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GEOTECHNICAL DATA REPORT ADDENDUM

Kitsap County Hauled Waste Upgrades

KITSAP COUNTY, WASHINGTON

February 8, 2024

Shannon & Wilson No: 110699-006

SHANNON & WILSON

Submitted To: HDR Engineering Inc.
835 North Post Street
Spokane, WA 99201
Attn: Mr. Andrew Staples

Subject: GEOTECHNICAL DATA REPORT ADDENDUM, KITSAP COUNTY HAULED WASTE UPGRADES, KITSAP COUNTY, WASHINGTON

Shannon & Wilson prepared this report addendum and participated in this project as a subconsultant to HDR Engineering, Inc. Our scope of services was specified in subconsultant agreement with HDR dated May 3, 2023, and as modified Amendment 1, dated September 13, 2023. This report addendum presents the geotechnical data collected for the project as part of Amendment 1 scope and was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report addendum, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON

DAVID CHARLES WARD
42341

2/8/2024

David Ward, PE, LEG
Vice President

ECS:DCW/ecs:aec

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1 INTRODUCTION

This addendum to the geotechnical data report presents the results of the additional geotechnical explorations for the Kitsap County Hauled Waste Upgrades project (Project) in Kitsap County, Washington. Our geotechnical services covered by this addendum included:

- Drilling and sampling two boreholes,
- Installing two observation wells,
- Performing geotechnical laboratory analysis, and
- Preparing the geotechnical data report.

2 SITE AND PROJECT DESCRIPTION

The Project site is at the Central Kitsap Wastewater Treatment Plant (WWTP) located along the Brownsville Highway, northeast of Silverdale, Washington (Figure 1). Kitsap County recently purchased parcel 112501-1-038-2007, which is the adjacent parcel east of the existing Central Kitsap WWTP. The proposed maintenance building was originally located at the WWTP site but with purchase will be moved to the adjacent parcel.

The purpose of this addendum is to present the geotechnical data collected in the vicinity of the revised maintenance building location. The proposed maintenance building will be a single-story structure on a slab foundation.

3 GEOTECHNICAL EXPLORATION PROGRAM

Our geotechnical exploration program consisted of drilling and sampling two geotechnical borings, designated KT-9 and KT-10, and installing observation wells at both locations. The approximate locations of the borings and observation wells are shown in the Site and Exploration Plan (Figure 2). Holt Services, Inc. under subcontract to Shannon & Wilson, performed the drilling, sampling, and observation well construction. A Shannon & Wilson field representative was on site to observe the drilling, collect soil samples, observe the observation well construction, and prepare the field boring logs.

A summary of the subsurface explorations is provided in Table A-1 in Appendix A.

3.1 Drilling

Holt used a truck-mounted, B-59 Mobile Drill to drill the borings. The borings were performed using hollow-stem auger (HSA) method. HSA uses a bit with carbide teeth and 8-inch-diameter flights to advance and temporarily case the borehole. As the HSA rotates, the flights move the cuttings from the bottom up to the surface, where it is shoveled into drums and later removed from the site.

Borehole locations were determined by Shannon & Wilson based on the proposed building location provided by HDR prior to the start of drilling. Borehole locations were cleared of utilities by a public utility locator and by a private utility locator, Applied Professional Services, prior to drilling.

3.2 Soil Sampling

Soil samples were obtained in conjunction with Standard Penetration Tests (SPTs). The SPTs were performed in accordance with ASTM D1586-18e1, Standard Test Method for SPT and Split-Barrel Sampling of Soils (ASTM, 2018a). The depth at which the samples were collected, and the corresponding Standard Penetration Resistance (N-values) are recorded in the boring log in Appendix A. The SPT N-value is a useful parameter for determining the relative density or consistency of the soils. Density or consistency, as it is related to the SPT N-value, is shown in the log key in Appendix A.

3.3 Borehole Completion

After the last sample was obtained in borings, Holt installed well casings with a threaded, 2-inch-inside-diameter polyvinyl chloride well casing, a slotted portion (screen) to allow for the inflow of water, and an end cap (sump) to the bottom of the slotted section. A filter pack consisting of silica sand was placed around the screen to act as a filter against the adjacent soil. Bentonite chips were placed down the hole, above the filter pack, to create an impermeable seal. An 8-inch steel monument lid was concreted in place at the surface to protect the observation well. The installation details for the observation wells are shown graphically on the boring logs in Appendix A.

Both wells were constructed by Holt in accordance with applicable Washington State Department of Ecology regulations and standards.

All soil cuttings generated during drilling were placed in 55-gallon drums and disposed of off-site by Holt.

