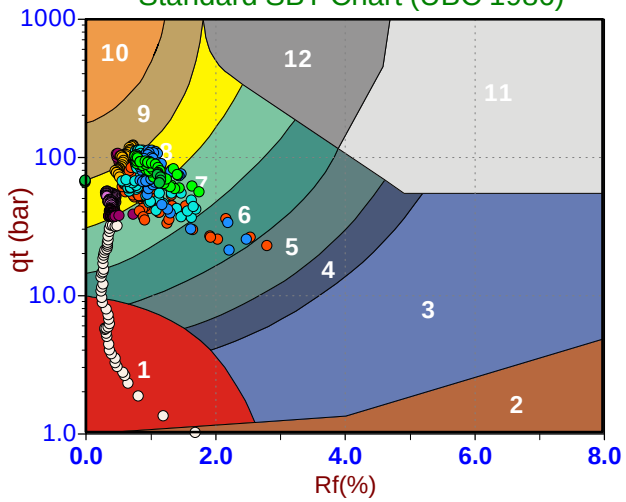
Job No: 24-59-27874
Date: 2024-07-11 13:11
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT16-GT
Cone: 681:T375F10U35 Area=15 cm²

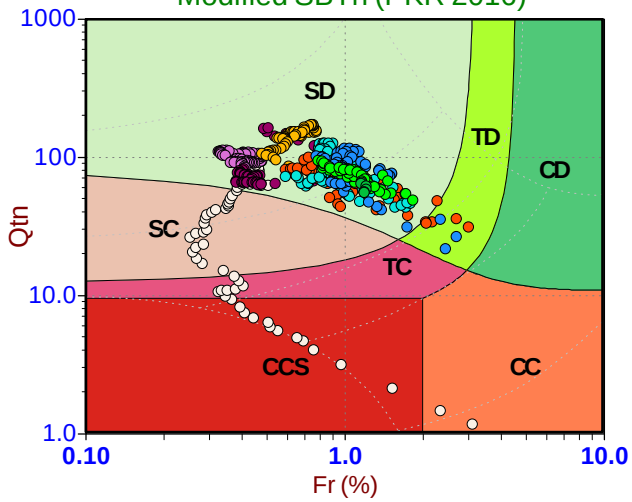
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

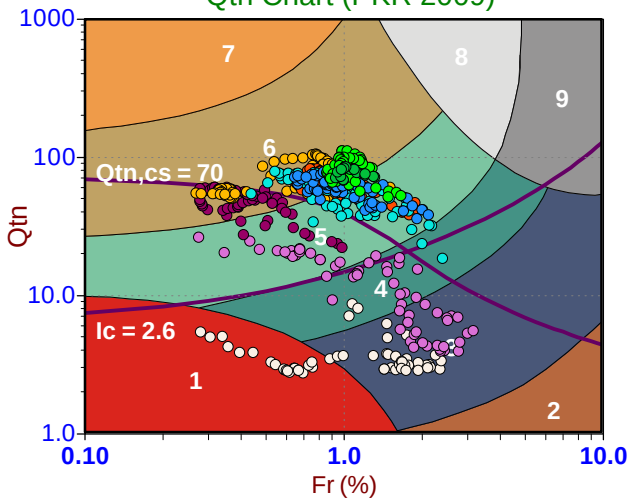
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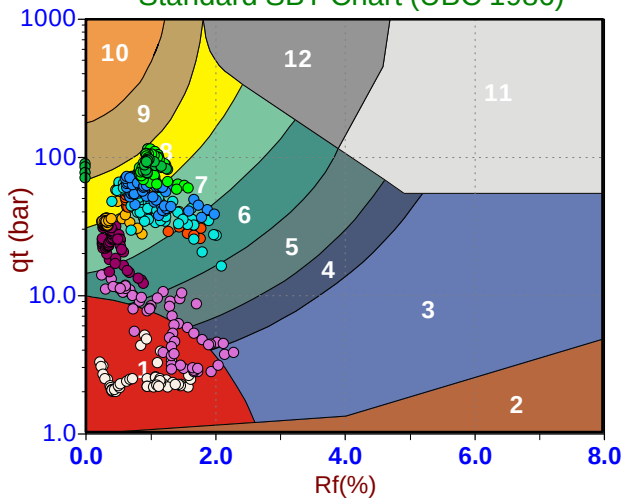
Job No: 24-59-27874
Date: 2024-07-11 10:18
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT20-GT
Cone: 681:T375F10U35 Area=15 cm²

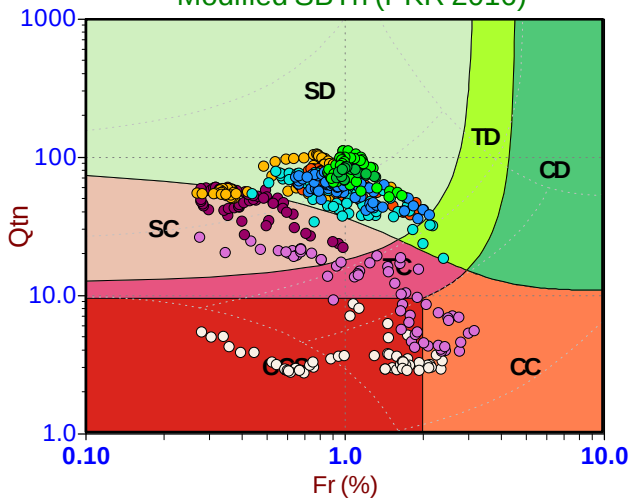
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

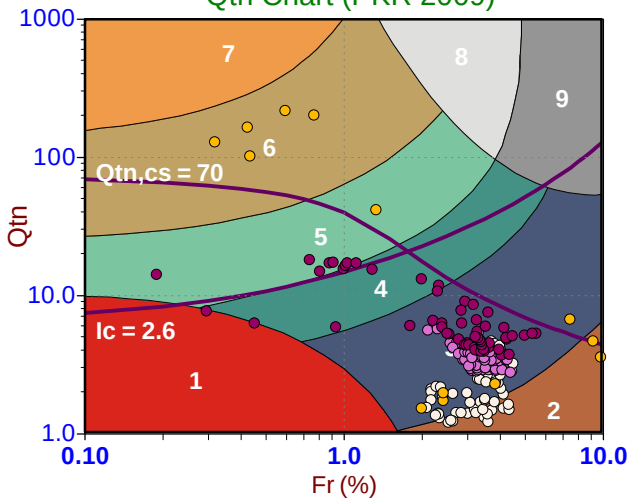
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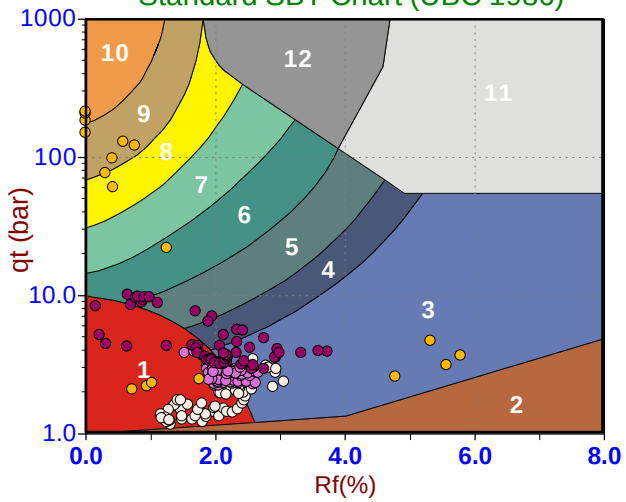
Job No: 24-59-27874
Date: 2024-07-10 08:15
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT23-GT
Cone: 681:T375F10U35 Area=15 cm²

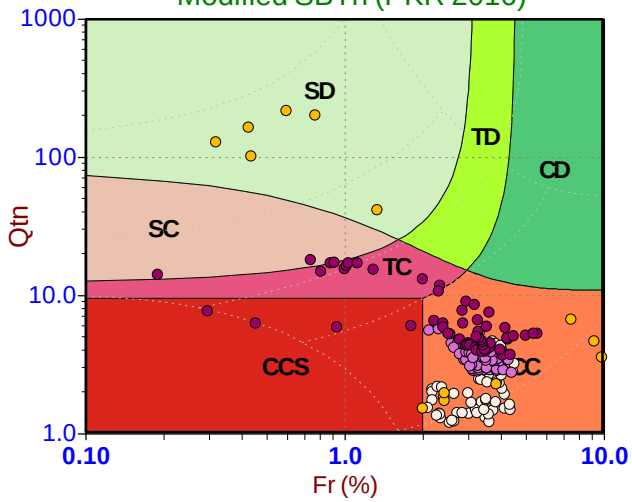
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

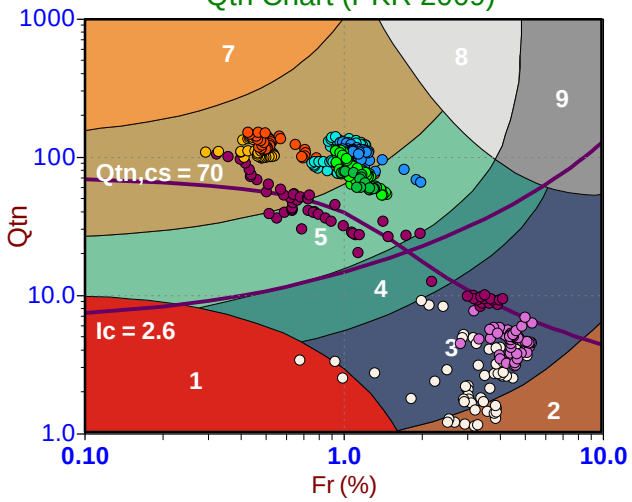
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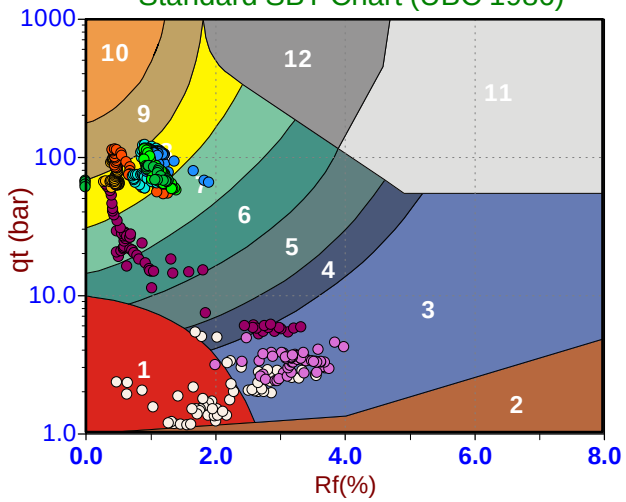
Job No: 24-59-27874
Date: 2024-07-10 10:53
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT23B-GT
Cone: 681:T375F10U35 Area=15 cm²

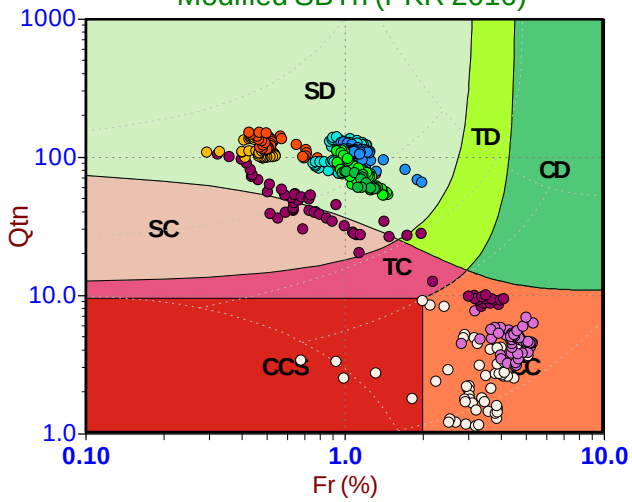
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

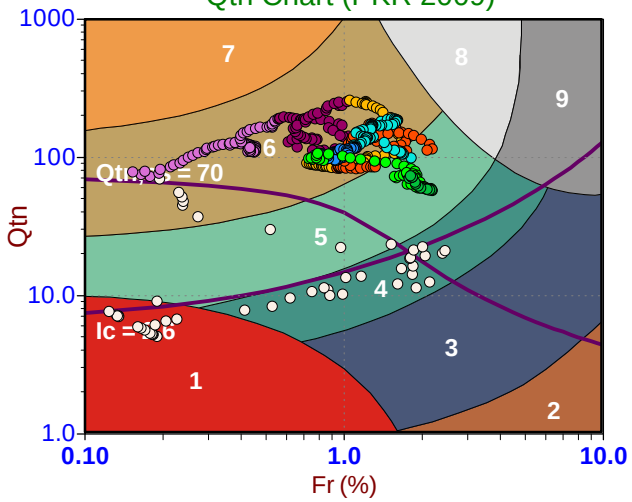
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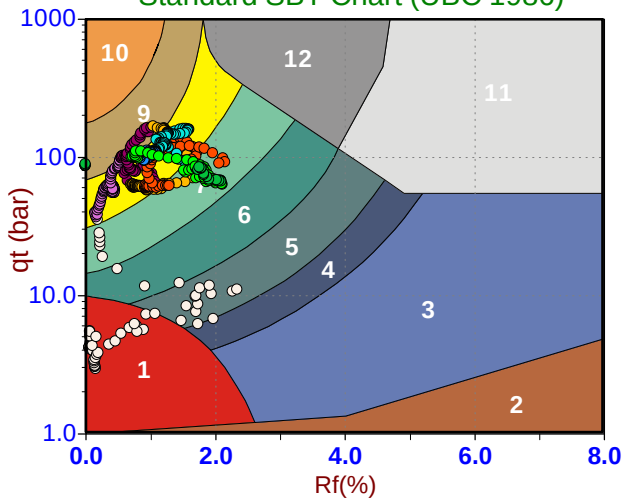
Job No: 24-59-27874
Date: 2024-07-09 11:24
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT24-GT
Cone: 1007:T1500F15U35 Area=15 cm²

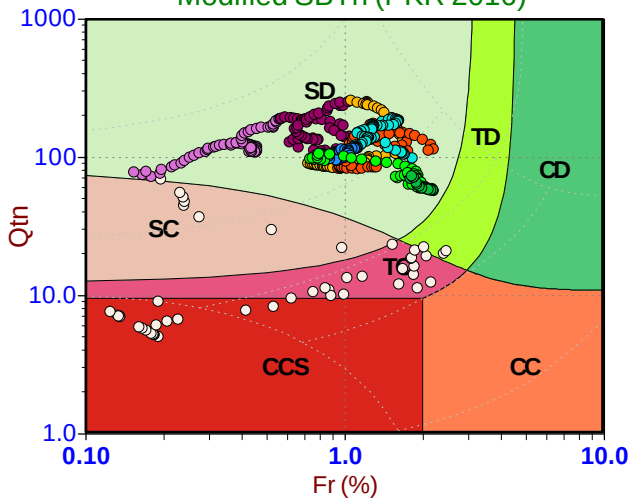
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

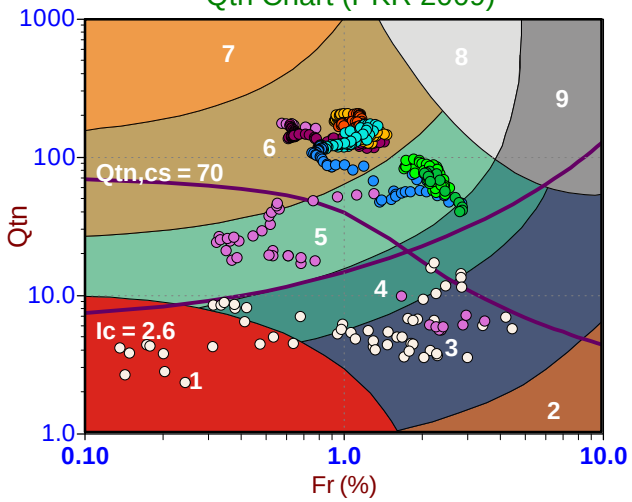
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Anchor QEA

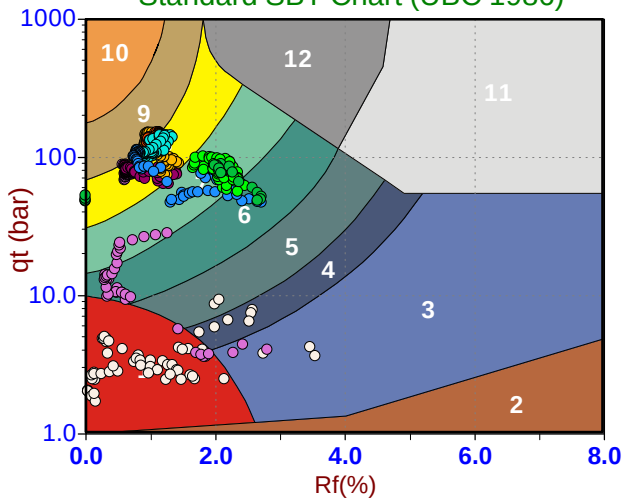
Job No: 24-59-27874
Date: 2024-07-09 07:59
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT25-GT
Cone: 1007:T1500F15U35 Area=15 cm²

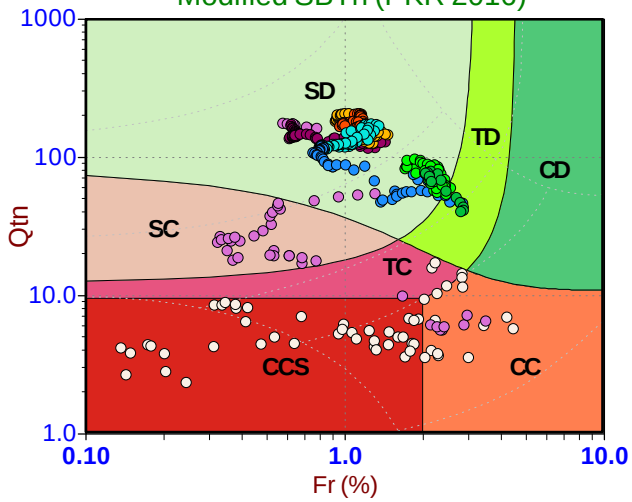
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

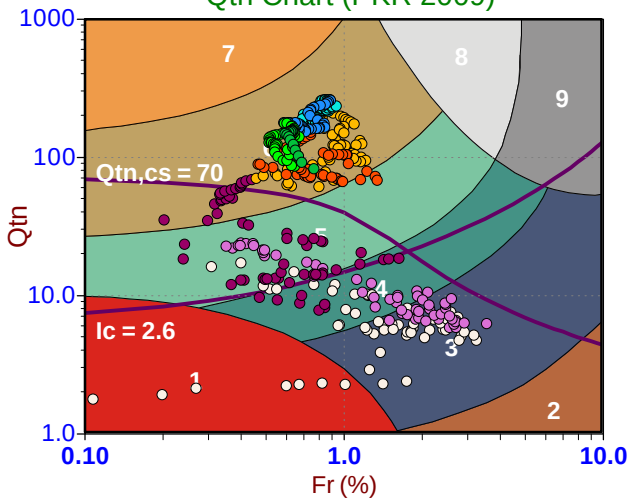
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Anchor QEA

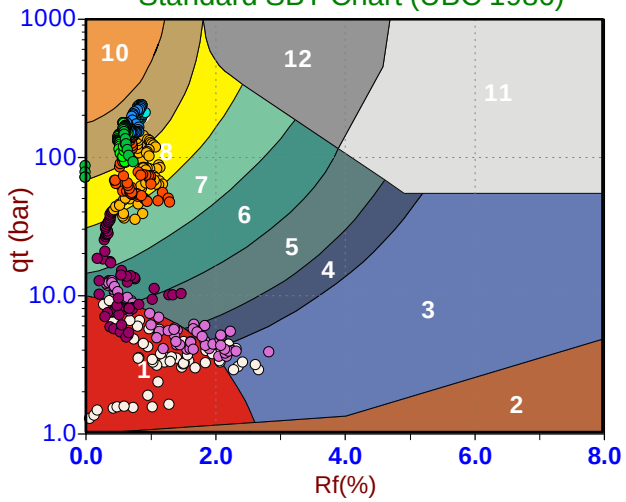
Job No: 24-59-27874
Date: 2024-07-10 14:31
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT27-GT
Cone: 681:T375F10U35 Area=15 cm²

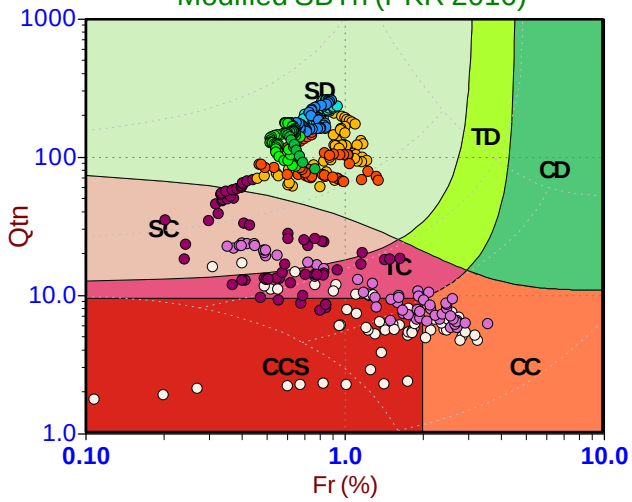
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

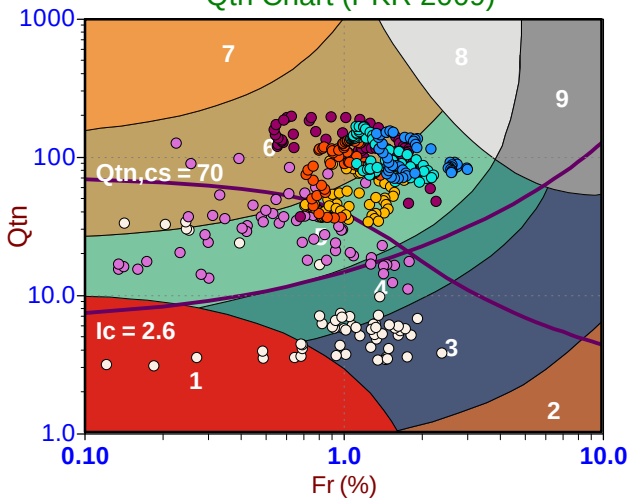
CONETEC

Anchor QEA

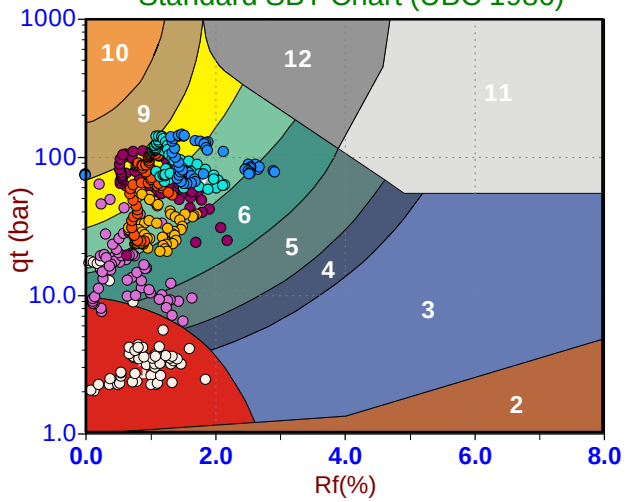
Job No: 24-59-27874
Date: 2024-07-14 07:19
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT28-GT
Cone: 1007:T1500F15U35 Area=15 cm²

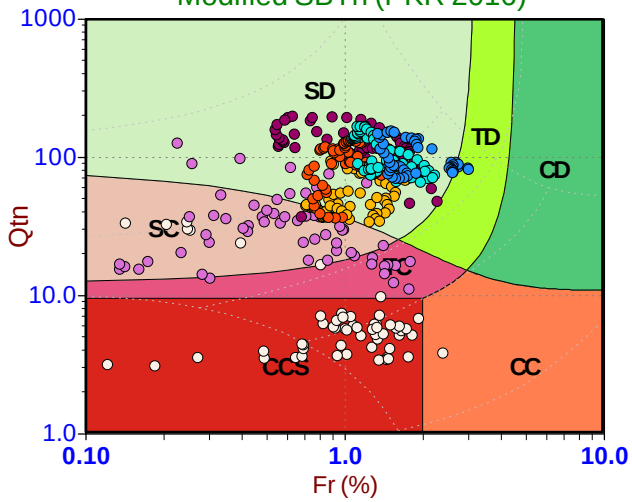
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

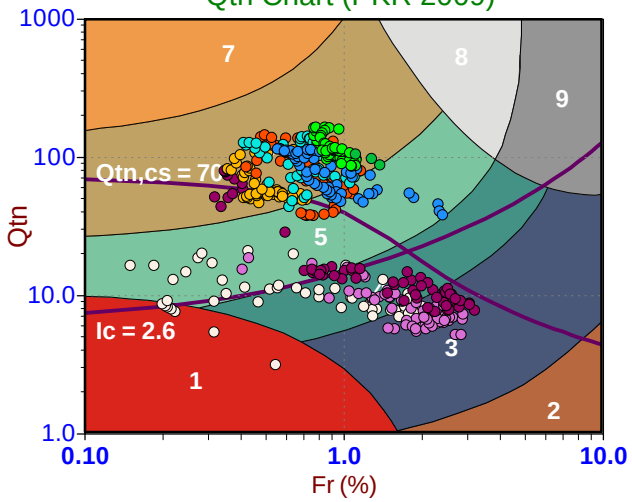
CONETEC

Anchor QEA

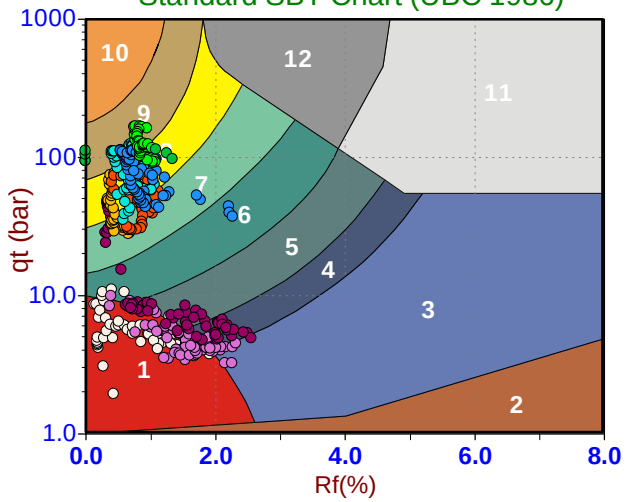
Job No: 24-59-27874
Date: 2024-07-12 07:16
Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT29-GT
Cone: 681:T375F10U35 Area=15 cm²

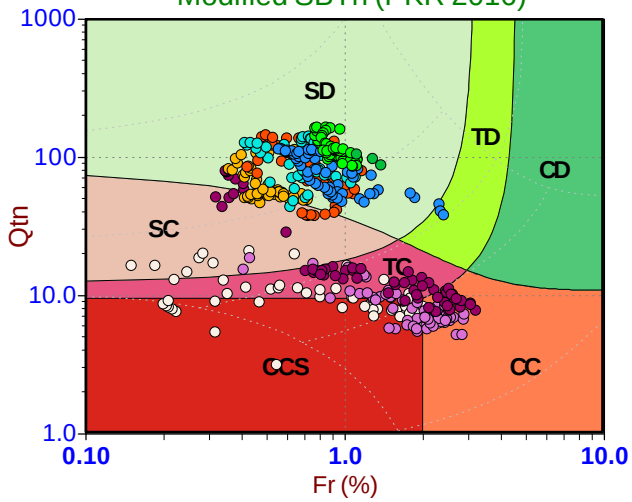
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



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)

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

CONETEC

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 measuered 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

BCPTu ASSUMED UNIT WEIGHT SUMMARY

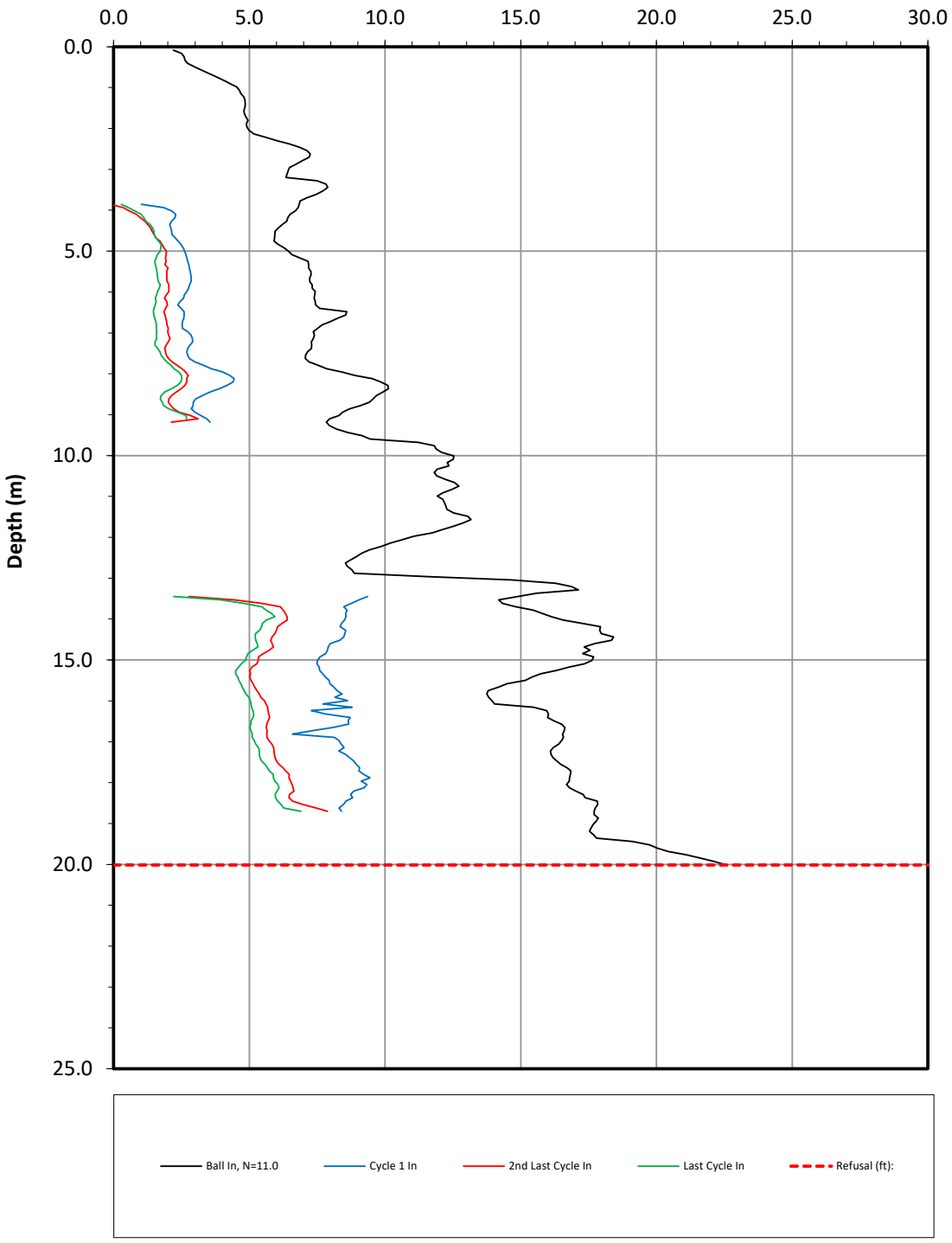
Sounding ID	File Name	Final Depth (ft)	Assumed Unit Weight Start Depth (ft)	Assumed Unit Weight End Depth (ft)	Assumed Unit Weight[1] (kN/m^3)	Refer to Notation Number
LDW23-GT05-GT-FFP	24-59-27874_BP05	20.01	-19.17	0.00	9.81	
LDW23-GT05-GT-FFP	24-59-27874_BP05	20.01	0.00	20.01	17.50	
LDW23-GT07-GT-FFP	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/m^3 was assumed for data above the mudline, within the water layer.
1. A unit weight of 17.50 kN/m^3 was assumed for data below the mudlline.

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

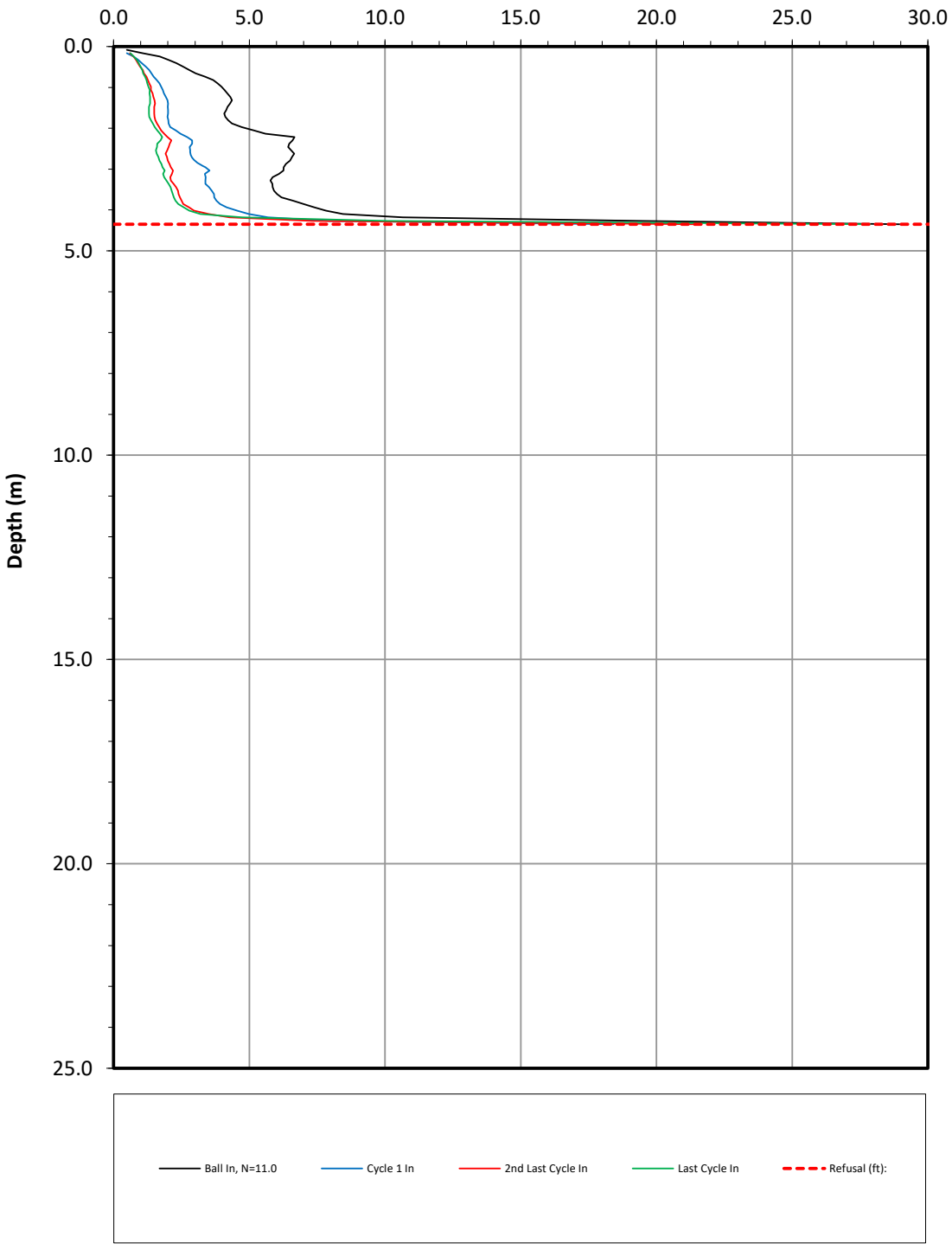
Flow Penetrometer Undrained Strength



Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Sounding ID: LDW23-GT07-GT-FFP
Sounding Date: 2024-07-13

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

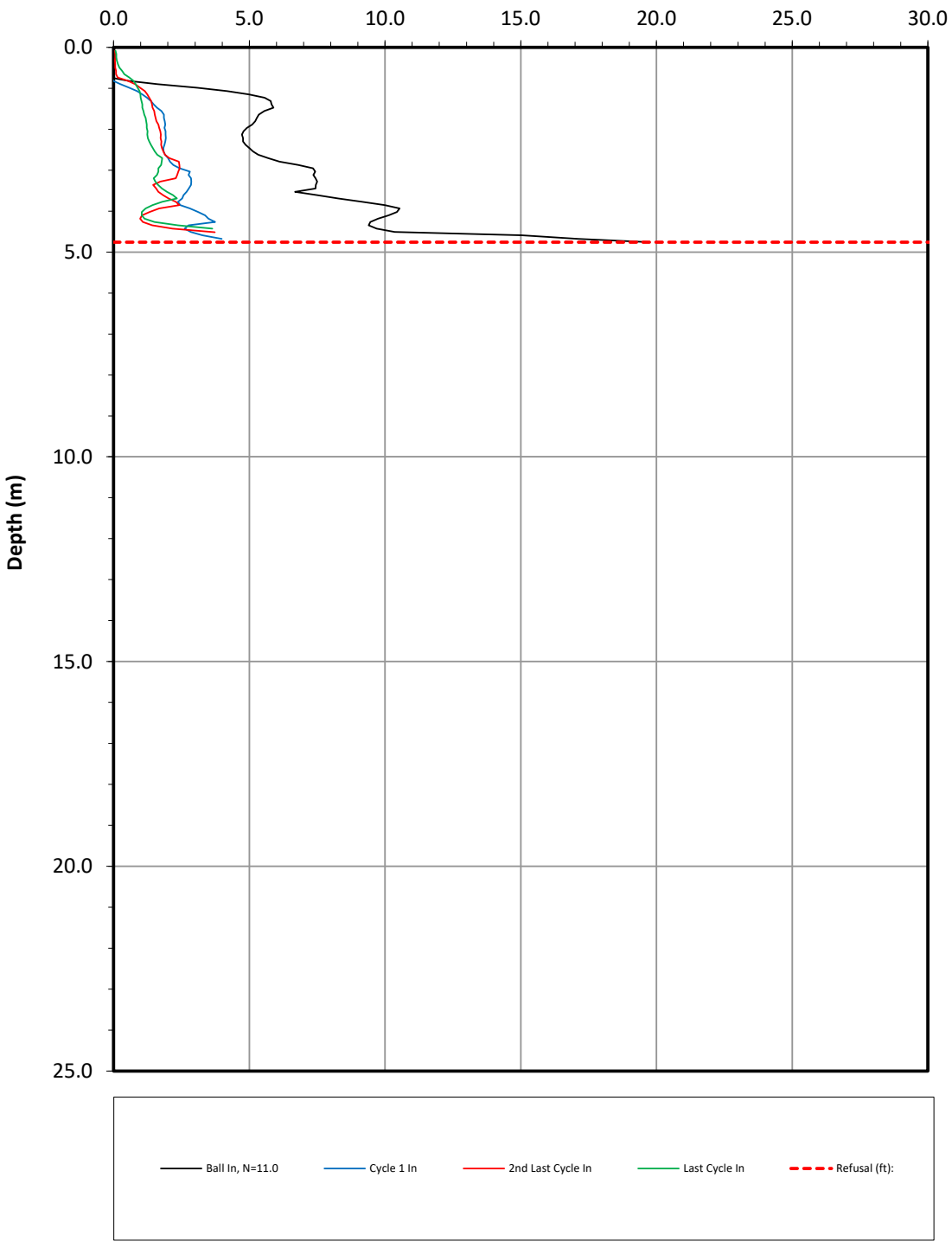
Flow Penetrometer Undrained Strength



Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Sounding ID: LDW23-GT12-GT-FFP
Sounding Date: 2024-07-13

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

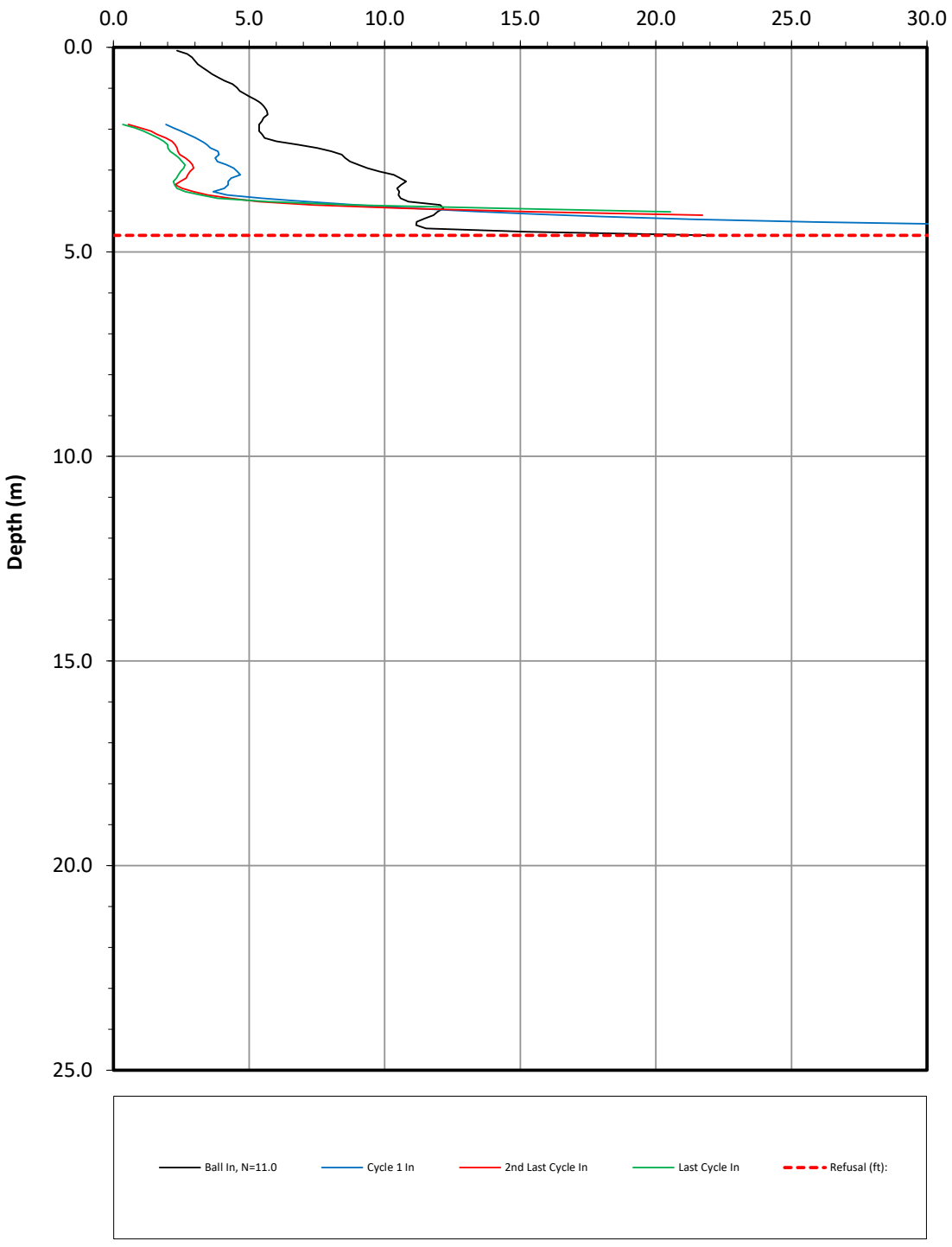
Flow Penetrometer Undrained Strength



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

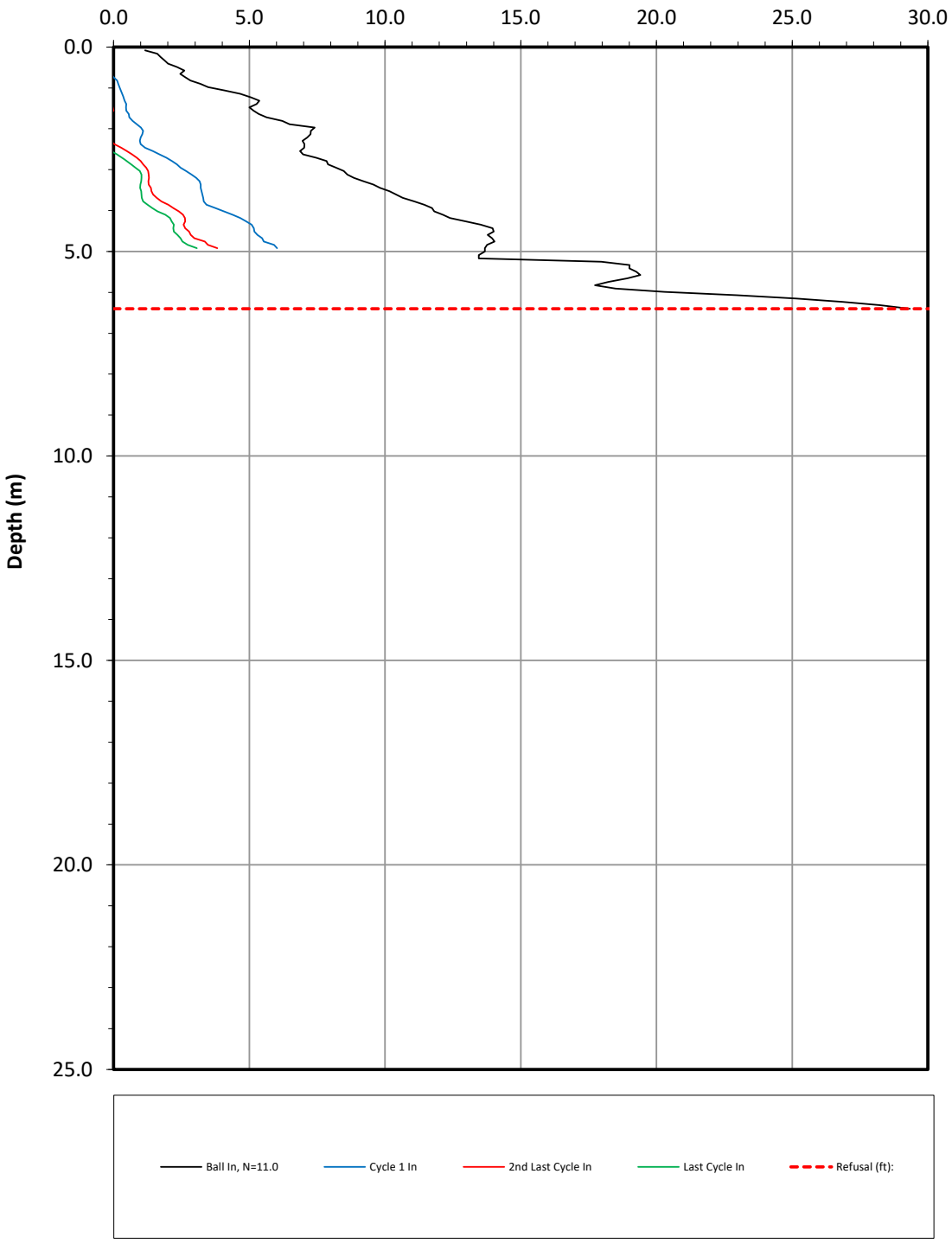
Flow Penetrometer Undrained Strength



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
Latitude (deg): 47.53506
Longitude (deg): -122.32329

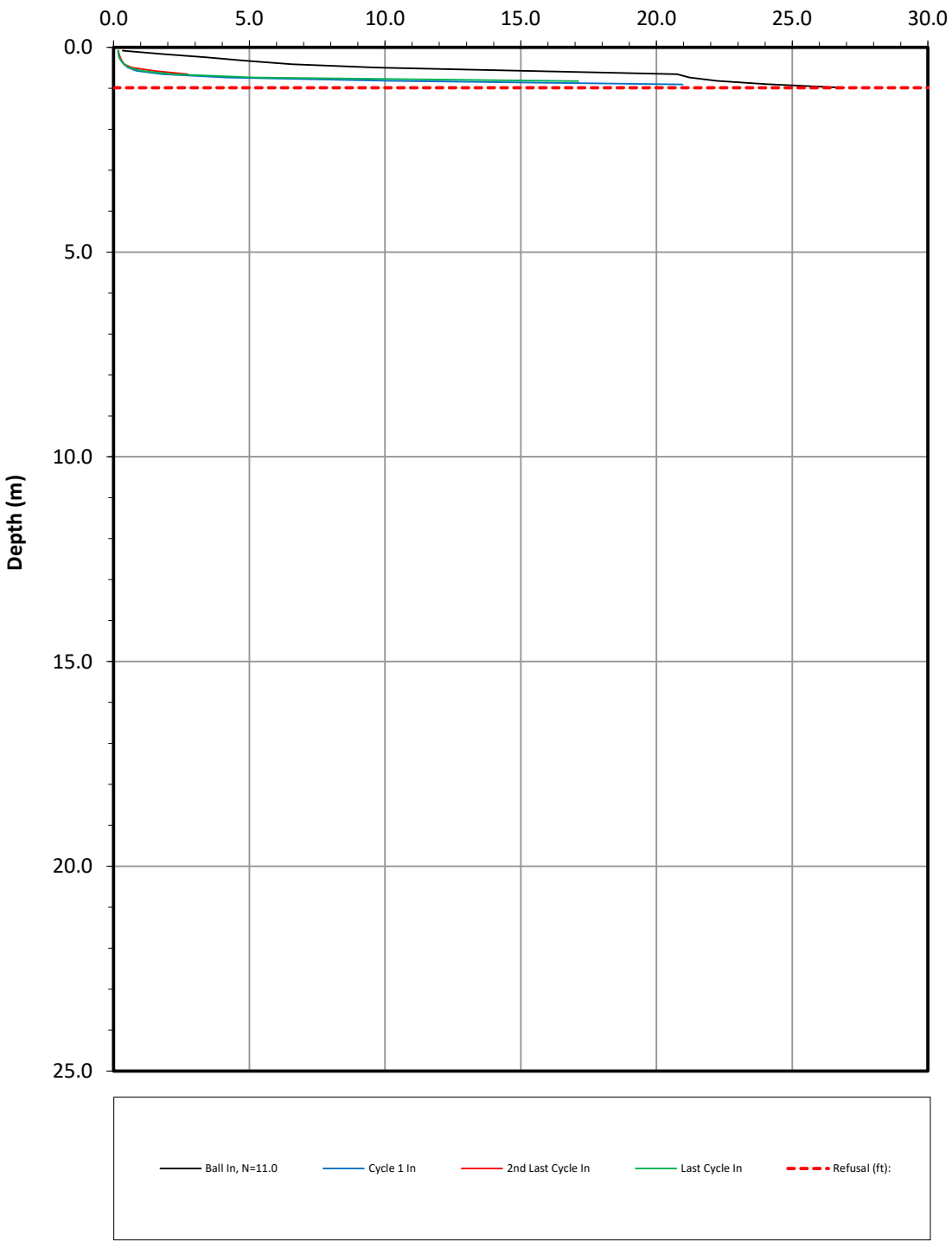
Flow Penetrometer Undrained Strength



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

CONETEC

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 cm^2 and 15 cm^2 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 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm^2 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 "u_2" 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.