3.4 Boring Logs

The Project boring logs are presented in Appendix A. A boring log is a written record of the subsurface conditions encountered during drilling. It graphically shows the geologic units (layers) encountered in the boring and the Unified Soil Classification System (USCS) symbol of each geologic layer. The right-hand side of the boring log also includes the recorded N-value, as well as the measured moisture content and percent fines from laboratory testing where tests were performed. Other information shown in the boring logs is observed and measured groundwater levels, approximate ground surface elevation and northing and easting, and types and depths of sampling. The Project boring logs are presented in Appendix A.

3.5 Geologic Units

Based on the review of the samples and the available geologic maps for the Project area, a list of geologic units encountered was developed. Geologic units were defined based on their geologic history and engineering properties. These geologic units are interpretive and are based on the grouping of complex sediments and soil types into units. The geologic unit designations are shown in conjunction with the descriptions on the boring logs. A list with descriptions of geologic units encountered in the current geotechnical explorations, from youngest to oldest, is presented in Table A-2 in Appendix A.

3.6 Groundwater Measurements

Observation wells were measured using an electronic water level indicator. These readings were converted to groundwater elevations using well installation measurements and the approximate ground surface elevation. The measured water levels for each observation well are included in the boring logs in Appendix A.

3.7 Previous Drilling

There is no known previous drilling on the parcel where the planned maintenance building is located. Landau Associates and Shannon & Wilson drilled boreholes at the Central Kitsap Wastewater Treatment Plant. These locations and borehole logs can be found in the Central Kitsap Hauled Waste Upgrades Geotechnical Data Report (Shannon & Wilson, 2023)

4 LABORATORY TESTING

Geotechnical laboratory tests were performed on selected samples retrieved from the borings to assist with classifying the soil and to provide data for our engineering analyses.

Visual classification of the soil samples was performed at the site by the field representative, and then at the laboratory by a senior geologist. The geotechnical laboratory testing performed by Shannon & Wilson and included visual classification, water content determinations, and particle-size analysis. One sample was tested for typical parameters associated with corrosion analysis by Norton Corrosion Limited.

4.1 Visual Classification

We visually classified soil samples retrieved from the borings using a system based on ASTM D2487-17, Standard Practice for Classification of Soils for Engineering Purposes (USCS) (ASTM, 2020), and ASTM D2488-17e1, Standard Recommended Practice for Description of Soils (Visual-Manual Procedure) (ASTM, 2018b). We assigned a USCS group name and symbol based on our visual classification of particles finer than 76.2 millimeters (3 inches). We revised visual classifications using results of the index tests discussed below.

4.2 Water Content Determination

We tested the water content of selected samples in accordance with ASTM D2216-19, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM, 2019). Water content test results are presented in the boring logs in Appendix A.

4.3 Grain-Size Distribution Analysis

We performed mechanical sieve analyses on selected soil specimens to determine the grain-size distribution of coarse-grained soil particles in accordance with ASTM D6913-17, Standard Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis (ASTM, 2017a). Grain-size distributions are used to classify the granular component of soils and can correlate with soil properties, including frost susceptibility, permeability, shear strength, liquefaction potential, capillary action, and sensitivity to moisture. Grain-size distribution plots provide tabular information about each specimen, including USCS group symbol and group name, water content, constituent (i.e., cobble, gravel, sand, and fines) percentages, personnel initials, ASTM standard designation, and any applicable testing remarks. The results of the laboratory analysis are in Appendix B, and fines contents are plotted as data points in the boring logs in Appendix A.

4.4 Corrosion Testing

A composite sample was submitted to Norton Corrosion in Woodinville, Washington, for corrosion testing. The sample was tested for moisture content, pH, resistivity, sulfides, chlorides, and redox potential. The test results are presented in Appendix B.

5 LIMITATIONS

This geotechnical data report addendum presents the data from field explorations, and field and laboratory testing of subsurface conditions at the specific locations and depths indicated, using the means and methods described in this report addendum. No other representation is made. This report addendum should be made available to the prospective contractors for information on factual data only. Subsurface conditions that are interpreted from the data included in this report may not be construed as a guarantee or warranty of such interpreted conditions.

Natural processes or human activity may alter subsurface conditions. Because a geotechnical report is based on conditions that existed at the time of subsurface explorations, construction decisions should not be based on a report whose adequacy may have been affected by time, unless verified. Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely taking soil samples from borings.

We have prepared the document "Important Information About Your Geotechnical Report" to assist you and others in understanding the use and limitations of this geotechnical data report addendum. Please read this document to learn how you can lower your risks for this Project.

6 REFERENCES

ASTM International, 2017a, Standard test method for particle-size distribution (gradation) of soils using sieve analysis, D6913-17: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 34 p., available: www.astm.org.

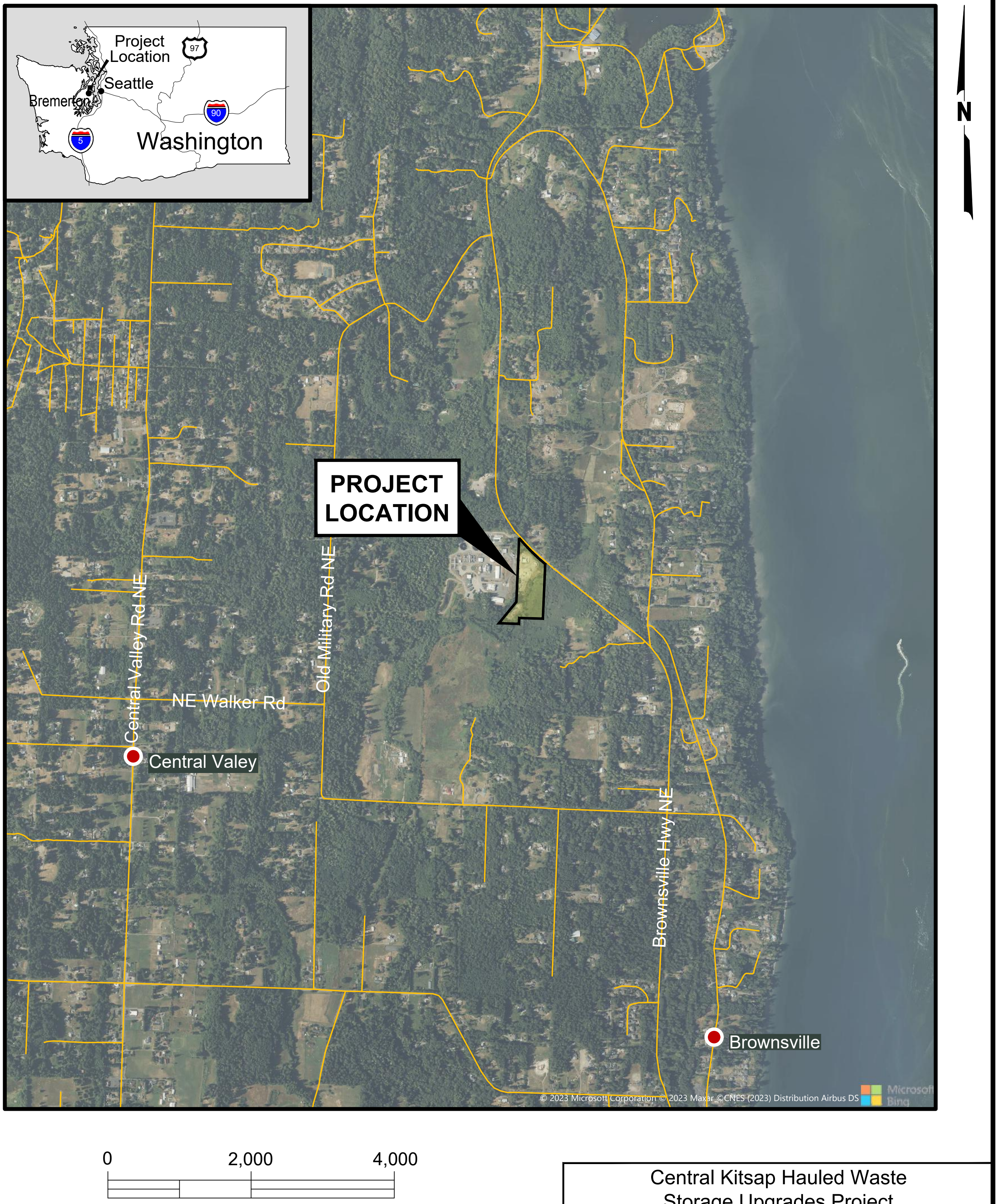
ASTM International, 2018a, Standard test method for standard penetration test (SPT) and split-barrel sampling of soils, D1586-18e1: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 26 p., available: www.astm.org.

ASTM International, 2018b, Standard practice for description and identification of soils (visual/manual procedure), D2488-17e1: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 13 p., available: www.astm.org.

ASTM International, 2019, Standard test methods for laboratory determination of water (moisture) content of soil and rock by mass, D2216-19: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420- D5876, 7 p., available: www.astm.org.