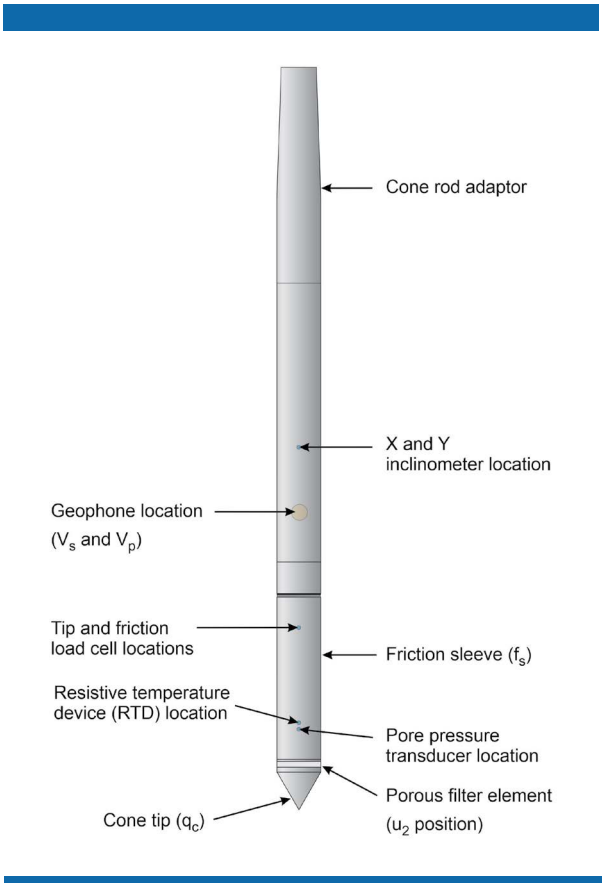


Figure CPTu. Piezocone Penetrometer (15 cm²)

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.

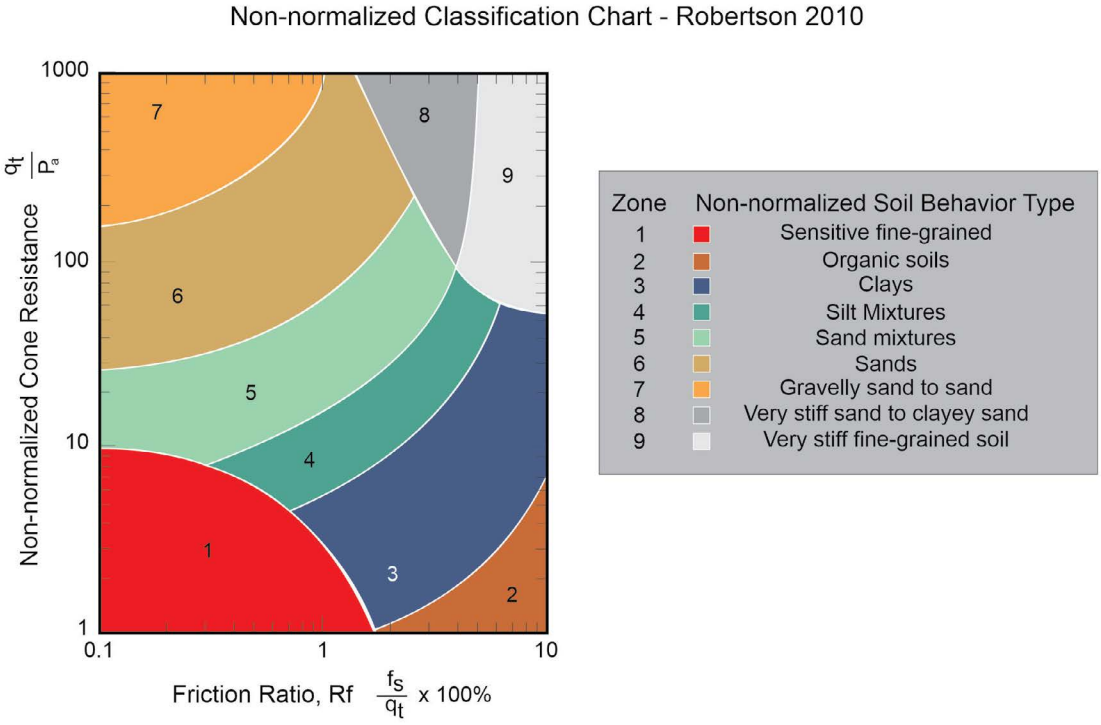


Figure SBT. Non-Normalized Soil Behavior Type Classification Chart (SBT)

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):

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

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 (Rf) 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 cm^2 and 15 cm^2 tip base area configurations in order to maximize signal resolution for various soil conditions. The 15 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm^2 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 cm^2, 100 cm^2 or 150 cm^2. 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.

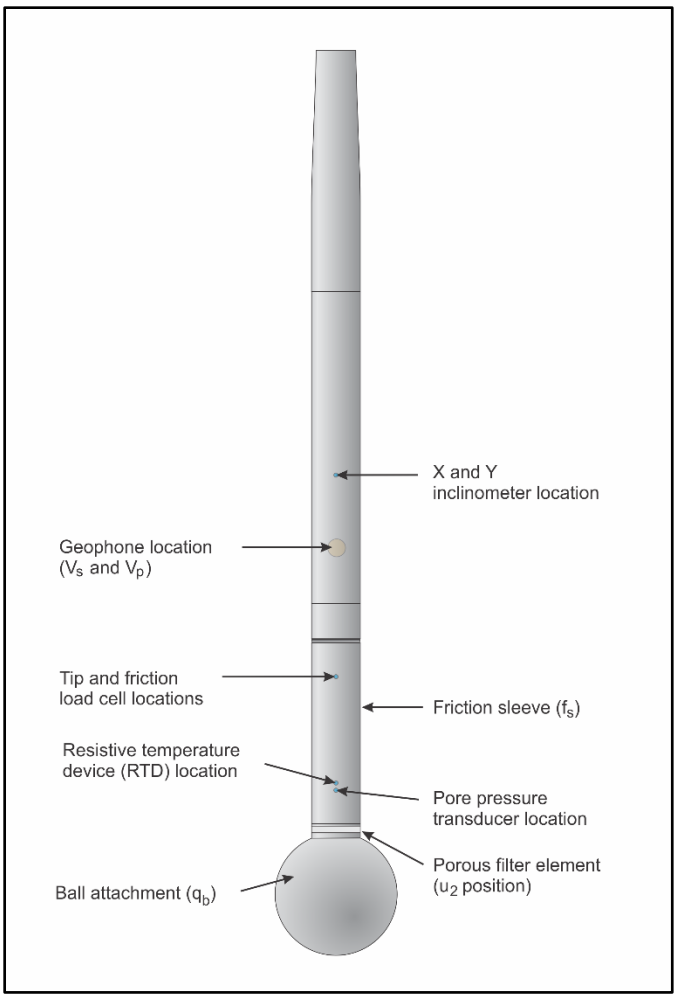


Figure BCPTu. Piezocone penetrometer with a spherical attachment

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 (Su) 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 (Su) derived from the full flow penetration test is related to the net ball tip resistance (q_{btnet}) and ball factor (N_{ball}) using the following relationship:

$$Su = \frac{q_{btnet}}{N_{ball}}$$

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

CONETEC

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

CONETEC

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 Bq parameter. The normalized Qtn 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.

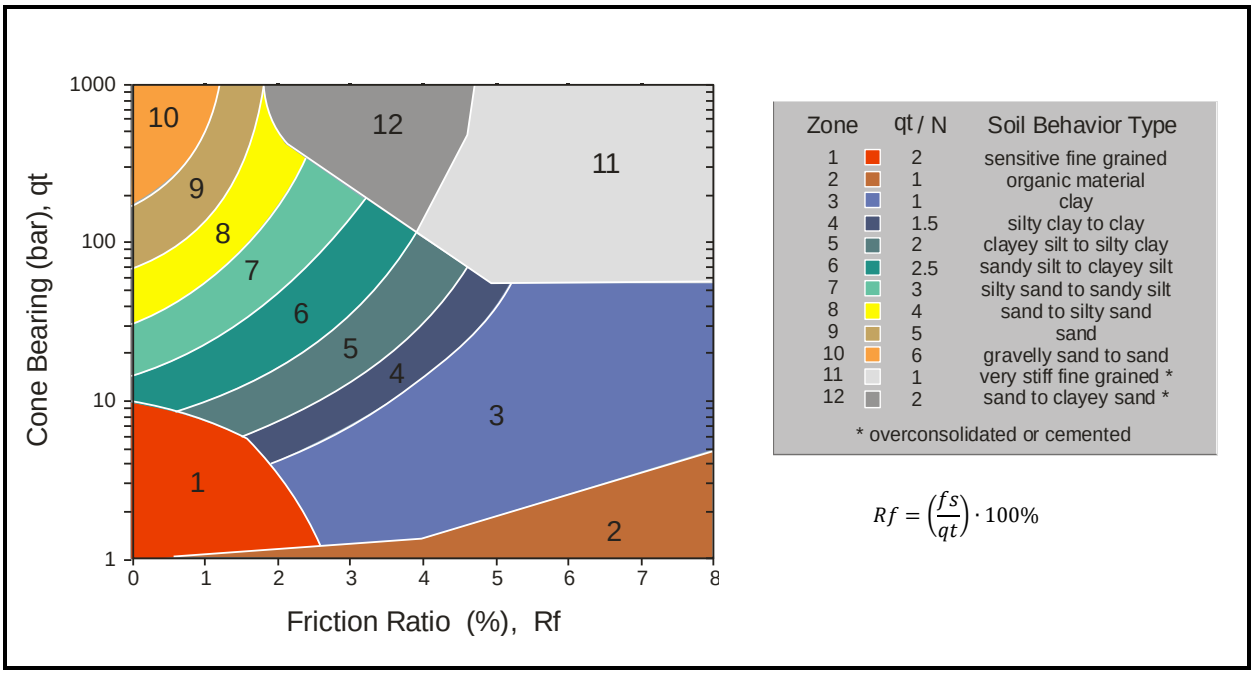


Figure 1. Non-normalized Soil Behavior Type Classification Chart (SBT)

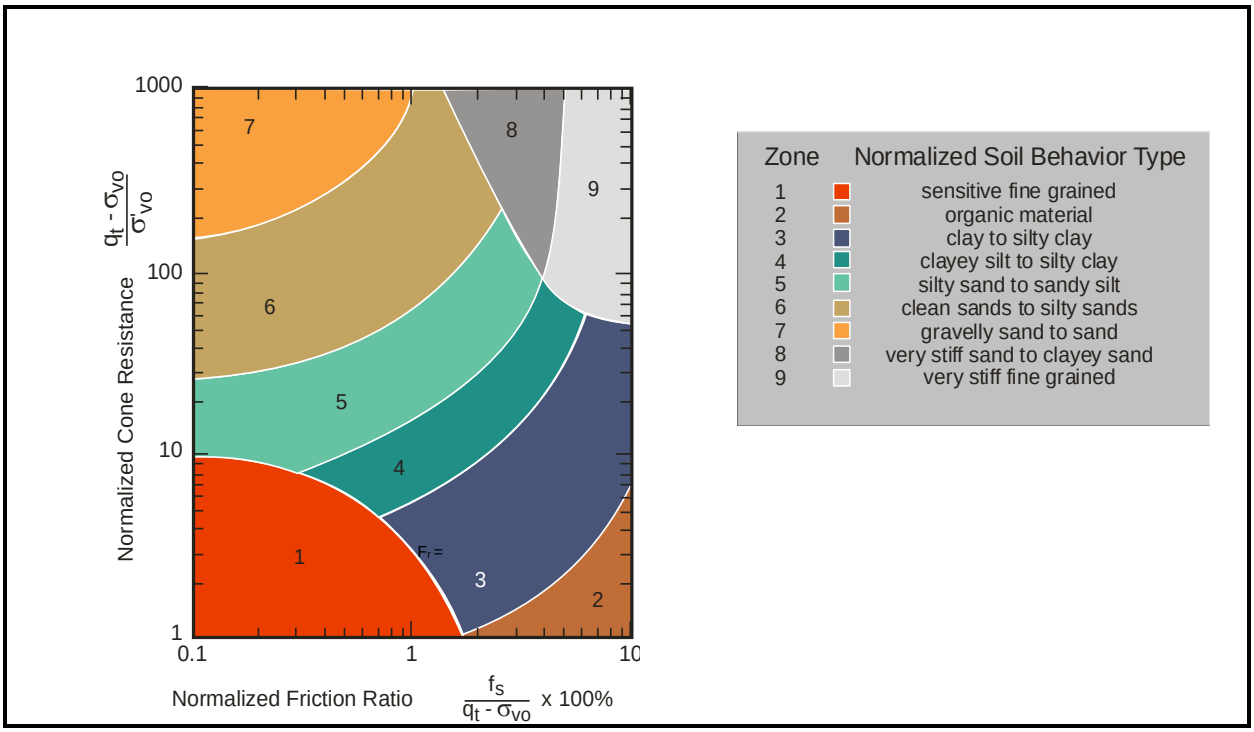


Figure 2. Normalized Soil Behavior Type Classification Chart (SBTn)

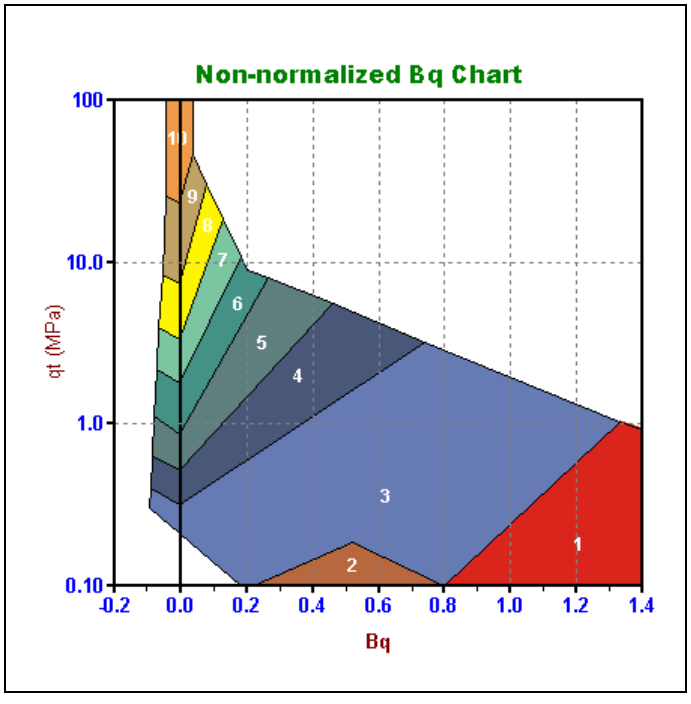


Figure 3a. Alternate Soil Behavior Type Chart (SBT Bq): q_t - B_q

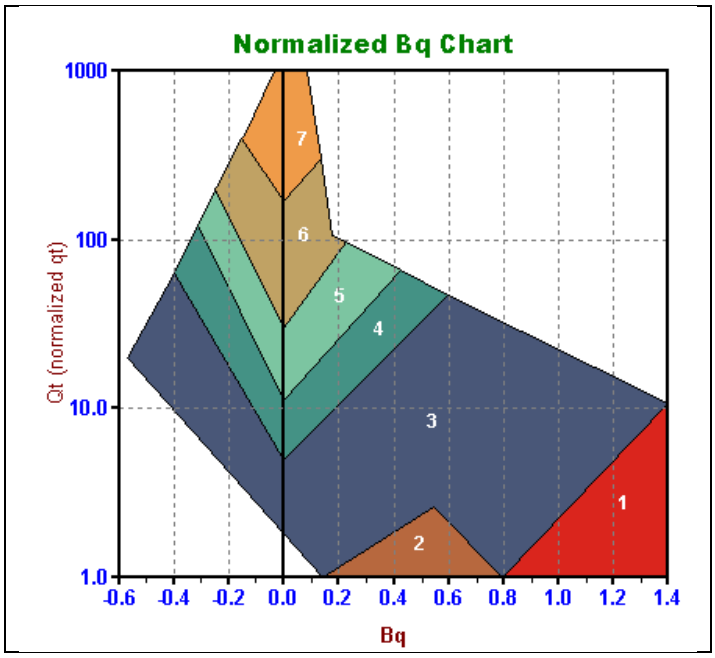


Figure 3b. Alternate Soil Behavior Type Charts (SBT Bqn): Q_t-B_q

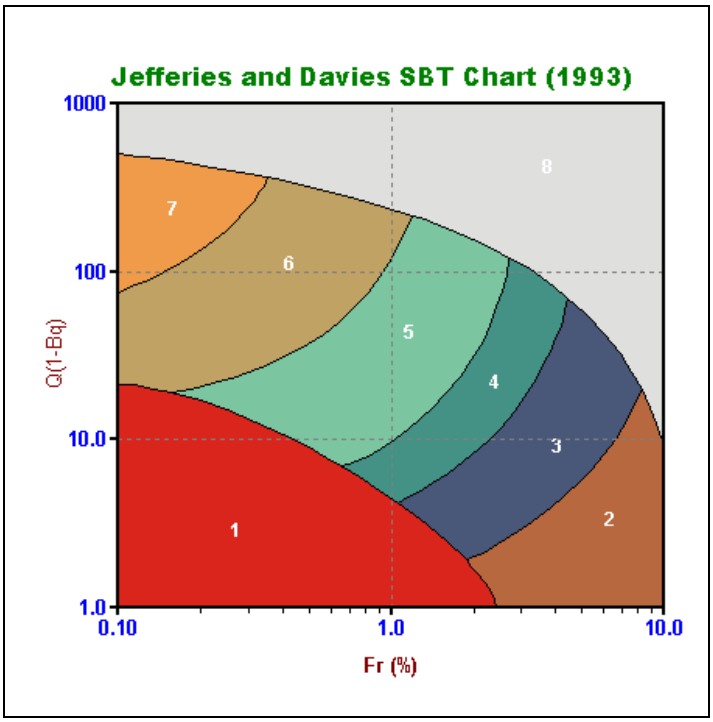


Figure 3c. Alternate Soil Behavior Type Charts: $Q(1-B_q)$ - F_r

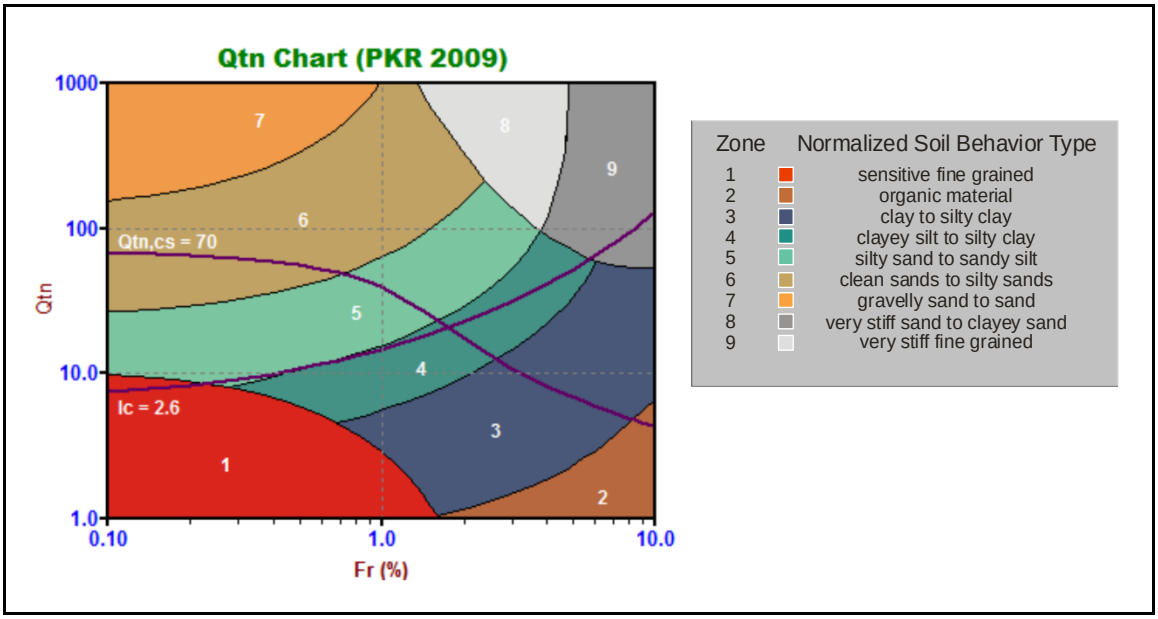


Figure 4. Normalized Soil Behavior Type Chart using Q_{tn} (SBT Qtn)

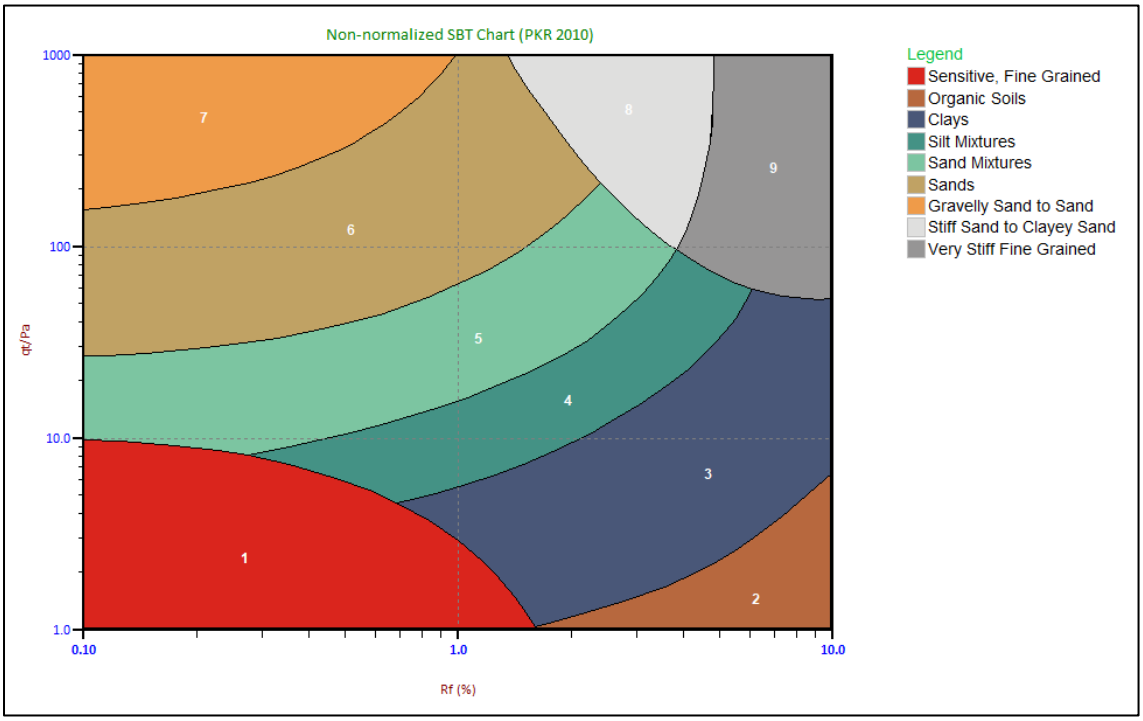


Figure 5. Non-normalized Soil Behavior Type Chart (2010)

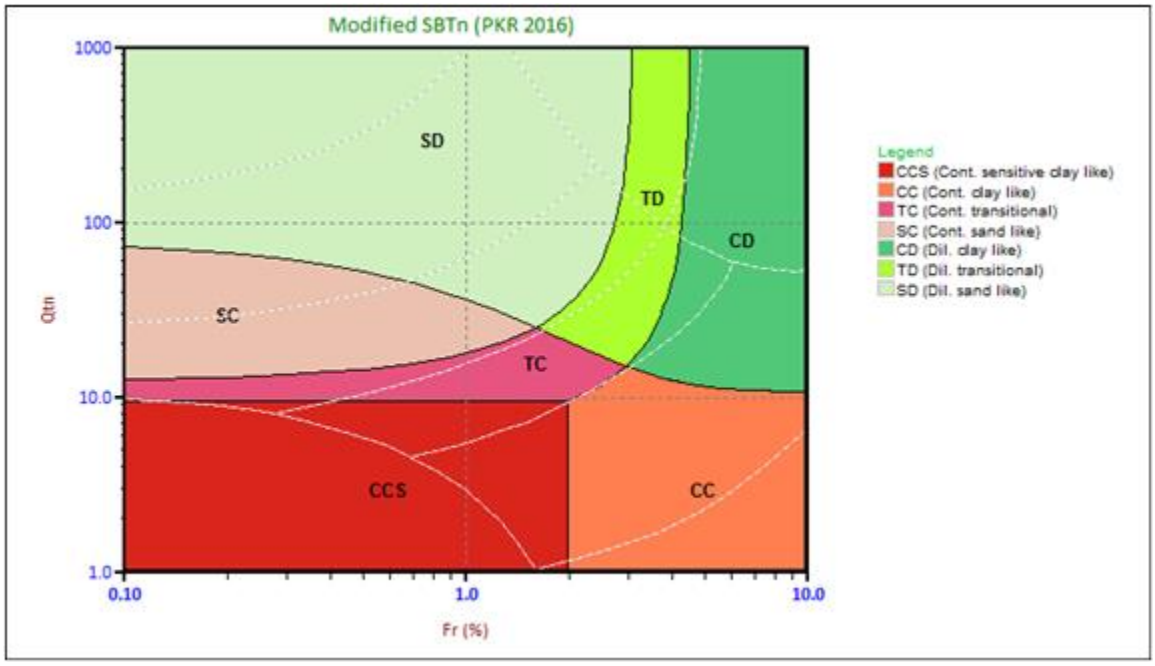


Figure 6. Modified SBTn Behavior Based Chart

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 1and 1a 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

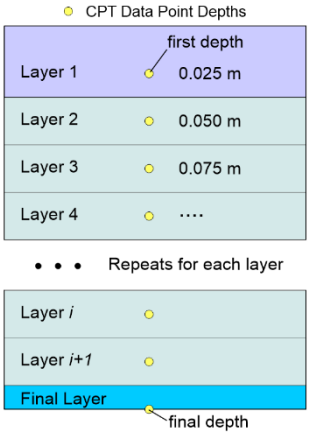
by a three or four character indicator of the output set selected (e.g. BSC, TBL, NLI, NL2, IFI, IFI2, IFI3) and possibly followed by an operator selected suffix identifying the characteristics of the particular calculation run.

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 *(where calculations are done at each point then Mid Layer Depth = Recorded Depth)*	*[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)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when calculations are done at each point*	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.	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when calculations are done at each point*	1
Avg fs	Averaged sleeve friction (f_s) No pore pressure corrections are applied to f_s.	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when calculations are done at each point*	CK*
Avg Rf	Averaged friction ratio (R_f) where friction ratio is defined as: $R_f = 100\% \cdot \frac{fs}{q_t}$	$AvgRf = 100\% \cdot \frac{Avgfs}{Avgqt}$ *not an average of individual R_f values*	CK*
Avg u	Averaged dynamic pore pressure *(u)*	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when calculations are done at each point*	CK*
Avg Res	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$AvgRes = \frac{1}{n}\sum_{i=1}^{n} Resistivity_i$ *n=1 when calculations are done at each point*	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)	$AvgUVIF = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when calculations are done at each point*	CK*
Avg Temp	Averaged Temperature (this data is not always available)	$AvgTemp = \frac{1}{n}\sum_{i=1}^{n} Temperature_i$ *n=1 when calculations are done at each point*	CK*
Avg Gamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$AvgGamma = \frac{1}{n}\sum_{i=1}^{n} Gamma_i$ *n=1 when calculations are done at each point*	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

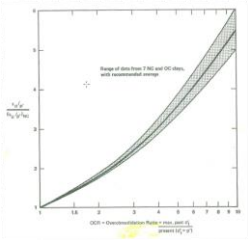
Calculated Parameter	Description	Equation	Ref
SBT-Bq	Non-normalized Soil Behavior type based on non-normalized tip resistance and the B_q parameter	See Figure 3a	1, 2, 5
SBT-Bqn	Normalized Soil Behavior type based on normalized tip resistance (Q_t, now called Q_{t1}) and the B_q parameter	See Figure 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.	Unit Weight of soil determined from one of the following user selectable options: 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 The last option may co-exist with any of the other options.	See references	3, 5, 15, 21, 24, 29, 33

Calculated Parameter	Description	Equation	Ref
TStress σ_v	Total vertical overburden stress at Mid Layer Depth *A layer is defined as the averaging interval specified by the user where depths are reported at their respective mid-layer depth.* 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. 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. For over-water work the total stress due to the column of water above the mid line is taken into account where appropriate.	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ *where* γ_i is layer unit weight h_i is layer thickness 	CK*
EStress σ_v'	Effective vertical overburden stress at mid-layer depth.	$\sigma_v' = \sigma_v - u_{eq}$	CK*
Equil u u_{eq} or u_0	Equilibrium pore pressures are determined from one of the following user selectable options: 1) hydrostatic below the water table 2) user supplied profile 3) combination of those above 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. 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.	For the hydrostatic option: $u_{eq} = \gamma_w \cdot (D - D_{wt})$ 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	CK*
K_0	Coefficient of earth pressure at rest, K_0.	$K_O = (1 - \sin\Phi') OCR^{\sin\Phi'}$	17
C_n	Overburden stress correction factor used for $(N_1)_{60}$ and older CPT parameters.	$C_n = (P_a/\sigma_v')^{0.5}$ where $0.0 < C_n < 2.0$ *(user adjustable, typically ranging from 1.7 to 2.0)* P_a *is atmospheric pressure (100 kPa)*	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.	$(N_1)_{60} = C_n \bullet N_{60}$	4
$N_{60}I_c$	SPT N_{60} values based on the I_c parameter, as defined by Robertson and Wride 1998 (3), or by Robertson 2009 (15).	$(q_t/P_a)/ N_{60} = 8.5 (1 – I_c/4.6)$ $(q_t/P_a)/ N_{60} = 10^{(1.1268 – 0.2817Ic)}$ P_a being atmospheric pressure	3, 5 15, 31
$(N_1)_{60}I_c$	SPT N_{60} value corrected for overburden pressure (using N_{60} I_c). User has 3 options.	*1) $(N_1)_{60}Ic = C_n \bullet (N_{60} I_c)$* 2) $q_{c1n}/ (N_1)_{60}I_c = 8.5 (1 – I_c/4.6)$ 3) $(Q_{tn})/ (N_1)_{60}I_c = 10^{(1.1268 – 0.2817Ic)}$	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.	$Su = \frac{qt - \sigma_v}{N_{kt}}$	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.	$Su = \frac{u_2 - u_{eq}}{N_{\Delta u}}$	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)	$= \frac{\Delta u}{qt}$ *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	$Bq = \frac{\Delta u}{qt - \sigma_v}$ 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)	$qt - \sigma_v$	36
q_e or qE 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	$\frac{qt - u_2}{\sigma_v'}$	36
Q_t or Norm: Qt 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.	$Qt = \frac{qt - \sigma_v}{\sigma_v'}$	2, 5, 15
F_r or Norm: Fr	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson (1990)	$Fr = 100\% \cdot \frac{fs}{qt - \sigma_v}$	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 I_c parameter. Later papers added the +1 term to the equation.	$Q \cdot (1 - Bq)$ $Q \cdot (1 - Bq) + 1$ *where Bq 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)	$q_{c1} = q_t \cdot (Pa/\sigma_v')^{0.5}$ 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)	$q_{c1}(0.5) = (q_t/P_a) \cdot (Pa/\sigma_v')^{0.5}$ where: P_a = atmospheric pressure	5
q_{c1} (C_n)	Normalized tip resistance, q_{c1}, based on C_n (this method has stress units)	$q_{c1}(Cn) = C_n * q_t$	5, 12
q_{c1} (C_q)	Normalized tip resistance, q_{c1}, based on C_q (this method has stress units)	$q_{c1}(Cq) = C_q * q_t$ (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
I_c or Ic (RW1998)	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. Ic(RW1998) is different from that of Jefferies and Davies (7) and is different from Ic(PKR2009).	$I_c = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ *Where:* $Q = \left(\frac{qt - \sigma_v}{P_a}\right)\left(\frac{P_a}{\sigma_v'}\right)^n$ *Or* $Q = q_{c1n} = \left(\frac{qt}{P_a}\right)\left(\frac{P_a}{\sigma_v'}\right)^n$ *depending on the iteration in determining I_c* *And Fr is in percent* *P_a = atmospheric pressure* *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* *Note that NCEER replaced 0.75 with 0.70*	3, 4, 5 10
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 (PKR 2009) =* *$[(3.47 - \log_{10}Q_{tn})^2 + (1.22 + \log_{10}F_r)^2]^{0.5}$*	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 (PKR 2009) = 0.381 (I_c) + 0.05 (σ_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).	*$Q_{tn} = [(qt - \sigma_v)/P_a](P_a/\sigma_v')^n$* *where P_a = atmospheric pressure (100 kPa)* *n = stress ratio exponent described above*	15
FC	Apparent fines content (%)	*FC=1.75($Ic^{3.25}$) - 3.7* *FC=100 for $I_c > 3.5$* *FC=0 for $I_c < 1.26$* *FC = 5% if $1.64 < I_c < 2.6$ AND $F_r<0.5$*	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)	$I_c < 1.31$ 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	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.	$CD = 70 = (Q_{tn} - 11)(1 + 0.06F_r)^{17}$ lower bound of CD = 60: $CD = 60 = (Q_{tn} - 9.5)(1 + 0.06F_r)^{17}$	30

Calculated Parameter	Description	Equation	Ref
I_B	Hyberbolic 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) 1st order approximation using q_tNet (clays) 3) 1st order approximation using Δu_2 (clays) 4) 1st order approximation using q_e (clays) 5) Based on Vs	All stresses in kPa 1) $\sigma_p' = 0.33 \cdot (q_t - \sigma_v)^{m'} (\sigma_{atm}/100)^{1-m'}$ 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) $\sigma_p' = (Vs/4.59)^{1.47}$	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 plot of S_u/σ_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 Qt	1) requires a user defined value for NC Su/P_c' ratio 2 through 5) *based on yield stresses* 6) YSR (Vs) = $\sigma_p'(Vs) / \sigma_v'$ 7) OCR = $0.25 \cdot (Qt)^{1.25}$	9 19 20 20 20 18 32
Es/qt	Intermediate parameter for calculating Young's Modulus, E, in sands. It is the Y axis of the reference chart. Note that Figured 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
	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. Figure 5.59 from LRP shows a dimensionless form of the equation, q_{c1}, displaying the same range of values. Figure 5.59's X axis uses $q_{c1} = \left(\frac{q_c}{P_a}\right)\left(\frac{P_a}{\sigma_v'}\right)^{0.5}$ 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. 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.		
Es or E_s Young's Modulus E	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: a) OC Sands b) Aged NC Sands c) Recent NC Sands 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%.	Mean normal stress is evaluated from: $\sigma_m' = \frac{1}{3}(\sigma_v' + \sigma_h' + \sigma_h')$ where σ_v'= vertical effective stress σ_h'= horizontal effective stress *and* $\sigma_h = K_o \cdot \sigma_v'$ with K_o assumed to be 0.5	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	= *Su* (N_{kt}) / σ_v'	9, 23
Vs or V_s	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 V_p	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

Calculated Parameter	Description	Equation	Ref
V_{s30} V_{s100}	The average shear wave velocity of the near surface materials to a depth of 30 m (100 ft). It is based on the sum of all travel times through all layers in the top 30m (100 ft). V_{s100} is the same calculation as V_{s30} except down to a depth of 100 feet.	$V_{s30} = \frac{total\ thickness\ of\ all\ layers\ to\ 30\ m}{\Sigma\left(\frac{layer\ thickness}{layer\ shear\ wave\ velocity}\right)}$ $V_{s30} = \frac{total\ thickness\ of\ all\ layers\ to\ 30\ m}{\Sigma\ (layer\ travel\ times)}$	38
G_{max}	G_{max} determined from SCPT shear wave velocities (not estimated values). Note that seismic data (V_s) is collected over set depth intervals (typically 1 meter). Each data point over the test segment is assigned the same V_s value. Since soil density changes with depth, slightly different G_{max} values may be calculated over the test depth interval.	$G_{max} = \rho V_s^2$ where ρ is the mass density of the soil determined from the estimated unit weights at each test depth	27
qtNet/G_{max}	Net tip resistance ratio with respect to the small strain modulus G_{max} determined from SCPT shear wave velocities (not estimated values)	$= (qt - \sigma_v) / G_{max}$ where $G_{max} = \rho V_s^2$ and ρ is the mass density of the soil determined from the estimated unit weights at each test depth	15, 28, 30
qUlt	A site specific and client specific parameter for estimating the limiting stress for "crane walk" accessibility	$q_{ult} = CraneWalkFactor \cdot S_u$ Where: *CraneWalkFactor* is client provided	U*
Estimated G_o	Estimated value for small strain shear modulus	$G_o = 0.0188[10^{(0.55Ic + 1,68)}](q_t - \sigma_v)$	15
Estimated E_{25}	Estimated value for Young's Modulus, E, at a 25% working load	$E_{25} = \alpha_E$ (qtNet) where $\alpha_E = 0.015[10^{(0.55Ic + 1,68)}]$	15
k_{SBT}	Estimated soil permeability derived from Soil Behavior Type (SBT) Chart I_c values.	For $1.0 < I_c \leq 3.27$: $k = 10^{(0.952 - 3.04Ic)}$ in m/s For $3.27 < Ic < 4.0$: $k = 10^{(-4.52 - 1.37Ic)}$ in m/s	35
M or D' Constrained Modulus	Constrained Modulus based on 1) Robertson, M 2) Mayne, D'	1) Robertson $M = \alpha_M (q_t - \sigma_v)$ $I_c > 2.2$ (fine grained) $\alpha_M = Qt$ when $Qt < 14$ $\alpha_M = 14$ when $Qt > 14$ $Ic < 2.2$ (coarse grained) $\alpha_M = 0.0188\ [10^{(0.55Ic + 1.68)}]$ $D' = \alpha_D (qt - \sigma_v)$ where $\alpha_D = 5$	32 23

Table 1b. CPT Parameter Calculation Methods – Liquefaction Parameters

Calculated Parameter	Description	Equation	Ref
K_{SPT} or K_s	Equivalent clean sand factor for $(N_1)60$	$K_{SPT} = 1 + ((0.75/30) \bullet (FC - 5))$	10
K_{CPT} or K_c (RW1998)	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $I_c \leq 1.64$ $K_{cpt} = f(I_c)$ for $I_c > 1.64$ (see reference) $K_c = -0.403\ I_c^4 + 5.581\ I_c^3 - 21.63 I_c^2 + 33.75\ I_c - 17.88$	3, 10
K_c (PKR 2010)	Clean sand equivalent factor to be applied to Q_{tn}	$K_c = 1.0$ for $I_c \leq 1.64$ $K_c = -0.403\ I_c^4 + 5.581\ I_c^3 - 21.63 I_c^2 + 33.75\ I_c - 17.88$ for $I_c > 1.64$	16
$(N_1)_{60cs}I_C$	Clean sand equivalent SPT $(N_1)_{60}I_c$. User has 3 options.	1) $(N_1)_{60cs}Ic = \alpha + \beta((N_1)_{60}I_c)$ 2) $(N_1)_{60cs}Ic = K_{SPT} * ((N_1)_{60}I_c)$ 3) $(q_{c1ncs})/(N_1)_{60cs}I_c = 8.5\ (1 - I_c/4.6)$ FC ≤ 5%: $\alpha = 0,\ \beta = 1.0$ FC ≥ 35% $\alpha = 5.0,\ \beta = 1.2$ 5% < FC < 35% $\alpha = exp[1.76 - (190/FC^2)]$ $\beta = [0.99 + (FC^{1.5}/1000)]$	10 10 5
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \bullet K_{cpt}$	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
Su(Liq)/ESv 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
Su(Liq)/ESv 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
Kg 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 Ψ = -0.05 curve	25
URS NP Fr	Normalized friction ratio point on Ψ = -0.05 curve used in SP distance calculation		25
URS NP Q_{tn}	Normalized tip resistance (Q_{tn}) point on Ψ = -0.05 curve used in SP Distance calculation		25

Table 2. References

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39	Campanella, R.G., Robertson, P.K., Gillespie, D., 1982, "Cone penetration testing in deltaic soils", Canadian Geotechnical Journal, 20: 23-35.

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 (Su) 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:

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

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 cm^2 / 100 cm^2 or 1/10.