ASTM International, 2020, Standard practice for classification of soils for engineering purposes (unified soil classification system), D2487-17e1: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 10 p., available: www.astm.org.

Shannon & Wilson, 2023, Kitsap County Hauled Waste Upgrades Geotechnical Data Report, 49 p.



Approximate Scale in Feet

Central Kitsap Hauled Waste
Storage Upgrades Project
Poulsbo, Washington

VICINITY MAP

February 2024 110699-006

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FIG. 1

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive_SEA\110699\006\110699-006 Vicinity Map.dwg Date: 02-02-2024 Login: JRS

LEGEND

KT-9 ⊙	Current Boring Designation and Approximate Location *(Shannon & Wilson, Inc.)*
KT-1 ⊙	Previous Boring Designation and Approximate Location *(Shannon & Wilson, Inc.)*
LAI-1 ◐	Boring Designation and Approximate Location *(Landau Associates)*

0 150 300

Scale in Feet

Central Kitsap Hauled Waste
Storage Upgrades Project
Poulsbo, Washington

SITE AND EXPLORATION PLAN

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FIG. 2

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APPENDIX A: SUBSURFACE EXPLORATIONS

Appendix A

Subsurface Explorations

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Tables

Figures

Table A-1: Summary of Explorations

Borehole ID	Hole Depth (ft)	Drill Date	Drilling Method	Approximate Ground Elevation[1] (ft)	Northing[2]	Easting[2]	Well Installed	Bottom Depth of Well Screen (ft)
KT-9	30.8	9/22/2023	Hollow Stem Auger	170.5	251184	1198221	Yes	29.7
KT-10	30.3	9/22/2023	Hollow Stem Auger	170.5	251170	1198266	Yes	29.7

NOTES:

1 Elevations are approximate and are in Vertical Datum NAVD88

2 Coordinates in WSP North NAD83

Table A-2 - Geologic Units and Descriptions

Unit Name	Abbreviation	General Unit Description	Soil Description
HOLOCENE UNITS			
Fill	Hf	Fill place by humans, both engineered and nonengineered	Various materials, including debris; garbage; cobbles and boulders; commonly dense to stiff if engineered, but very loose to dense or very soft to stiff in non-engineered
PRE-VASHON UNITS			
Till-Like	Qvd	Glacial deposit intermediate between till and outwash; sub-glacially reworked	Silty gravelly sand, silty Sand, sandy Gravel; highly variable over short distances; cobbles and boulders common; dense to very dense.

NOTE:

The geologic units are interpretive and based on our opinion of the grouping of complex sediments and soil types into units appropriate for the project. The description of each geologic unit include only general information regarding the environment of deposition and basic soil characteristics. For example, cobbles and boulders are only included in the description of those units where they are most prominent.

SOIL CLASSIFICATION

Shannon & Wilson uses a soil identification system modified from the Unified Soil Classification System (USCS) as described on this Key. Soil descriptions are based on visual-manual procedures (ASTM D2488) and available laboratory index test results (ASTM D2487).

Exhibit A: Unified Soil Classification System (USCS)[1]

Major Divisions			Symbol / Graphic	Typical Identifications (USCS Group Names)[2,4]
COARSE-GRAINED SOILS *(> 50% of soil is retained on the No. 200 sieve[3])*	**GRAVELS** *(> 50% of coarse fraction retained on the No. 4 sieve[3])*	**Gravel** *(< 5% fines[3])*	GW	Well-graded Gravel; Well-Graded Gravel with Sand
			GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(> 12% fines[3])*	GM	Silty Gravel; Silty Gravel with Sand
			GC	Clayey Gravel; Clayey Gravel with Sand
	SANDS *(≥ 50% of coarse fraction passes the No. 4 sieve[3])*	**Sand** *(< 5% fines[3])*	SW	Well-graded Sand; Well-graded Sand with Gravel
			SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(> 12% fines[3])*	SM	Silty Sand; Silty Sand with Gravel
			SC	Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(≥ 50% of soil passes the No. 200 sieve[3])*	**SILTS AND CLAYS** *(liquid limit < 50)*	**Inorganic**	ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly, Lean Clay
		Organic	OL	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly, Organic Silt or Clay
	SILTS AND CLAYS *(liquid limit ≥ 50)*	**Inorganic**	MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly, Elastic Silt
			CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly, Fat Clay
		Organic	OH	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly, Organic Silt or Clay
HIGHLY ORGANIC SOILS	*Primarily organic matter, dark in color, and organic odor*		PT	Peat or other Highly Organic Soils (see ASTM D4427)

***NOTE:** For gravels and sands with 5 to 12% fines[3], the following are added to the Group Name:* with Silt and/or Clay or Silty Clay. *Dual Symbols are used:* GW-GM, GP-GM, SW-SM, SP-SM GW-GC, GP-GC, SW-SC, SP-SC

EXHIBIT A NOTES:
1. Adapted, with permission, from USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488.
2. Borderline symbols (symbols separated by a slash) indicate that the soil characteristics are close to the defining boundary between two groups (e.g., CL/ML = Lean Clay to Silt; SP-SM/SM = Sand with Silt to Silty Sand).
3. No. 4 size = 4.75 millimeters (mm) = 0.187 inch; No. 200 sieve size = 0.075 mm = 0.003 inch. Particles smaller 0.075 mm are termed "fines".
4. Poorly graded indicates a narrow range or missing grain sizes. Well-graded indicates a full-range and even distribution of grain sizes.
5. If cobbles and/or boulders are observed, "with cobbles" or "with boulders" or "with cobbles and boulders" is added to the Group Name.

Exhibit B-1: Standard Penetration Test (SPT)

Term	Description
Hammer	140-pound weight with a 30-inch free fall. Hammer types vary (e.g., automatic, rope and cathead). If available, the hammer type and energy ratio (E-ratio) is noted on the boring log.
Sampler	Barrel I.D. / O.D. = 1.5 inches / 2 inches (liner not used) Barrel Length = 30 inches; Shoe I.D. = 1.375 inches
N-Value (N)[1]	Sum of the count of hammer blows to penetrate the second and third 6-inch increments in blows per foot (bpf). **Refusal**: 50 blows for 6 inches or less or 10 blows for 0 inch.

Exhibit B-2: Relative Consistency of Cohesive Soils

Term	N[2] (bpf)	PP[3] (tsf)	TV[3] (tsf)
Very Soft	0 - 2	0 - 0.25	0 - 0.12
Soft	2 - 4	0.25 - 0.5	0.12 - 0.25
Medium Stiff	4 - 8	0.5 - 1	0.25 - 0.5
Stiff	8 - 15	1 - 2	0.5 - 1
Very Stiff	15 - 30	2 - 4	1 - 2
Hard	> 30	> 4	> 2

Exhibit B-3: Relative Density of Cohesionless Soils

Term	N[2] (bpf)
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

EXHIBIT B NOTES:
1. N-values shown on boring logs are as recorded in the field and have not been corrected for hammer energy, overburden, or other factors. Where the hammer E-ratio is available, the N-value normalized to a ratio of 60% (N_{60}) is listed.
2. Based on ASTM Standard D1586. Relative densities/consistencies noted on the boring logs are based on uncorrected N-values.
3. PP = pocket penetrometer; TV = torvane, tsf = tons per square foot. Correlations based on experience and multiple published references.

Exhibit C: Soil Structure[1]

Term	Description
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Fissured	Breaks along definite planes or fractures with little resistance.
Homogeneous	Same color and appearance throughout.
Interbedded	Alternating layers at least 1/4 inch thick of varying material or color. *Singular: bed*
Laminated	Alternating layers less than 1/4 inch thick of varying material or color. *Singular: lamination*
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.

EXHIBIT C NOTE:
1. Adapted, with permission, from ASTM D2488.

Exhibit D: Soil Plasticity[1]

Term	Description
Nonplastic	Cannot roll a 1/8-inch thread at any water content.
Low Plasticity	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.
Medium Plasticity	A thread is easy to roll and not much time in rolling is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.
High Plasticity	It takes considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.

EXHIBIT D NOTE:
1. Adapted, with permission, from ASTM D2488.

Exhibit E: Soil Moisture Content[1]

Term	Description
Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible water.
Wet	Visible free water, from below water table.

EXHIBIT E NOTE:
1. Adapted, with permission, from ASTM D2488 (Figure 2).

Exhibit F: Soil Cementation[1]

Term	Description
Weak	Crumbles or breaks with handling or slight finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

EXHIBIT F NOTE:
1. Adapted, with permission, from ASTM D2488.

Exhibit G: Percentages

Term	Percent[1]
Trace	<5
Few	5 to 10
Little	15 to 25
Some	30 to 45
Mostly	>50

EXHIBIT G NOTE:
1. Percent estimated by weight for sand and gravel, and by volume for cobbles, organics, and other non-soil material (e.g., rubble, debris).

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LOG KEY

SOIL CLASSIFICATION *(continued)*

See Page 1 for Soil Classification Exhibits A through G

Exhibit H: Particle Angularity and Shape[1]

Term	Description
Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width to thickness ratio > 3.
Elongated	Width to thickness ratio < 3.