Table 1
BCPTu Parameter Calculation Methods

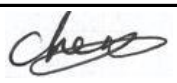
Interpreted Parameter	Description	Equation	Ref
q_{btnet}	Net ball tip resistance	$q_{btnet}=q_{bt}-\left[\sigma_{vo}\times\frac{A_s}{A_p}\right]$	
γ	Soil unit weight	• User defined • From pore pressure dissipation data in fluid behaving materials • Lab data • Uniform unit weight (from client, or based on historical data) • From an adjacent CPTu test	
Su	Undrained shear strength	$Su=\frac{q_{btnet}}{N_{ball}}$	

Calibration Records

CONETEC

Adara Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

CERTIFICATE OF CALIBRATION

Calibration Information			
Cone Serial Number	EC681	Model	A15 T375 F10 U35
Date	2023-10-27		
Technician Performing Calibration	Richard Chen	Signature	
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 cm²
Friction Stress Limit	10	bar	Friction Surface Area	225 cm²
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

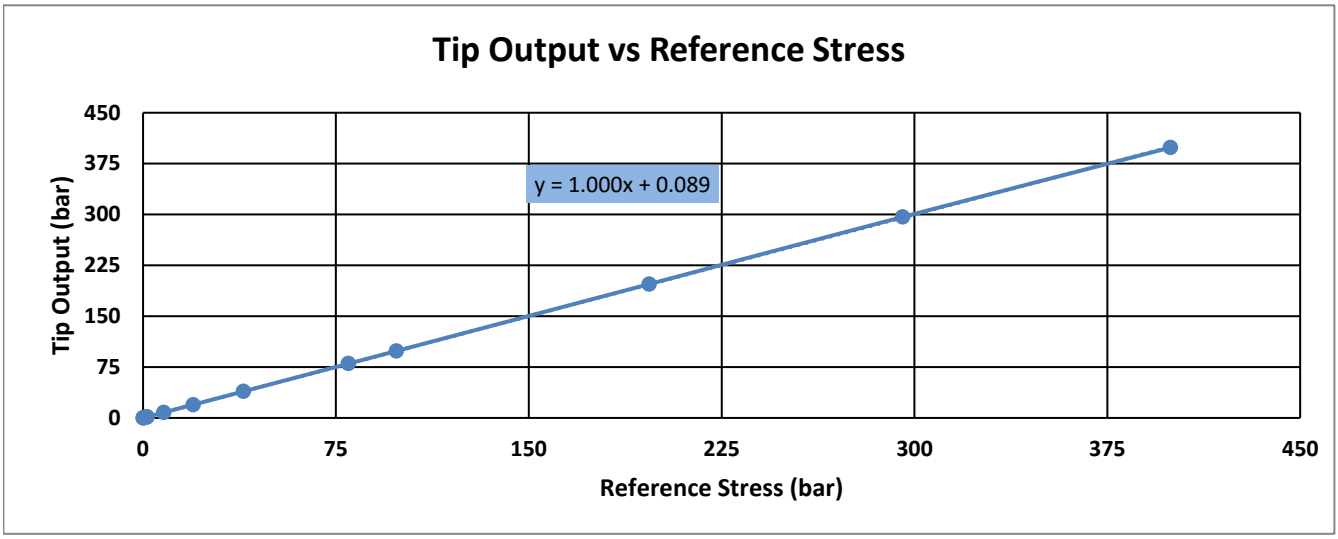
Calibrated in general accordance with the ASTM D5778-20 and D7400-08 standards

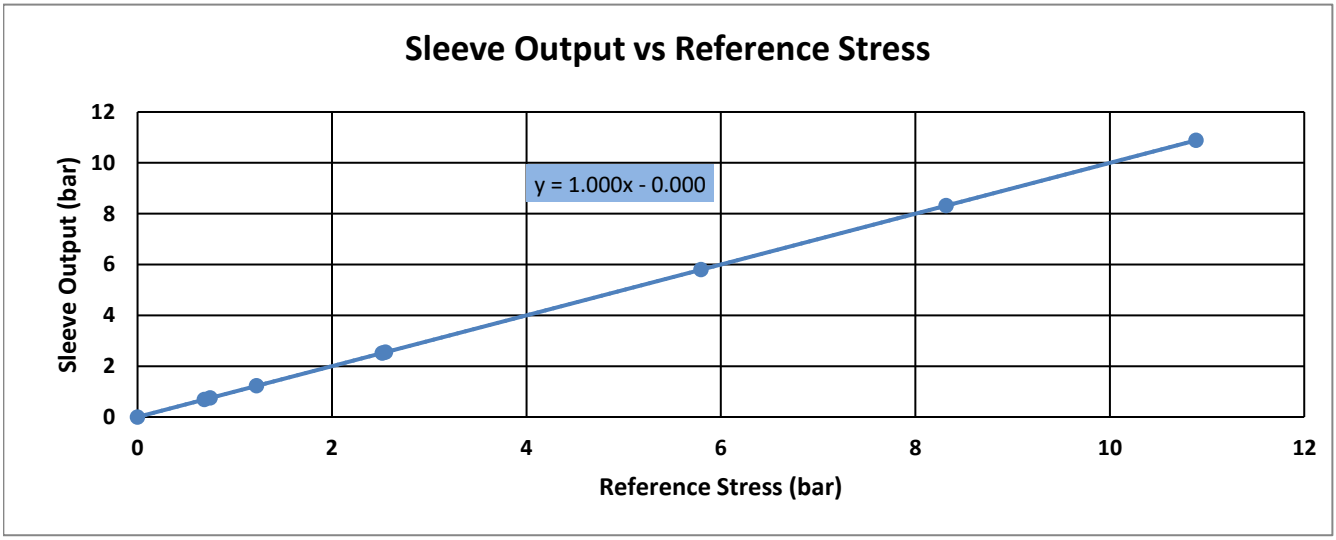
Calibrated with Adara calibration procedure EC_CPTCAL-2.1

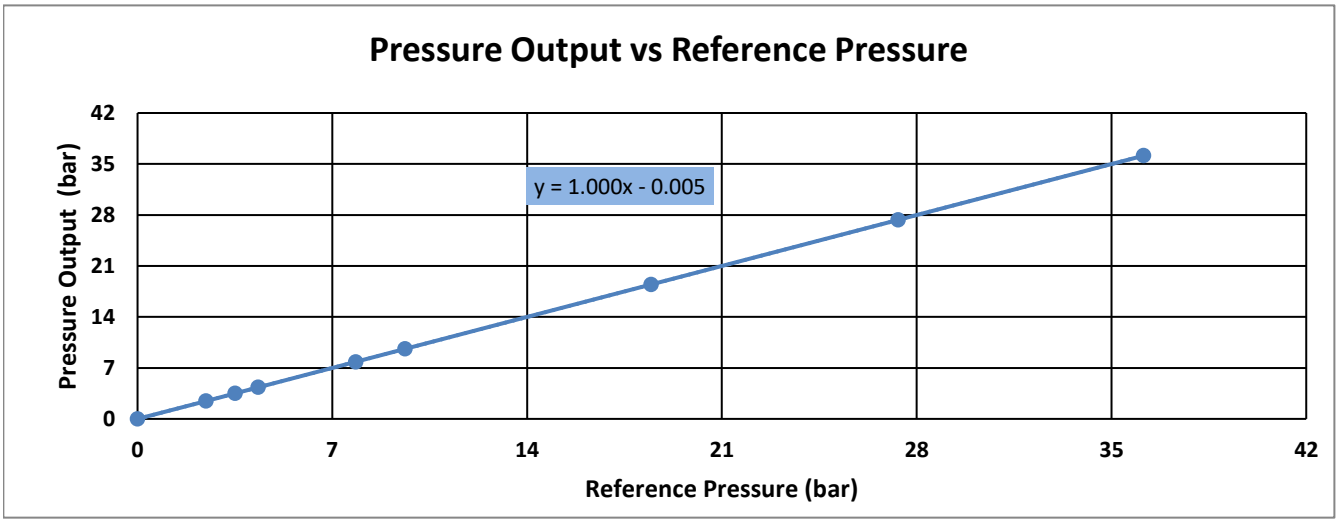
Collective uncertainty of the measurement standards conforms to a test uncertainty ratio (TUR) of 3:1 for tip and sleeve measurement and 4:1 for pressure measurement with a confidence level k=2

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Cone Output vs Reference Stress/Pressure Plots







Adara Systems Ltd.
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Tel: 1-604-273-6013

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

Adara Systems Ltd.
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Tel: 1-604-273-6013

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 Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

Adara Error Definitions

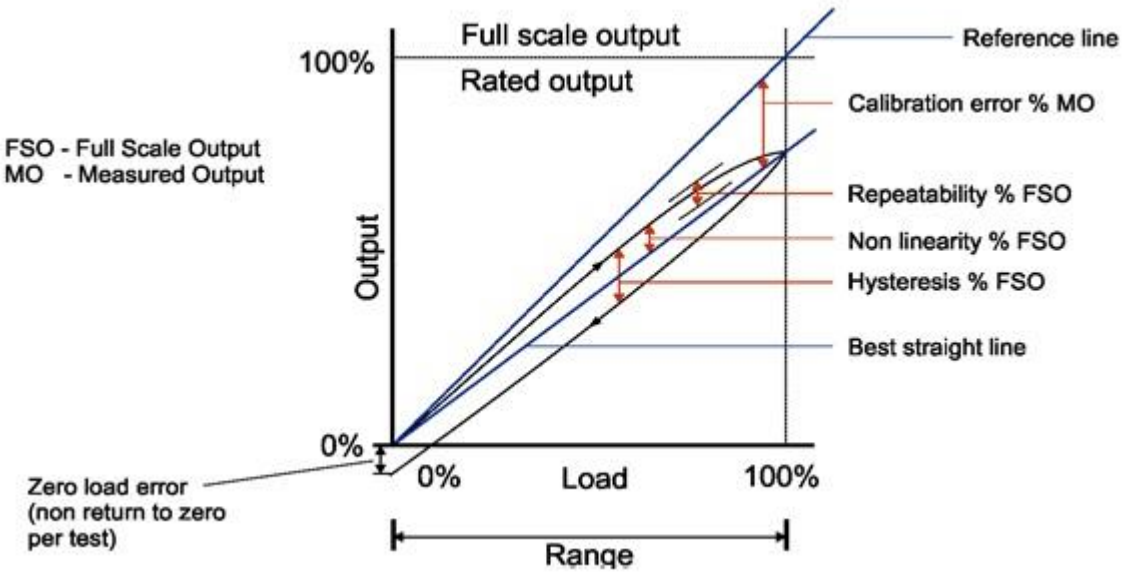


Figure 1: Definition of Calibration Terms for Load Cell and Transducers (Adapted from [1])

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

Adara Systems Ltd.
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Tel: 1-604-273-6013

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.

Adara Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

CERTIFICATE OF CALIBRATION

Calibration Information			
Cone Serial Number	EC767	Model	A10 T1000 F10 U35
Date	2024-02-13		
Technician Performing Calibration	Richard Chen	Signature	
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 cm²
Friction Stress Limit	10	bar	Friction Surface Area	150 cm²
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

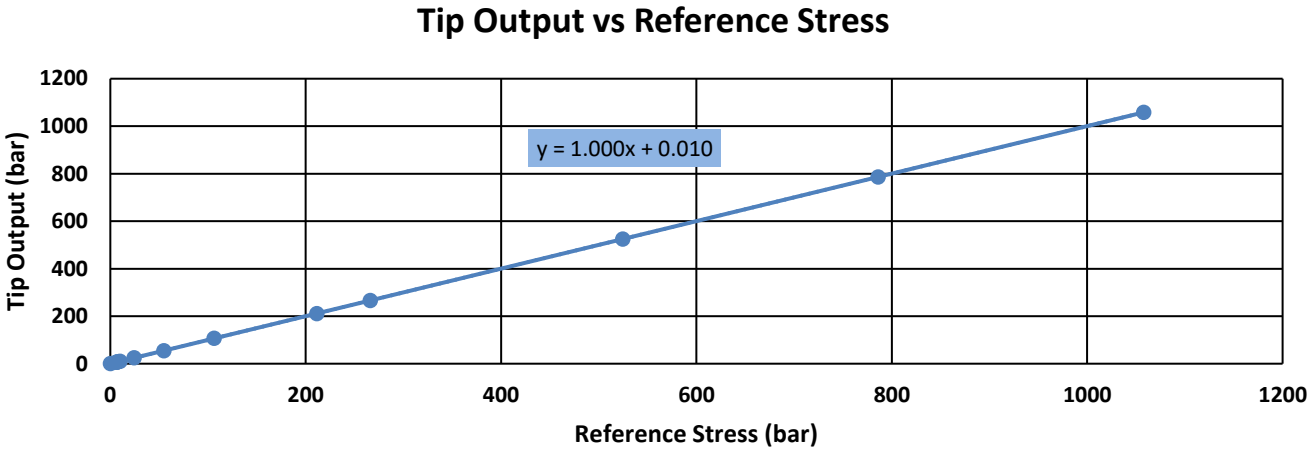
Calibrated in general accordance with the ASTM D5778-20 and D7400-08 standards

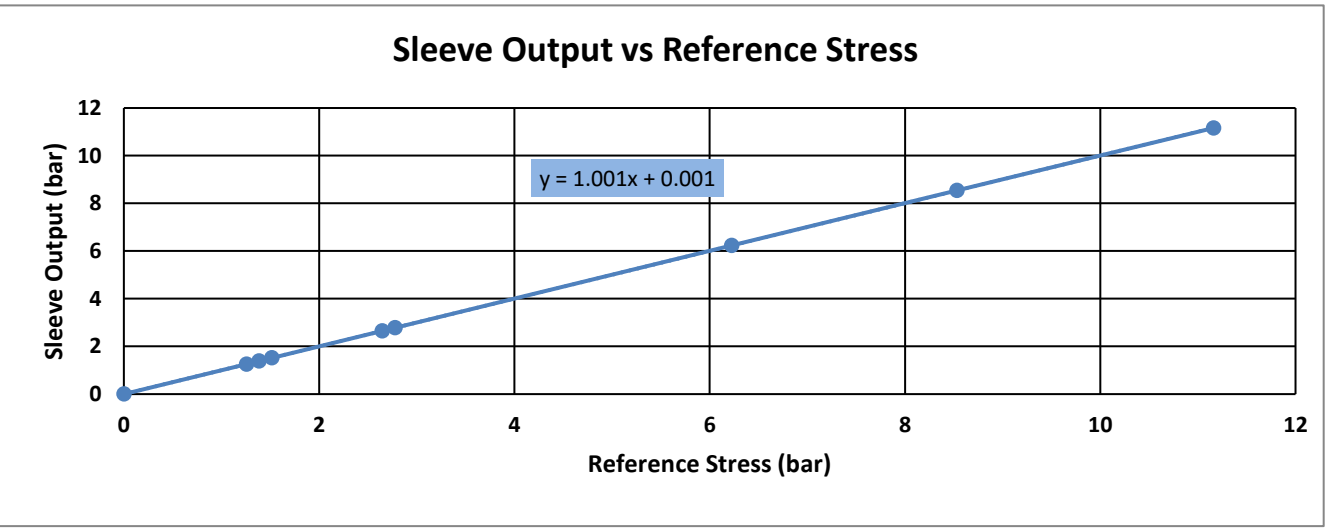
Calibrated with Adara calibration procedure EC_CPTCAL-2.2

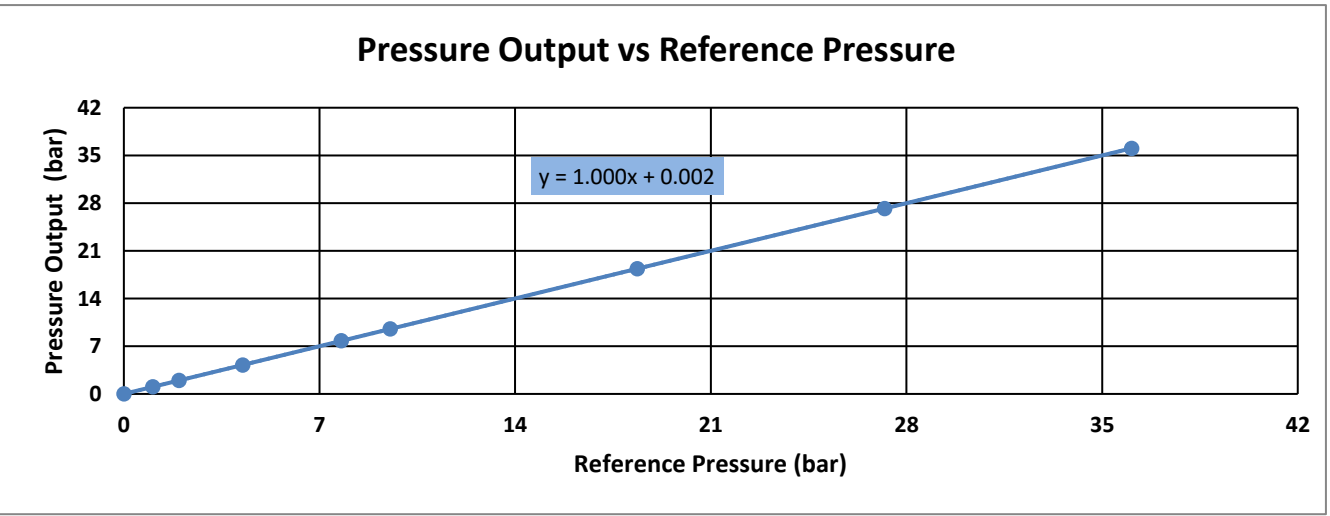
Collective uncertainty of the measurement standards conforms to a test uncertainty ratio (TUR) of 3:1 for tip and sleeve measurement and 4:1 for pressure measurement with a confidence level k=2

Adara Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
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Cone Output vs Reference Stress/Pressure Plots







Adara Systems Ltd.
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Tel: 1-604-273-6013

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

Adara Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

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 Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

Adara Error Definitions

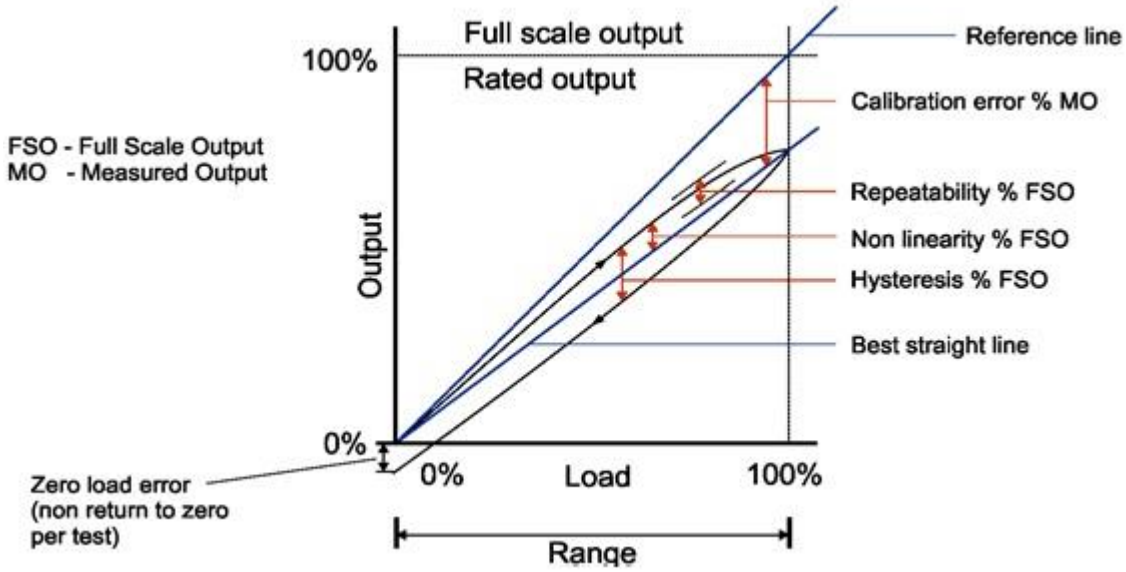


Figure 1: Definition of Calibration Terms for Load Cell and Transducers (Adapted from [1])

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

Adara Systems Ltd.
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Tel: 1-604-273-6013

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

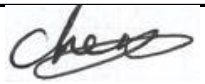
[1] ASTM D5778-20. "Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils". ASTM, West Conshohocken, PA, USA.

[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.

Adara Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

CERTIFICATE OF CALIBRATION

Calibration Information			
Cone Serial Number	EC1007	Model	A15 T1500 F15 U35
Date	2023-11-24		
Technician Performing Calibration	Richard Chen	Signature	
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 cm²
Friction Stress Limit	15	bar	Friction Surface Area	225 cm²
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

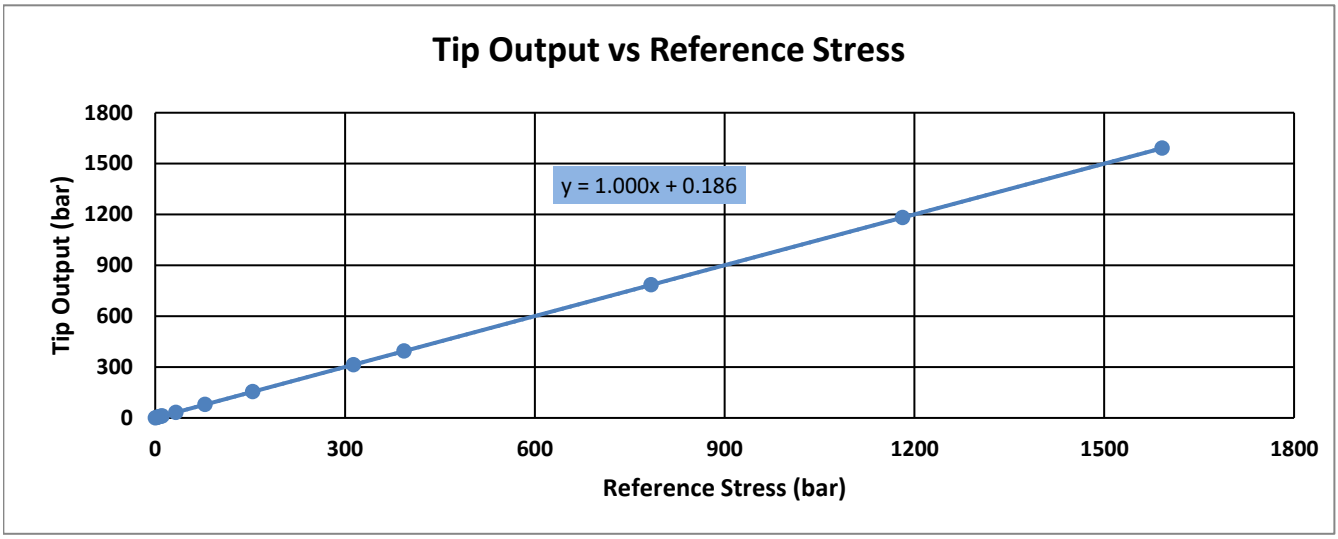
Calibrated in general accordance with the ASTM D5778-20 and D7400-08 standards

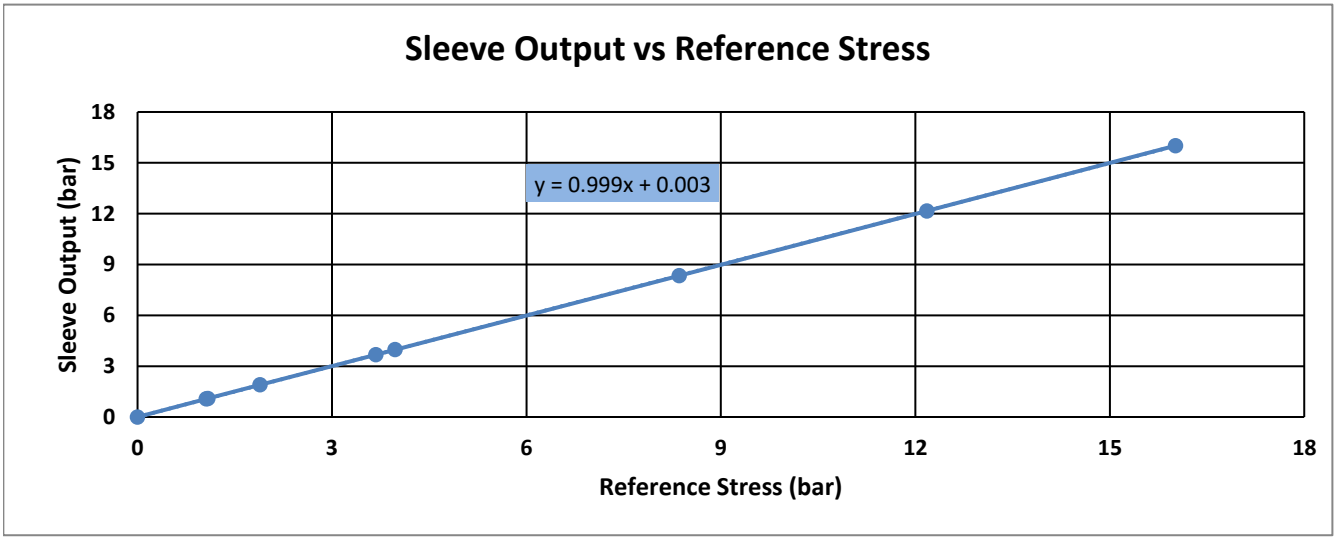
Calibrated with Adara calibration procedure EC_CPTCAL-2.1

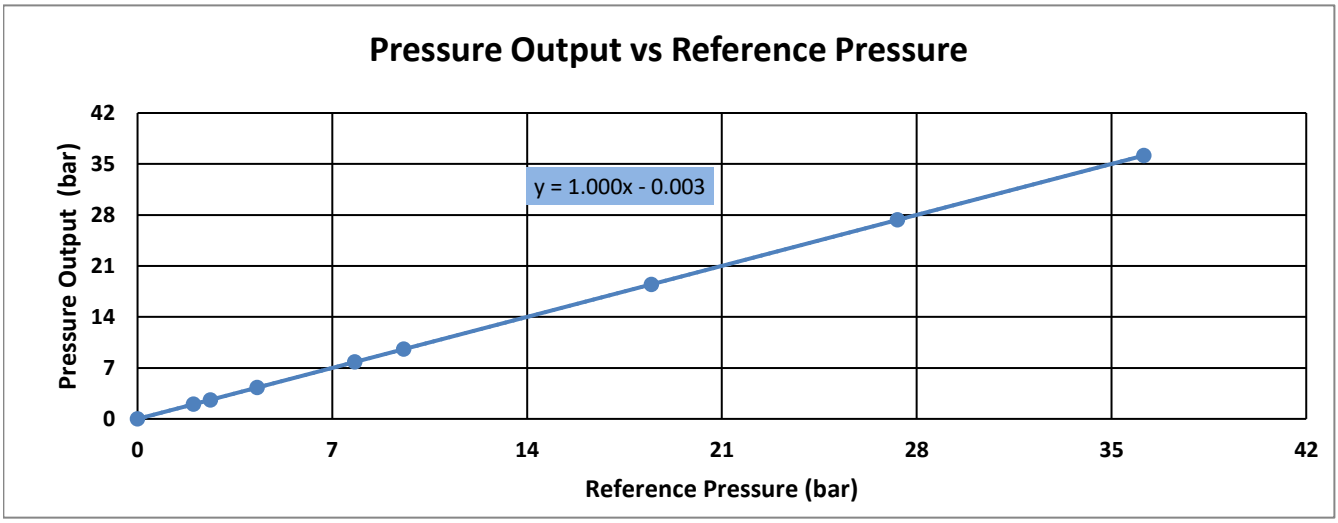
Collective uncertainty of the measurement standards conforms to a test uncertainty ratio (TUR) of 3:1 for tip and sleeve measurement and 4:1 for pressure measurement with a confidence level k=2

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Cone Output vs Reference Stress/Pressure Plots







Adara Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

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

Adara Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

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 Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

Adara Error Definitions

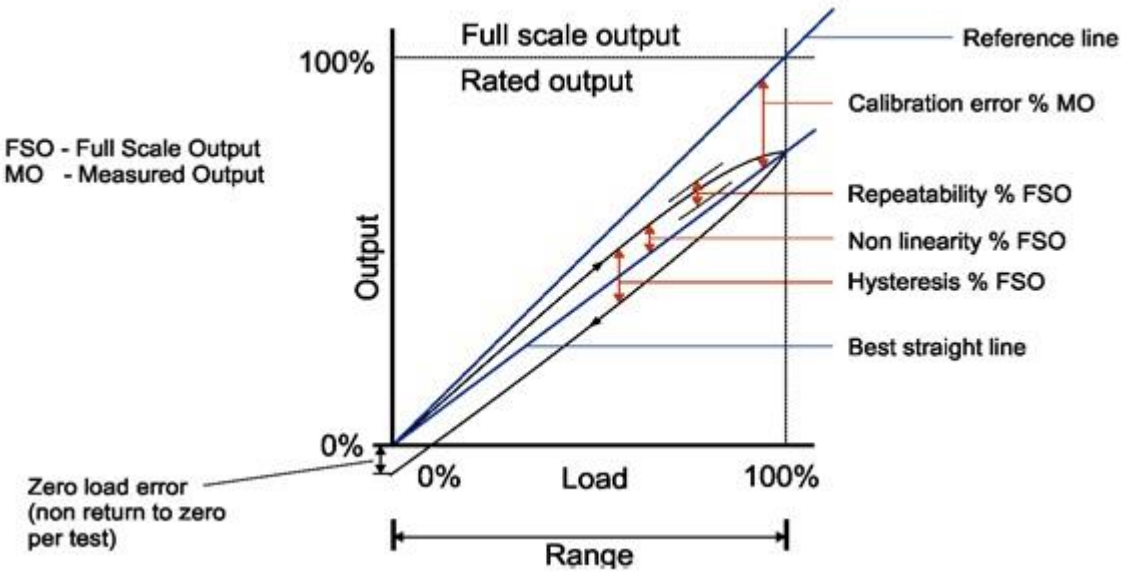


Figure 1: Definition of Calibration Terms for Load Cell and Transducers (Adapted from [1])

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

Adara Systems Ltd.
201-8327 Eastlake Drive, Burnaby, BC, Canada V5A4W2
Tel: 1-604-273-6013

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.

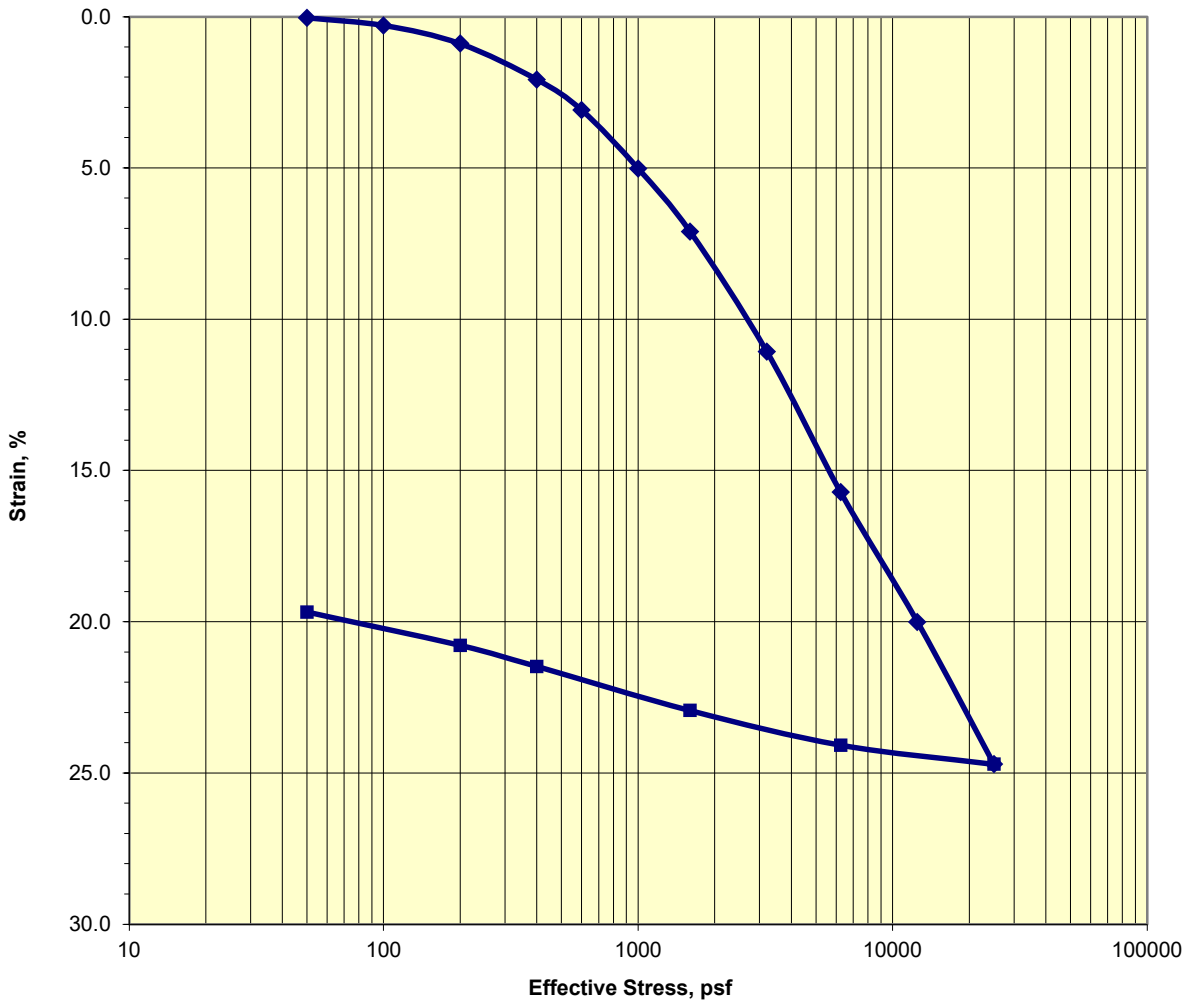
Appendix F – Geotechnical Design Analysis

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

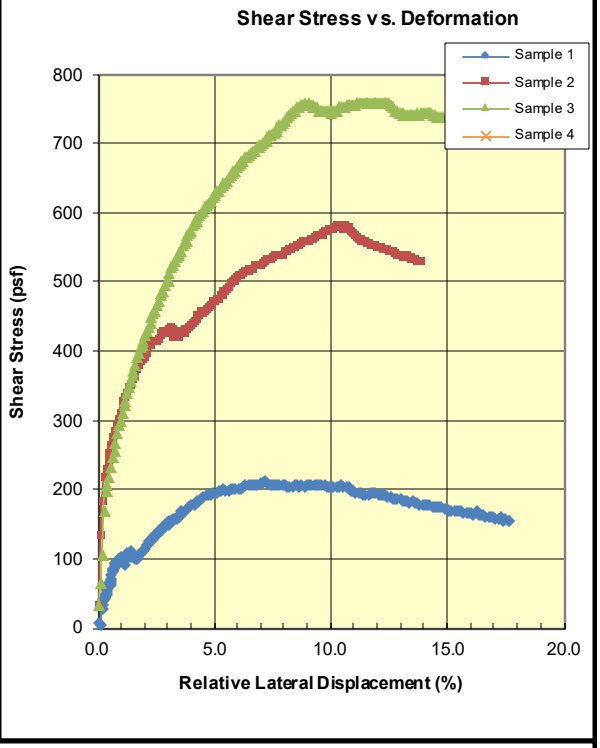
Remarks:

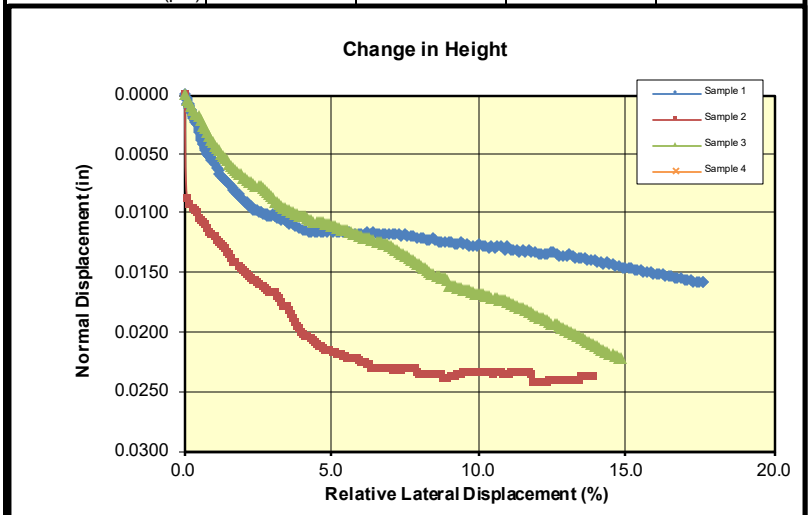
Consolidated Drained Direct Shear (ASTM D3080)

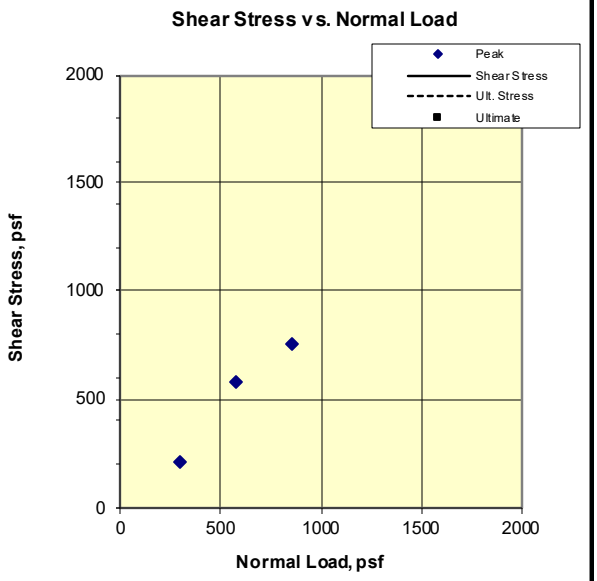
CTL Job #:	1007-006	Project #:	210075-01-03	By:	MD
Client:	Anchor QEA	Date:	2/13/2025	Checked:	PJ
Project Name:	Middle Reach of the Lower Dwamish Waterway	Remolding Info:			

Specimen Data				
	1	2	3	4
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	
ΔHeight 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	
ΔHeight (in) at Peak	0.0118	0.0233	0.0156	
Ultimate Stress (psf)				

Phi (deg)		Ult. Phi (deg)	
Cohesion (psf)		Ult. Cohesion (psf)	







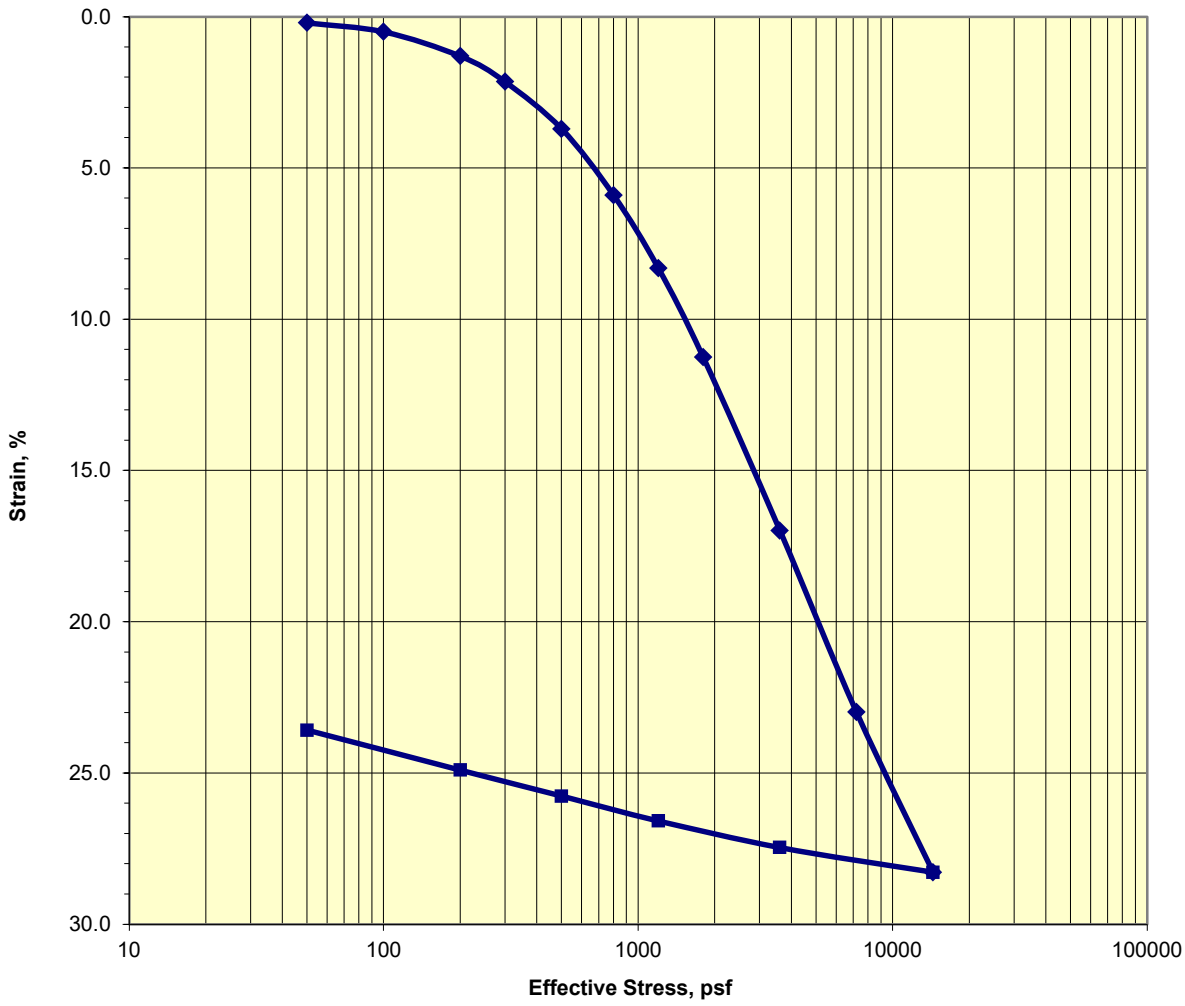
Remarks: Engineering judgement is required to determine phi and cohesion, no phi or cohesion is reported. To add phi and cohesion to the report go to the “phi” tab and in cells G30, G31, H30, and H31 enter end points for a line through the 3 data points. The points plotted can be changed on the "Eng 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

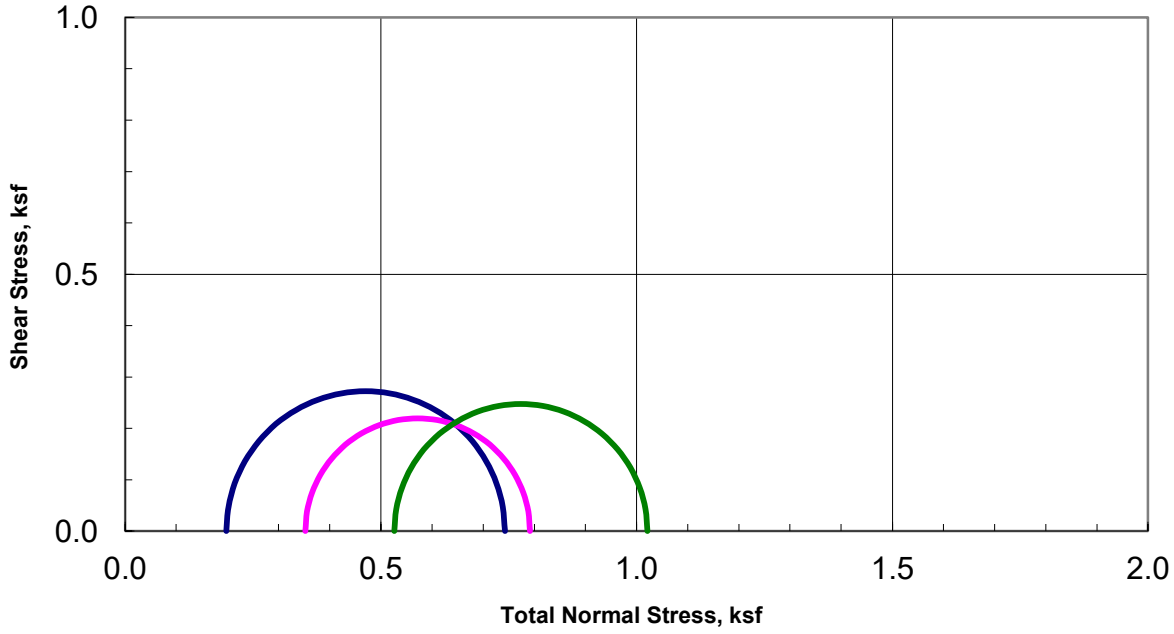


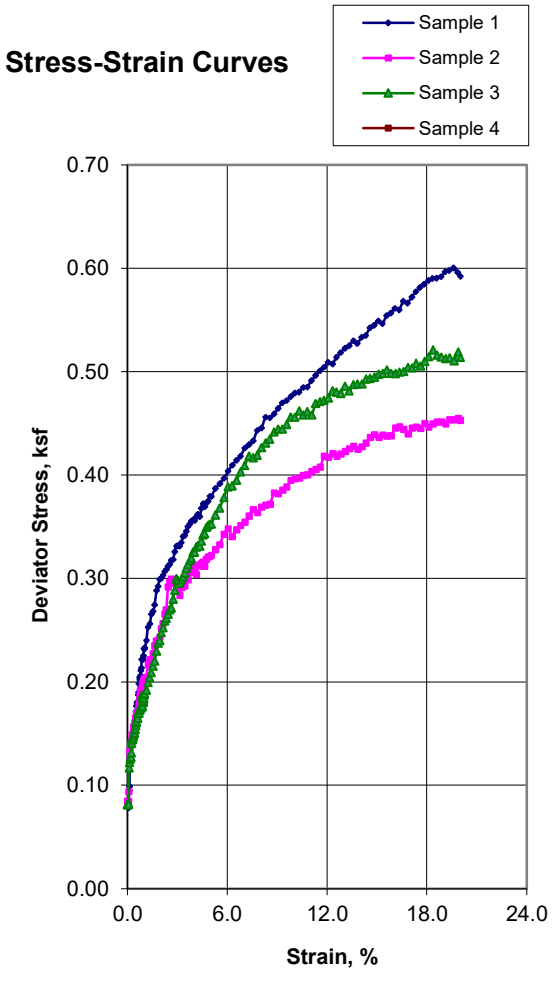
Assumed Gs 2.75	Initial	Final
Moisture %:	62.5	42.4
Dry Density, pcf:	60.5	79.3
Void Ratio:	1.839	1.166
% Saturation:	93.5	100.0

Remarks:

Cooper Testing Labs, Inc.
937 Commercial Street
Palo Alto, CA 94303

Unconsolidated-Undrained Triaxial Test
ASTM D2850





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 #	
1	Black CLAY w/ organics
2	Black CLAY
3	Black CLAY w/ organics
4	

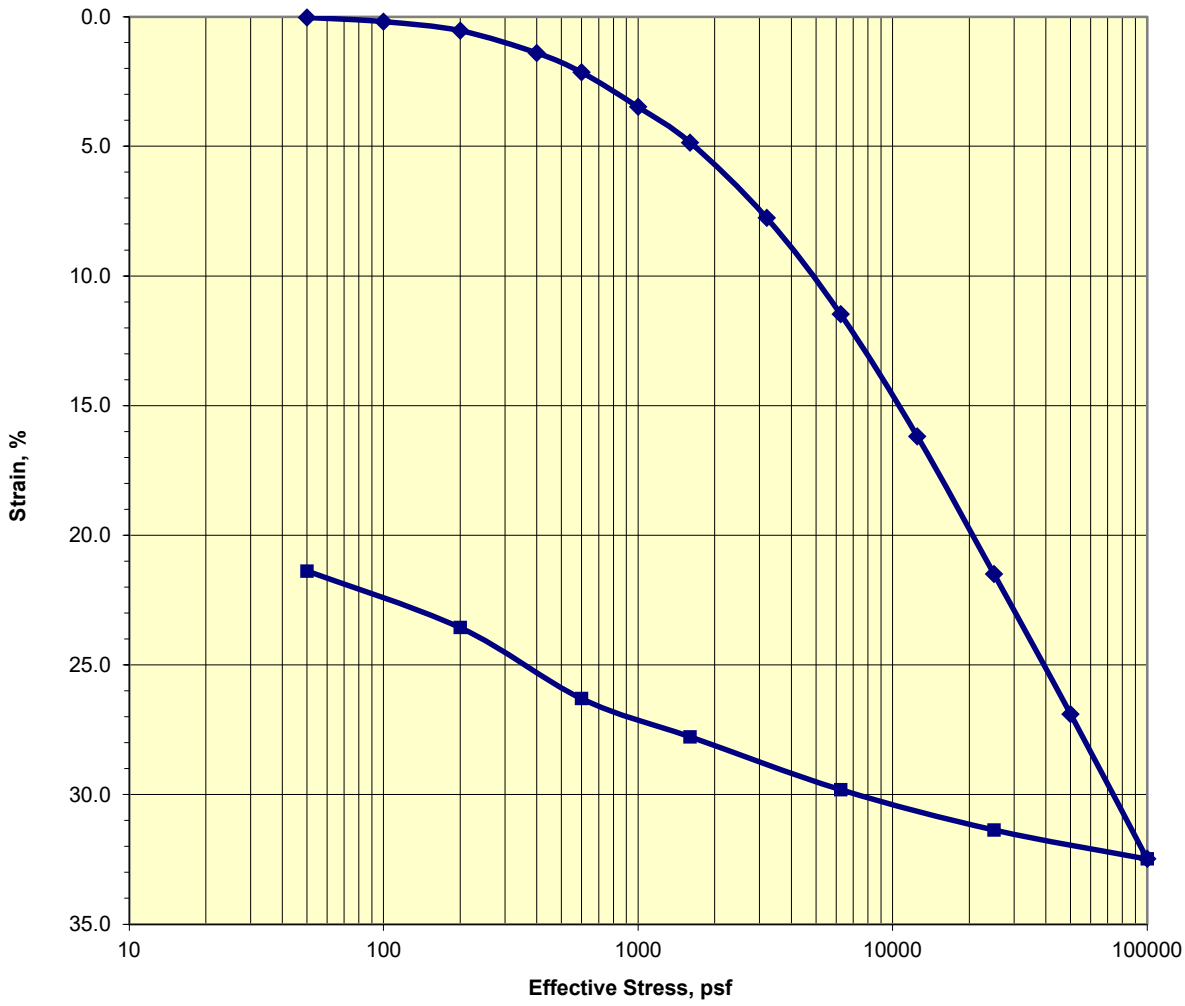
Remarks:

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

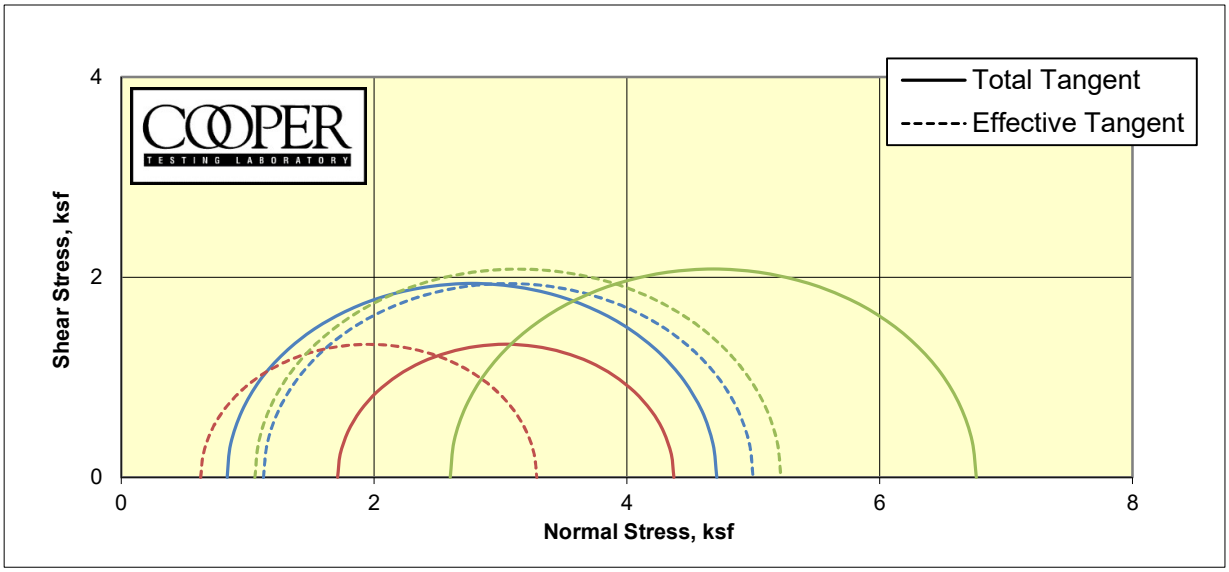
Strain-Log-P Curve

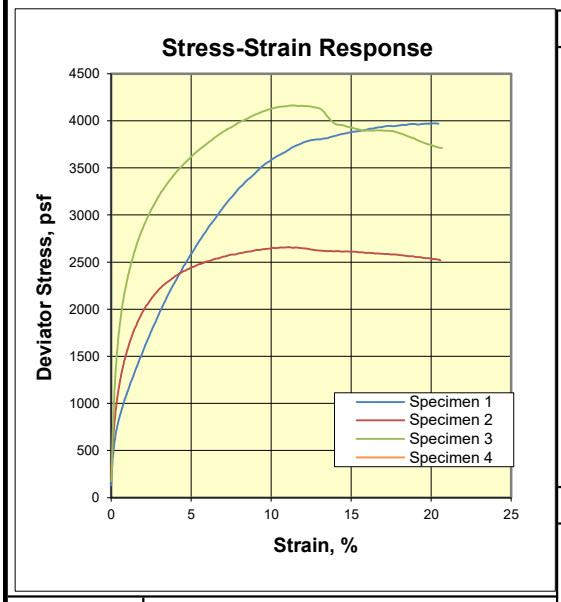


Assumed Gs 2.65	Initial	Final
Moisture %:	56.6	38.7
Dry Density, pcf:	64.2	81.7
Void Ratio:	1.578	1.026
% Saturation:	95.1	100.0

Remarks:

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767





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 ©

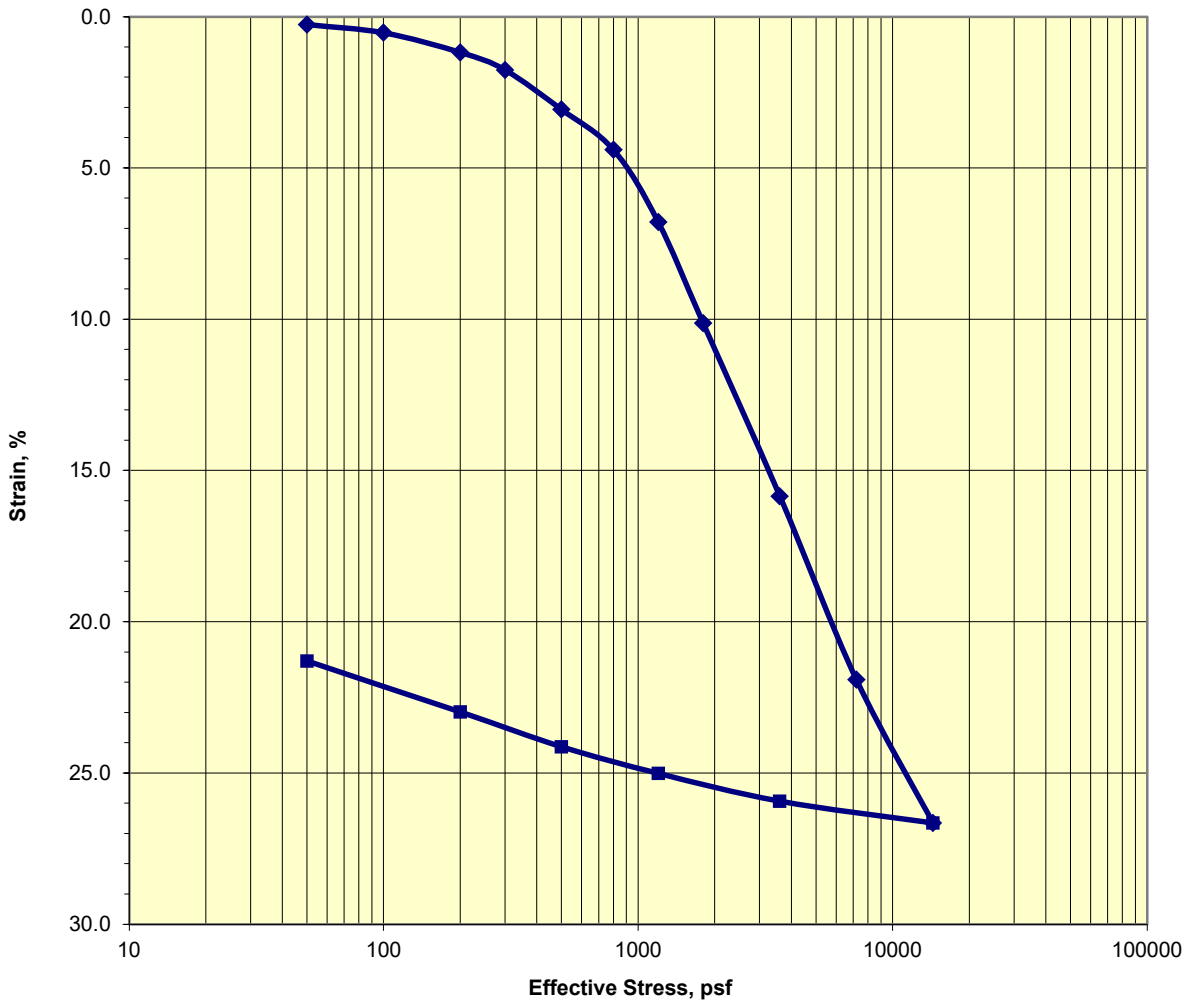
Remarks: The significangt differences in dry density and moisture content between the points may impact the results. Engineering judgement is required to determine phi and cohesion, no phi or cohesion is reported. To add phi and cohesion to the report go to the “Report” tab and in cells M18 through P19 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.

Specimen	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	

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

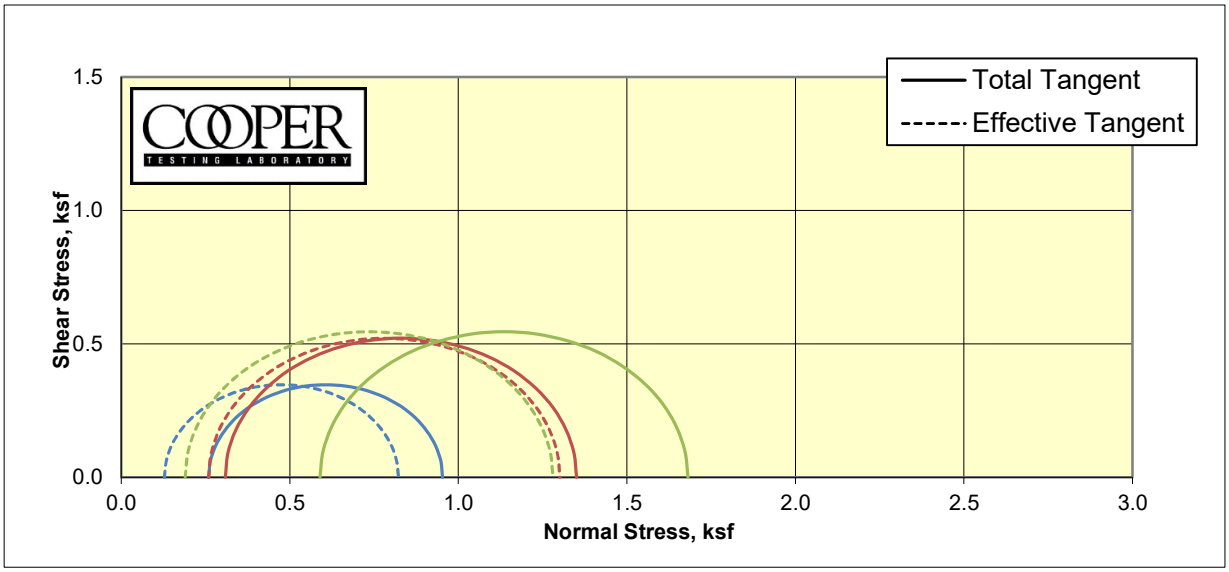
Strain-Log-P Curve

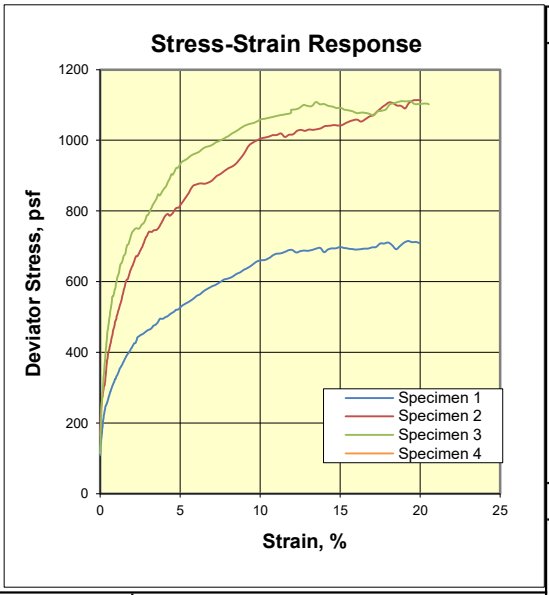


Assumed Gs 2.7	Initial	Final
Moisture %:	62.7	43.4
Dry Density, pcf:	60.8	77.6
Void Ratio:	1.771	1.173
% Saturation:	95.5	100.0

Remarks:

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



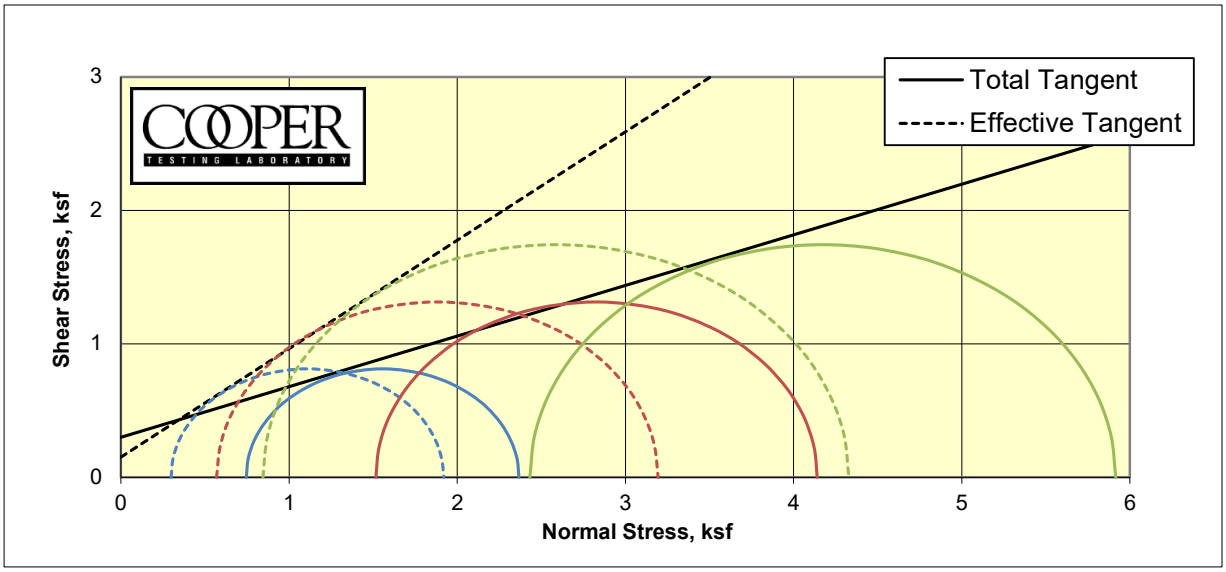


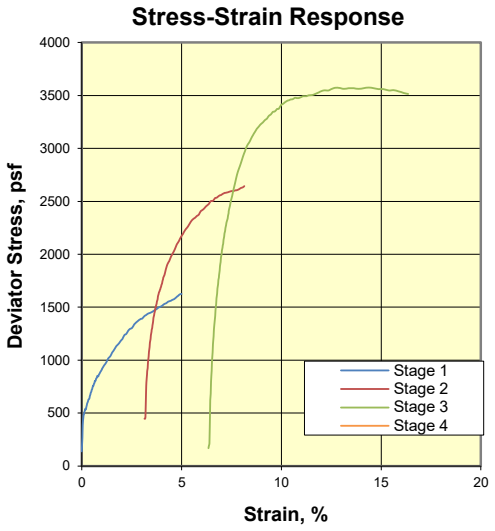
CTL Number:	1007-006
Client Name:	Anchor QEA
Project Name:	Middle Ranch of the Lower Duwamish Waterway
Project Number:	210075-01.03
Date:	12/3/2024 By: MD/DC
Total C	ksf
Total phi	degrees
Eff. C	ksf
Eff. Phi	degrees ©

Remarks: The significangt 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.

Specimen	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	

Staged Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767m





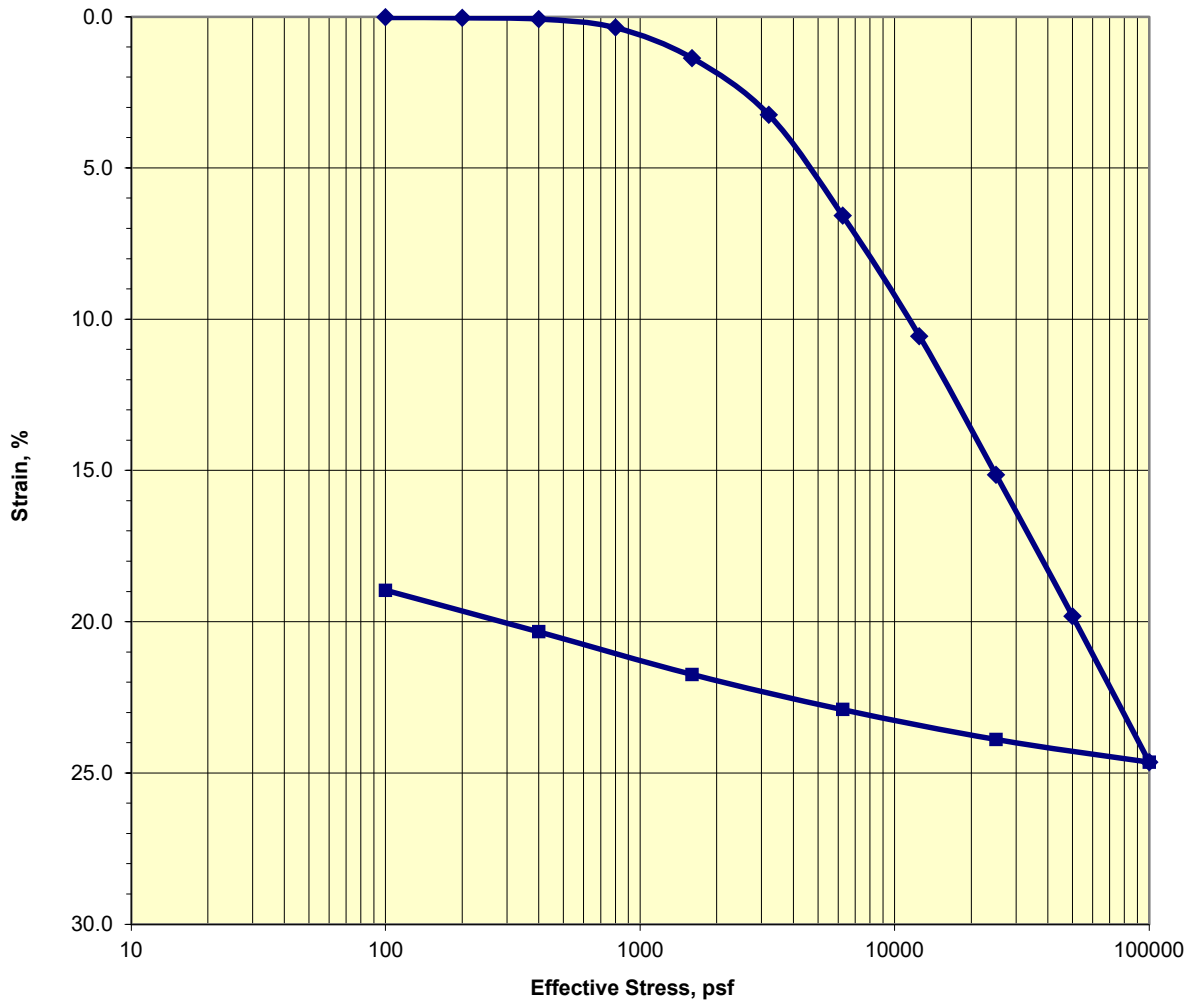
CTL Number:	1007-006
Client Name:	Anchor QEA
Project Name:	Middle Reach of the Lower Dwamish Waterway
Project Number:	210075-01-03
Date:	2/13/2025 By: MD/DC
Total C	0.300 ksf
Total phi	20.8 degrees
Eff. C	0.150 ksf
Eff. Phi	39.1 degrees ©

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

Strain-Log-P Curve



Assumed Gs 2.6	Initial	Final
Moisture %:	47.9	32.0
Dry Density, pcf:	69.9	88.6
Void Ratio:	1.322	0.831
% Saturation:	94.1	100.0

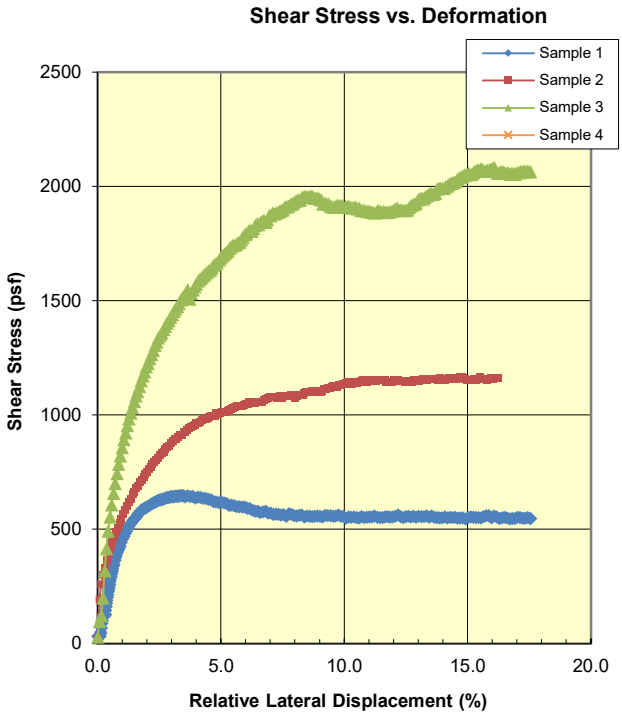
Remarks:

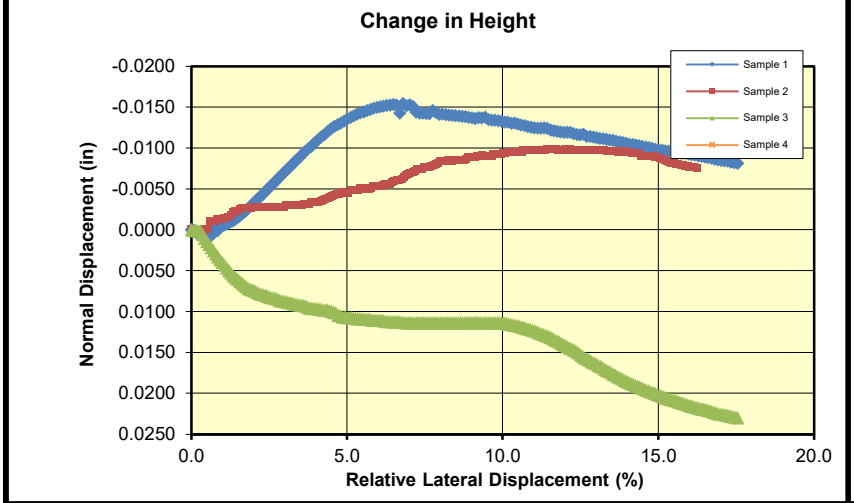
Consolidated Drained Direct Shear (ASTM D3080)

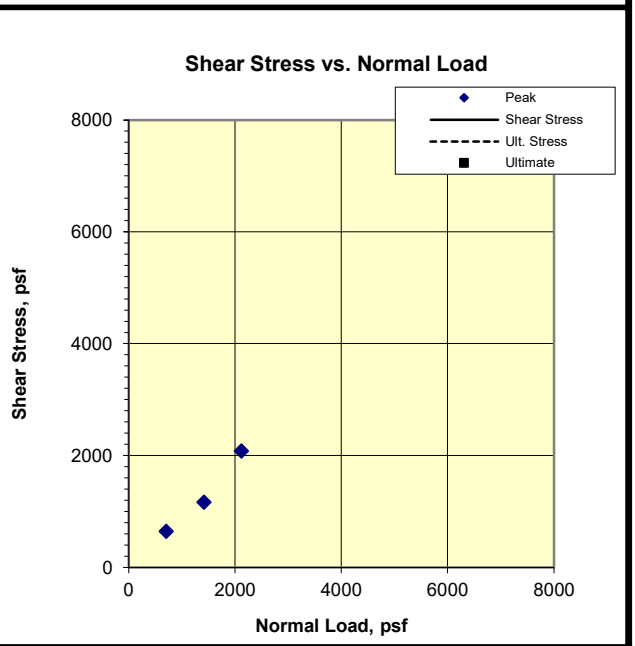
CTL Job #:	1007-006	Project #:	210075.01.03	By:	MD
Client:	Anchor QEA	Date:	3/6/2025	Checked:	PJ
Project Name:	Middle Reach of the Lower Duwamish Waterway	Remolding Info:			

Specimen Data				
	1	2	3	4
Boring:	LDW23_GT33B_GT-21.5-24	LDW23_GT33B_GT-21.5-24	LDW23_GT33B_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)	





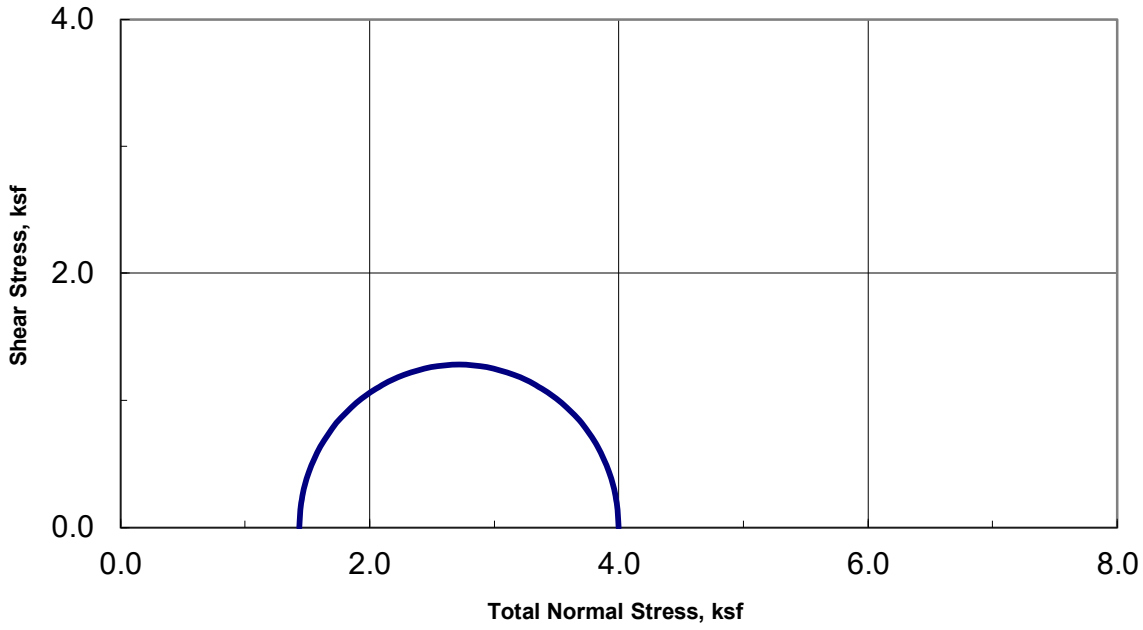


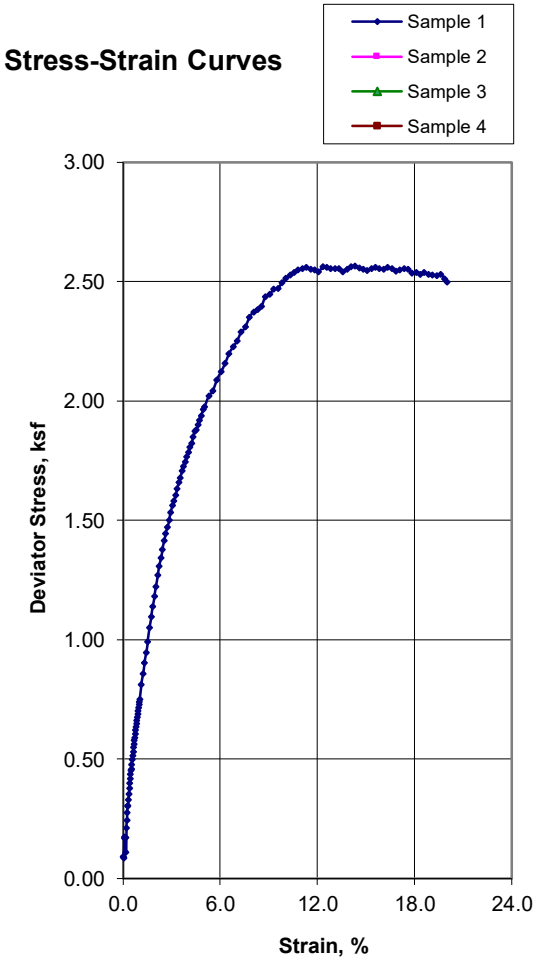
Remarks: Engineering judgement is required to determine phi and cohesion, no phi or cohesion is reported. To add phi and cohesion to the report go to the "phi" tab and in cells G30, G31, H30, and H31 enter end points for a line through the 3 data points. The points plotted can be changed on the "Eng Values" tab using cells L6, A2, C2, and E2.

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Cooper Testing Labs, Inc.
937 Commercial Street
Palo Alto, CA 94303

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:

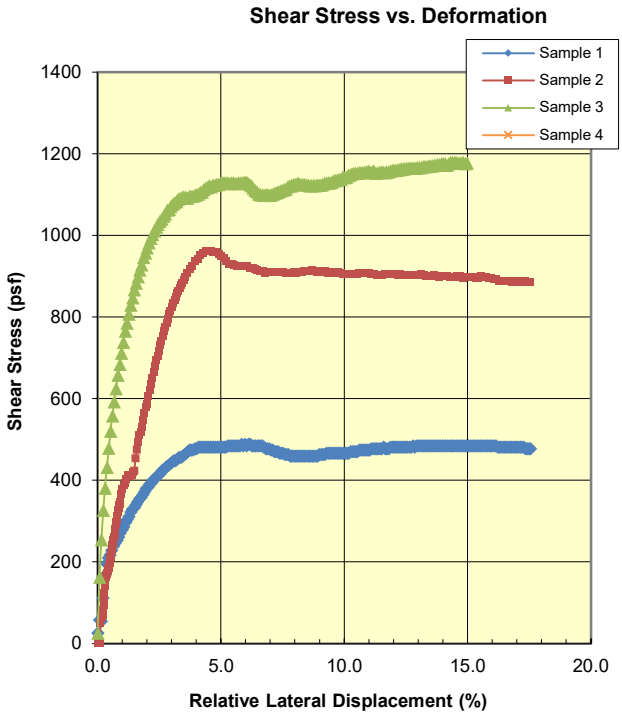
Note: Strengths are picked at the peak deviator stress or 15% strain which ever occurs first per ASTM D2850.

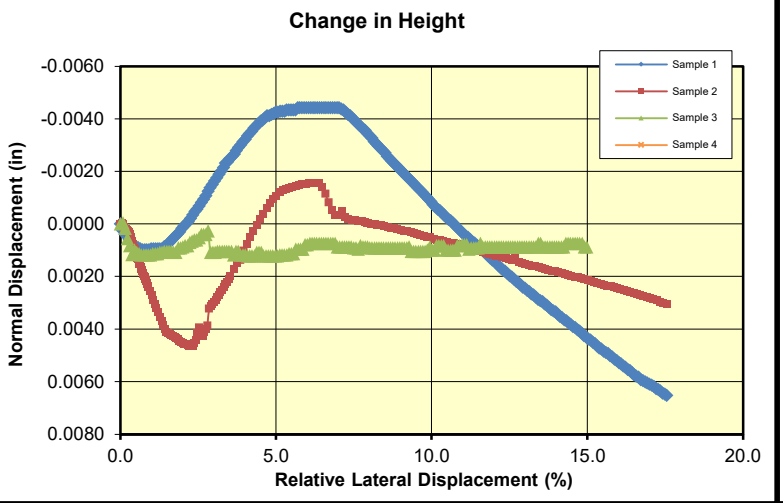
Consolidated Drained Direct Shear (ASTM D3080)

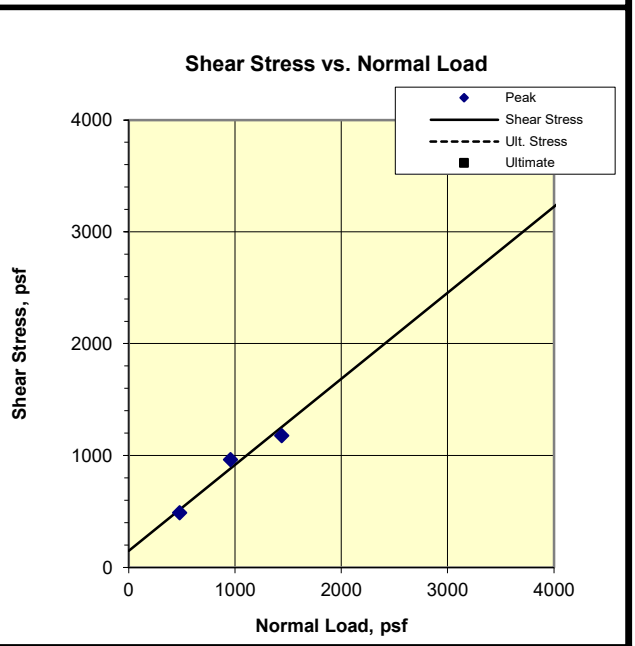
CTL Job #:	1007-006	Project #:	210075.01.03	By:	MD
Client:	Anchor QEA	Date:	3/5/2025	Checked:	PJ
Project Name:	Middle Reach of the Lower Duwamish Waterway	Remolding Info:			

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)	



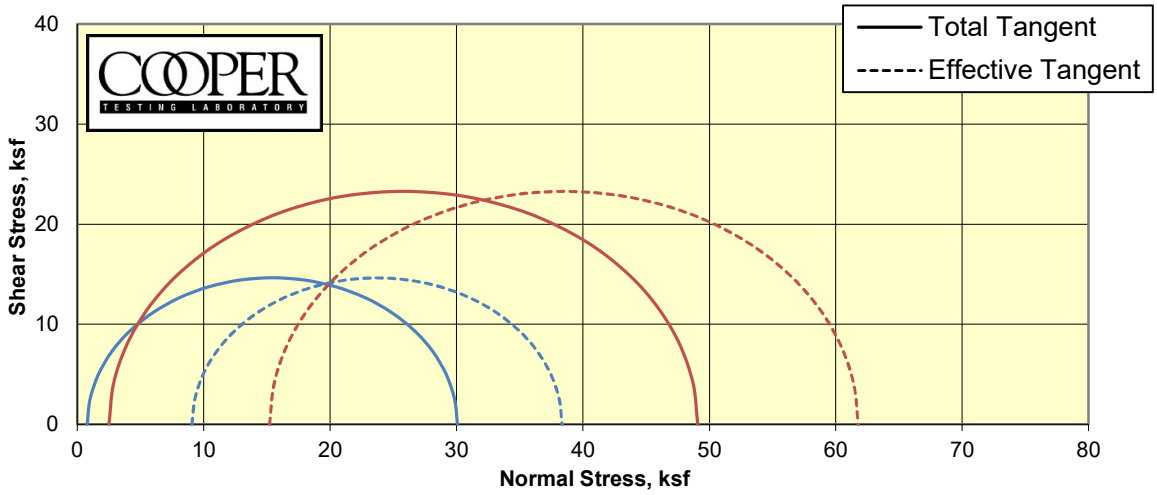


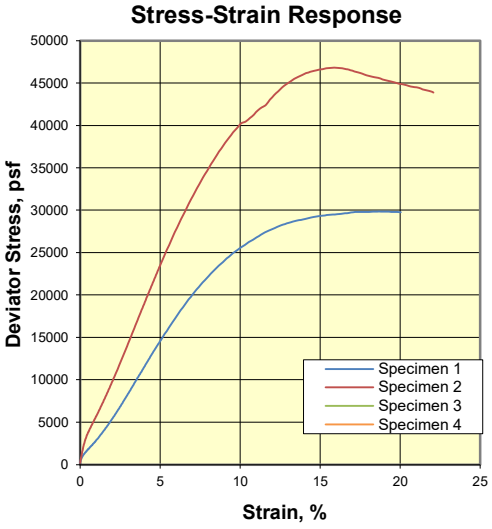


Remarks:

©

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767





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 ©

Specimen	1	2	3	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		

Client:	Anchor QEA, LLC.	**Date:**	October 15, 2024
Address:	1201 3rd Avenue, Suite 2600	**Project:**	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
	Seattle, WA 98101	**Project #:**	24B105
Attn:	Cindy Fields	**Sample #:**	B24-1561 - 1585
Revised On:		**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

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT32-GT-6.4-6.5-20240730	**Tested By:**	Z. Romney
Sample #:	B24-1563	**Control No.:**	10152024

Unified Soils Classification System, ASTM D-2487
OH, Organic Silty Clay
Sample Color
Brown

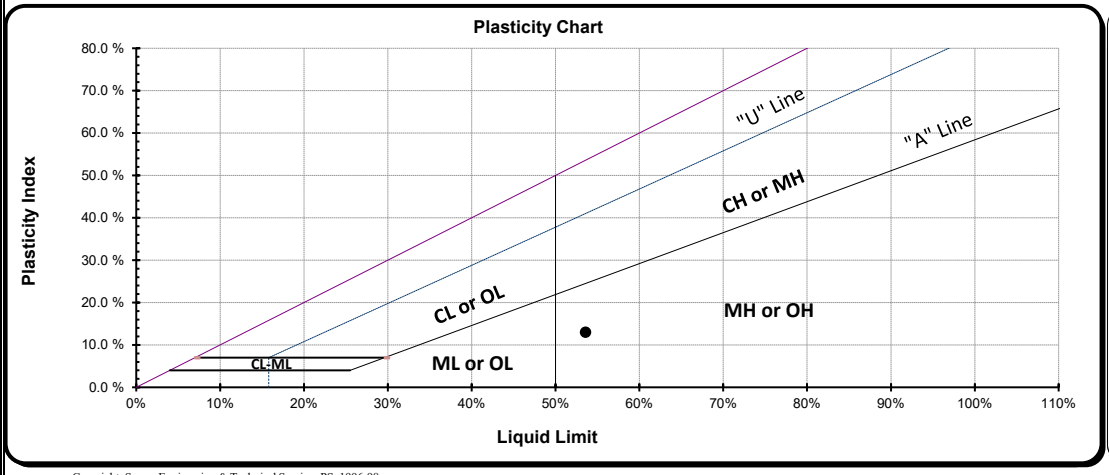
Liquid Limit Determination

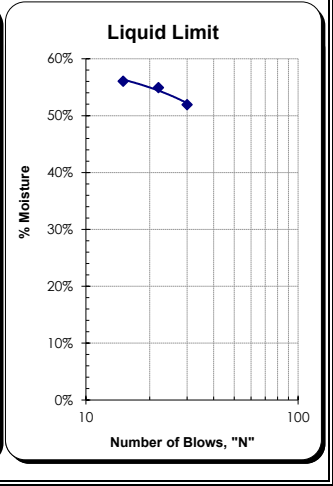
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	27.62	30.41	35.15			
Weight of Dry Soils + Pan:	23.20	26.52	29.54			
Weight of Pan:	14.69	19.44	19.53			
Weight of Dry Soils:	8.51	7.08	10.01			
Weight of Moisture:	4.42	3.89	5.61			
% Moisture:	51.9 %	54.9 %	56.0 %			
Number of Blows:	30	22	15			

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 %				





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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	**Date Received:** 23-Sep-24	**Unified Soil Classification System, ASTM-2487**
Project #: 24B105	**Sampled By:** Client	SP-SM, Poorly graded Sand with Silt
Client: Anchor QEA, LLC.	**Date Tested:** 9-Oct-24	**Sample Color:**
Source: LDW23-GT32-GT-10-11.5-20240730	**Tested By:** S. Boesenberg	Brown
Sample#: B24-1564	**Control No.:** 10152024	

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

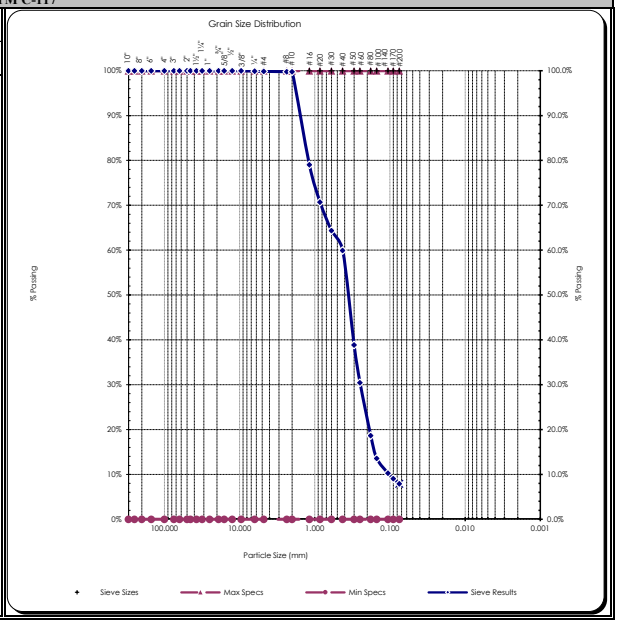
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

Hydrometer Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	23-Sep-24	**Unified Soil Classification System, ASTM-2487**	
Project #:	24B105	**Sampled By:**	Client	SP-SM, Poorly graded Sand with Silt	
Client :	Anchor QEA, LLC.	**Date Tested:**	9-Oct-24	**Sample Color**	
Source:	LDW23-GT32-GT-10-11.5-20240730	**Tested By:**	S. Boesenberg	Brown	
Sample#:	B24-1564	**Control No.:**	10152024		

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.55	grams
Hydroscopic Moist.:	0.51%	
Adj. Sample Wgt :	100.04	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	6	6.0%	0.0378 mm
5	5	5.0%	0.0240 mm
15	4	4.0%	0.0139 mm
30	3	3.0%	0.0099 mm
60	1	1.0%	0.0071 mm
250	1	1.0%	0.0035 mm
1440	1	1.0%	0.0014 mm

% Gravel:	0.1%	**Liquid Limit:**	n/a
% Sand:	91.9%	**Plastic Limit:**	n/a
% Silt:	6.9%	**Plasticity Index:**	n/a
% Clay:	1.0%		

ASTM C-136

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"	100%	6.300 mm
#4	100%	4.750 mm
#10	100%	2.000 mm
#20	71%	0.850 mm
#40	60%	0.425 mm
#100	14%	0.150 mm
#200	7.9%	0.075 mm
Silts	7.9%	0.074 mm
	6.6%	0.050 mm
	4.6%	0.020 mm
Clays	1.0%	0.005 mm
	1.0%	0.002 mm
Colloids	0.7%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

USDA Soil Textural Classification
Sand

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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	**Date Received:**	23-Sep-24	**Unified Soil Classification System, ASTM-2487**	
Project #:	24B105	**Sampled By:**	Client	SM, Silty Sand	
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24	**Sample Color:**	
Source:	LDW23-GT32-GT-15-16.5-20240730	**Tested By:**	S. Boesenberg	Brown	
Sample#:	B24-1565	**Control No.:**	10152024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

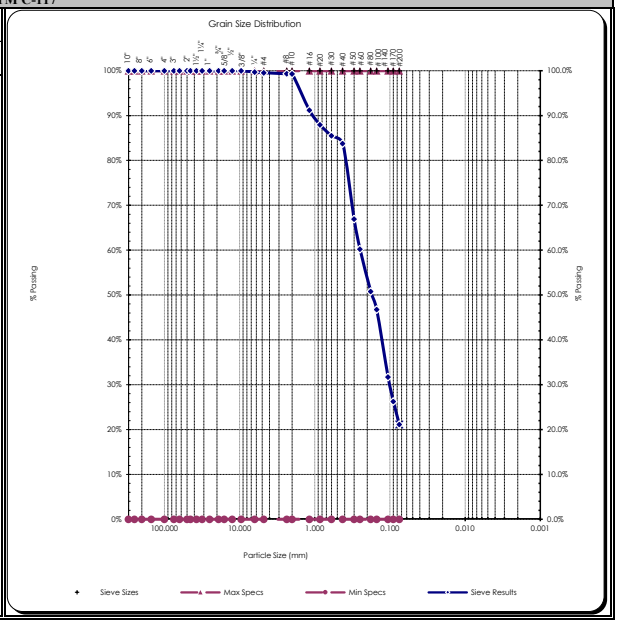
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.018	mm	% Gravel =	0.4%	Coeff. of Curvature, C_C =	1.16
$D_{(10)}$ =	0.035	mm	% Sand =	78.4%	Coeff. of Uniformity, C_U =	7.00
$D_{(15)}$ =	0.053	mm	% Silt & Clay =	21.1%	Fineness Modulus =	1.11
$D_{(30)}$ =	0.101	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.174	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	0.248	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	1.058	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	1/4		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

MATERIALS TESTING & CONSULTING, INC.