EXHIBIT H NOTE:
1. Adapted, with permission, from ASTM D2488.

Exhibit I: Additional Descriptive Terms

Term	Description
Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling action.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

SOIL CLASSIFICATION REFERENCES:

ASTM International, [current edition], Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, available: www.astm.org.

U.S. Army Corps of Engineers, 1953, The unified soil classification system: Vicksburg, Miss., Waterways Experiment Station, Technical Memorandum 3-357, 2 v., March.

SYMBOLOGY AND GRAPHICS

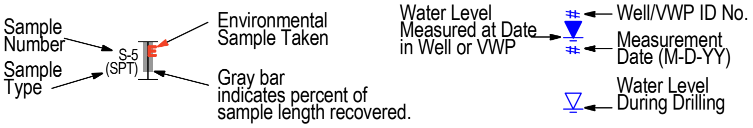
Exhibit J: Sample and Run Graphics

Graphic	Description	Graphic	Description	Graphic	Description
⌶	SPT split spoon (2-inch OD)	┆	Split spoon (SS) (diameters vary)	▮	Core run (typically rock)
⧄	Grab (GB) from cuttings or excavation	‖	Modified California (MC) sampler	⋮	Sheath (SH) (used for geoprobes)
▯	Tube (TB) (e.g., Shelby, piston)	§	Sonic core (SC) run (typically soil)		

Exhibit K: Hole Backfill and Instrument Graphics

Graphic	Description	Graphic	Description	Graphic	Description
▧	Bentonite-cement grout	▩	Surface cement seal	▥	Blank pipe or instrument casing
▨	Bentonite grout	⁘	Sand filter pack	☰	Perforated or slotted pipe
▦	Bentonite chips	▤	Slough *(hole caved)*	■	VWP and electric lead

Exhibit L: Other Log Symbols



ROCK CLASSIFICATION

Shannon & Wilson uses a rock classification system modified from the system recommended by the International Society for Rock Mechanics (ISRM). Copyright limitations prevent us from reproducing summary tables from the ISRM system on this Key. General descriptions are provided in Exhibit M.

Exhibit M: General Rock Descriptive Terms - ISRM

Term	General Description
Strength	Ranges from extremely weak (q_u = 36 to 135 psi) to extremely strong (q_u > 36,250 psi), and is based on the ability to break the rock with a hammer or scrape the rock with a knife.
Weathering	Ranges from fresh (no visible signs of weathering) to completely weathered, based on observed degree of discoloration, decomposition, and/or disintegration. When the rock material has completely converted to soil, it is termed a residual soil.
Fabric	Describes the rock structure based on observed layering, tendency to break, and distribution of minerals (e.g., massive, bedded, foliated).
Roughness	For discontinuities: Includes rough, smooth, and slickensided, and includes other descriptive terms (e.g., stepped, undular, irregular, planar).
Spacing	For discontinuities: Ranges from extremely close (< 1 inch) to extremely wide (> 20 feet).
Persistence	For discontinuities: Ranges from very low to very high.
Other	Description of discontinuities (joints, fractures, bedding planes, etc.), observations of potential displacement, gouge, shear, etc.

REFERENCE: Brown, E. T., ed., 1981, Rock characterization, testing & monitoring: International Society of Rock Mechanics (ISRM) suggested methods: Oxford, Pergamon Press, 211 p.

Exhibit N: Rock Name Graphics

No rock names defined for this Project

Exhibit O: Recovery and RQD Equations[1]

Term	Equation
Core Recovery (REC) in %	$100\% \times \frac{\text{Length of Core Recovered}}{\text{Length of Core Run}}$
Rock Quality Designation (RQD) in %	$100\% \times \frac{\text{Length of Core in Pieces > 4 in}}{\text{Length of Core Run}}$

REFERENCE: Loehr, J. E.; Lutenegger, A.; Rosenblad, B.; and Boeckmann, A., 2016, Geotechnical site characterization: U.S. Federal Highway Administration Report FHWA NHI-16-072, Geotechnical Engineering Circular no. 5, 1 v.

ACRONYMS AND ABBREVIATIONS

ATD	at time of drilling	N	field (uncorrected) SPT N-value	REF	refusal
bpf	blows per foot	N_{60}	SPT N-value corrected for 60% ETR	RQD	rock quality designation (ASTM D6032)
dia, diam	diameter	NA, n/a	not applicable or not available	SC	sonic core
Elev.	elevation	NE	northeast	SE	southeast
ENV	environmental sample	NP	nonplastic	SPT	Standard Penetration Test (ASTM D1586)
ETR	energy transfer ratio (hammer)	NR	no recovery	SW	southwest
FC	fines content (< 0.075 mm)	NW	northwest	TP	test pit
FeO	iron oxide	OC	organic content	tsf	tons per square foot
ft or '	foot or feet	OD	outside diameter	TV	tor vane reading
gal	gallons	OW	observation well	UCS, q_u	unconfined compressive strength
GP	geoprobe	pcf	pounds per cubic foot	USCS	Unified Soil Classification System
GWT	groundwater table	PI	plasticity index	VST	vane shear test
HSA	hollow-stem auger	PID	photoionization detector	VWP	vibrating wire piezometer
ID	inside diameter or identification	PL	plastic limit	WC	natural water content
in or "	inch	PMT	pressuremeter test	WOH	weight of hammer
incl	inclinometer	PP	pocket penetrometer reading	WOR	weight of rods
ksf	kips per square foot	ppm	parts per million		
lbs	pounds	psi	pounds per square inch		
LL	liquid limit	PT	nonstandard penetration test N-value		
mm	millimeter	REC	recovery		

BORING LOG

Kitsap County Hauled Waste Upgrades
Kitsap County, Washington

KT-9
Page 1 of 1

EXPLORATION INFORMATION

Total Depth:	30.8 feet
Top Elevation:	~170 feet
Vertical Datum:	NAVD88
Northing:	~251,184 feet
Easting:	~1,198,221 feet
Horizontal Datum:	WA-N SP [NAD 1983]
Hole Start Date:	September 22, 2023
Hole Finish Date:	September 22, 2023

DRILLING INFORMATION

Drilling Method:	Hollow Stem Auger
Drilling Company:	Holt
Drill Rig Equipment:	B-59
Hole Size:	8 inch
Rod Type/Dia.:	NWJ 2.63 inch
Hammer Wt. / Drop:	140 lbs/30 inches
Hammer ETR:	~80% (estimated)
Well Tag No.:	BPW 198

BASIC LEGEND

(See separate LOG KEY for additional symbols, acronyms, and definitions)