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT32-GT-25.7-26.5-20240730	**Tested By:**	Z. Romney
Sample #:	B24-1567	**Control No.:**	10152024

Visual Soils Classification
Sandy Silt
Sample Color
Brown

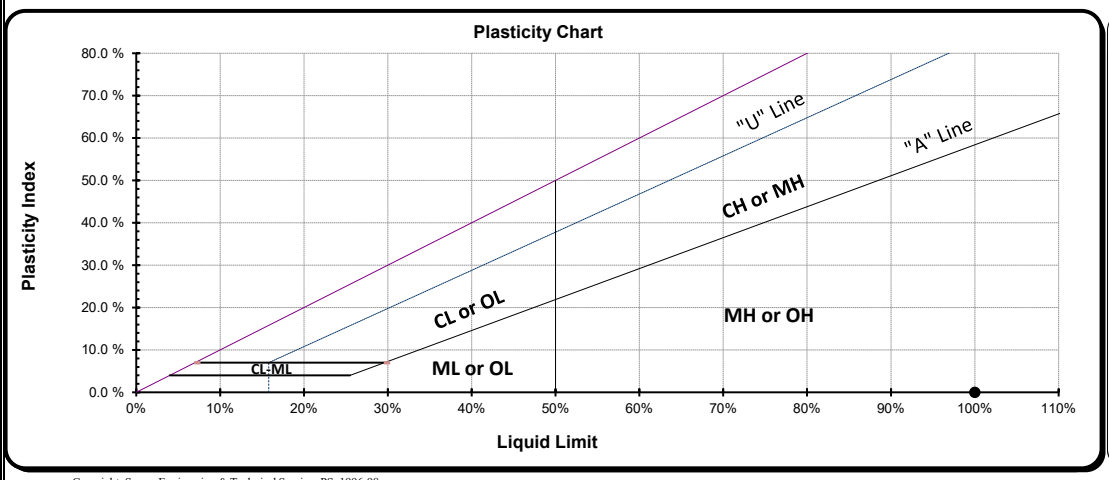
Liquid Limit Determination

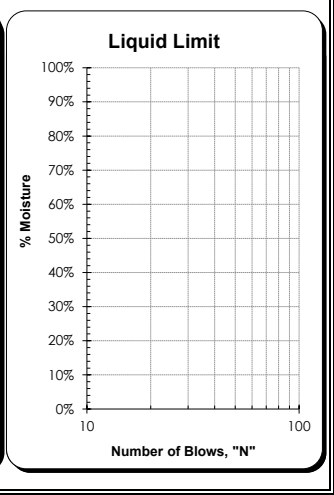
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:			Unable to Establish			
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

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	**Date Received:**	23-Sep-24	**Unified Soil Classification System, ASTM-2487**	
Project #:	24B105	**Sampled By:**	Client	SP, Poorly graded Sand	
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24	**Sample Color:**	
Source:	LDW23-GT32-GT-35-36.5-20240730	**Tested By:**	S. Boesenberg	Brown	
Sample#:	B24-1568	**Control No.:**	10152024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

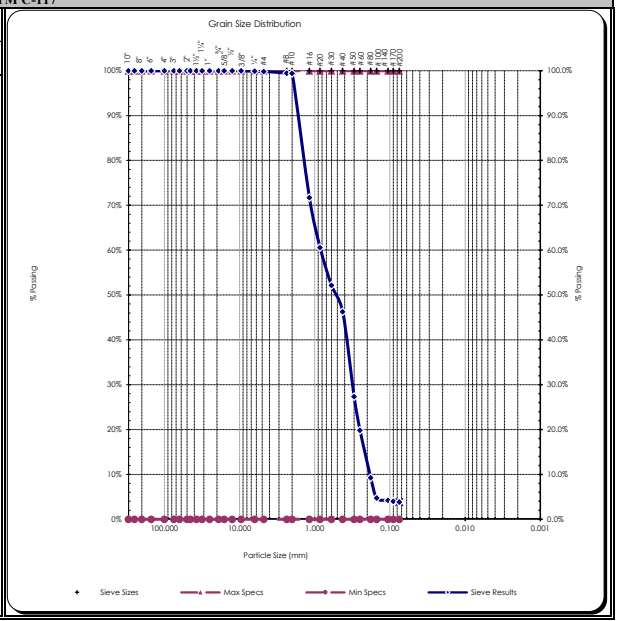
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

Hydrometer Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT32-GT-35-36.5-20240730	**Tested By:**	S. Boesenberg
Sample#:	B24-1568	**Control No.:**	10152024

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.57	grams
Hydroscopic Moist.:	0.66%	
Adj. Sample Wgt :	99.91	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	3	3.0%	0.0384 mm
5	2.5	2.5%	0.0244 mm
15	2.5	2.5%	0.0141 mm
30	2.5	2.5%	0.0100 mm
60	1.5	1.5%	0.0071 mm
250	1	1.0%	0.0035 mm
1440	1	1.0%	0.0014 mm

% Gravel:	0.2%	**Liquid Limit:**	n/a
% Sand:	96.0%	**Plastic Limit:**	n/a
% Silt:	2.6%	**Plasticity Index:**	n/a
% Clay:	1.2%		

ASTM C-136

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"	100%	6.300 mm
#4	100%	4.750 mm
#10	99%	2.000 mm
#20	61%	0.850 mm
#40	46%	0.425 mm
#100	5%	0.150 mm
#200	3.8%	0.075 mm
Silts	3.8%	0.074 mm
	3.3%	0.050 mm
	2.5%	0.020 mm
Clays	1.2%	0.005 mm
	1.0%	0.002 mm
Colloids	0.7%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

USDA Soil Textural Classification
Sand

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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT32-GT-40-41.5-20240730	**Tested By:**	S. Boesenberg
Sample#:	B24-1569	**Control No.:**	10152024

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

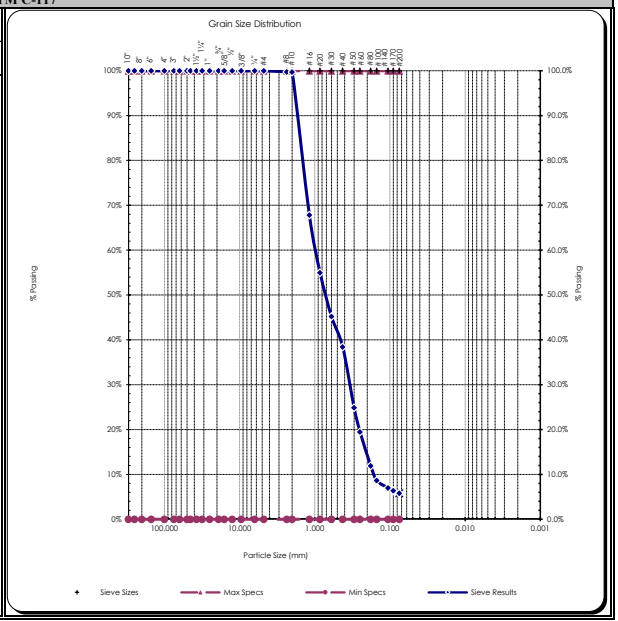
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.065	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 0.76
$D_{(10)}$ =	0.162	mm	% Sand =	94.2%	Coeff. of Uniformity, C_U = 6.03
$D_{(15)}$ =	0.209	mm	% Silt & Clay =	5.8%	Fineness Modulus = 2.54
$D_{(30)}$ =	0.347	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.723	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.980	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	1.750	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	8/53		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Silt with Sand	
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24	**Sample Color:**	
Source:	LDW23-GT33B-GT-5-6.5-20240730	**Tested By:**	S. Boesenberg	Brown	
Sample#:	B24-1571	**Control No.:**	10152024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

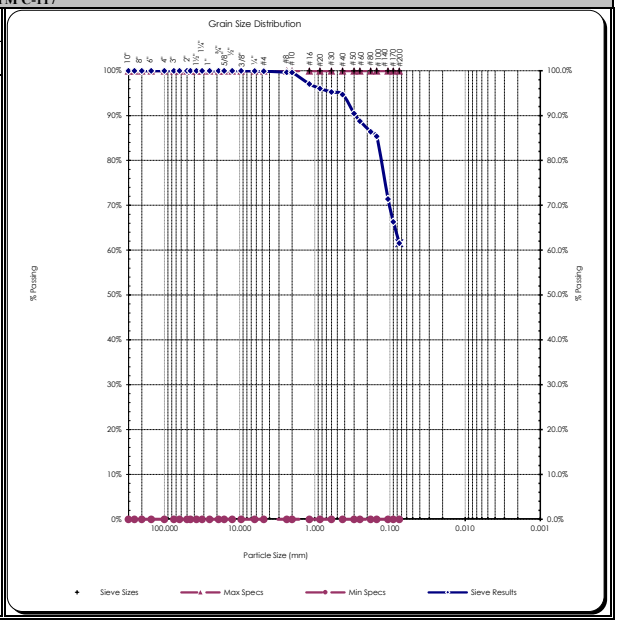
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.006	mm	% Gravel =	0.1%	Coeff. of Curvature, C_C =	1.50
$D_{(10)}$ =	0.012	mm	% Sand =	38.4%	Coeff. of Uniformity, C_U =	6.00
$D_{(15)}$ =	0.018	mm	% Silt & Clay =	61.5%	Fineness Modulus =	0.32
$D_{(30)}$ =	0.037	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.061	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	0.073	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.286	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	13/20		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT33B-GT-10-11-20240730	**Tested By:**	S. Boesenberg
Sample#:	B24-1572	**Control No.:**	10152024

Unified Soils Classification System, ASTM D-2487
SP, Poorly graded Sand with Gravel
Sample Color:
Gray

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

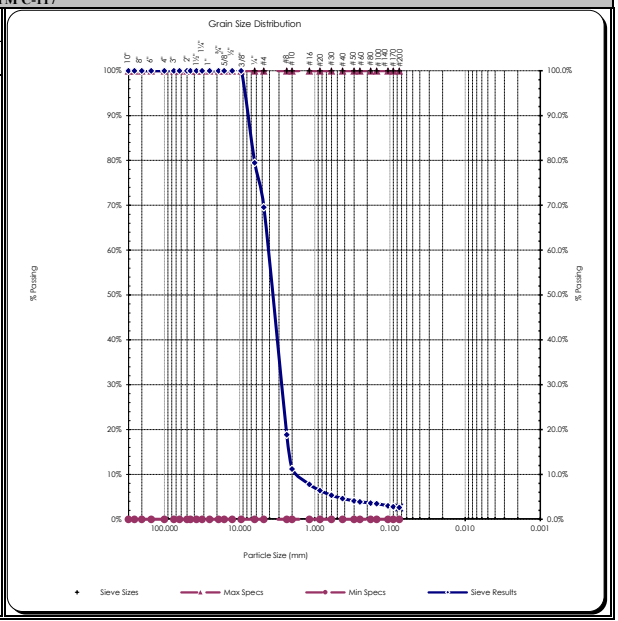
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.516	mm	% Gravel =	30.4%	Coeff. of Curvature, C_C = 1.13
$D_{(10)}$ =	1.710	mm	% Sand =	66.9%	Coeff. of Uniformity, C_U = 2.51
$D_{(15)}$ =	2.178	mm	% Silt & Clay =	2.6%	Fineness Modulus = 4.91
$D_{(30)}$ =	2.885	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	3.828	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	4.300	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	7.940	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	4/7		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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		79%	100.0%	0.0%
#4	4.75	70%	70%	100.0%	0.0%
#8	2.36		19%	100.0%	0.0%
#10	2.00	11%	11%	100.0%	0.0%
#16	1.18		8%	100.0%	0.0%
#20	0.850		6%	100.0%	0.0%
#30	0.600		5%	100.0%	0.0%
#40	0.425	5%	5%	100.0%	0.0%
#50	0.300		4%	100.0%	0.0%
#60	0.250		4%	100.0%	0.0%
#80	0.180		4%	100.0%	0.0%
#100	0.150	3%	3%	100.0%	0.0%
#140	0.106		3%	100.0%	0.0%
#170	0.090		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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT33B-GT-15-16.5-20240730	**Tested By:**	S. Boesenberg
Sample#:	B24-1574	**Control No.:**	10152024

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

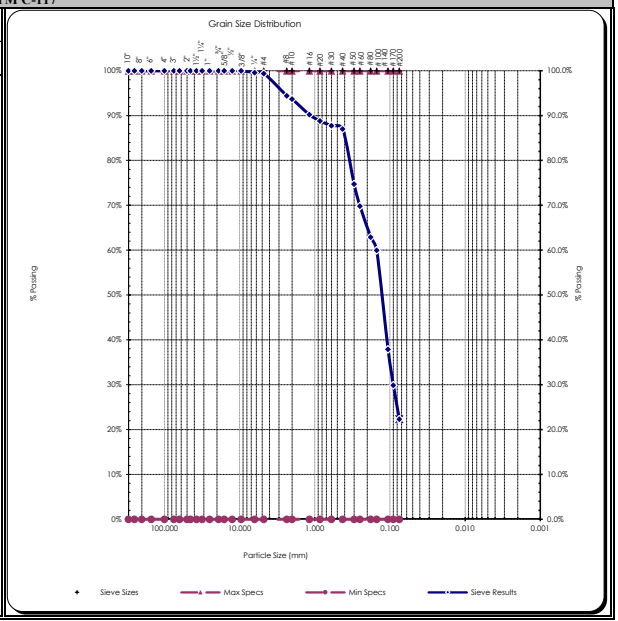
Sample Meets Specs ? N/A

$D_{(5)}$ =	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
$D_{(30)}$ =	0.090	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.130	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.150	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT33B-GT-15-16.5-20240730	**Tested By:**	S. Boesenberg
Sample#:	B24-1574	**Control No.:**	10152024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.45	grams
Hydroscopic Moist.:	1.67%	
Adj. Sample Wgt :	49.62	grams

Hydrometer Reading Minutes	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

% Gravel:	0.6%	**Liquid Limit:**	n/a
% Sand:	77.1%	**Plastic Limit:**	n/a
% Silt:	19.1%	**Plasticity Index:**	n/a
% Clay:	3.2%		

ASTM C-136

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"	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

USDA Soil Textural Classification

	Particle Size
% 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:

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT33B-GT-20-21.5-20240730	**Tested By:**	Z. Romney
Sample #:	B24-1575	**Control No.:**	10152024

Unified Soils Classification System, ASTM D-2487
ML, Clayey Silt
Sample Color
Brown

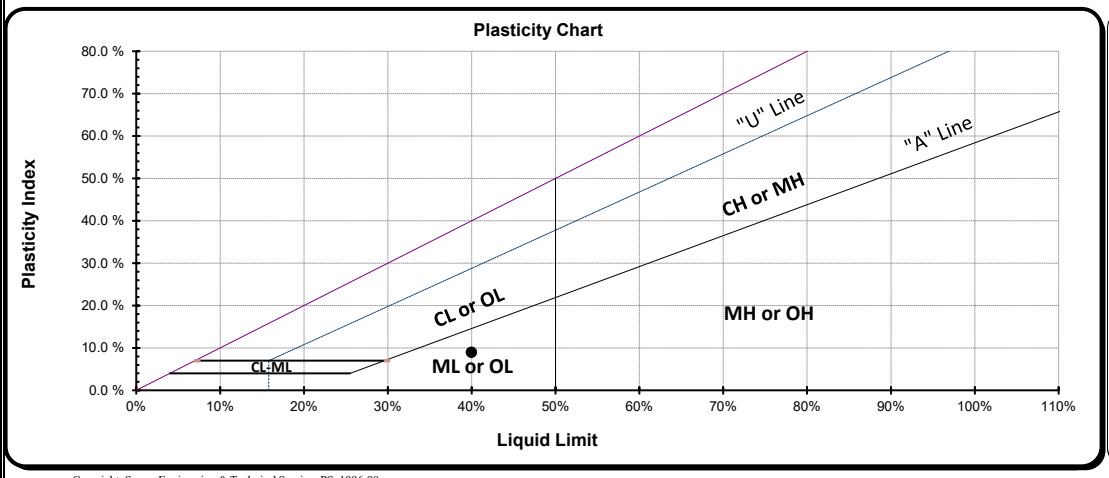
Liquid Limit Determination

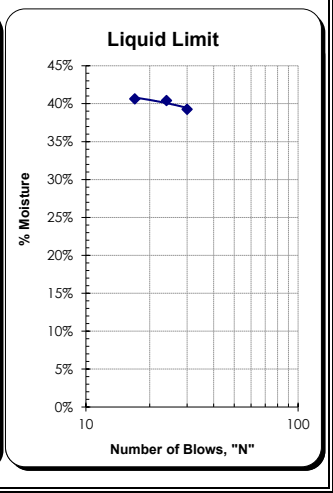
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	32.49	26.28	33.44			
Weight of Dry Soils + Pan:	28.80	22.74	29.68			
Weight of Pan:	19.40	13.98	20.43			
Weight of Dry Soils:	9.40	8.76	9.25			
Weight of Moisture:	3.69	3.54	3.76			
% Moisture:	39.3 %	40.4 %	40.7 %			
Number of Blows:	30	24	17			

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 %				





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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

Specific Gravity of Soils, ASTM D-854

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Client: Anchor QEA, LLC.
Project #: 24B105
Sampled by: Client
Date Received: September 23, 2024
Tested by: S. Boesenberg
Date Tested: October 10, 2024
Control. No.: 10152024

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B24-1577	LWD23-GT33B-GT-30-31.5-20240730	414.10	448.40	34.3	SA-050 (B-1)	91.89	249.27	0.99727	361.83	340.48	24.1	2.648752	0.99907	2.646289
B24-1583	LWD23-GT34-GT-25-26.5-20240729	419.30	449.20	29.9	SA-050 (B-2)	92.08	249.31	0.99727	358.98	340.71	24.1	2.571073	0.99907	2.568682

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT34-GT-5-6.5-20240729	**Tested By:**	S. Boesenberg
Sample#:	B24-1579	**Control No.:**	10152024

Unified Soil Classification System, ASTM-2487
SM, Silty Sand with Gravel
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

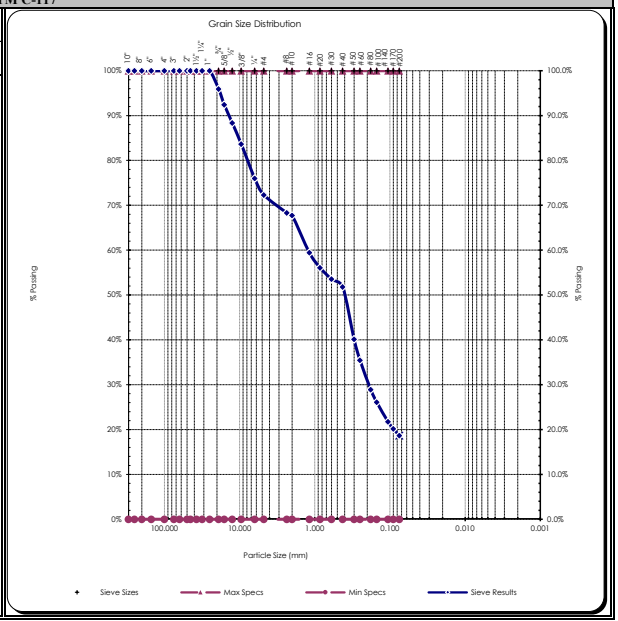
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.020	mm	% Gravel =	27.7%	Coeff. of Curvature, C_C = 0.74
$D_{(10)}$ =	0.040	mm	% Sand =	53.6%	Coeff. of Uniformity, C_U = 30.79
$D_{(15)}$ =	0.060	mm	% Silt & Clay =	18.7%	Fineness Modulus = 3.01
$D_{(30)}$ =	0.192	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.406	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	1.237	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	13.921	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	31/86		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT34-GT-5-6.5-20240729	**Tested By:**	S. Boesenberg
Sample#:	B24-1579	**Control No.:**	10152024

Unified Soil Classification System, ASTM-2487
SM, Silty Sand with Gravel
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.09	grams
Hydroscopic Moist.:	1.33%	
Adj. Sample Wgt :	49.43	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	9.5	13.0%	0.0371 mm
5	7	9.6%	0.0238 mm
15	6	8.2%	0.0138 mm
30	5	6.9%	0.0098 mm
60	4	5.5%	0.0070 mm
250	3	4.1%	0.0034 mm
1440	3	4.1%	0.0014 mm

% Gravel:	27.7%	**Liquid Limit:**	n/a
% Sand:	53.6%	**Plastic Limit:**	n/a
% Silt:	13.9%	**Plasticity Index:**	n/a
% Clay:	4.7%		

ASTM C-136

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"	96%	19.000 mm
5/8"	92%	16.000 mm
1/2"	88%	12.500 mm
3/8"	84%	9.500 mm
1/4"	76%	6.300 mm
#4	72%	4.750 mm
#10	68%	2.000 mm
#20	56%	0.850 mm
#40	52%	0.425 mm
#100	26%	0.150 mm
#200	18.7%	0.075 mm
Silts	18.5%	0.074 mm
	14.9%	0.050 mm
	9.1%	0.020 mm
Clays	4.7%	0.005 mm
	4.1%	0.002 mm
Colloids	2.9%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% 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:

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT34-GT-15.3-16.1-20240729	**Tested By:**	S. Boesenberg
Sample#:	B24-1581	**Control No.:**	10152024

Visual Soils Classification
Sandy Silt
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

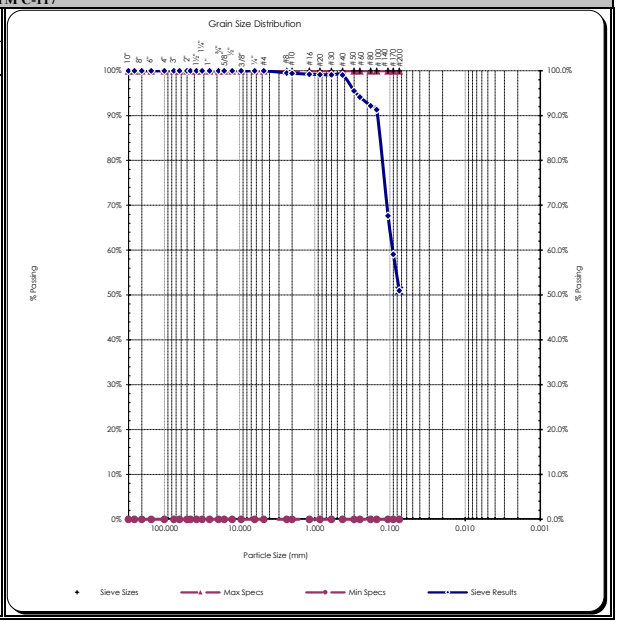
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.007	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 1.44
$D_{(10)}$ =	0.015	mm	% Sand =	49.0%	Coeff. of Uniformity, C_U = 6.24
$D_{(15)}$ =	0.022	mm	% Silt & Clay =	51.0%	Fineness Modulus = 0.15
$D_{(30)}$ =	0.044	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.074	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.092	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.148	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	17/33		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT34-GT-15.3-16.1-20240729	**Tested By:**	S. Boesenberg
Sample#:	B24-1581	**Control No.:**	10152024

Visual Soils Classification
Sandy Silt
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.38	grams
Hydroscopic Moist.:	2.22%	
Adj. Sample Wgt :	49.29	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	9	18.2%	0.0371 mm
5	8	16.1%	0.0236 mm
15	5	10.1%	0.0139 mm
30	5	10.1%	0.0098 mm
60	3	6.1%	0.0070 mm
250	2	4.0%	0.0035 mm
1440	2	4.0%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	49.0%	**Plastic Limit:**	n/a
% Silt:	46.1%	**Plasticity Index:**	n/a
% Clay:	4.9%		

ASTM C-136

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"	100%	6.300 mm
#4	100%	4.750 mm
#10	99%	2.000 mm
#20	99%	0.850 mm
#40	99%	0.425 mm
#100	91%	0.150 mm
#200	51.0%	0.075 mm
Silts	50.1%	0.074 mm
	29.3%	0.050 mm
	13.9%	0.020 mm
Clays	4.9%	0.005 mm
	4.0%	0.002 mm
Colloids	2.8%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

USDA Soil Textural Classification
Sandy 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT34-GT-25-26.5-20240729	**Tested By:**	Z. Romney
Sample #:	B24-1583	**Control No.:**	10152024

Unified Soils Classification System, ASTM D-2487
ML, Silty Clay
Sample Color
Brown

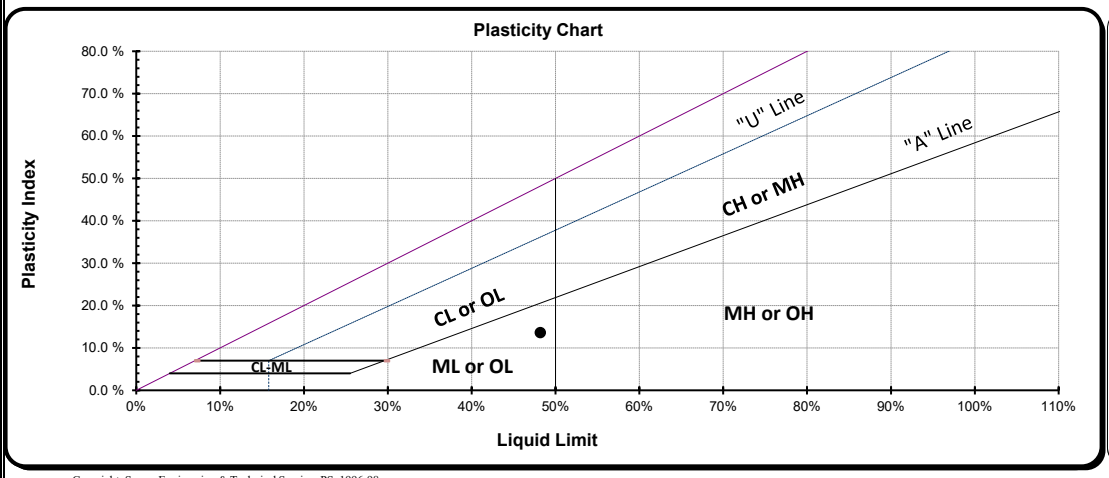
Liquid Limit Determination

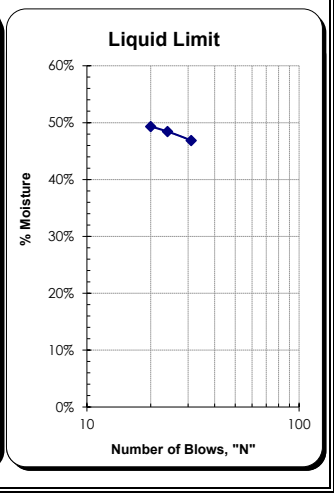
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.28	36.63	25.94			
Weight of Dry Soils + Pan:	26.09	31.15	22.01			
Weight of Pan:	19.28	19.84	14.04			
Weight of Dry Soils:	6.81	11.31	7.97			
Weight of Moisture:	3.19	5.48	3.93			
% Moisture:	46.8 %	48.5 %	49.3 %			
Number of Blows:	31	24	20			

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 %				





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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Oct-24
Source:	LDW23-GT34-GT-35.5-36.5-20240729	**Tested By:**	S. Boesenberg
Sample#:	B24-1585	**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

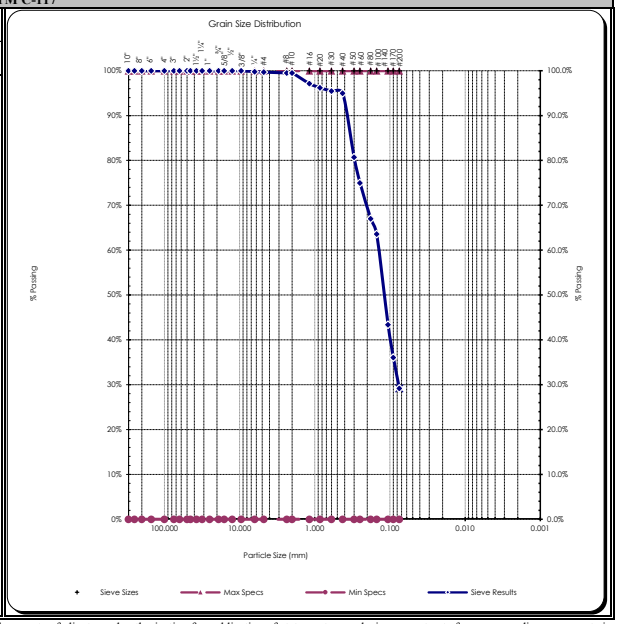
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.013	mm	% Gravel =	0.3%	Coeff. of Curvature, C_C = 1.61
$D_{(10)}$ =	0.026	mm	% Sand =	70.5%	Coeff. of Uniformity, C_U = 5.53
$D_{(15)}$ =	0.039	mm	% Silt & Clay =	29.2%	Fineness Modulus = 0.64
$D_{(30)}$ =	0.077	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.120	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.142	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.381	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	4/13		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

Client:	Anchor QEA, LLC.	**Date:**	October 18, 2024
Address:	1201 3rd Avenue, Suite 2600	**Project:**	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
	Seattle, WA 98101	**Project #:**	24B105
Attn:	Cindy Fields	**Sample #:**	B24-1586 - 1611
Revised On:		**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%

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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	**Date Received:**	23-Sep-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Clayey Sandy Silt	
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24	**Sample Color:**	
Source:	LDW23-GT30-GT-5-6.5-20240620	**Tested By:**	S. Boesenberg	Brown	
Sample#:	B24-1587	**Control No.:**	10182024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

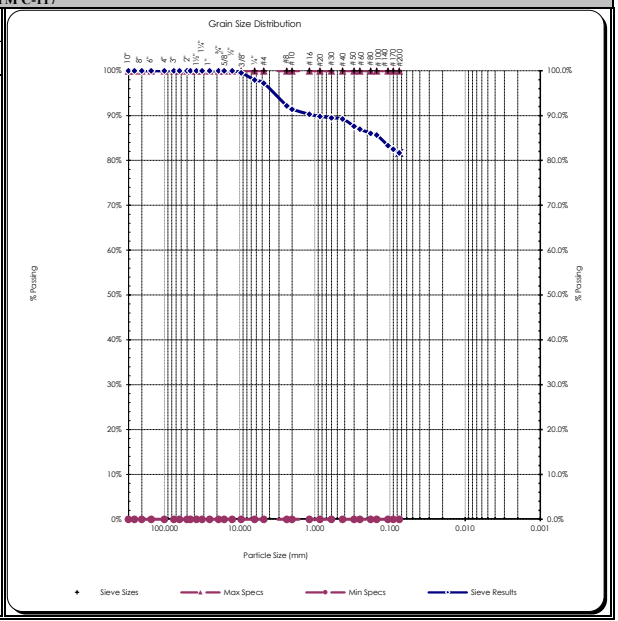
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Clayey Sandy Silt	
Client :	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24	**Sample Color**	
Source:	LDW23-GT30-GT-5-6.5-20240620	**Tested By:**	S. Boesenberg	Brown	
Sample#:	B24-1587	**Control No.:**	10182024		

ASTM D-422 HYDROMETER ANALYSIS

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%	**Liquid Limit:**	n/a
% Sand:	15.5%	**Plastic Limit:**	n/a
% Silt:	59.3%	**Plasticity Index:**	n/a
% Clay:	22.4%		

ASTM C-136

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%	0.074 mm
	72.8%	0.050 mm
	55.9%	0.020 mm
Clays	22.4%	0.005 mm
	11.5%	0.002 mm
Colloids	6.7%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% Sand:	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

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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	16-Oct-24
Source:	LDW23-GT30-GT-10-11.5-20240620	**Tested By:**	S. Boesenberg
Sample #:	B24-1588	**Control No.:**	10182024

Unified Soils Classification System, ASTM D-2487
OH, Organic Silty Clay
Sample Color
Brown

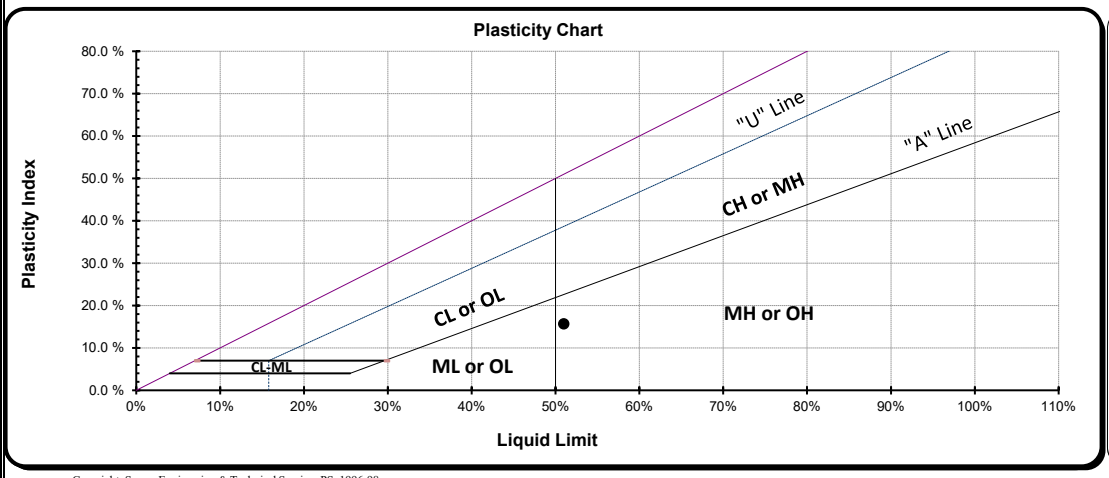
Liquid Limit Determination

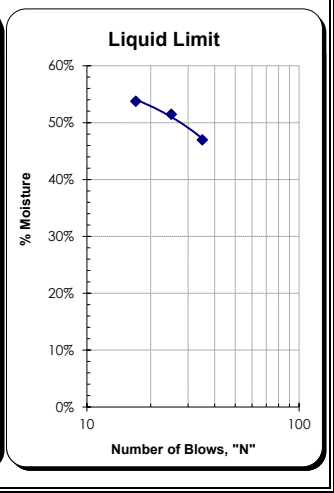
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	33.51	31.03	40.45			
Weight of Dry Soils + Pan:	28.69	27.04	33.03			
Weight of Pan:	18.43	19.29	19.23			
Weight of Dry Soils:	10.26	7.75	13.80			
Weight of Moisture:	4.82	3.99	7.42			
% Moisture:	47.0 %	51.5 %	53.8 %			
Number of Blows:	35	25	17			

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 %				





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Comments:

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Alex Eifrig
WABO Supervising Laboratory Technician

Specific Gravity of Soils, ASTM D-854

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Client: Anchor QEA, LLC.
Project #: 24B105
Sampled by: Client
Date Received: September 23, 2024
Tested by: S. Boesenberg
Date Tested: October 15 & 16, 2024
Control. No.: 10182024

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B24-1588	LDW23-GT30-GT-10-11.5-20240620	424.30	471.30	47.00	SA-050 (B-1)	91.89	249.27	0.99712	369.30	340.44	24.7	2.590659	0.99892	2.587861
B24-1596	LDW23-GT18-GT-15-16.5-20240619	417.40	464.70	47.30	SA-050 (B-2)	92.08	249.31	0.99717	369.30	340.68	24.5	2.5315165	0.99897	2.528909
B24-1606	LDW23-GT02-GT-20-21.5-20240617	358.33	397.26	38.93	SA-050 (B-1)	91.89	249.27	0.99723	365.14	340.47	24.3	2.7301055	0.99902	2.727430
B24-1610	LDW23-GT10-GT-10-11.5-20240618	360.31	394.56	34.25	SA-050 (B-2)	92.08	249.31	0.99723	362.00	340.70	24.3	2.6449079	0.99902	2.6423159

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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT30-GT-20-21.5-20240620	**Tested By:**	R. Bohler
Sample#:	B24-1591	**Control No.:**	10182024

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

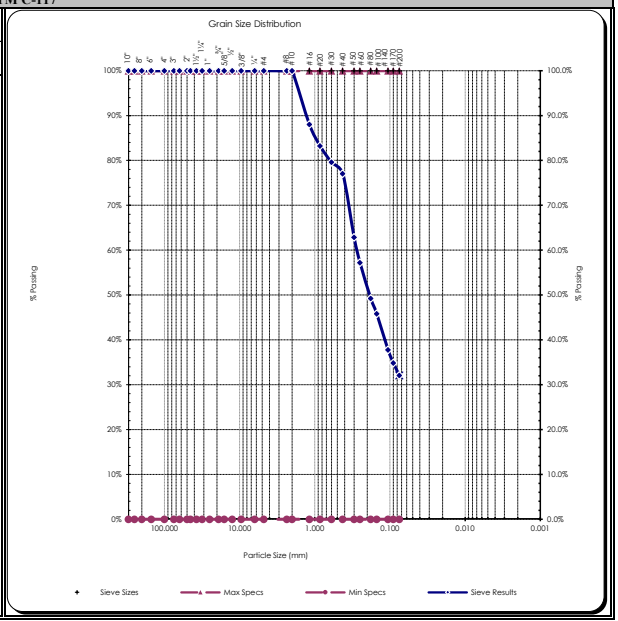
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.012	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 0.77
$D_{(10)}$ =	0.023	mm	% Sand =	67.9%	Coeff. of Uniformity, C_U = 11.75
$D_{(15)}$ =	0.035	mm	% Silt & Clay =	32.1%	Fineness Modulus = 1.24
$D_{(30)}$ =	0.070	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.187	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.275	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	1.315	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	5/12		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT18-GT-5-6.5-20240619	**Tested By:**	S. Boesenberg
Sample#:	B24-1594	**Control No.:**	10182024

Visual Soils Classification
Clayey Silt with Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

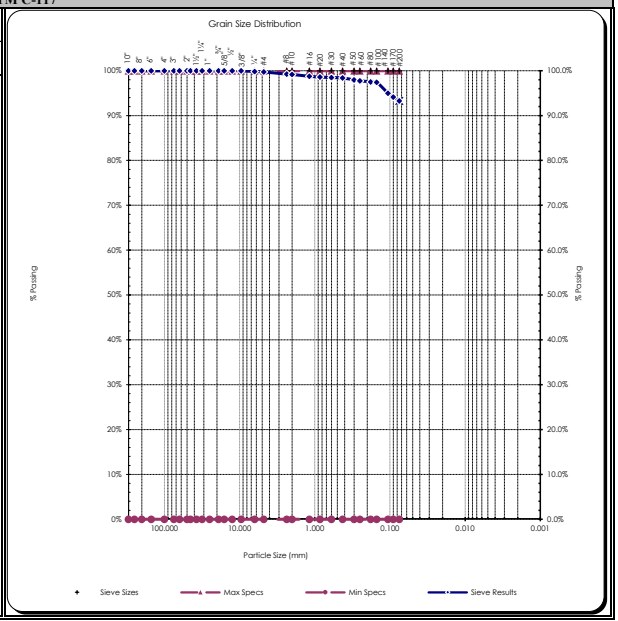
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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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WABO Supervising Laboratory Technician

Hydrometer Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT18-GT-5-6.5-20240619	**Tested By:**	S. Boesenberg
Sample#:	B24-1594	**Control No.:**	10182024

Visual Soils Classification
Clayey Silt with Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.57	grams
Hydroscopic Moist.:	10.64%	
Adj. Sample Wgt :	45.71	grams

Hydrometer Reading Minutes	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

% Gravel:	0.3%	**Liquid Limit:**	n/a
% Sand:	6.4%	**Plastic Limit:**	n/a
% Silt:	72.7%	**Plasticity Index:**	n/a
% Clay:	20.6%		

ASTM C-136

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"	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

USDA Soil Textural Classification

	Particle Size
% Sand:	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:

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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT18-GT-10-11.5-20240619	**Tested By:**	S. Boesenberg
Sample #:	B24-1595	**Control No.:**	10182024

Unified Soils Classification System, ASTM D-2487
OH, Organic Silty Clay
Sample Color
Brown

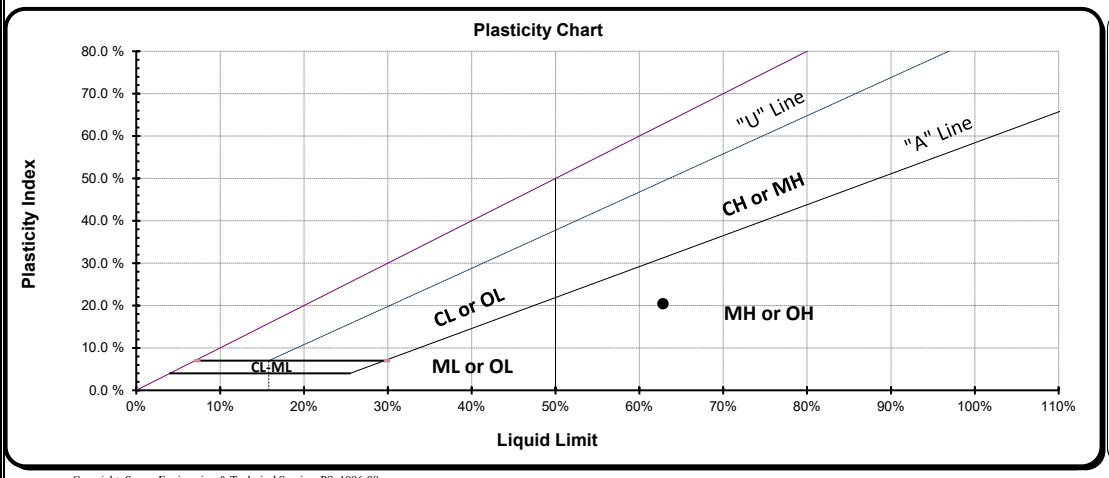
Liquid Limit Determination

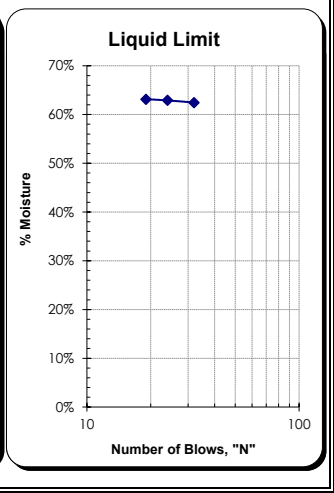
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.80	30.36	29.37			
Weight of Dry Soils + Pan:	26.11	26.68	25.91			
Weight of Pan:	20.20	20.83	20.43			
Weight of Dry Soils:	5.91	5.85	5.48			
Weight of Moisture:	3.69	3.68	3.46			
% Moisture:	62.4 %	62.9 %	63.1 %			
Number of Blows:	32	24	19			

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 %				





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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT18-GT-15-16.5-20240619	**Tested By:**	Z. Romney
Sample #:	B24-1596	**Control No.:**	10182024

Unified Soils Classification System, ASTM D-2487
OH, Organic Clayey Silt
Sample Color
Brown

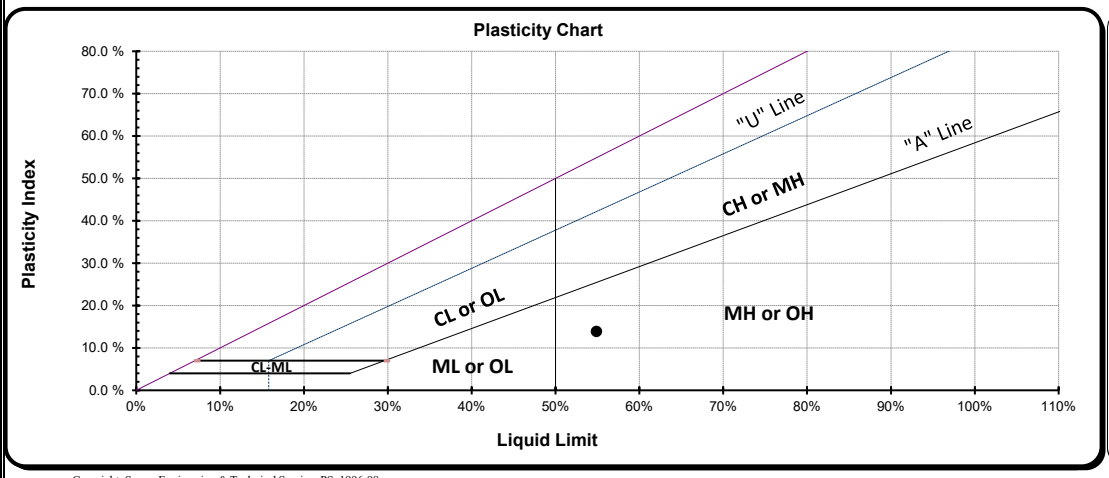
Liquid Limit Determination

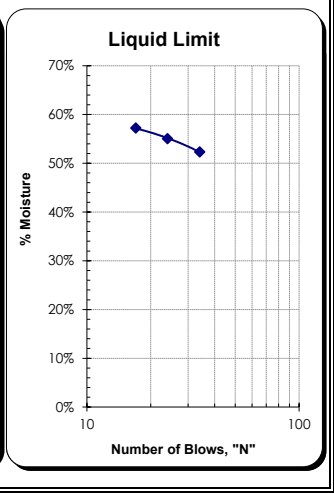
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	27.48	32.85	28.42			
Weight of Dry Soils + Pan:	22.85	28.07	23.19			
Weight of Pan:	14.00	19.39	14.05			
Weight of Dry Soils:	8.85	8.68	9.14			
Weight of Moisture:	4.63	4.78	5.23			
% Moisture:	52.3 %	55.1 %	57.2 %			
Number of Blows:	34	24	17			

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 %				





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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT18-GT-25-26.5-20240619	**Tested By:**	R. Bohler
Sample#:	B24-1597	**Control No.:**	10182024

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

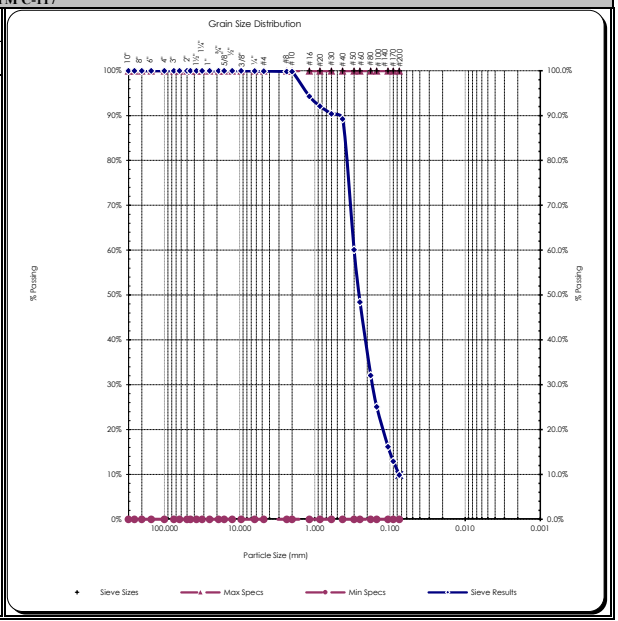
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.038	mm	% Gravel =	0.1%	Coeff. of Curvature, C_C = 1.29
$D_{(10)}$ =	0.076	mm	% Sand =	90.0%	Coeff. of Uniformity, C_U = 3.97
$D_{(15)}$ =	0.100	mm	% Silt & Clay =	9.9%	Fineness Modulus = 1.30
$D_{(30)}$ =	0.171	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.257	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.300	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.539	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	1/9		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

MATERIALS TESTING & CONSULTING, INC.

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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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT02-GT-5-6-20240617	**Tested By:**	S. Boesenberg
Sample #:	B24-1600	**Control No.:**	10182024

Unified Soils Classification System, ASTM D-2487
OH, Organic Clayey Silt
Sample Color
Brown

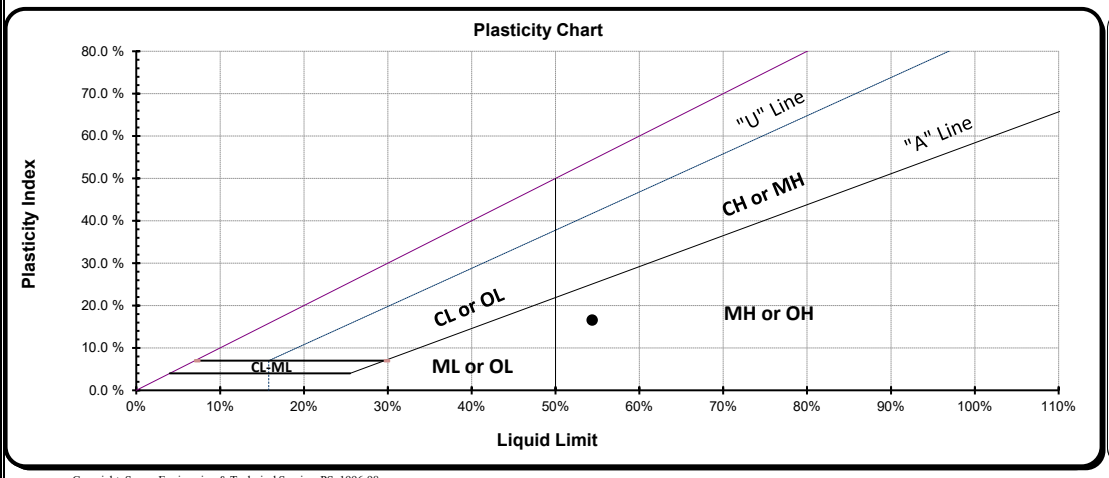
Liquid Limit Determination

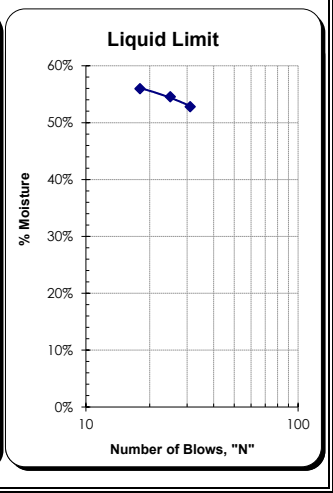
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.69	29.47	32.17			
Weight of Dry Soils + Pan:	26.30	25.94	27.59			
Weight of Pan:	19.88	19.47	19.41			
Weight of Dry Soils:	6.42	6.47	8.18			
Weight of Moisture:	3.39	3.53	4.58			
% Moisture:	52.8 %	54.6 %	56.0 %			
Number of Blows:	31	25	18			

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 %				





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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT02-GT-10.8-11.5-20240617	**Tested By:**	S. Boesenberg
Sample#:	B24-1603	**Control No.:**	10182024

Unified Soils Classification System, ASTM D-2487
OL, Clayey Silt with Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

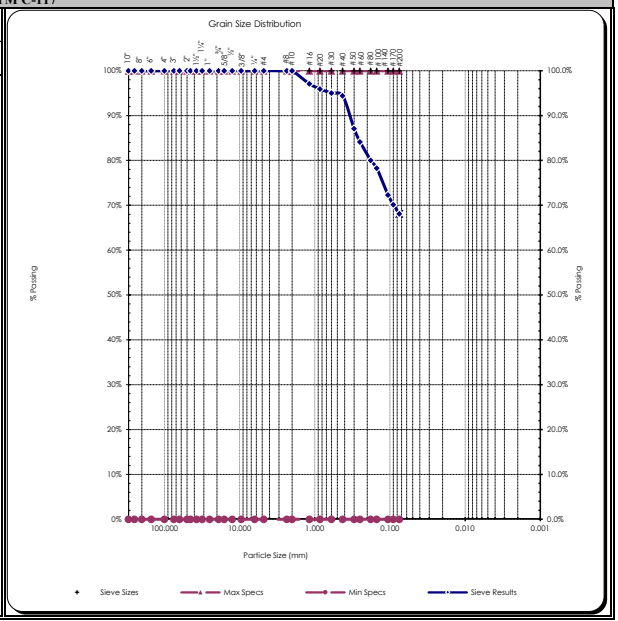
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.006	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 1.50
$D_{(10)}$ =	0.011	mm	% Sand =	31.9%	Coeff. of Uniformity, C_U = 6.00
$D_{(15)}$ =	0.017	mm	% Silt & Clay =	68.1%	Fineness Modulus = 0.43
$D_{(30)}$ =	0.033	mm	Liquid Limit =	45.1%	Plastic Limit = 34.2%
$D_{(50)}$ =	0.055	mm	Plasticity Index =	10.9%	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.066	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.350	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	44/61		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT02-GT-10.8-11.5-20240617	**Tested By:**	S. Boesenberg
Sample#:	B24-1603	**Control No.:**	10182024

Unified Soils Classification System, ASTM D-2487
OL, Clayey Silt with Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.16	grams
Hydroscopic Moist.:	4.16%	
Adj. Sample Wgt :	48.16	grams

Hydrometer Reading Minutes	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

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	31.9%	**Plastic Limit:**	n/a
% Silt:	51.7%	**Plasticity Index:**	n/a
% Clay:	16.4%		

ASTM C-136

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"	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

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

USDA Soil Textural Classification
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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT02-GT-10.8-11.5-20240617	**Tested By:**	S. Boesenberg
Sample #:	B24-1603	**Control No.:**	10182024

Unified Soils Classification System, ASTM D-2487
OL, Clayey Silt with Sand
Sample Color
Brown

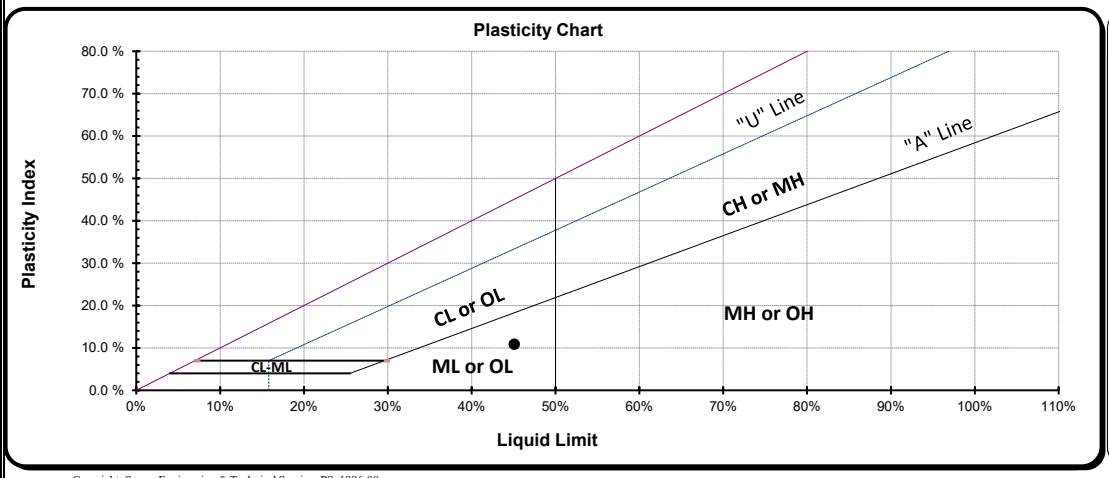
Liquid Limit Determination

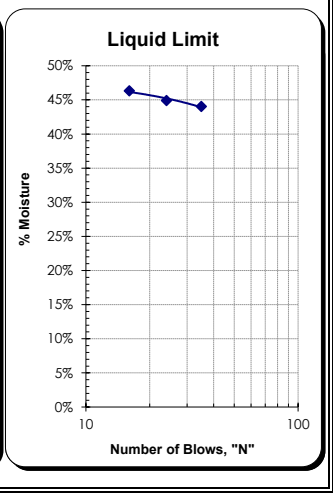
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	23.90	24.08	40.70			
Weight of Dry Soils + Pan:	21.09	21.13	36.71			
Weight of Pan:	14.71	14.56	28.10			
Weight of Dry Soils:	6.38	6.57	8.61			
Weight of Moisture:	2.81	2.95	3.99			
% Moisture:	44.0 %	44.9 %	46.3 %			
Number of Blows:	35	24	16			

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 %				





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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	23-Sep-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Silt with Clay and Sand	
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24	**Sample Color:**	
Source:	LDW23-GT02-GT-15.5-16.5-20240617	**Tested By:**	R. Bohler	Brown	
Sample#:	B24-1605	**Control No.:**	10182024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

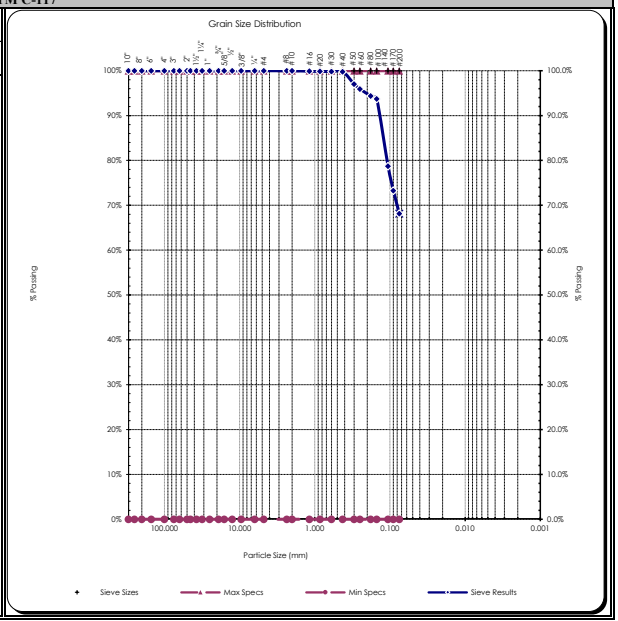
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.006	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.50
$D_{(10)}$ =	0.011	mm	% Sand =	31.9%	Coeff. of Uniformity, C_U =	6.00
$D_{(15)}$ =	0.017	mm	% Silt & Clay =	68.1%	Fineness Modulus =	0.10
$D_{(30)}$ =	0.033	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.055	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	0.066	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.139	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	28/41		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT10-GT-5-6.5-20240618	**Tested By:**	Z. Romney
Sample #:	B24-1609	**Control No.:**	10182024

Unified Soils Classification System, ASTM D-2487
OH, Organic Silty Clay with Sand
Sample Color
Brown

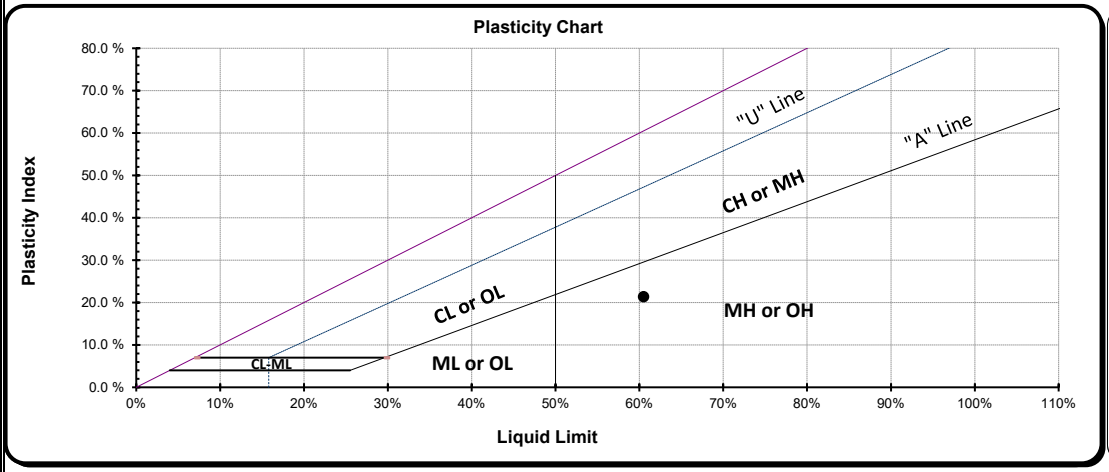
Liquid Limit Determination

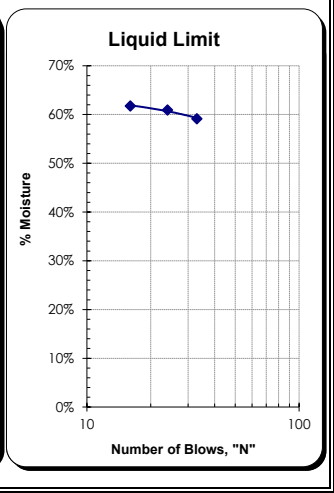
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	31.45	24.69	25.03			
Weight of Dry Soils + Pan:	26.93	20.65	20.85			
Weight of Pan:	19.29	14.02	14.08			
Weight of Dry Soils:	7.64	6.63	6.77			
Weight of Moisture:	4.52	4.04	4.18			
% Moisture:	59.2 %	60.9 %	61.7 %			
Number of Blows:	33	24	16			

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 %				





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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	**Date Received:**	23-Sep-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Clayey Silt	
Client:	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24	**Sample Color:**	
Source:	LDW23-GT10-GT-10-11.5-20240618	**Tested By:**	S. Boesenberg	Brown	
Sample#:	B24-1610	**Control No.:**	10182024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

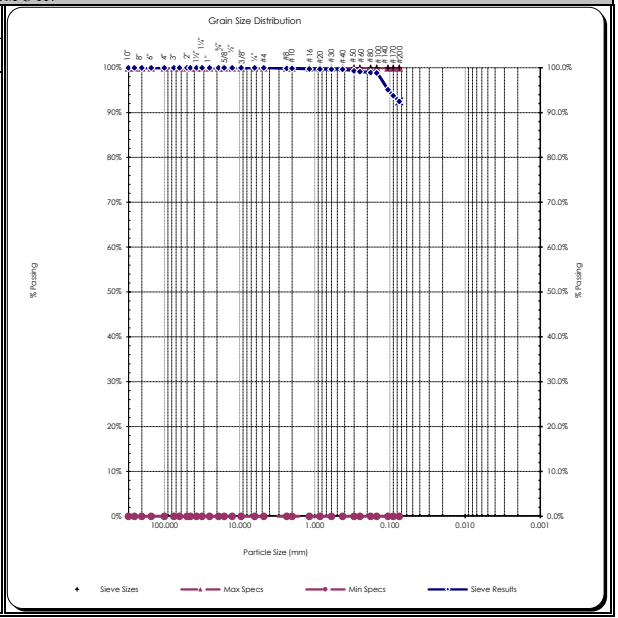
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.004	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.50
$D_{(10)}$ =	0.008	mm	% Sand =	7.5%	Coeff. of Uniformity, C_U =	6.00
$D_{(15)}$ =	0.012	mm	% Silt & Clay =	92.5%	Fineness Modulus =	0.03
$D_{(30)}$ =	0.024	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.041	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	0.049	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.073	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	13/14		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	15-Oct-24
Source:	LDW23-GT10-GT-10-11.5-20240618	**Tested By:**	S. Boesenberg
Sample#:	B24-1610	**Control No.:**	10182024

Visual Soils Classification
Clayey Silt
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.24	grams
Hydroscopic Moist.:	7.69%	
Adj. Sample Wgt :	46.65	grams

Hydrometer Reading Minutes	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

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	7.5%	**Plastic Limit:**	n/a
% Silt:	68.8%	**Plasticity Index:**	n/a
% Clay:	23.7%		

ASTM C-136

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"	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

USDA Soil Textural Classification

	Particle Size
% Sand:	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

Client:	Anchor QEA, LLC.	**Date:**	October 23, 2024
Address:	1201 3rd Avenue, Suite 2600	**Project:**	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
	Seattle, WA 98101	**Project #:**	24B105
Attn:	Cindy Fields	**Sample #:**	B24-1612 - 1637
Revised On:		**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%

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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	**Date Received:**	23-Sep-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Clayey Silt with Sand	
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24	**Sample Color:**	
Source:	LDW23-GT10-GT-15.5-16.5-20240618	**Tested By:**	Z. Romney	Brown	
Sample#:	B24-1612	**Control No.:**	10232024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

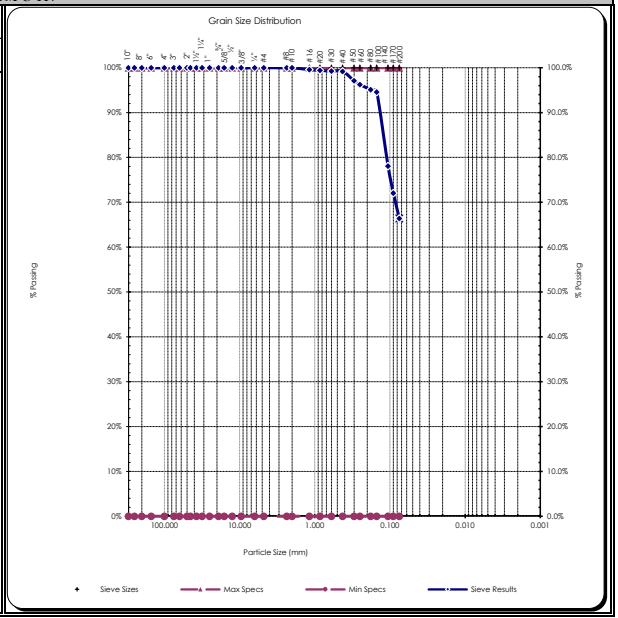
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.006	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.50
$D_{(10)}$ =	0.011	mm	% Sand =	33.6%	Coeff. of Uniformity, C_U =	6.00
$D_{(15)}$ =	0.017	mm	% Silt & Clay =	66.4%	Fineness Modulus =	0.09
$D_{(30)}$ =	0.034	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.056	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	0.068	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.138	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	2/3		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	18-Oct-24
Source:	LDW23-GT09-GT-0-1.5-20240618	**Tested By:**	S. Boesenberg
Sample #:	B24-1613	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
OH, Organic Clayey Silt
Sample Color
Brown

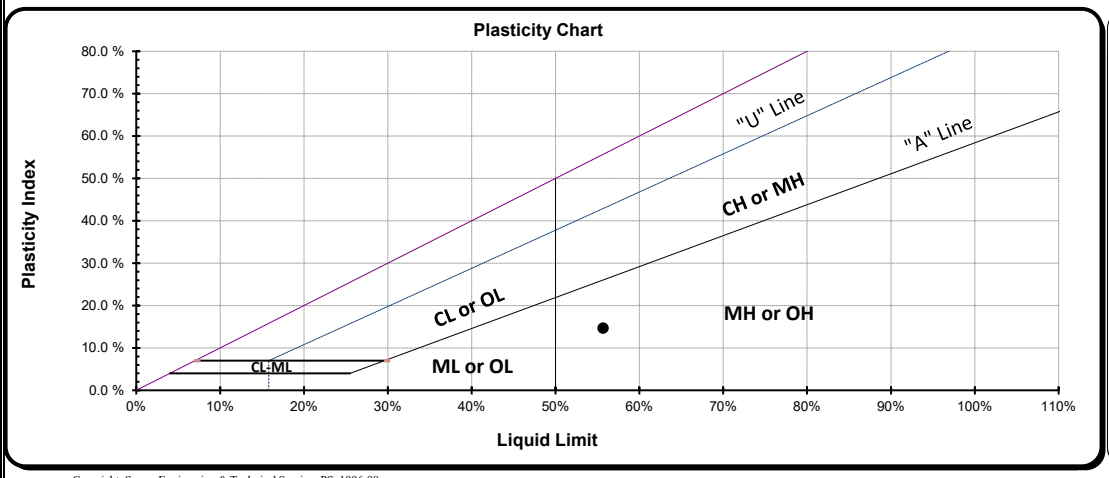
Liquid Limit Determination

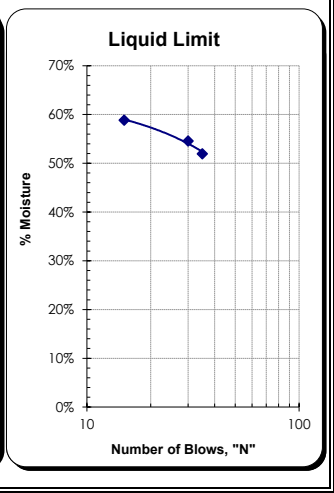
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	26.16	32.56	31.06			
Weight of Dry Soils + Pan:	22.20	27.89	26.80			
Weight of Pan:	14.58	19.33	19.56			
Weight of Dry Soils:	7.62	8.56	7.24			
Weight of Moisture:	3.96	4.67	4.26			
% Moisture:	52.0 %	54.6 %	58.8 %			
Number of Blows:	35	30	15			

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 %				





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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	18-Oct-24
Source:	LDW23-GT09-GT-5-6.2-20240618	**Tested By:**	S. Boesenberg
Sample #:	B24-1614	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
OH, Organic Clayey Silt with Sand
Sample Color
Brown

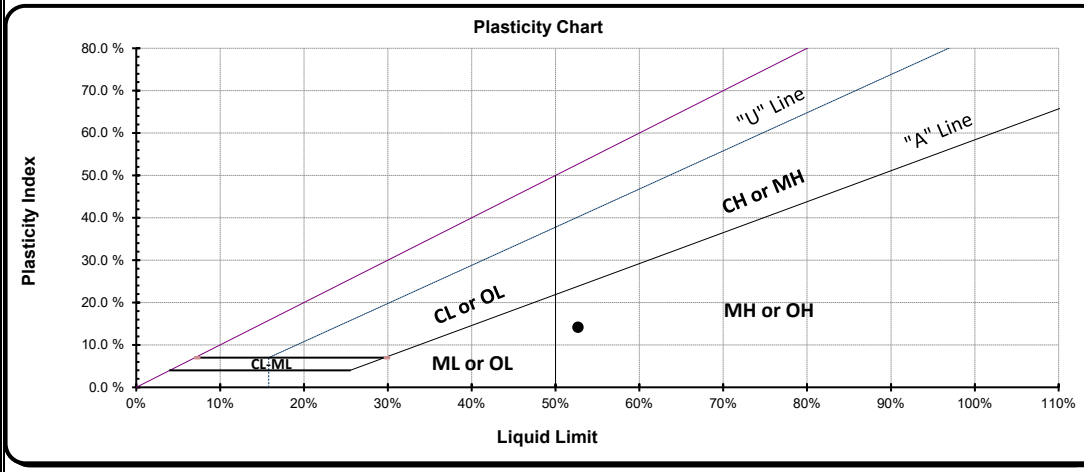
Liquid Limit Determination

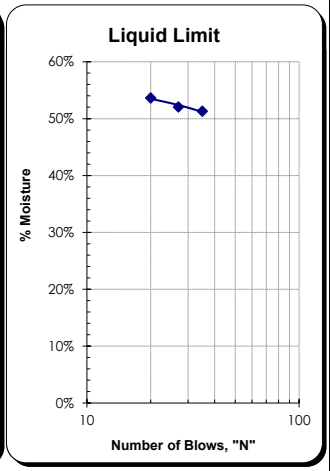
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.34	25.79	37.45			
Weight of Dry Soils + Pan:	26.02	23.63	34.21			
Weight of Pan:	19.55	19.48	28.17			
Weight of Dry Soils:	6.47	4.15	6.04			
Weight of Moisture:	3.32	2.16	3.24			
% Moisture:	51.3 %	52.1 %	53.6 %			
Number of Blows:	35	27	20			

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 %				





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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

Specific Gravity of Soils, ASTM D-854

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Client: Anchor QEA, LLC.
Project #: 24B105
Sampled by: Client
Date Received: September 23, 2024
Tested by: S. Boesenberg
Date Tested: October 18, 2024
Control. No.: 10232024

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B24-1614	LDW23-GT09-GT-5-6.2-20240618	356.71	396.14	39.43	SA-050 (B-2)	92.08	249.31	0.99854	365.84	341.03	18.3	2.697727	1.00034	2.698644
B24-1624	LDW23-GT19-GT-25-26.5-20240619	303.22	346.06	42.84	SA-050 (B-1)	91.89	249.27	0.99793	368.17	340.64	21.3	2.797438	0.99972	2.796655
B24-1630	LDW23-GT11-GT-15-16.5-20240801	303.21	337.15	33.94	SA-050 (B-2)	92.08	249.31	0.99723	361.84	340.70	24.3	2.651684	0.99902	2.649086
				0.00				#N/A		#N/A		#N/A	#N/A	#N/A

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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT09-GT-10-11.5-20240618	**Tested By:**	R. Bohler
Sample#:	B24-1616	**Control No.:**	10232024

Visual Soils Classification
Clayey Silt with Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

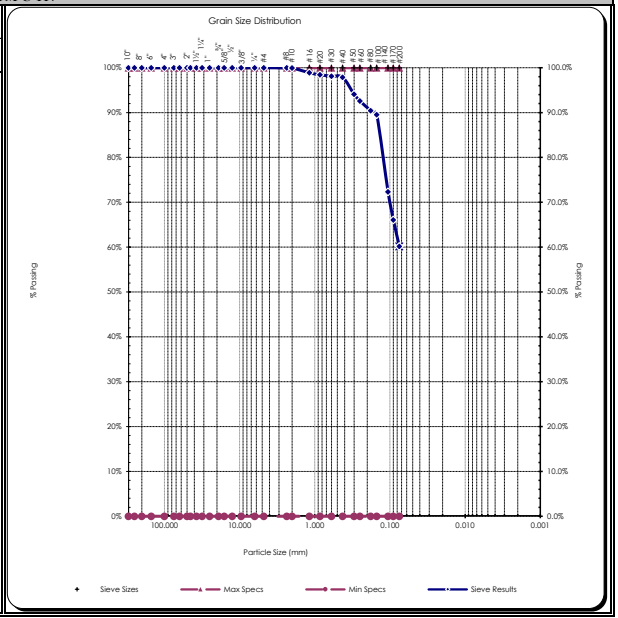
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.006	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 1.50
$D_{(10)}$ =	0.012	mm	% Sand =	39.8%	Coeff. of Uniformity, C_U = 6.00
$D_{(15)}$ =	0.019	mm	% Silt & Clay =	60.2%	Fineness Modulus = 0.19
$D_{(30)}$ =	0.037	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.062	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.075	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.165	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	8/13		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT09-GT-15-16.5-20240618	**Tested By:**	Z. Romney
Sample#:	B24-1617	**Control No.:**	10232024

Visual Soils Classification
Clayey Silt with Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

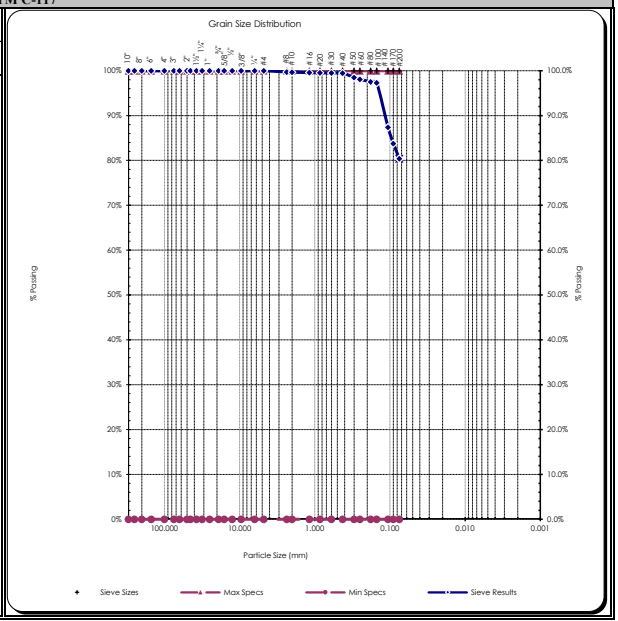
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT09-GT-15-16.5-20240618	**Tested By:**	Z. Romney
Sample#:	B24-1617	**Control No.:**	10232024

Visual Soils Classification
Clayey Silt with Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.15	grams
Hydroscopic Moist.:	5.58%	
Adj. Sample Wgt :	47.50	grams

Hydrometer Reading Minutes	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

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	19.6%	**Plastic Limit:**	n/a
% Silt:	63.3%	**Plasticity Index:**	n/a
% Clay:	17.1%		

ASTM C-136

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"	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

USDA Soil Textural Classification

	Particle Size
% Sand:	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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	18-Oct-24
Source:	LDW23-GT09-GT-15-16.5-20240618	**Tested By:**	S. Boesenberg
Sample #:	B24-1617	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
OL, Clayey Silt
Sample Color
Brown

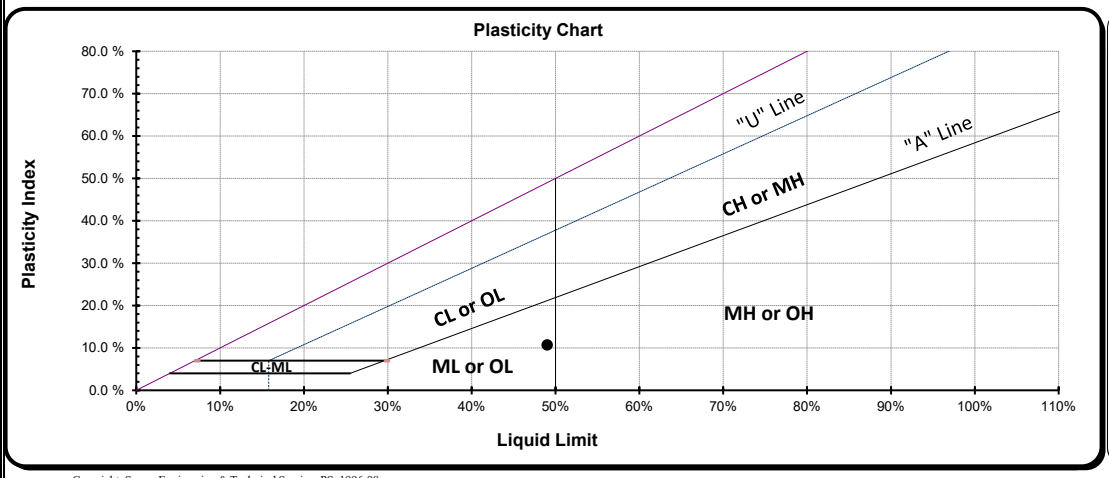
Liquid Limit Determination

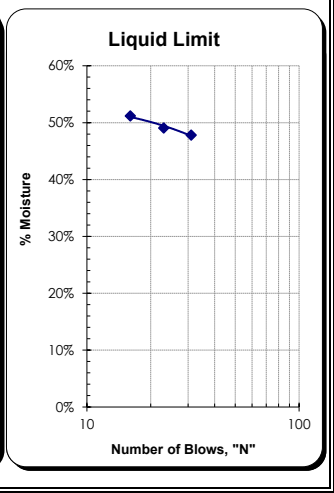
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	34.50	34.57	29.10			
Weight of Dry Soils + Pan:	29.31	29.75	25.88			
Weight of Pan:	18.46	19.93	19.59			
Weight of Dry Soils:	10.85	9.82	6.29			
Weight of Moisture:	5.19	4.82	3.22			
% Moisture:	47.8 %	49.1 %	51.2 %			
Number of Blows:	31	23	16			

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 %				





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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT19-GT-5-6.5-20240619	**Tested By:**	R. Bohler
Sample #:	B24-1619	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
OH, Organic Silty Clay
Sample Color
Brown

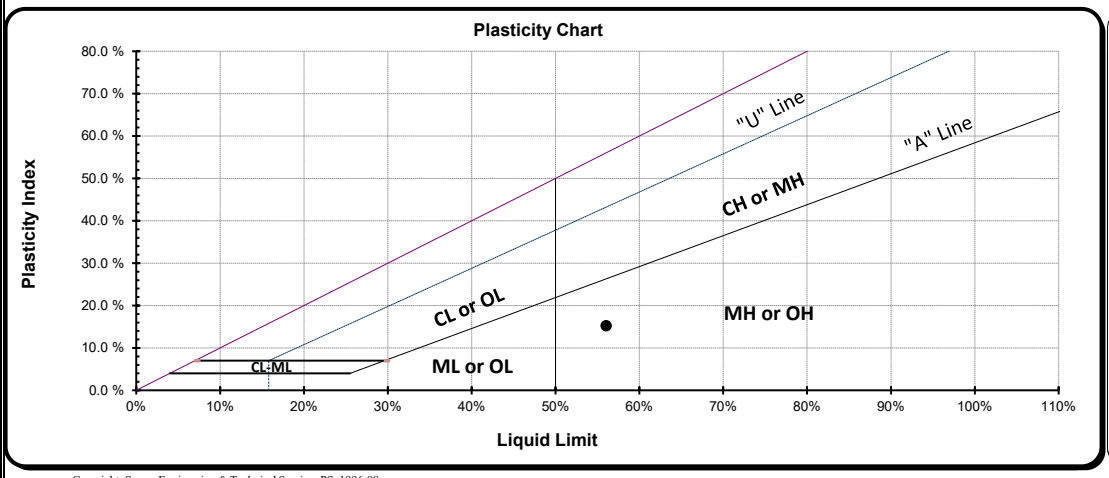
Liquid Limit Determination

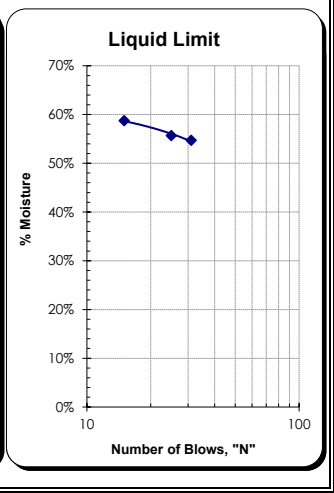
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	33.48	31.11	30.04			
Weight of Dry Soils + Pan:	28.88	27.21	26.62			
Weight of Pan:	20.47	20.21	20.80			
Weight of Dry Soils:	8.41	7.00	5.82			
Weight of Moisture:	4.60	3.90	3.42			
% Moisture:	54.7 %	55.7 %	58.8 %			
Number of Blows:	31	25	15			

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 %				





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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT19-GT-10-11.5-20240619	**Tested By:**	R. Bohler
Sample#:	B24-1620	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

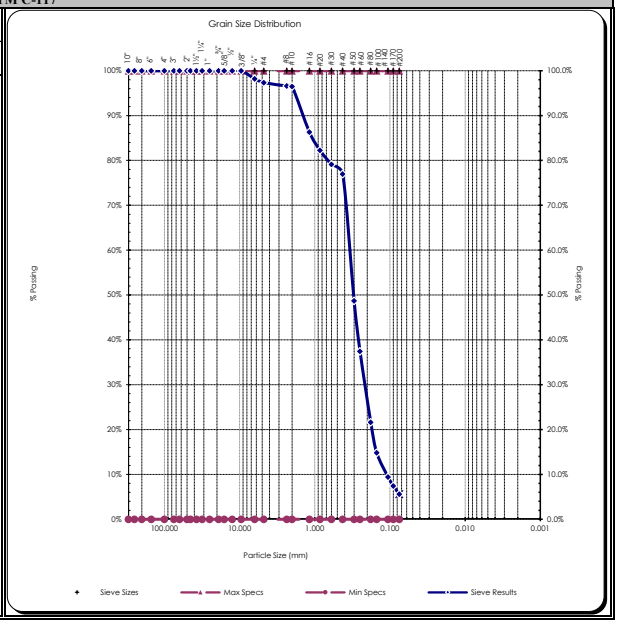
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.067	mm	% Gravel =	2.7%	Coeff. of Curvature, C_C = 1.22
$D_{(10)}$ =	0.111	mm	% Sand =	91.8%	Coeff. of Uniformity, C_U = 3.16
$D_{(15)}$ =	0.151	mm	% Silt & Clay =	5.6%	Fineness Modulus = 1.77
$D_{(30)}$ =	0.217	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.306	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.350	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	1.476	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	4/55		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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:

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT19-GT-25-26.5-20240619	**Tested By:**	S. Boesenberg
Sample#:	B24-1624	**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

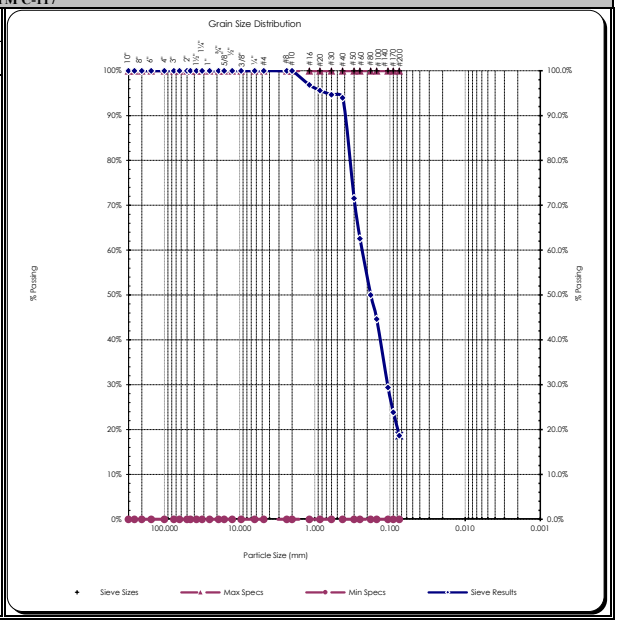
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.020	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 1.23
$D_{(10)}$ =	0.040	mm	% Sand =	81.3%	Coeff. of Uniformity, C_U = 5.87
$D_{(15)}$ =	0.060	mm	% Silt & Clay =	18.7%	Fineness Modulus = 0.92
$D_{(30)}$ =	0.108	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.180	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.236	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.403	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	1/5		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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		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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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT19-GT-25-26.5-20240619	**Tested By:**	S. Boesenberg
Sample#:	B24-1624	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.07	grams
Hydroscopic Moist.:	1.36%	
Adj. Sample Wgt :	98.73	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	8	8.1%	0.0374 mm
5	6	6.1%	0.0239 mm
15	4.5	4.6%	0.0139 mm
30	4	4.1%	0.0098 mm
60	2	2.0%	0.0070 mm
250	2	2.0%	0.0035 mm
1440	1	1.0%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	81.3%	**Plastic Limit:**	n/a
% Silt:	16.6%	**Plasticity Index:**	n/a
% Clay:	2.0%		

ASTM C-136

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"	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	45%	0.150 mm
#200	18.7%	0.075 mm
Silts	18.4%	0.074 mm
	11.6%	0.050 mm
	5.5%	0.020 mm
Clays	2.0%	0.005 mm
	1.3%	0.002 mm
Colloids	0.7%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

USDA Soil Textural Classification
Sand

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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT11-GT-1.3-2-20240801	**Tested By:**	S. Boesenberg
Sample#:	B24-1626	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand with Gravel
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

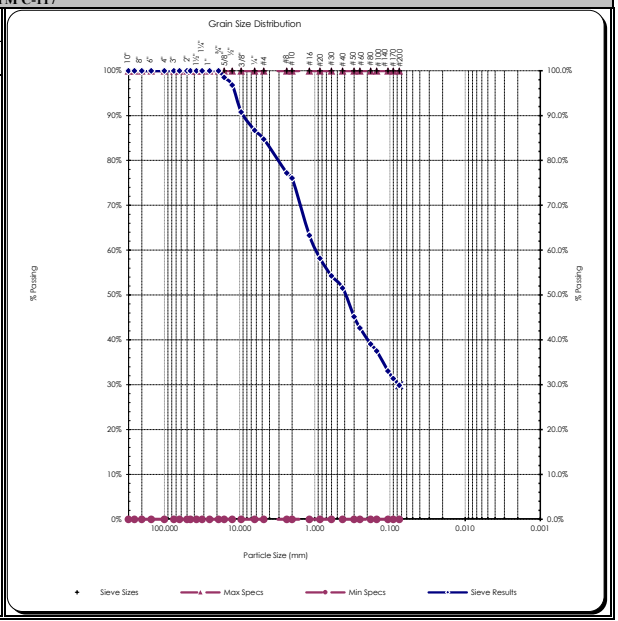
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.013	mm	% Gravel =	15.3%	Coeff. of Curvature, C_C = 0.24
$D_{(10)}$ =	0.025	mm	% Sand =	54.9%	Coeff. of Uniformity, C_U = 38.53
$D_{(15)}$ =	0.038	mm	% Silt & Clay =	29.9%	Fineness Modulus = 2.47
$D_{(30)}$ =	0.076	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.394	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.968	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	8.869	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	11/19		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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		99%	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%	100.0%	0.0%
#4	4.75	85%	85%	100.0%	0.0%
#8	2.36		77%	100.0%	0.0%
#10	2.00	76%	76%	100.0%	0.0%
#16	1.18		63%	100.0%	0.0%
#20	0.850		58%	100.0%	0.0%
#30	0.600		54%	100.0%	0.0%
#40	0.425	52%	52%	100.0%	0.0%
#50	0.300		45%	100.0%	0.0%
#60	0.250		43%	100.0%	0.0%
#80	0.180		39%	100.0%	0.0%
#100	0.150	38%	38%	100.0%	0.0%
#140	0.106		33%	100.0%	0.0%
#170	0.090		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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT11-GT-1.3-2-20240801	**Tested By:**	S. Boesenberg
Sample#:	B24-1626	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand with Gravel
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.29	grams
Hydroscopic Moist.:	4.79%	
Adj. Sample Wgt :	95.71	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	27	21.5%	0.0333 mm
5	21	16.7%	0.0219 mm
15	19	15.1%	0.0128 mm
30	15	11.9%	0.0093 mm
60	12	9.5%	0.0067 mm
250	10	7.9%	0.0033 mm
1440	7.5	6.0%	0.0014 mm

% Gravel:	15.3%	**Liquid Limit:**	n/a
% Sand:	54.9%	**Plastic Limit:**	n/a
% Silt:	21.1%	**Plasticity Index:**	n/a
% Clay:	8.7%		

ASTM C-136

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"	99%	16.000 mm
1/2"	97%	12.500 mm
3/8"	91%	9.500 mm
1/4"	87%	6.300 mm
#4	85%	4.750 mm
#10	76%	2.000 mm
#20	58%	0.850 mm
#40	52%	0.425 mm
#100	38%	0.150 mm
#200	29.9%	0.075 mm
Silts	29.7%	0.074 mm
	24.8%	0.050 mm
	16.4%	0.020 mm
Clays	8.7%	0.005 mm
	6.6%	0.002 mm
Colloids	4.2%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT11-GT-5-6.5-20240801	**Tested By:**	R. Bohler
Sample#:	B24-1627	**Control No.:**	10232024

Visual Soils Classification
Clayey, Silt with Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

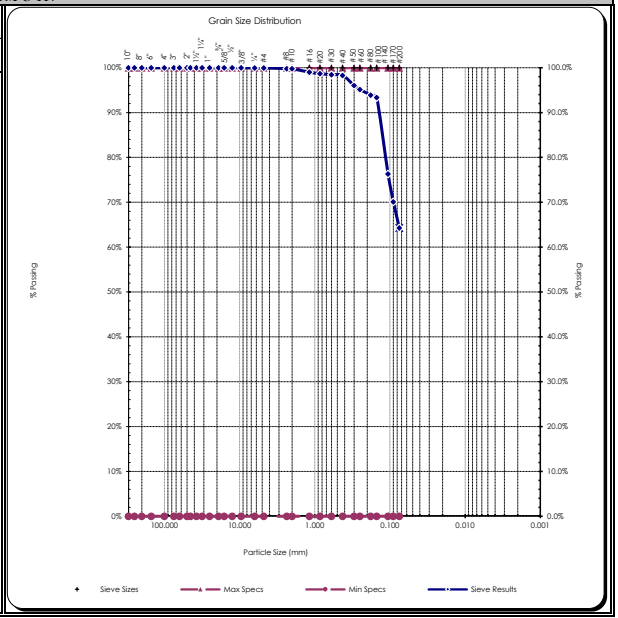
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.006	mm	% Gravel =	0.1%	Coeff. of Curvature, C_C = 1.50
$D_{(10)}$ =	0.012	mm	% Sand =	35.7%	Coeff. of Uniformity, C_U = 6.00
$D_{(15)}$ =	0.017	mm	% Silt & Clay =	64.3%	Fineness Modulus = 0.13
$D_{(30)}$ =	0.035	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.058	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.070	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.141	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	17/26		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

MATERIALS TESTING & CONSULTING, INC.

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	**Date Received:**	23-Sep-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Silty Sand	
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24	**Sample Color**	
Source:	LDW23-GT11-GT-10-10.8-20240801	**Tested By:**	S. Boesenberg	Brown	
Sample #:	B24-1628	**Control No.:**	10232024		

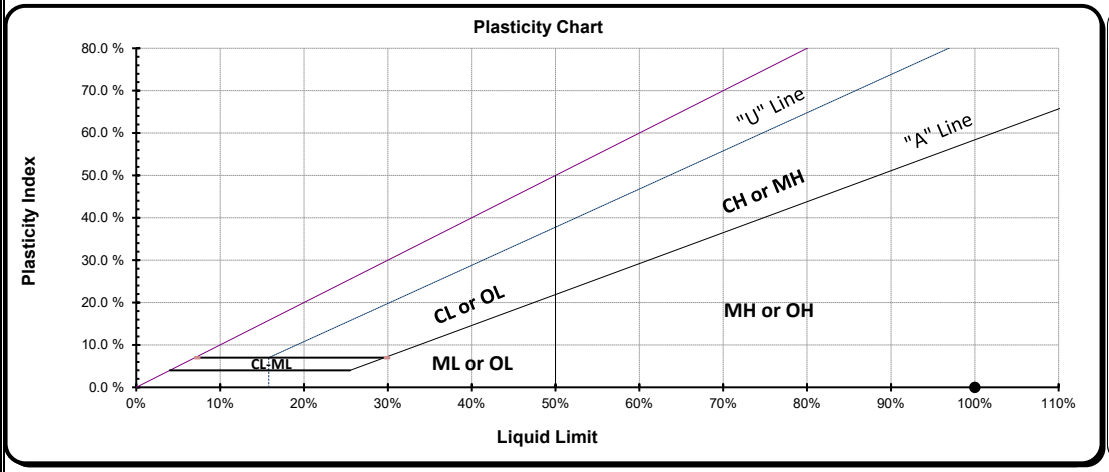
Liquid Limit Determination

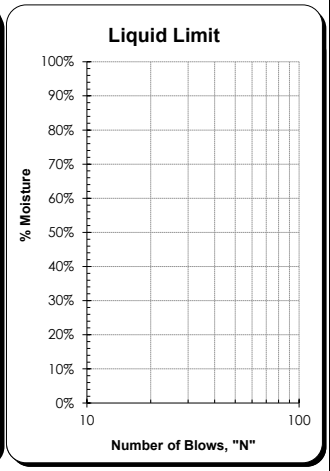
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:			Unable to Establish			
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT11-GT-20-21.3-20240801	**Tested By:**	S. Boesenberg
Sample#:	B24-1631	**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

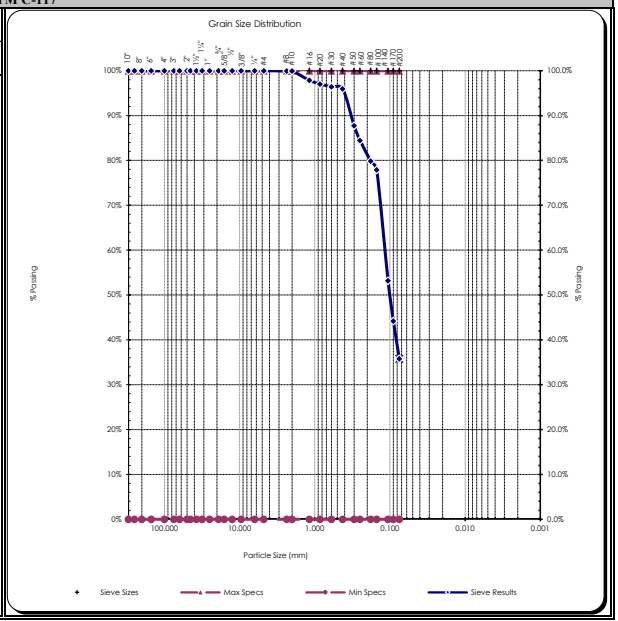
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.010	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 1.60
$D_{(10)}$ =	0.021	mm	% Sand =	64.2%	Coeff. of Uniformity, C_U = 5.64
$D_{(15)}$ =	0.031	mm	% Silt & Clay =	35.8%	Fineness Modulus = 0.40
$D_{(30)}$ =	0.063	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.100	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.118	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.334	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	22/59		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

Hydrometer Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT11-GT-20-21.3-20240801	**Tested By:**	S. Boesenberg
Sample#:	B24-1631	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.04	grams
Hydroscopic Moist.:	1.82%	
Adj. Sample Wgt :	98.25	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	17.5	17.8%	0.0355 mm
5	13.5	13.7%	0.0230 mm
15	8.5	8.6%	0.0137 mm
30	7.5	7.6%	0.0097 mm
60	5.5	5.6%	0.0069 mm
250	4	4.1%	0.0034 mm
1440	2.5	2.5%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	64.2%	**Plastic Limit:**	n/a
% Silt:	31.0%	**Plasticity Index:**	n/a
% Clay:	4.8%		

ASTM C-136

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"	100%	6.300 mm
#4	100%	4.750 mm
#10	100%	2.000 mm
#20	97%	0.850 mm
#40	96%	0.425 mm
#100	78%	0.150 mm
#200	35.8%	0.075 mm
Silts	35.3%	0.074 mm
	24.4%	0.050 mm
	12.1%	0.020 mm
Clays	4.8%	0.005 mm
	3.0%	0.002 mm
Colloids	1.8%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% 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:

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	21-Oct-24
Source:	LDW23-GT11-GT-25-26.5-20240801	**Tested By:**	R. Bohler
Sample #:	B24-1633	**Control No.:**	10232024

Unified Soils Classification System, ASTM D-2487
OH, Organic Silty Clay with Sand
Sample Color
Brown

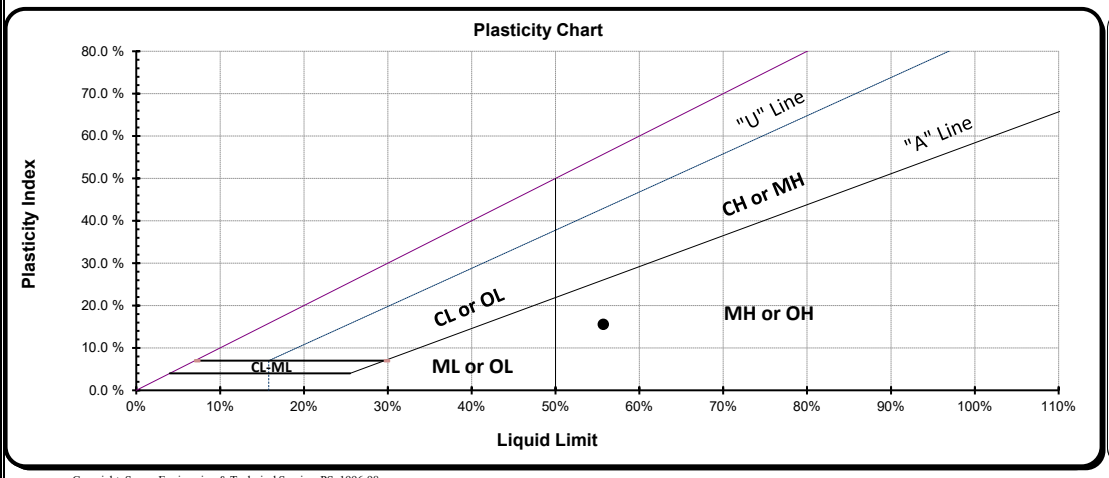
Liquid Limit Determination

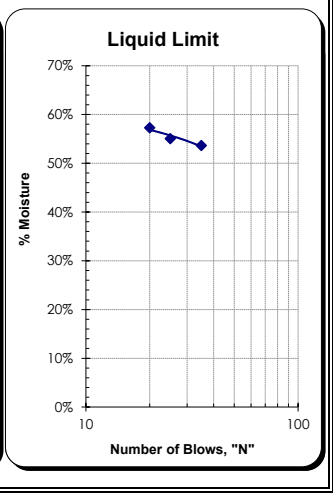
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	34.72	24.48	30.00			
Weight of Dry Soils + Pan:	29.35	20.88	26.34			
Weight of Pan:	19.34	14.34	19.95			
Weight of Dry Soils:	10.01	6.54	6.39			
Weight of Moisture:	5.37	3.60	3.66			
% Moisture:	53.7 %	55.1 %	57.3 %			
Number of Blows:	35	25	20			

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 %				





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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

Client:	Anchor QEA, LLC.	**Date:**	October 25, 2024
Address:	1201 3rd Avenue, Suite 2600	**Project:**	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
	Seattle, WA 98101	**Project #:**	24B105
Attn:	Cindy Fields	**Sample #:**	B24-1638 - 1662
Revised On:		**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

Alex Eifrig
WABO Supervising Laboratory Technician

Sieve Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT13-GT-5-6.5-20240801	**Tested By:**	R. Bohler
Sample#:	B24-1638	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand with Gravel
Sample Color:
Gray

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

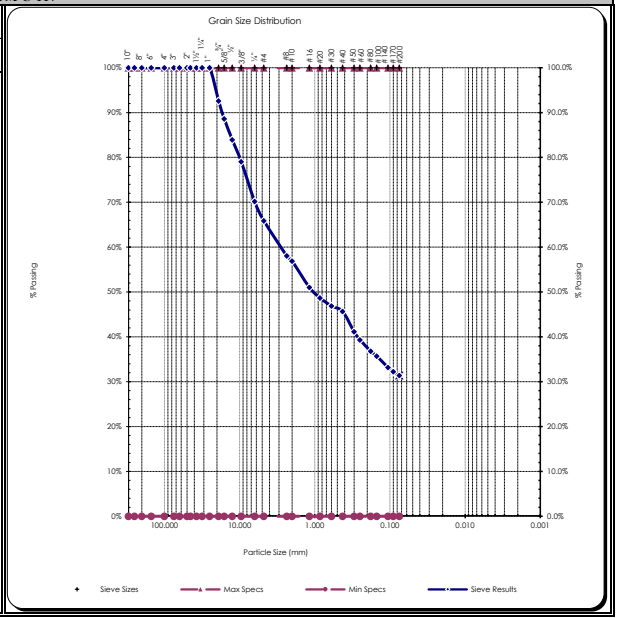
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	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
$D_{(30)}$ =	0.072	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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%	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%	100.0%	0.0%
#4	4.75	66%	66%	100.0%	0.0%
#8	2.36		58%	100.0%	0.0%
#10	2.00	57%	57%	100.0%	0.0%
#16	1.18		51%	100.0%	0.0%
#20	0.850		49%	100.0%	0.0%
#30	0.600		47%	100.0%	0.0%
#40	0.425	46%	46%	100.0%	0.0%
#50	0.300		41%	100.0%	0.0%
#60	0.250		39%	100.0%	0.0%
#80	0.180		37%	100.0%	0.0%
#100	0.150	36%	36%	100.0%	0.0%
#140	0.106		33%	100.0%	0.0%
#170	0.090		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	**Date Received:**	23-Sep-24	**Unified Soils Classification System, ASTM D-2487**	
Project #:	24B105	**Sampled By:**	Client	GP-GM, Poorly graded Gravel with Silt	
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24	**Sample Color:**	
Source:	LDW23-GT13-GT-10-11-20240801	**Tested By:**	R. Bohler	Brown	
Sample#:	B24-1639	**Control No.:**	10252024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

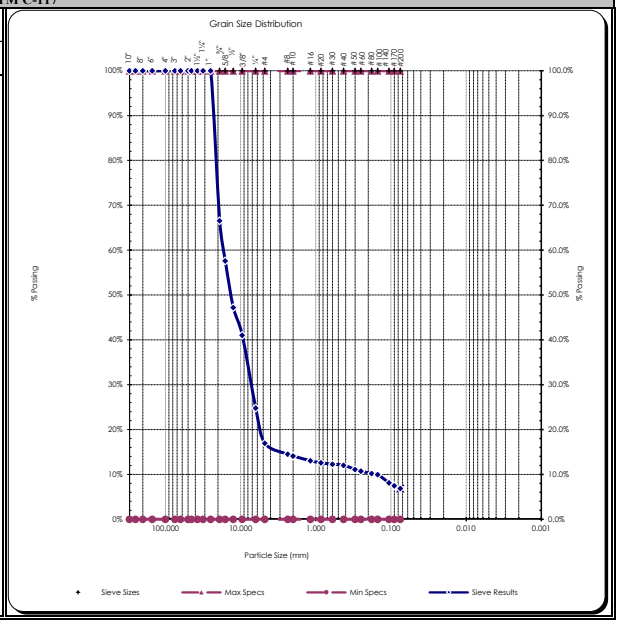
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.055	mm	% Gravel =	83.0%	Coeff. of Curvature, C_C =	20.66
$D_{(10)}$ =	0.155	mm	% Sand =	10.1%	Coeff. of Uniformity, C_U =	108.64
$D_{(15)}$ =	2.855	mm	% Silt & Clay =	6.9%	Fineness Modulus =	6.15
$D_{(30)}$ =	7.323	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	13.440	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	16.795	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	23.205	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	33/58		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	67%	67%	100.0%	0.0%
5/8"	16.00		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%	100.0%	0.0%
#4	4.75	17%	17%	100.0%	0.0%
#8	2.36		14%	100.0%	0.0%
#10	2.00	14%	14%	100.0%	0.0%
#16	1.18		13%	100.0%	0.0%
#20	0.850		13%	100.0%	0.0%
#30	0.600		12%	100.0%	0.0%
#40	0.425	12%	12%	100.0%	0.0%
#50	0.300		11%	100.0%	0.0%
#60	0.250		11%	100.0%	0.0%
#80	0.180		10%	100.0%	0.0%
#100	0.150	10%	10%	100.0%	0.0%
#140	0.106		8%	100.0%	0.0%
#170	0.090		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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT13-GT-11-11.5-20240801	**Tested By:**	S. Boesenberg
Sample#:	B24-1640	**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

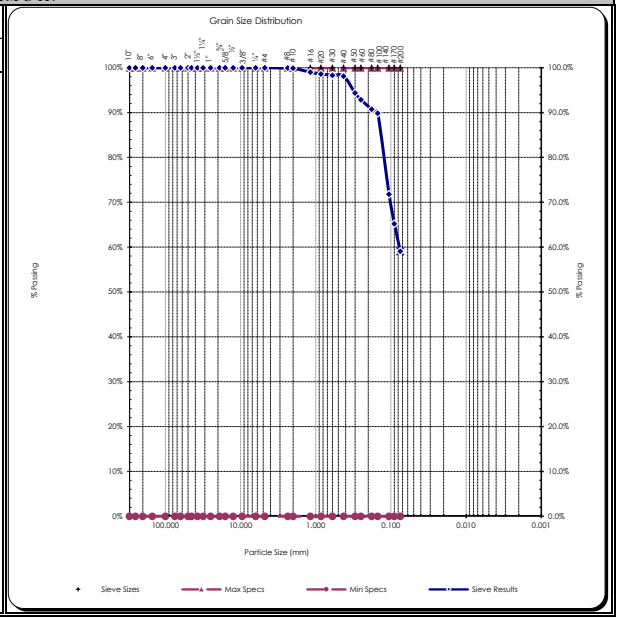
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.006	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 1.48
$D_{(10)}$ =	0.013	mm	% Sand =	40.9%	Coeff. of Uniformity, C_U = 6.08
$D_{(15)}$ =	0.019	mm	% Silt & Clay =	59.1%	Fineness Modulus = 0.19
$D_{(30)}$ =	0.038	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.063	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.077	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.155	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	56/93		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT13-GT-11-11.5-20240801	**Tested By:**	S. Boesenberg
Sample#:	B24-1640	**Control No.:**	10252024

Visual Soils Classification
Clayey, Silty Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.01	grams
Hydroscopic Moist.:	1.88%	
Adj. Sample Wgt :	98.16	grams

Hydrometer Reading Minutes	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

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	40.9%	**Plastic Limit:**	n/a
% Silt:	50.8%	**Plasticity Index:**	n/a
% Clay:	8.3%		

ASTM C-136

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"	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

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT13-GT-15-16.5-20240801	**Tested By:**	R. Bohler
Sample#:	B24-1641	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
SP-SM, Poorly graded Sand with Silt and Gravel
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

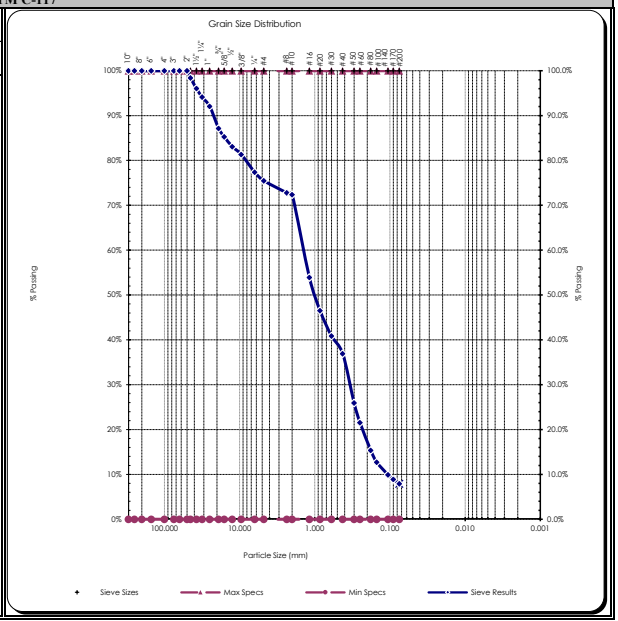
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

MATERIALS TESTING & CONSULTING, INC.

Specific Gravity of Soils, ASTM D-854

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Client: Anchor QEA, LLC.
Project #: 24B105
Sampled by: Client
Date Received: September 23, 2024
Tested by: S. Boesenberg
Date Tested: October 22, 2024
Control. No.: 10252024

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B24-1642	LDW23-GT13-GT-20-21.5-20240801	266.37	303.25	36.88	SA-050 (B-1)	91.89	249.27	0.99725	363.11	340.47	24.2	2.5890681	0.99904	2.5865826
B24-1660	LDW23-GT21-GT-15-16.5-20240805	429.66	471.88	42.22	SA-050 (B-2)	92.08	249.31	0.99732	367.99	340.72	23.9	2.823731	0.99912	2.8212461

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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	23-Oct-24
Source:	LDW23-GT13-GT-30-31.5-20240801	**Tested By:**	S. Boesenberg
Sample #:	B24-1644	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
OH, Organic Silty Clay
Sample Color
Brown

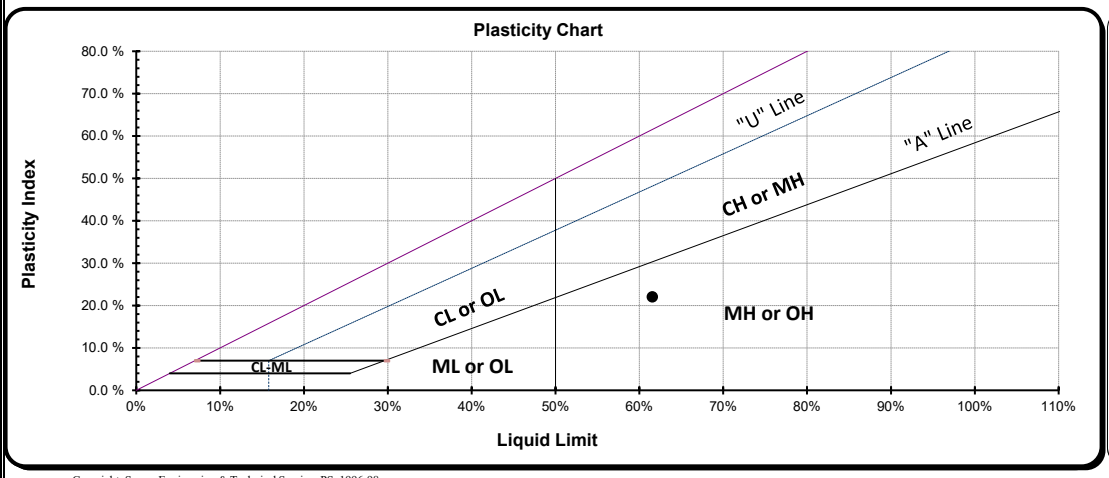
Liquid Limit Determination

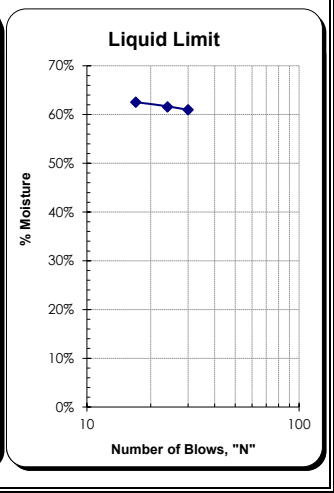
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.17	27.75	31.92			
Weight of Dry Soils + Pan:	23.48	24.24	27.31			
Weight of Pan:	14.15	18.54	19.94			
Weight of Dry Soils:	9.33	5.70	7.37			
Weight of Moisture:	5.69	3.51	4.61			
% Moisture:	61.0 %	61.6 %	62.6 %			
Number of Blows:	30	24	17			

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 %				





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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

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

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

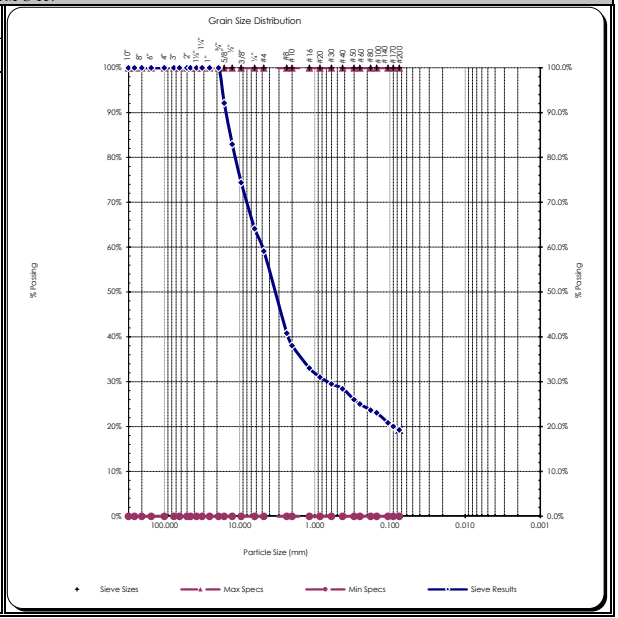
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.019	mm	% Gravel = 40.9%	Coeff. of Curvature, C_C = 2.38	
$D_{(10)}$ = 0.039	mm	% Sand = 39.9%	Coeff. of Uniformity, C_U = 128.95	
$D_{(15)}$ = 0.058	mm	% Silt & Clay = 19.3%	Fineness Modulus = 4.14	
$D_{(30)}$ = 0.682	mm	Liquid Limit = n/a	Plastic Limit = n/a	
$D_{(50)}$ = 3.559	mm	Plasticity Index = n/a	Moisture %, as sampled = n/a	
$D_{(60)}$ = 5.022	mm	Sand Equivalent = n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 15.190	mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 21/31		Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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%

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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT21-GT-5-6.5-20240805	**Tested By:**	S. Boesenberg
Sample#:	B24-1648	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
GM, Silty Gravel with Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.01	grams
Hydroscopic Moist.:	3.06%	
Adj. Sample Wgt :	48.53	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	15.5	12.2%	0.0359 mm
5	13.5	10.6%	0.0230 mm
15	10.5	8.2%	0.0135 mm
30	8.5	6.7%	0.0097 mm
60	8	6.3%	0.0068 mm
250	5.5	4.3%	0.0034 mm
1440	3	2.4%	0.0014 mm

% Gravel:	40.9%	**Liquid Limit:**	n/a
% Sand:	39.9%	**Plastic Limit:**	n/a
% Silt:	14.0%	**Plasticity Index:**	n/a
% Clay:	5.2%		

ASTM C-136

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"	92%	16.000 mm
1/2"	83%	12.500 mm
3/8"	74%	9.500 mm
1/4"	64%	6.300 mm
#4	59%	4.750 mm
#10	38%	2.000 mm
#20	31%	0.850 mm
#40	28%	0.425 mm
#100	23%	0.150 mm
#200	19.3%	0.075 mm
Silts	19.1%	0.074 mm
	14.7%	0.050 mm
	9.8%	0.020 mm
Clays	5.2%	0.005 mm
	2.9%	0.002 mm
Colloids	1.6%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT21-GT-10-11.5-20240805	**Tested By:**	R. Bohler
Sample#:	B24-1649	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
SP-SM, Poorly graded Sand with Silt and Gravel
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

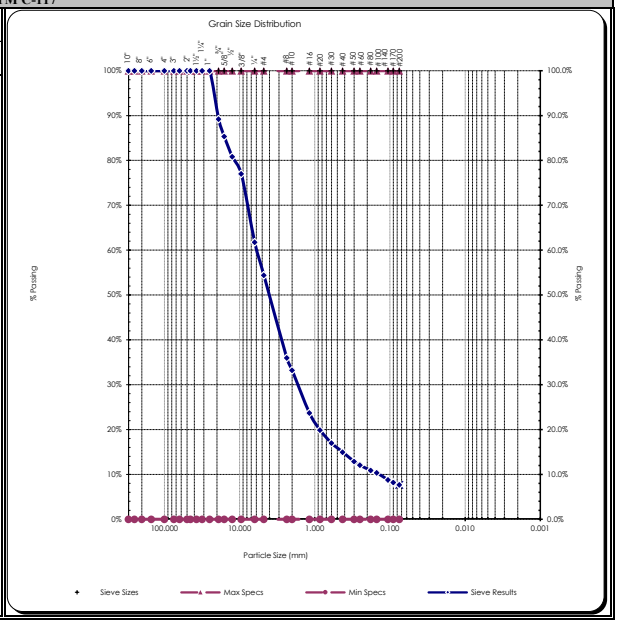
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.049	mm	% Gravel =	45.6%	Coeff. of Curvature, C_C = 3.59
$D_{(10)}$ =	0.140	mm	% Sand =	46.7%	Coeff. of Uniformity, C_U = 42.44
$D_{(15)}$ =	0.427	mm	% Silt & Clay =	7.7%	Fineness Modulus = 4.79
$D_{(30)}$ =	1.723	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	4.180	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	5.928	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	19.437	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	23/45		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT21-GT-20-21.3-20240805	**Tested By:**	S. Boesenberg
Sample#:	B24-1651	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
GP, Poorly graded Gravel with Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

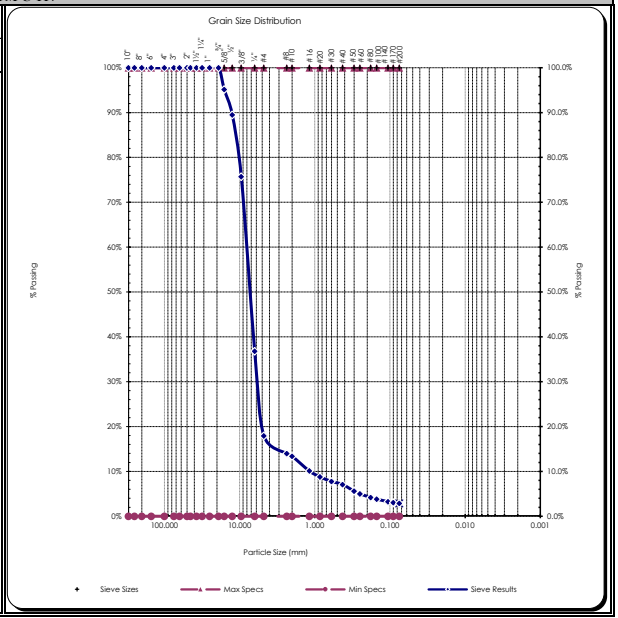
Sample Meets Specs ? N/A

$D_{(5)}$ =	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
$D_{(30)}$ =	5.743	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	7.387	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	8.208	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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%
#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	2.9%	2.9%	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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT21-GT-20-21.3-20240805	**Tested By:**	S. Boesenberg
Sample#:	B24-1651	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
GP, Poorly graded Gravel with Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	12.70	grams
Hydroscopic Moist.:	2.22%	
Adj. Sample Wgt :	12.42	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	2.5	2.7%	0.0386 mm
5	2	2.2%	0.0244 mm
15	1	1.1%	0.0141 mm
30	1	1.1%	0.0100 mm
60	1	1.1%	0.0071 mm
250	1	1.1%	0.0035 mm
1440	1	1.1%	0.0014 mm

% Gravel:	82.1%	**Liquid Limit:**	n/a
% Sand:	15.0%	**Plastic Limit:**	n/a
% Silt:	1.8%	**Plasticity Index:**	n/a
% Clay:	1.1%		

ASTM C-136

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"	95%	16.000 mm
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
#20	9%	0.850 mm
#40	7%	0.425 mm
#100	4%	0.150 mm
#200	2.9%	0.075 mm
Silts	2.9%	0.074 mm
	2.7%	0.050 mm
	1.7%	0.020 mm
Clays	1.1%	0.005 mm
	1.1%	0.002 mm
Colloids	0.7%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT21-GT-41.1-41.5-20240805	**Tested By:**	R. Bohler
Sample#:	B24-1657	**Control No.:**	10252024

Visual Soils Classification
Sandy Silt
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

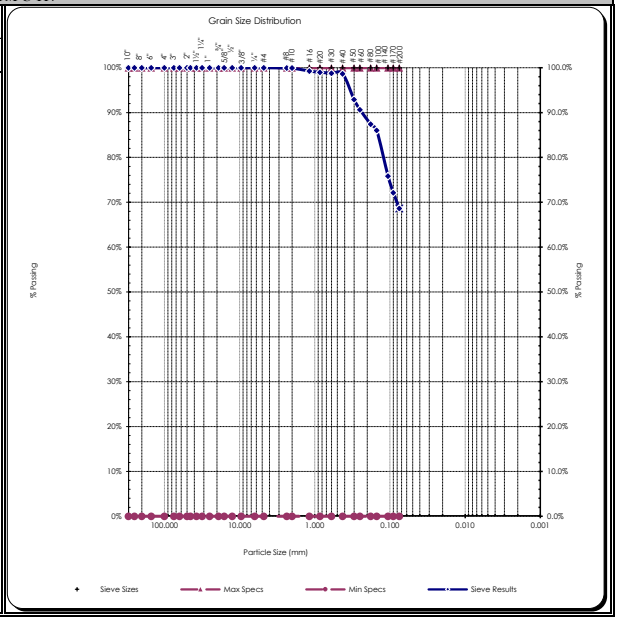
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.005	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 1.50
$D_{(10)}$ =	0.011	mm	% Sand =	31.4%	Coeff. of Uniformity, C_U = 6.00
$D_{(15)}$ =	0.016	mm	% Silt & Clay =	68.6%	Fineness Modulus = 0.23
$D_{(30)}$ =	0.033	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.055	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.066	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.236	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	16/23		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT35-GT-0.5-1.6-20240805	**Tested By:**	R. Bohler
Sample#:	B24-1658	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
GW-GM, Well-graded Gravel with Silt and Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

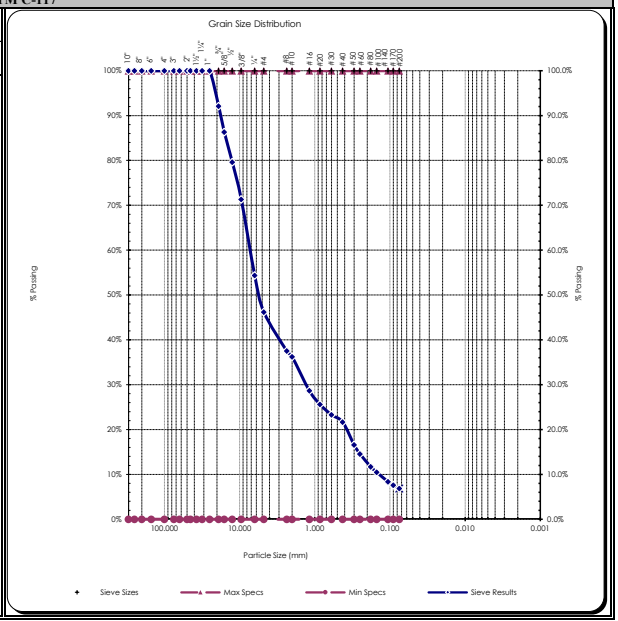
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT35-GT-1.6-2-20240805	**Tested By:**	S. Boesenberg
Sample#:	B24-1659	**Control No.:**	10252024

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

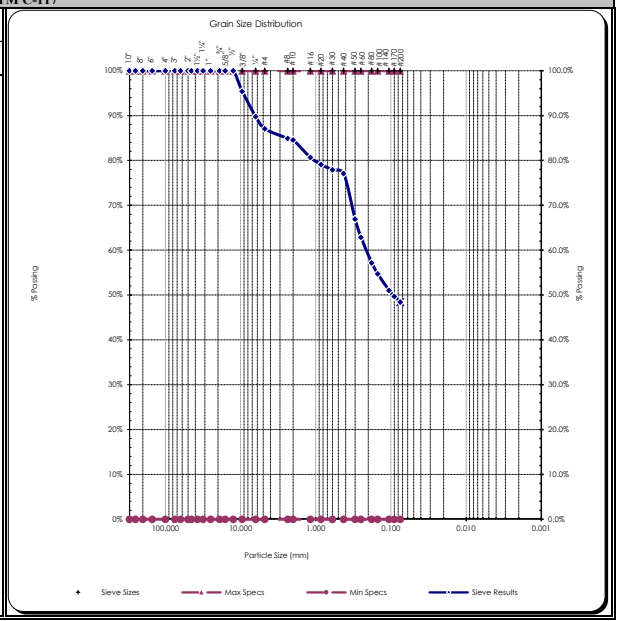
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT35-GT-1.6-2-20240805	**Tested By:**	S. Boesenberg
Sample#:	B24-1659	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.04	grams
Hydroscopic Moist.:	1.34%	
Adj. Sample Wgt :	98.72	grams

Hydrometer Reading Minutes	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

% Gravel:	12.9%	**Liquid Limit:**	n/a
% Sand:	38.6%	**Plastic Limit:**	n/a
% Silt:	37.4%	**Plasticity Index:**	n/a
% Clay:	11.0%		

ASTM C-136

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"	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

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	22-Oct-24
Source:	LDW23-GT26-GT-0-1.5-20240805	**Tested By:**	R. Bohler
Sample#:	B24-1661	**Control No.:**	10252024

Unified Soils Classification System, ASTM D-2487
SP, Poorly graded Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

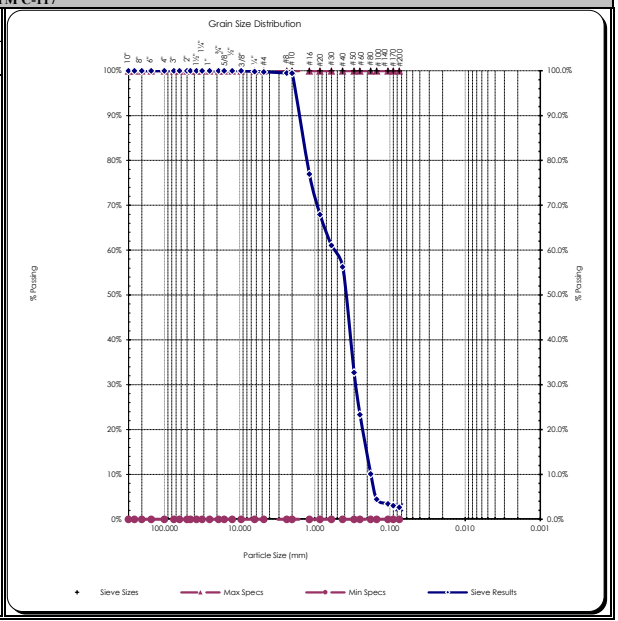
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.153	mm	% Gravel =	0.3%	Coeff. of Curvature, C_C = 0.81
$D_{(10)}$ =	0.179	mm	% Sand =	97.1%	Coeff. of Uniformity, C_U = 3.13
$D_{(15)}$ =	0.206	mm	% Silt & Clay =	2.7%	Fineness Modulus = 2.25
$D_{(30)}$ =	0.286	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.392	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.561	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	1.655	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	1/21		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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.	**Date:**	October 29, 2024
Address:	1201 3rd Avenue, Suite 2600	**Project:**	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
	Seattle, WA 98101	**Project #:**	24B105
Attn:	Cindy Fields	**Sample #:**	B24-1663 - 1685
Revised On:		**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!

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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	25-Oct-24
Source:	LDW23-GT26-GT-10-10.8-20240624	**Tested By:**	Z. Romney
Sample#:	B24-1663	**Control No.:**	10292024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand with Gravel
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

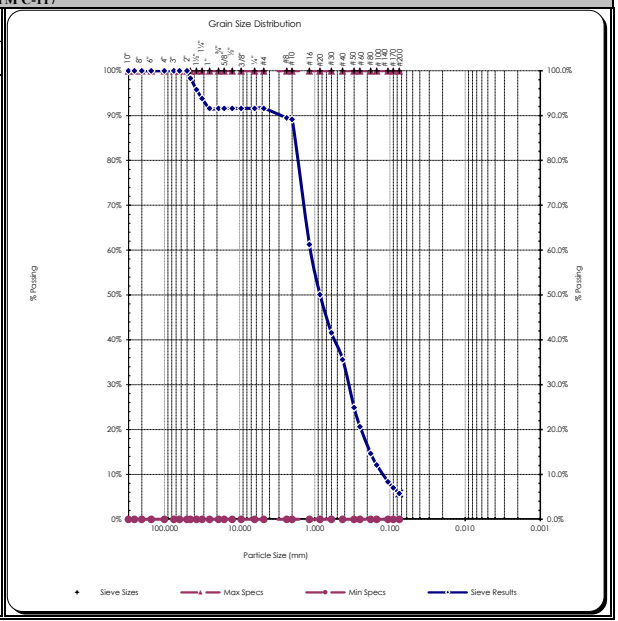
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24	**Unified Soils Classification System, ASTM D-2487**	
Project #:	24B105	**Sampled By:**	Client	SM, Silty Sand	
Client:	Anchor QEA, LLC.	**Date Tested:**	25-Oct-24	**Sample Color:**	
Source:	LDW23-GT26-GT-15-16.1-20240624	**Tested By:**	Z. Romney	Brown	
Sample#:	B24-1665	**Control No.:**	10292024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

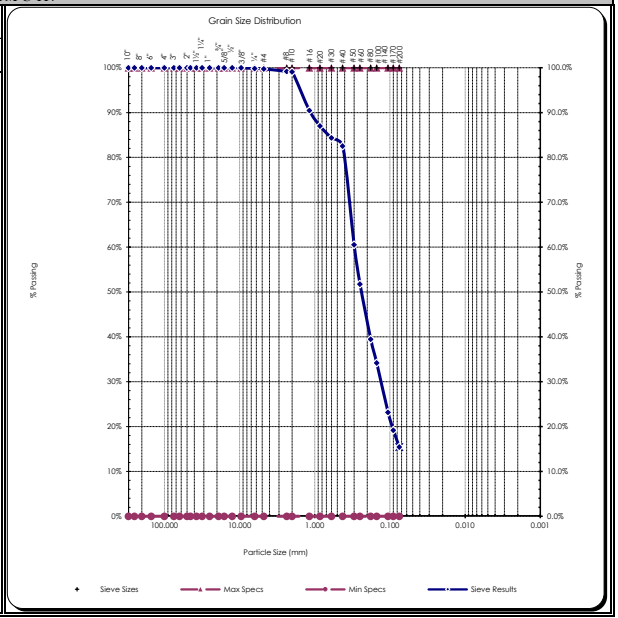
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.024	mm	% Gravel =	0.3%	Coeff. of Curvature, C_C =	1.23
$D_{(10)}$ =	0.049	mm	% Sand =	84.3%	Coeff. of Uniformity, C_U =	6.11
$D_{(15)}$ =	0.073	mm	% Silt & Clay =	15.4%	Fineness Modulus =	1.31
$D_{(30)}$ =	0.133	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.240	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	0.297	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	1.135	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	3/16		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

Specific Gravity of Soils, ASTM D-854

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Client: Anchor QEA, LLC.
Project #: 24B105
Sampled by: Client
Date Received: September 23, 2024
Tested by: S. Boesenberg
Date Tested: October 24, 25, & 28, 2024
Control. No.: 10292024

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B24-1667	LDW23-GT26-GT-20-21.5-20240624	379.50	428.19	48.69	SA-050 (B-1)	91.89	249.27	0.99717	371.22	340.45	24.5	2.7163838	0.99897	2.7135859
B24-1671	LDW23-GT22-GT-15-16.5-20240622	500.49	542.12	41.63	SA-050 (B-1)	91.89	249.27	0.99700	366.12	340.41	25.2	2.6145901	0.99879	2.6114264
B24-1676	LDW23-GT17-GT-10-11.5-20240622	268.71	313.74	45.03	SA-050 (B-1)	91.89	249.27	0.99700	367.87	340.41	25.2	2.5625719	0.99879	2.559471

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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

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

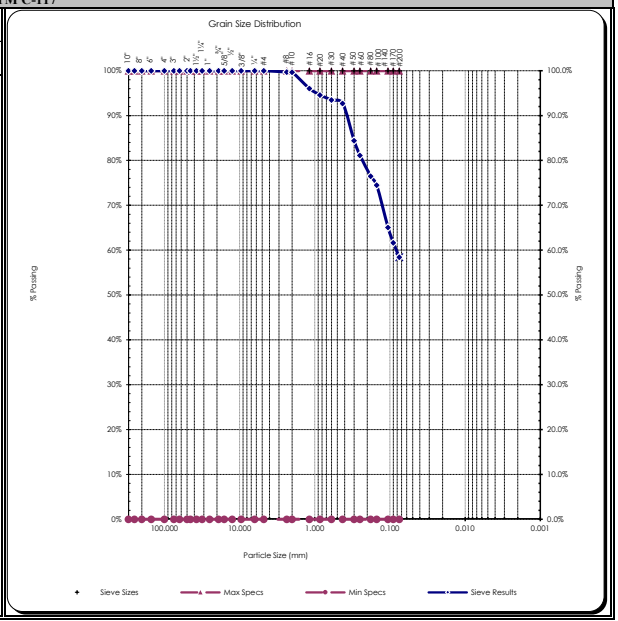
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.006	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C = 1.40
$D_{(10)}$ =	0.013	mm	% Sand =	41.6%	Coeff. of Uniformity, C_U = 6.42
$D_{(15)}$ =	0.019	mm	% Silt & Clay =	58.4%	Fineness Modulus = 0.52
$D_{(30)}$ =	0.039	mm	Liquid Limit =	n/a	Plastic Limit = n/a
$D_{(50)}$ =	0.064	mm	Plasticity Index =	n/a	Moisture %, as sampled = n/a
$D_{(60)}$ =	0.082	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.384	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	17/27		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	25-Oct-24
Source:	LDW23-GT22-GT-5-6.5-20240622	**Tested By:**	S. Boesenberg
Sample#:	B24-1669	**Control No.:**	10292024

Visual Soils Classification
Clayey, Sandy Silt
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.27	grams
Hydroscopic Moist.:	5.08%	
Adj. Sample Wgt :	47.84	grams

Hydrometer Reading Minutes	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

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	41.6%	**Plastic Limit:**	n/a
% Silt:	47.2%	**Plasticity Index:**	n/a
% Clay:	11.2%		

ASTM C-136

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"	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

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	25-Oct-24
Source:	LDW23-GT22-GT-10-11.5-20240622	**Tested By:**	Z. Romney
Sample#:	B24-1670	**Control No.:**	10292024

Unified Soils Classification System, ASTM D-2487
SW-SM, Well-graded Sand with Silt
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

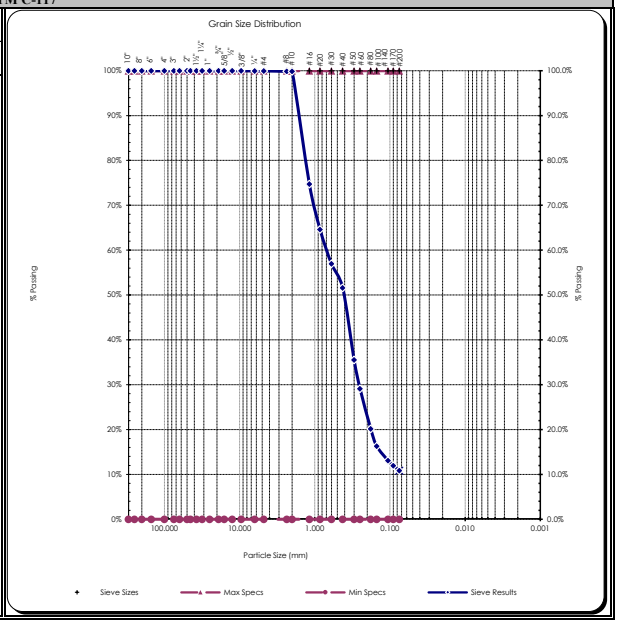
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.035	mm	% Gravel =	0.1%	Coeff. of Curvature, C_C =	1.36
$D_{(10)}$ =	0.069	mm	% Sand =	89.1%	Coeff. of Uniformity, C_U =	10.12
$D_{(15)}$ =	0.132	mm	% Silt & Clay =	10.8%	Fineness Modulus =	2.17
$D_{(30)}$ =	0.257	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.413	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	0.700	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	1.679	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	4/19		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	23-Sep-24	**Unified Soils Classification System, ASTM D-2487**	
Project #:	24B105	**Sampled By:**	Client	SM, Silty Sand	
Client:	Anchor QEA, LLC.	**Date Tested:**	25-Oct-24	**Sample Color:**	
Source:	LDW23-GT22-GT-25-26.5-20240622	**Tested By:**	Z. Romney	Brown	
Sample#:	B24-1673	**Control No.:**	10292024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

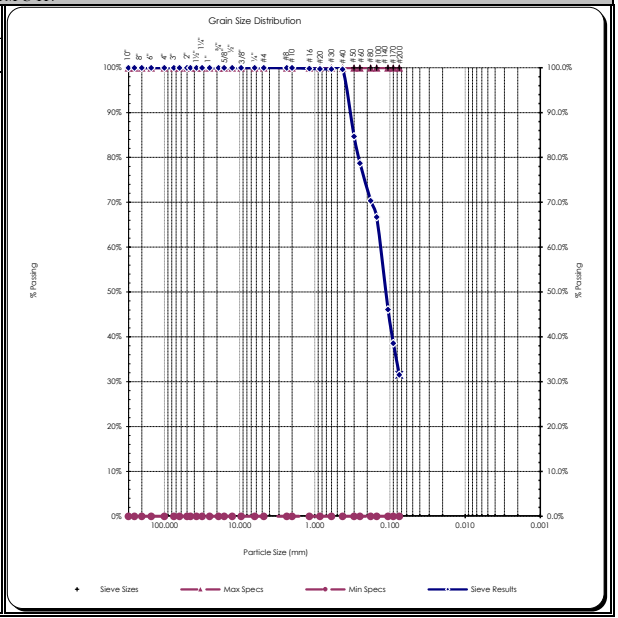
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	0.012	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.58
$D_{(10)}$ =	0.024	mm	% Sand =	68.5%	Coeff. of Uniformity, C_U =	5.71
$D_{(15)}$ =	0.036	mm	% Silt & Clay =	31.5%	Fineness Modulus =	0.49
$D_{(30)}$ =	0.071	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.114	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	0.136	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.344	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	19/60		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

MATERIALS TESTING & CONSULTING, INC.

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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	25-Oct-24
Source:	LDW23-GT17-GT-5-6.5-20240622	**Tested By:**	R. Bohler
Sample #:	B24-1675	**Control No.:**	10292024

Unified Soils Classification System, ASTM D-2487
OH, Organic Silty Clay
Sample Color
Brown

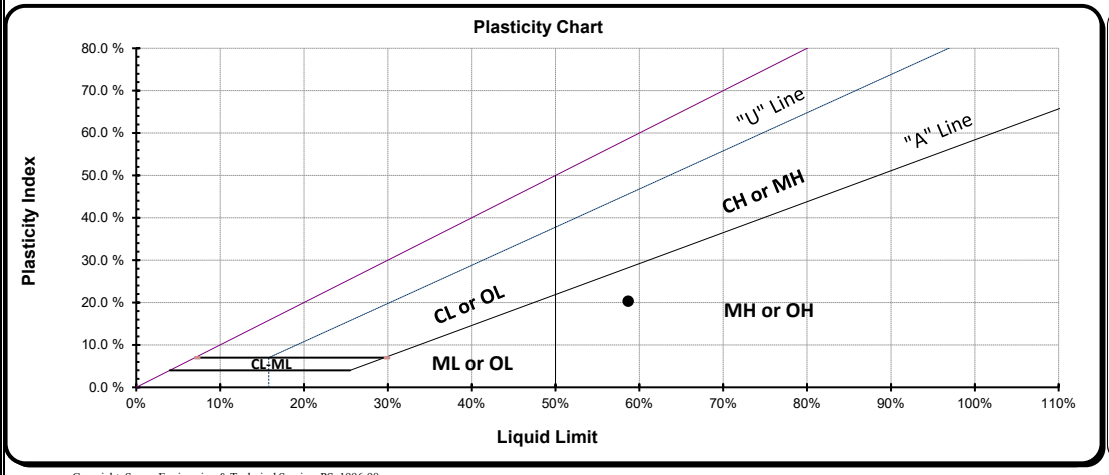
Liquid Limit Determination

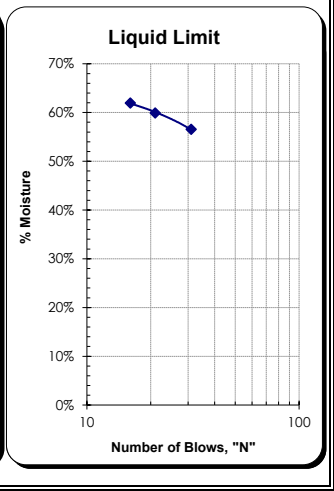
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	32.95	30.08	33.23			
Weight of Dry Soils + Pan:	28.05	26.15	28.00			
Weight of Pan:	19.39	19.59	19.56			
Weight of Dry Soils:	8.66	6.56	8.44			
Weight of Moisture:	4.90	3.93	5.23			
% Moisture:	56.6 %	59.9 %	62.0 %			
Number of Blows:	31	21	16			

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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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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	25-Oct-24
Source:	LDW23-GT17-GT-15-16.5-20240622	**Tested By:**	S. Boesenberg
Sample #:	B24-1677	**Control No.:**	10292024

Unified Soils Classification System, ASTM D-2487
ML, Clayey Silt
Sample Color
Brown

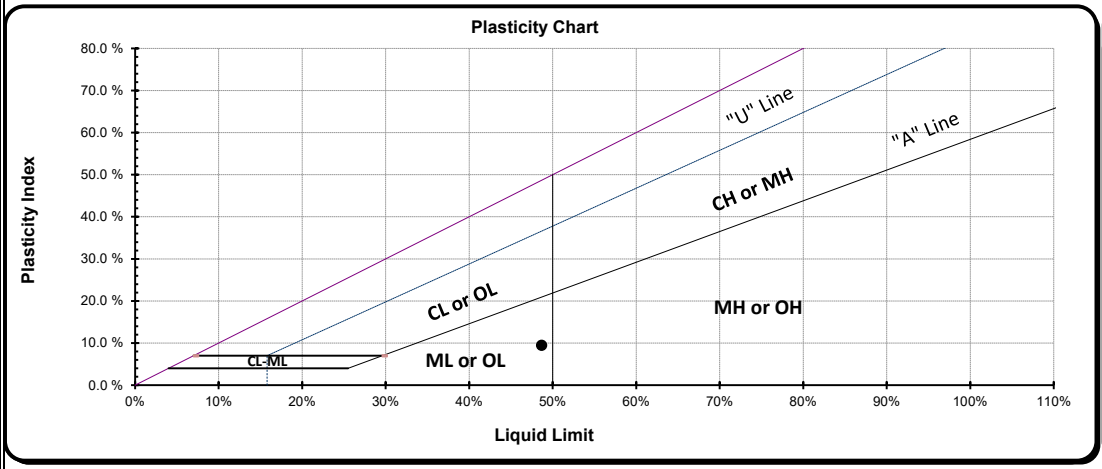
Liquid Limit Determination

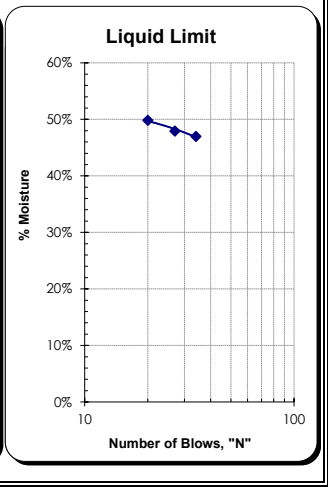
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	26.70	32.31	31.25			
Weight of Dry Soils + Pan:	22.77	28.33	27.27			
Weight of Pan:	14.41	20.03	19.29			
Weight of Dry Soils:	8.36	8.30	7.98			
Weight of Moisture:	3.93	3.98	3.98			
% Moisture:	47.0 %	48.0 %	49.9 %			
Number of Blows:	34	27	20			

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

MATERIALS TESTING & CONSULTING, INC.

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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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	**Date Received:**	23-Sep-24	**Unified Soils Classification System, ASTM D-2487**	
Project #:	24B105	**Sampled By:**	Client	SM, Silty Sand	
Client:	Anchor QEA, LLC.	**Date Tested:**	25-Oct-24	**Sample Color:**	
Source:	LDW23-GT17-GT-20-21.5-20240622	**Tested By:**	Z. Romney	Brown	
Sample#:	B24-1678	**Control No.:**	10292024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

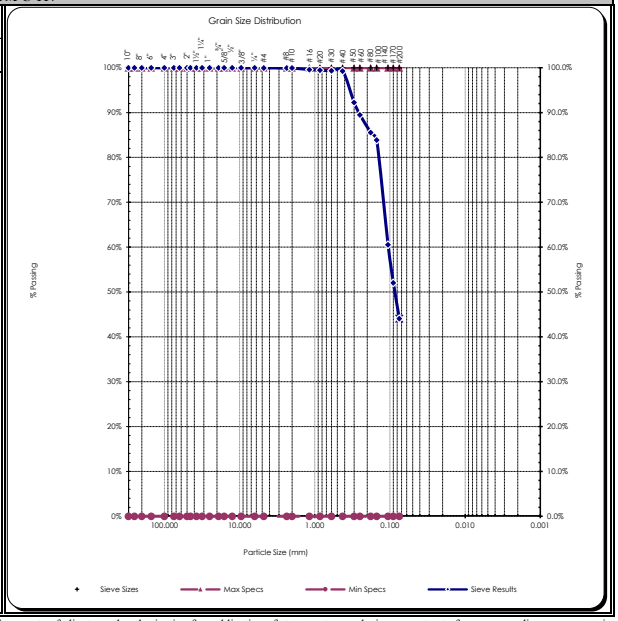
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

Client:	Anchor QEA, LLC.	**Date:**	December 13, 2024
Address:	1201 3rd Avenue, Suite 2600	**Project:**	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
	Seattle, WA 98101	**Project #:**	24B105
Attn:	Cindy Fields	**Sample #:**	B24-1898 - 1918
Revised On:		**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!

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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Dec-24
Source:	LDW23 - GT08B - GT - 5 - 6.5 - 20241030	**Tested By:**	R. Bohler
Sample#:	B24-1898	**Control No.:**	12132024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand with Gravel
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

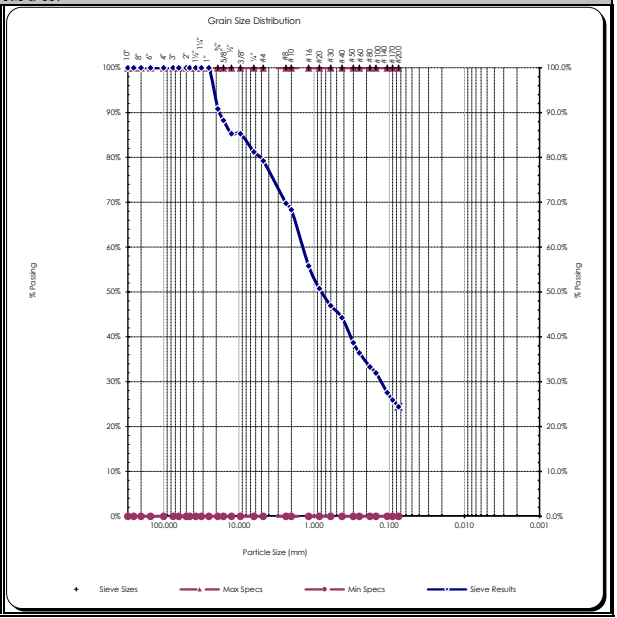
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Specific Gravity of Soils, ASTM D-854

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Client: Anchor QEA, LLC.
Project #: 24B105
Sampled by: Client
Date Received: November 22, 2024
Tested by: S. Boesenberg
Date Tested: December 9 & 10, 2024
Control. No.: 12132024

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B24-1901	LDW23 - GT08B - GT - 20 - 21.5 - 20241030	306.45	355.29	48.84	SA-050 (B-1)	91.89	249.27	0.99723	371.47	340.47	24.3	2.7377415	0.99902	2.7350585
B24-1909	LDW23 - GT04B - GT - 12.7 - 14.2 - 20241029	303.18	350.70	47.52	SA-050 (B-2)	92.08	249.31	0.99723	370.22	340.70	24.3	2.6400863	0.99902	2.6374991
B24-1917	LDW23 - GT35B - GT - 20 - 21.5 - 20241028	268.88	318.44	49.56	SA-050 (B-1)	91.89	249.27	0.99725	371.84	340.47	24.2	2.723899	0.99904	2.721284

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

MATERIALS TESTING & CONSULTING, INC.

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	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Dec-24
Source:	LDW23 - GT08B - GT - 10 - 11.5 - 20241030	**Tested By:**	R. Bohler
Sample#:	B24-1899	**Control No.:**	12132024

Visual Soils Classification
Clayey Silt with Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

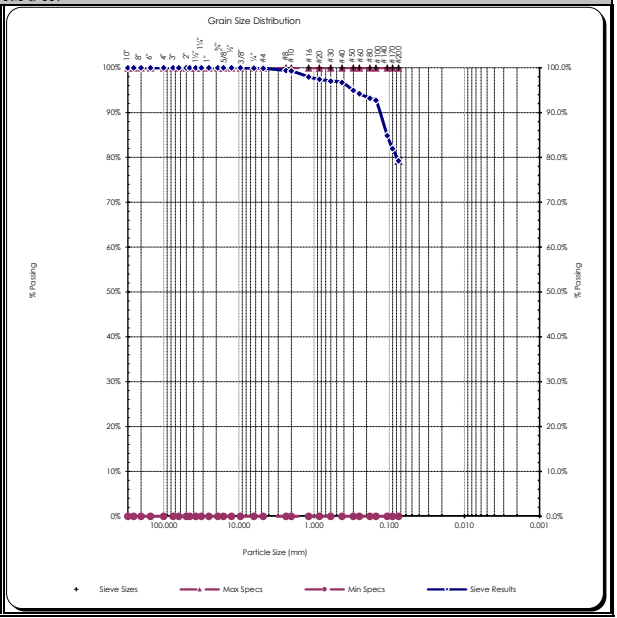
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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%	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	**Date Received:**	22-Nov-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Clayey Silt with Sand	
Client :	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24	**Sample Color**	
Source:	LDW23 - GT08B - GT - 10 - 11.5 - 20241030	**Tested By:**	R. Bohler	Brown	
Sample#:	B24-1899	**Control No.:**	12132024		

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.05	grams
Hydroscopic Moist.:	4.28%	
Adj. Sample Wgt :	48.00	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	30	62.1%	0.0326 mm
5	24	49.7%	0.0215 mm
15	17	35.2%	0.0129 mm
30	15	31.0%	0.0093 mm
60	11.5	23.8%	0.0067 mm
250	8	16.6%	0.0033 mm
1440	4.5	9.3%	0.0014 mm

% Gravel:	0.1%	**Liquid Limit:**	n/a
% Sand:	20.6%	**Plastic Limit:**	n/a
% Silt:	59.1%	**Plasticity Index:**	n/a
% Clay:	20.1%		

ASTM C-136

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"	100%	6.300 mm
#4	100%	4.750 mm
#10	99%	2.000 mm
#20	97%	0.850 mm
#40	97%	0.425 mm
#100	93%	0.150 mm
#200	79.3%	0.075 mm
Silts	78.9%	0.074 mm
	69.1%	0.050 mm
	47.1%	0.020 mm
Clays	20.1%	0.005 mm
	11.5%	0.002 mm
Colloids	6.6%	0.001 mm

USDA Soil Textural Classification

		Particle Size
% Sand:	30.4%	2.0 - 0.05 mm
% Silt:	58.0%	0.05 - 0.002 mm
% Clay:	11.6%	< 0.002 mm

USDA Soil Textural Classification
Silt 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	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Dec-24
Source:	LDW23 - GT08B - GT - 26.1 - 26.5 - 20241030	**Tested By:**	R. Bohler
Sample#:	B24-1903	**Control No.:**	12132024

Visual Soils Classification
Silt with Clayey Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

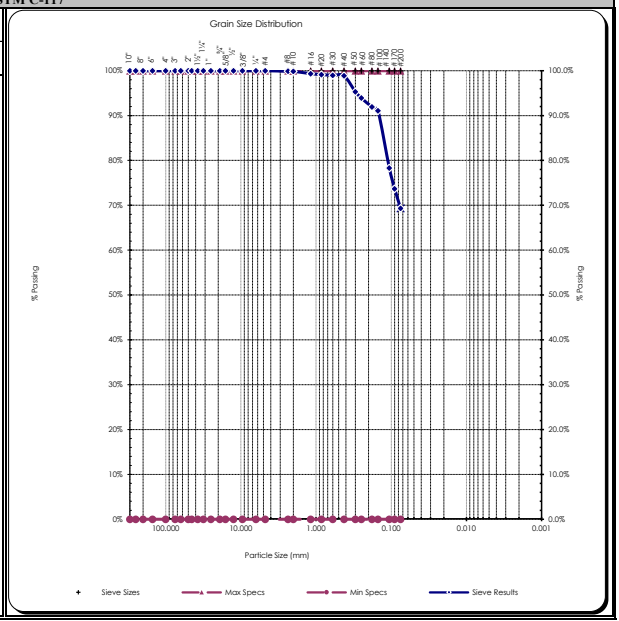
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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		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%



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Comments:

Reviewed by: Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	22-Nov-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Silt with Clayey Sand	
Client :	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24	**Sample Color**	
Source:	LDW23 - GT08B - GT - 26.1 - 26.5 - 20241030	**Tested By:**	R. Bohler	Brown	
Sample#:	B24-1903	**Control No.:**	12132024		

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.07	grams
Hydroscopic Moist.:	4.39%	
Adj. Sample Wgt :	47.96	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	23	47.9%	0.0341 mm
5	17	35.4%	0.0224 mm
15	12	25.0%	0.0133 mm
30	10	20.8%	0.0096 mm
60	7.5	15.6%	0.0069 mm
250	5	10.4%	0.0034 mm
1440	4	8.3%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	30.7%	**Plastic Limit:**	n/a
% Silt:	56.5%	**Plasticity Index:**	n/a
% Clay:	12.8%		

ASTM C-136

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"	100%	6.300 mm
#4	100%	4.750 mm
#10	100%	2.000 mm
#20	99%	0.850 mm
#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

USDA Soil Textural Classification

		Particle Size
% Sand:	43.7%	2.0 - 0.05 mm
% Silt:	47.3%	0.05 - 0.002 mm
% Clay:	9.0%	< 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	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Dec-24
Source:	LDW23 - GT08B - GT - 30 - 31.5 - 20241030	**Tested By:**	R. Bohler
Sample#:	B24-1904	**Control No.:**	12132024

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

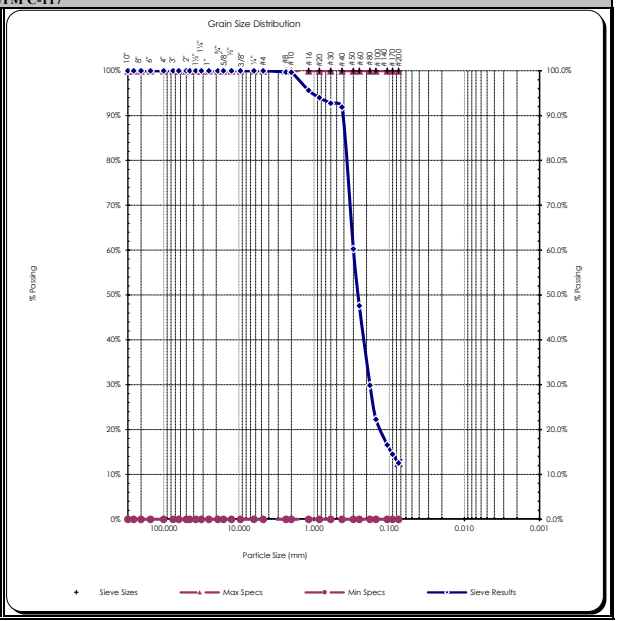
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

Hydrometer Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	22-Nov-24	**Unified Soils Classification System, ASTM D-2487**	
Project #:	24B105	**Sampled By:**	Client	SM, Silty Sand	
Client :	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24	**Sample Color**	
Source:	LDW23 - GT08B - GT - 30 - 31.5 - 20241030	**Tested By:**	R. Bohler	Brown	
Sample#:	B24-1904	**Control No.:**	12132024		

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.03	grams
Hydroscopic Moist.:	0.77%	
Adj. Sample Wgt :	99.27	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	9	9.0%	0.0371 mm
5	7	7.0%	0.0238 mm
15	6	6.0%	0.0138 mm
30	5	5.0%	0.0098 mm
60	4	4.0%	0.0070 mm
250	3	3.0%	0.0034 mm
1440	2.5	2.5%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	87.5%	**Plastic Limit:**	n/a
% Silt:	9.1%	**Plasticity Index:**	n/a
% Clay:	3.5%		

ASTM C-136

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"	100%	6.300 mm
#4	100%	4.750 mm
#10	100%	2.000 mm
#20	94%	0.850 mm
#40	92%	0.425 mm
#100	22%	0.150 mm
#200	12.5%	0.075 mm
Silts	12.5%	0.074 mm
	10.2%	0.050 mm
	6.6%	0.020 mm
Clays	3.5%	0.005 mm
	2.7%	0.002 mm
Colloids	1.7%	0.001 mm

USDA Soil Textural Classification

		Particle Size
% Sand:	89.7%	2.0 - 0.05 mm
% Silt:	7.6%	0.05 - 0.002 mm
% Clay:	2.7%	< 0.002 mm

USDA Soil Textural Classification
Sand

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	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Dec-24
Source:	LDW23 - GT08B - GT - 35 - 36.5 - 20241030	**Tested By:**	R. Bohler
Sample#:	B24-1905	**Control No.:**	12132024

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

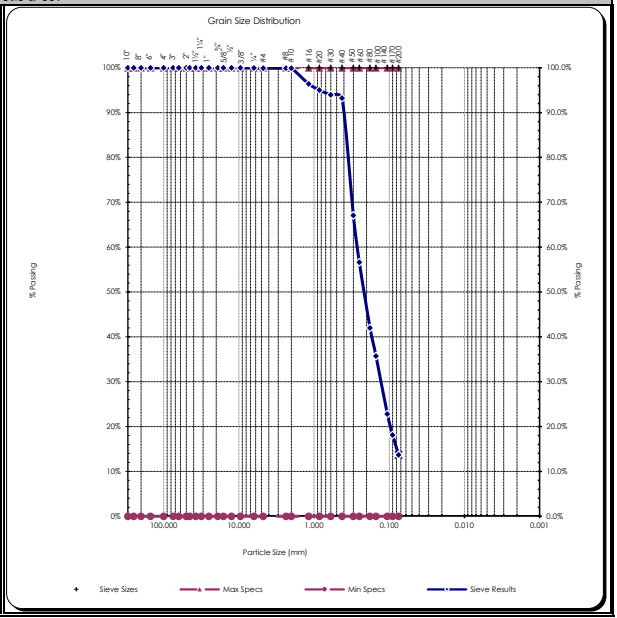
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Dec-24
Source:	LDW23 - GT04B - GT - 5 - 6.5 - 20241029	**Tested By:**	R. Bohler
Sample#:	B24-1907	**Control No.:**	12132024

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

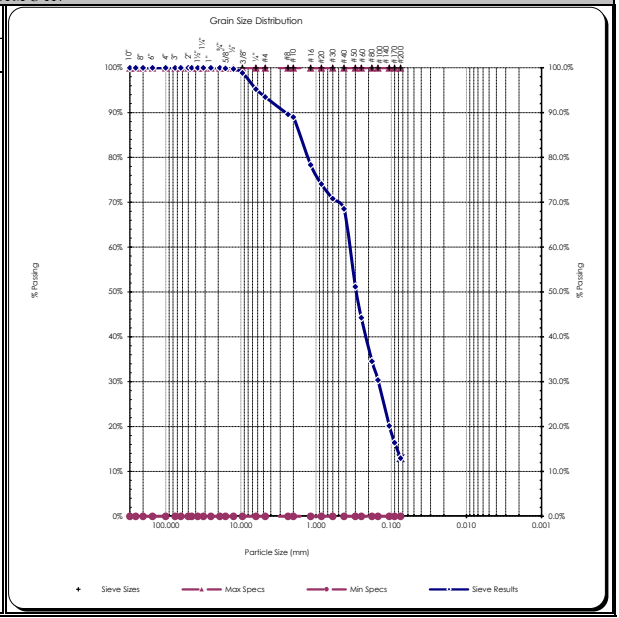
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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%	99%	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

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Dec-24
Source:	LDW23 - GT04B - GT - 8.7 - 10 - 20241029	**Tested By:**	R. Bohler
Sample#:	B24-1908	**Control No.:**	12132024

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

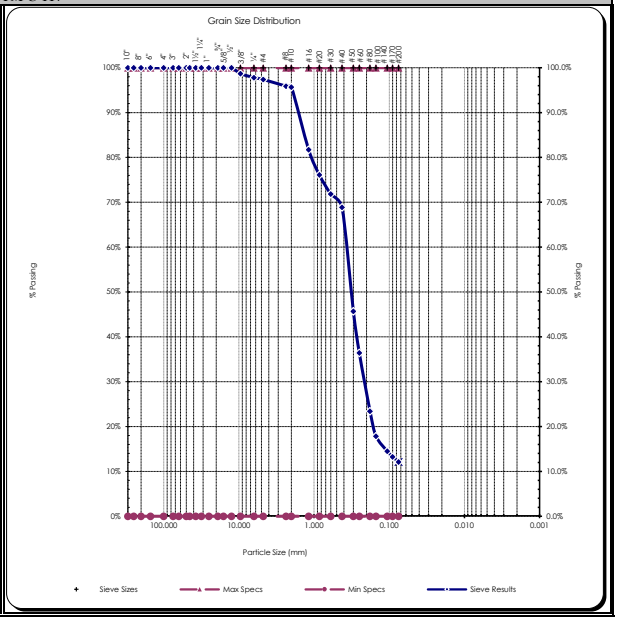
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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%	99%	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%

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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	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24
Source:	LDW23 - GT04B - GT - 8.7 - 10 - 20241029	**Tested By:**	R. Bohler
Sample#:	B24-1908	**Control No.:**	12132024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.00	grams
Hydroscopic Moist.:	2.40%	
Adj. Sample Wgt :	97.66	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	13	12.7%	0.0364 mm
5	11	10.8%	0.0232 mm
15	9	8.8%	0.0136 mm
30	8	7.8%	0.0097 mm
60	7.5	7.3%	0.0069 mm
250	6.5	6.4%	0.0034 mm
1440	4	3.9%	0.0014 mm

% Gravel:	2.6%	**Liquid Limit:**	n/a
% Sand:	85.3%	**Plastic Limit:**	n/a
% Silt:	5.3%	**Plasticity Index:**	n/a
% Clay:	6.8%		

ASTM C-136

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"	99%	9.500 mm
1/4"	98%	6.300 mm
#4	97%	4.750 mm
#10	96%	2.000 mm
#20	76%	0.850 mm
#40	69%	0.425 mm
#100	18%	0.150 mm
#200	12.1%	0.075 mm
Silts	12.1%	0.074 mm
	12.5%	0.050 mm
	10.1%	0.020 mm
Clays	6.8%	0.005 mm
	4.6%	0.002 mm
Colloids	2.8%	0.001 mm

USDA Soil Textural Classification

		Particle Size
% Sand:	86.9%	2.0 - 0.05 mm
% Silt:	8.2%	0.05 - 0.002 mm
% Clay:	4.9%	< 0.002 mm

USDA Soil Textural Classification
Loamy Sand

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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	**Date Received:**	22-Nov-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Clayey Silt	
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Dec-24	**Sample Color:**	
Source:	LDW23 - GT04B - GT - 12.7 - 14.2 - 20241029	**Tested By:**	R. Bohler	Brown	
Sample#:	B24-1909	**Control No.:**	12132024		

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

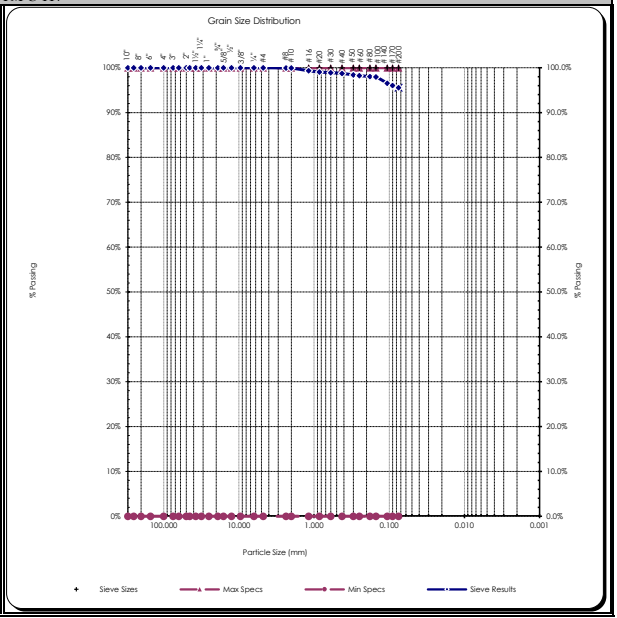
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.004	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.50
$D_{(10)}$ =	0.008	mm	% Sand =	4.4%	Coeff. of Uniformity, C_U =	6.00
$D_{(15)}$ =	0.012	mm	% Silt & Clay =	95.6%	Fineness Modulus =	0.06
$D_{(30)}$ =	0.024	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.039	mm	Plasticity Index =	n/a	Moisture %, as sampled =	n/a
$D_{(60)}$ =	0.047	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.071	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	30/31		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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		98%	100.0%	0.0%
#60	0.250		98%	100.0%	0.0%
#80	0.180		98%	100.0%	0.0%
#100	0.150	98%	98%	100.0%	0.0%
#140	0.106		97%	100.0%	0.0%
#170	0.090		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

Hydrometer Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	22-Nov-24	**Visual Soils Classification**	
Project #:	24B105	**Sampled By:**	Client	Clayey Silt	
Client :	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24	**Sample Color**	
Source:	LDW23 - GT04B - GT - 12.7 - 14.2 - 20241029	**Tested By:**	R. Bohler	Brown	
Sample#:	B24-1909	**Control No.:**	12132024		

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.13	grams
Hydroscopic Moist.:	5.09%	
Adj. Sample Wgt :	47.70	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	41	85.9%	0.0299 mm
5	36	75.4%	0.0197 mm
15	31	64.9%	0.0118 mm
30	26	54.5%	0.0086 mm
60	22	46.1%	0.0063 mm
250	13	27.2%	0.0033 mm
1440	6	12.6%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	4.4%	**Plastic Limit:**	n/a
% Silt:	57.4%	**Plasticity Index:**	n/a
% Clay:	38.1%		

ASTM C-136

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"	100%	6.300 mm
#4	100%	4.750 mm
#10	100%	2.000 mm
#20	99%	0.850 mm
#40	99%	0.425 mm
#100	98%	0.150 mm
#200	95.6%	0.075 mm
Silts	95.3%	0.074 mm
	90.2%	0.050 mm
	75.7%	0.020 mm
Clays	38.1%	0.005 mm
	17.3%	0.002 mm
Colloids	8.9%	0.001 mm

USDA Soil Textural Classification

		Particle Size
% Sand:	9.7%	2.0 - 0.05 mm
% Silt:	73.0%	0.05 - 0.002 mm
% Clay:	17.3%	< 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	**Date Received:**	23-Sep-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24
Source:	LDW23 - GT04B - GT - 12.7 - 14 - 20241029	**Tested By:**	R. Bohler
Sample #:	B24-1909	**Control No.:**	12132024

Unified Soils Classification System, ASTM D-2487
MH, Clayey Silt with Sand
Sample Color
Brown

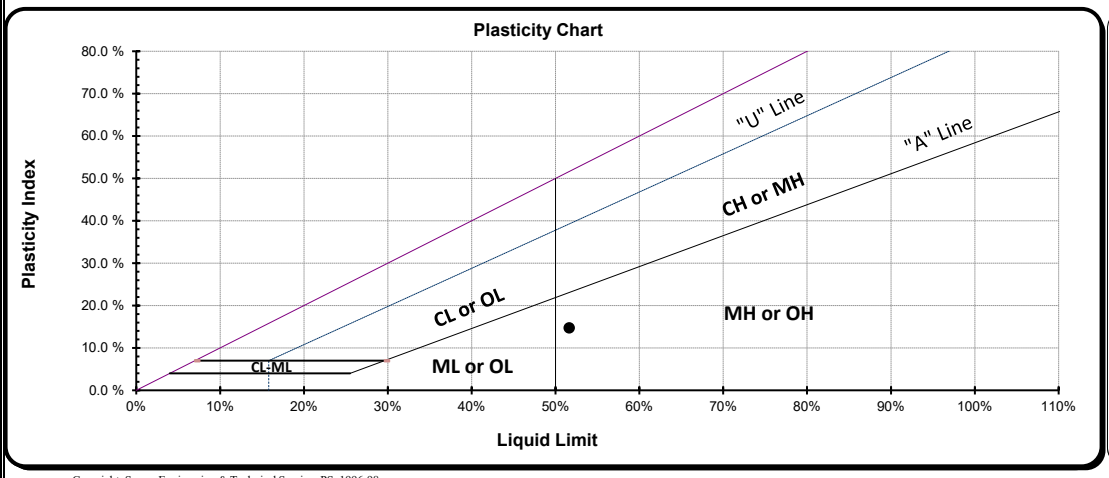
Liquid Limit Determination

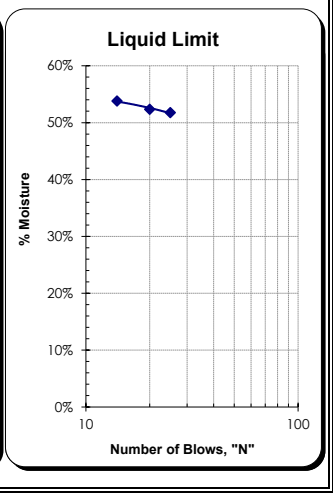
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	31.03	30.70	23.64			
Weight of Dry Soils + Pan:	26.91	26.70	20.32			
Weight of Pan:	18.95	19.06	14.15			
Weight of Dry Soils:	7.96	7.64	6.17			
Weight of Moisture:	4.12	4.00	3.32			
% Moisture:	51.8 %	52.4 %	53.8 %			
Number of Blows:	25	20	14			

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 %				





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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	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24
Source:	LDW23 - GT04B - GT - 30 - 31.5 - 20241029	**Tested By:**	Z. Romney
Sample#:	B24-1912	**Control No.:**	12132024

Unified Soils Classification System, ASTM D-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

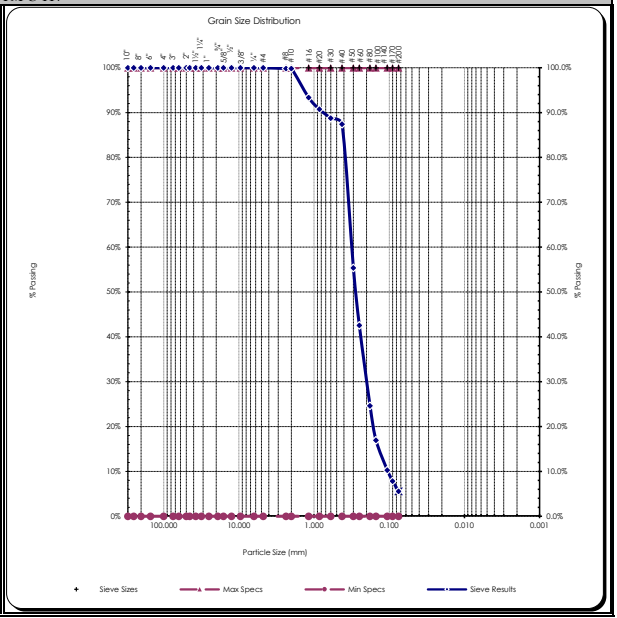
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =	

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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		93%	100.0%	0.0%
#20	0.850		91%	100.0%	0.0%
#30	0.600		89%	100.0%	0.0%
#40	0.425	87%	87%	100.0%	0.0%
#50	0.300		55%	100.0%	0.0%
#60	0.250		43%	100.0%	0.0%
#80	0.180		25%	100.0%	0.0%
#100	0.150	17%	17%	100.0%	0.0%
#140	0.106		10%	100.0%	0.0%
#170	0.090		8%	100.0%	0.0%
#200	0.075	5.6%	5.6%	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	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24
Source:	LDW23 - GT35B - GT - 10 - 11.2 - 20241028	**Tested By:**	Z. Romney
Sample#:	B24-1914	**Control No.:**	12132024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand with Gravel
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

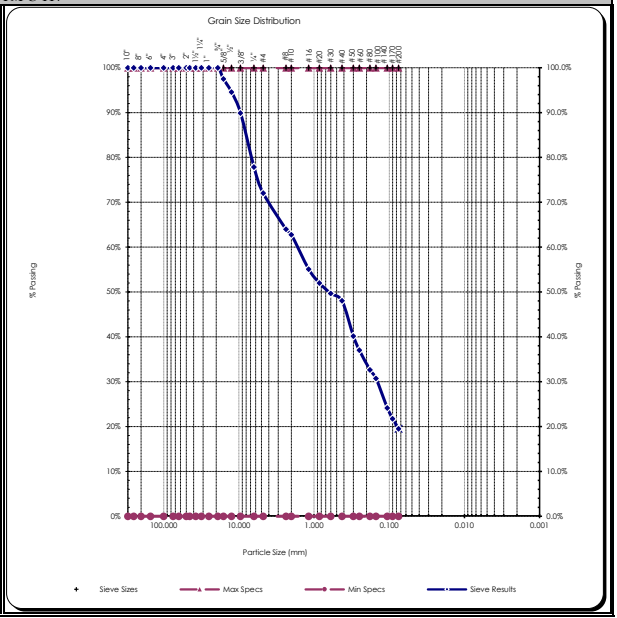
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	10-Dec-24
Source:	LDW23 - GT35B - GT - 15 - 16.5 - 20241028	**Tested By:**	R. Bohler
Sample#:	B24-1916	**Control No.:**	12132024

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

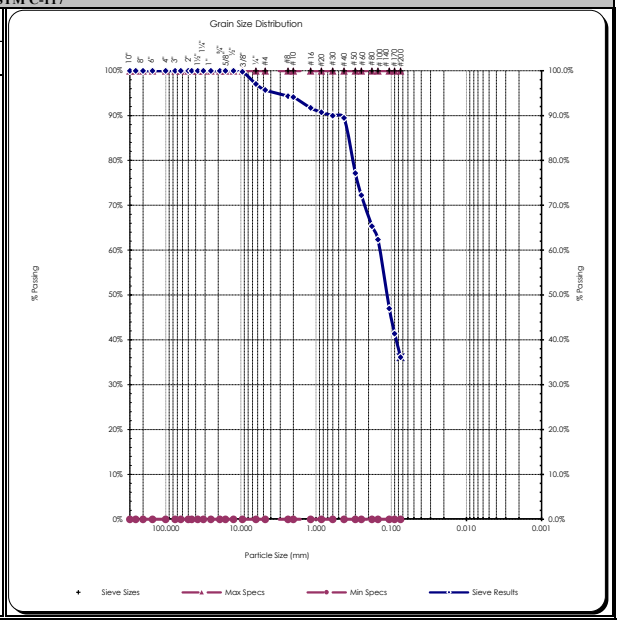
Specifications
No Specs

Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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

Hydrometer Report

Project:	Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client :	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24
Source:	LDW23 - GT35B - GT - 15 - 16.5 - 20241028	**Tested By:**	R. Bohler
Sample#:	B24-1916	**Control No.:**	12132024

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
Brown

ASTM D-422 HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.50	grams
Hydroscopic Moist.:	8.43%	
Adj. Sample Wgt :	46.57	grams

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	10	20.2%	0.0370 mm
5	8.5	17.2%	0.0236 mm
15	7	14.1%	0.0137 mm
30	6	12.1%	0.0097 mm
60	4	8.1%	0.0070 mm
250	2	4.0%	0.0035 mm
1440	2	4.0%	0.0014 mm

% Gravel:	4.3%	**Liquid Limit:**	n/a
% Sand:	59.6%	**Plastic Limit:**	n/a
% Silt:	30.3%	**Plasticity Index:**	n/a
% Clay:	5.8%		

ASTM C-136

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"	97%	6.300 mm
#4	96%	4.750 mm
#10	94%	2.000 mm
#20	91%	0.850 mm
#40	89%	0.425 mm
#100	62%	0.150 mm
#200	36.1%	0.075 mm
Silts	35.7%	0.074 mm
	25.7%	0.050 mm
	16.1%	0.020 mm
Clays	5.8%	0.005 mm
	4.0%	0.002 mm
Colloids	2.8%	0.001 mm

USDA Soil Textural Classification

		Particle Size
% Sand:	72.7%	2.0 - 0.05 mm
% Silt:	23.0%	0.05 - 0.002 mm
% Clay:	4.3%	< 0.002 mm

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	**Date Received:**	22-Nov-24
Project #:	24B105	**Sampled By:**	Client
Client:	Anchor QEA, LLC.	**Date Tested:**	11-Dec-24
Source:	LDW23 - GT35B - GT - 25 - 26.5 - 20241028	**Tested By:**	Z. Romney
Sample#:	B24-1918	**Control No.:**	12132024

Unified Soils Classification System, ASTM D-2487
SP, Poorly graded Sand
Sample Color:
Brown

Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281

Specifications
No Specs

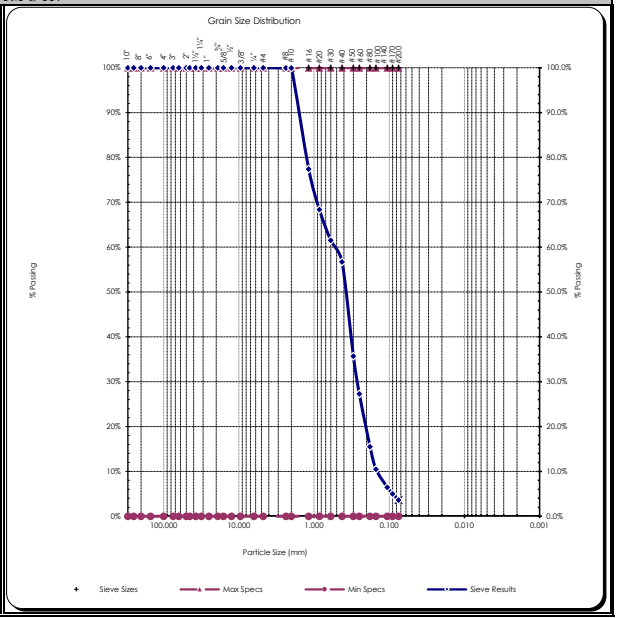
Sample Meets Specs ? N/A

$D_{(5)}$ =	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 =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs 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%

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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

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
							B-2	SPT	34
							B-6	SPT	34
	1213	James Hardie Gypsum Storm Water Outfall	Pacific Testing Laboratories	12/15/1993	Report		BH-1	SPT	32
	2783	Proposed Kaiser Dock Upgrade	HartCrowser	3/1/1996	Report		HC-101	SPT	95
							HC-102	SPT	95
1.65-1.7E	1210	James Hardie Gypsum Proposed Mooring Dolphins	HartCrowser	11/14/1994	Report	5975 East Marginal Way S.	HC-1	SPT	59
							HC-2	SPT	29
							HC-3	SPT	29
							P-1	CPT	80
							P-2	CPT	80
1.75E	40	Foundation Investigation for Proposed Warehouse	GeoLabs, Inc.	3/26/1969	Report	First Avenue South at Slip No. 2	B-1	SPT	49.5
							B-2	SPT	29.5
1.85-2.0W	620	Addendum Report of Soils Investigation	Dames & Moore	11/23/1977	Figure / Logs	206 SW Michigan St	B-1	SPT	69
	3519	Geotechnical Report First Avenue South Bridge	Shannon & Wilson Inc.	4/8/1993	Report	First Avenue South Bridge	U-2	SPT	99
	3522	First Avenue South Bridge Improvements	Dames & Moore	7/22/1993	Memo		MW-19	SPT	16.5
	7279	Highland Park Way SW	Seattle Engineering Department	6/20/1969	Figure / Logs	SW Front St & W Marginal Way SW	TB-1	SPT	30
							TB-6	SPT	35.3
2.0-2.1	2026	Geotechnical Report First Avenue South Bridge	Shannon & Wilson Inc.	8/1/1992	Report	First Avenue South Bridge	B-1	SPT	230.6
							B-2	SPT	230.5
	3519	Geotechnical Report First Avenue South Bridge	Shannon & Wilson Inc.	4/8/1993	Report	First Avenue South Bridge	U-1	SPT	99
	7278	---	Metropolitan Engineers	11/28/1964	Figure / Logs	West Marginal Way	B-36	SPT	35.8
							B-38	SPT	20.5
	7793	Proposed Utility Tunnel	Washington State Highway Commission	4/28/1972	Subsurface Profile	SR 509 Keyon to 1st Ave.	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
							TH-9	SPT	189.5
	10403	First Avenue South Bridge Utilidor Relocation	Shannon & Wilson Inc.	8/1/1993	Report	First Avenue South Bridge	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
							GP-8	CPT	97
	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

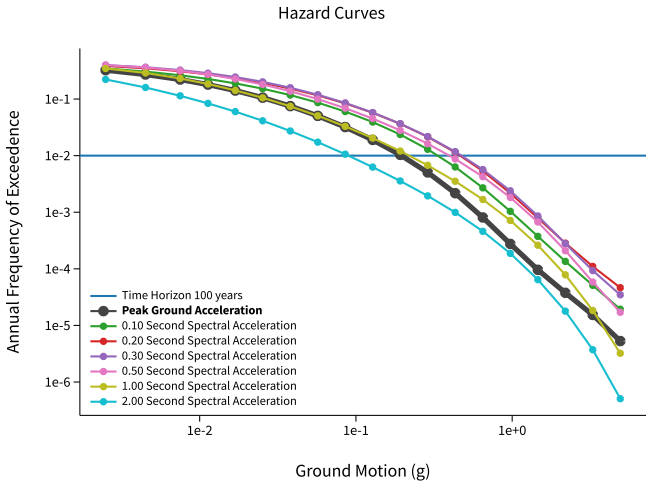
RM: river mile

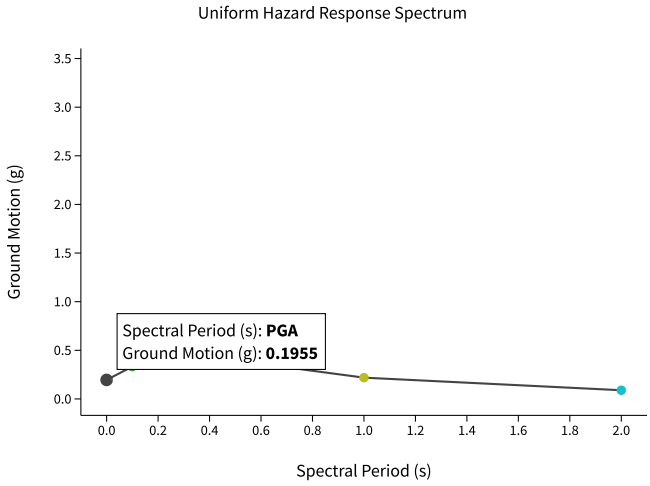
SPT: standard penetration test

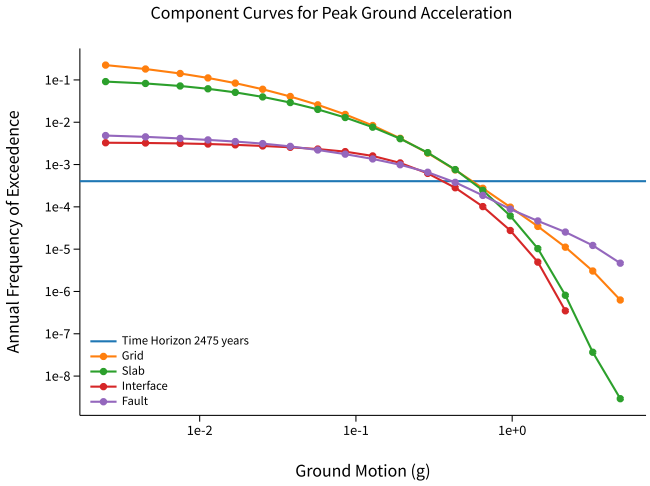
Appendix F – Geotechnical Design Analysis

Attachment F.5
USGS Unified Hazard Tool Outputs

Hazard Curve





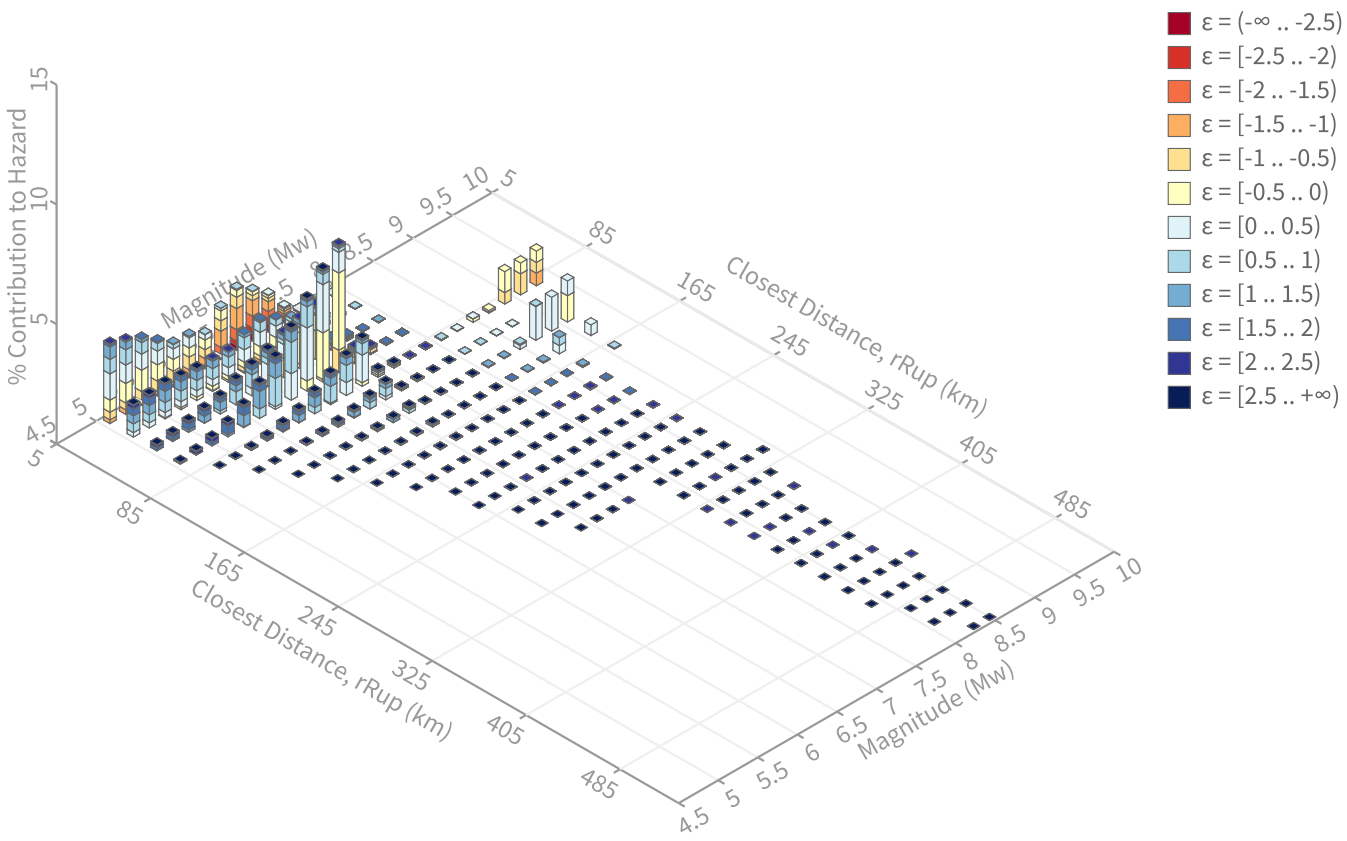


View Raw Data

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
ε_0: 0.21 σ

Mode (largest m-r bin)

m: 7.1
r: 68.3 km
ε_0: -0.19 σ
Contribution: 5.31 %

Mode (largest m-r-ε_0 bin)

m: 7.1
r: 68.22 km
ε_0: -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

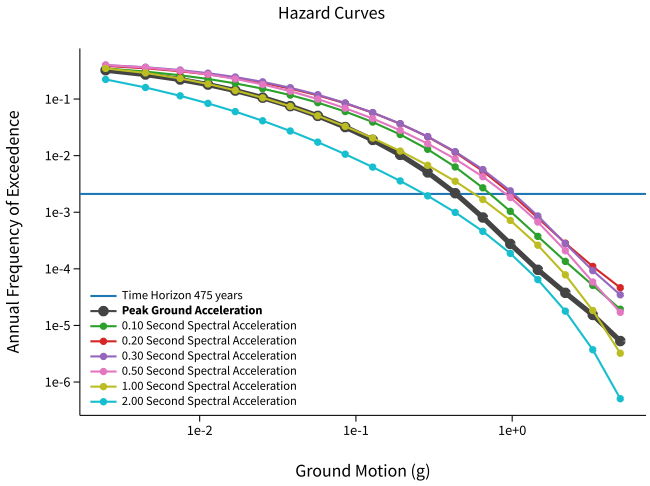
Epsilon keys

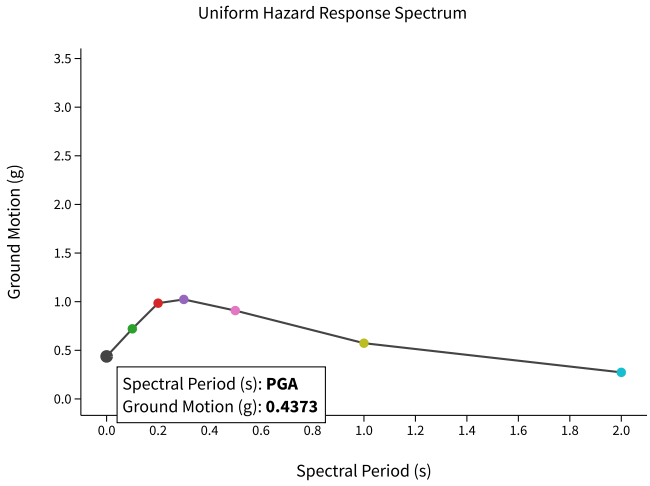
ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

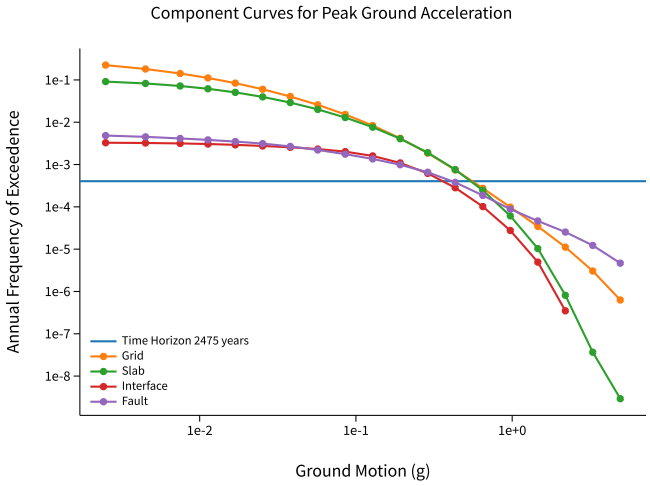
Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
pacnwdeep.2014.in	Slab							23.66
pacnwdeep.2014.in	Slab							10.66
puget_2014.ch.in	Grid							8.19
puget_2014.gr.in	Grid							7.74
Seattle	Fault							5.67
Seattle - northern		4.05	6.92	-1.95	122.347°W	47.574°N	340.43	2.66
Seattle - middle		3.82	6.78	-1.78	122.381°W	47.557°N	297.21	1.51
Seattle - southern		5.70	6.74	-1.47	122.335°W	47.516°N	190.56	1.50
WUSmap_2014_fixSm.ch.in (opt)	Grid							5.33
WUSmap_2014_fixSm.gr.in (opt)	Grid							4.92
sub0_ch_mid.in	Interface							4.43
Cascadia Megathrust - whole CSZ Characteristic		122.92	8.90	0.07	123.916°W	47.709°N	279.61	4.43
sub0_ch_bot.in	Interface							4.05
Cascadia Megathrust - whole CSZ Characteristic		88.57	9.08	-0.64	123.357°W	47.313°N	252.36	4.05
pacnwdeep.2014.in	Slab							3.94
WUSmap_2014_adSm.ch.in (opt)	Grid							3.38
WUSmap_2014_adSm.gr.in (opt)	Grid							3.14
Geologic Model Partial Rupture	Fault							2.26
puget_2014_M8.in	Grid							2.06
WUSmap_2014_fixSm_M8.in (opt)	Grid							1.28
sub0_ch_top.in	Interface							1.09
Cascadia Megathrust - whole CSZ Characteristic		151.97	8.81	0.52	124.334°W	47.627°N	274.48	1.09
Geologic Model Full Rupture	Fault							1.09

Hazard Curve





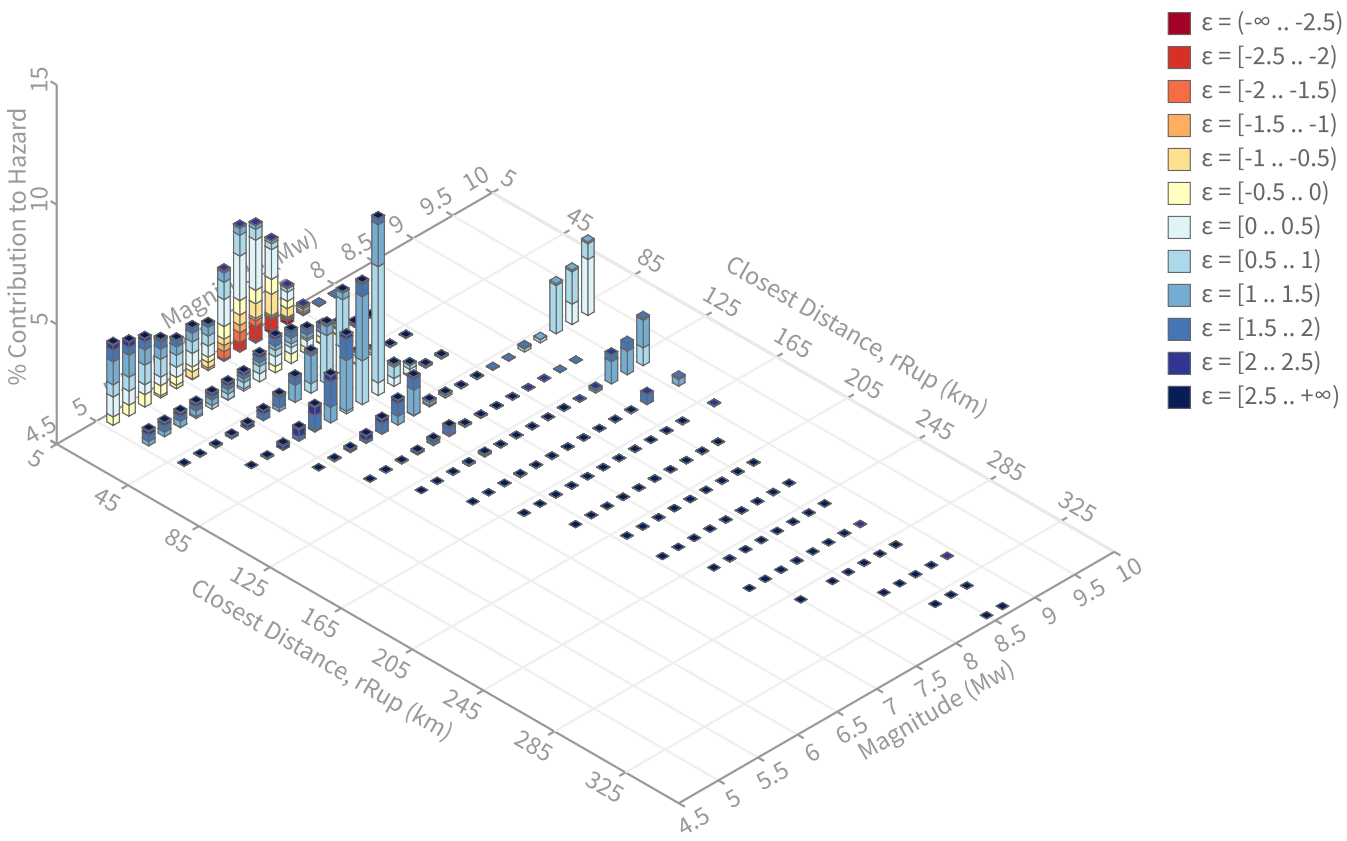


View Raw Data

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
ε_0: 0.76 σ

Mode (largest m-r bin)

m: 7.1
r: 67.32 km
ε_0: 0.87 σ
Contribution: 7.38 %

Mode (largest m-r-ε_0 bin)

m: 7.11
r: 65.73 km
ε_0: 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 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
pacnwdeep.2014.in	Slab							21.07
Seattle	Fault							14.23
Seattle - northern		3.57	6.95	-0.53	122.347°W	47.574°N	340.43	7.30
Seattle - middle		3.14	6.80	-0.44	122.381°W	47.557°N	297.21	3.77
Seattle - southern		5.09	6.76	-0.23	122.335°W	47.516°N	190.56	3.15
pacnwdeep.2014.in	Slab							10.08
sub0_ch_bot.in	Interface							7.29
Cascadia Megathrust - whole CSZ Characteristic		88.57	9.11	0.54	123.357°W	47.313°N	252.36	7.29
puget_2014.ch.in	Grid							7.12
puget_2014.gr.in	Grid							6.37
WUSmap_2014_fixSm.ch.in (opt)	Grid							4.45
sub0_ch_mid.in	Interface							4.37
Cascadia Megathrust - whole CSZ Characteristic		122.92	8.92	1.25	123.916°W	47.709°N	279.61	4.37
WUSmap_2014_fixSm.gr.in (opt)	Grid							3.99
WUSmap_2014_adSm.ch.in (opt)	Grid							2.93
WUSmap_2014_adSm.gr.in (opt)	Grid							2.64
pacnwdeep.2014.in	Slab							2.01
puget_2014_M8.in	Grid							1.86
Geologic Model Partial Rupture	Fault							1.77
pacnwdeep_Mmax75.2014.in	Slab							1.31
Geologic Model Full Rupture	Fault							1.12
WUSmap_2014_fixSm_M8.in (opt)	Grid							1.09