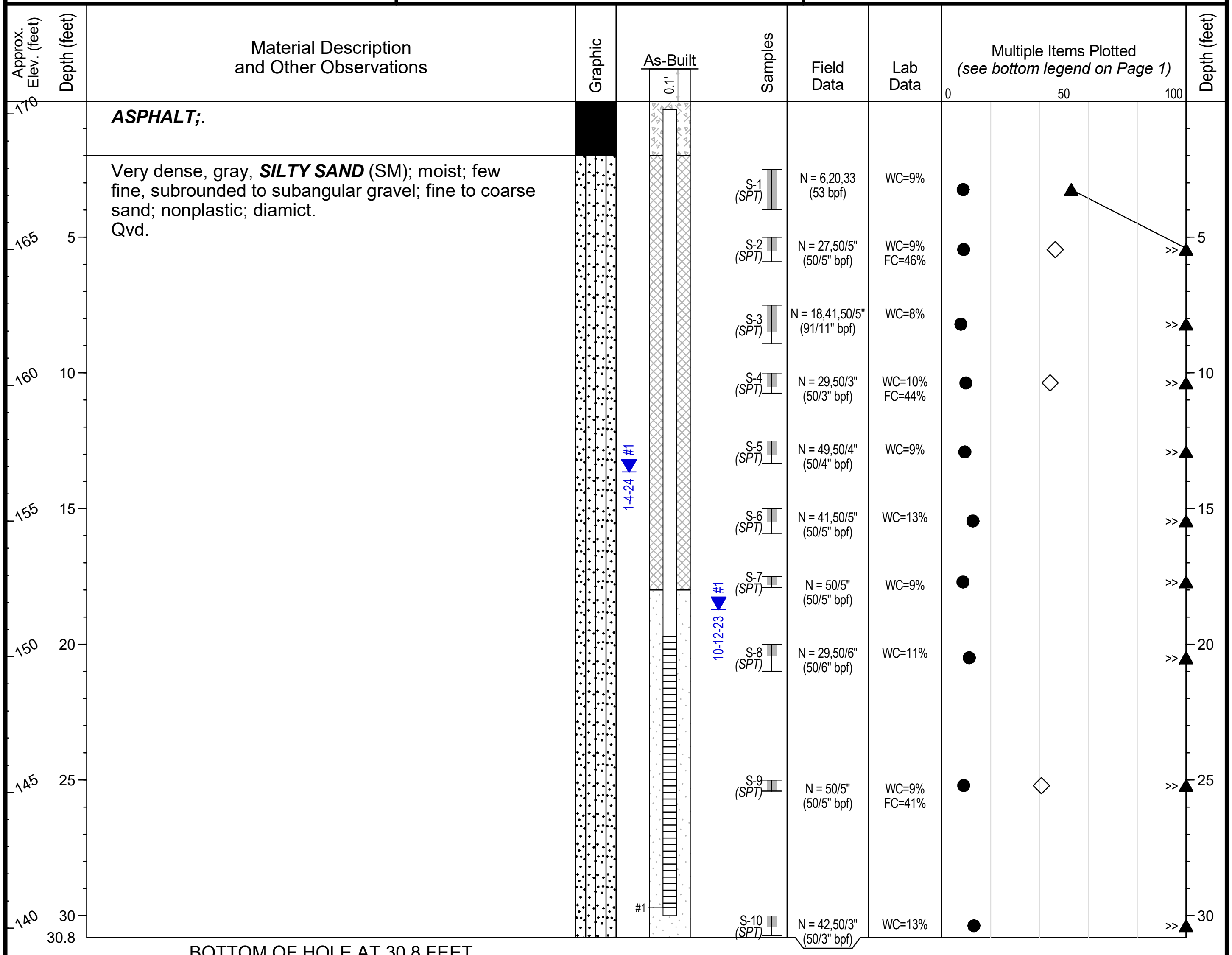
Abbreviations

N	Standard Penetration test (blows per 6" increment)
PT	Nonstandard penetration test (blows per 6" incr.)
(bpf)	Blows per foot for penetration test
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
LL/PL	Liquid limit / plastic limit (Atterberg Limits)

Symbols

Sample Number → S-5
Sample Type → (SPT)
Gray bar indicates percent of sample length recovered.

Water Level During Drilling → ▽
Water Level Measured at Date in Well or VWP ▼
ID No. ← #
Measurement Date (M-D-YY) ← #



Material Description and Other Observations
***ASPHALT;*.**
Very dense, gray, ***SILTY SAND*** (SM); moist; few fine, subrounded to subangular gravel; fine to coarse sand; nonplastic; diamict. Qvd.

Samples	Field Data	Lab Data
S-1 (SPT)	N = 6,20,33 (53 bpf)	WC=9%
S-2 (SPT)	N = 27,50/5" (50/5" bpf)	WC=9% FC=46%
S-3 (SPT)	N = 18,41,50/5" (91/11" bpf)	WC=8%
S-4 (SPT)	N = 29,50/3" (50/3" bpf)	WC=10% FC=44%
S-5 (SPT)	N = 49,50/4" (50/4" bpf)	WC=9%
S-6 (SPT)	N = 41,50/5" (50/5" bpf)	WC=13%
S-7 (SPT)	N = 50/5" (50/5" bpf)	WC=9%
S-8 (SPT)	N = 29,50/6" (50/6" bpf)	WC=11%
S-9 (SPT)	N = 50/5" (50/5" bpf)	WC=9% FC=41%
S-10 (SPT)	N = 42,50/3" (50/3" bpf)	WC=13%

BOTTOM OF HOLE AT 30.8 FEET

NOTES:
- Refer to LOG KEY for explanation of symbols, codes, abbreviations, and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- Group symbol is based on visual-manual identification and selected lab testing.
- Report text contains limitations and information needed to contextually understand this log.

▲ Uncorrected N-value, bpf
▼ Uncorrected, Nonstandard N-value, bpf
● = WC% ◇ = FC%

FINAL

Logged by:	PMH
Review by:	ECS
Version:	1

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SHANNON & WILSON

BORING LOG

Kitsap County Hauled Waste Upgrades
Kitsap County, Washington

KT-10
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EXPLORATION INFORMATION

Total Depth:	*30.3 feet*
Top Elevation:	*~171 feet*
Vertical Datum:	*NAVD88*
Northing:	*~251,170 feet*
Easting:	*~1,198,266 feet*
Horizontal Datum:	*WA-N SP [NAD 1983]*
Hole Start Date:	*September 22, 2023*
Hole Finish Date:	*September 22, 2023*

DRILLING INFORMATION

Drilling Method:	*Hollow Stem Auger*
Drilling Company:	*Holt*
Drill Rig Equipment:	*B-59*
Hole Size:	*8 inch*
Rod Type/Dia.:	*NWJ 2.63 inch*
Hammer Wt. / Drop:	*140 lbs/30 inches*
Hammer ETR:	*~80% (estimated)*
Well Tag No.:	*BPW 199*

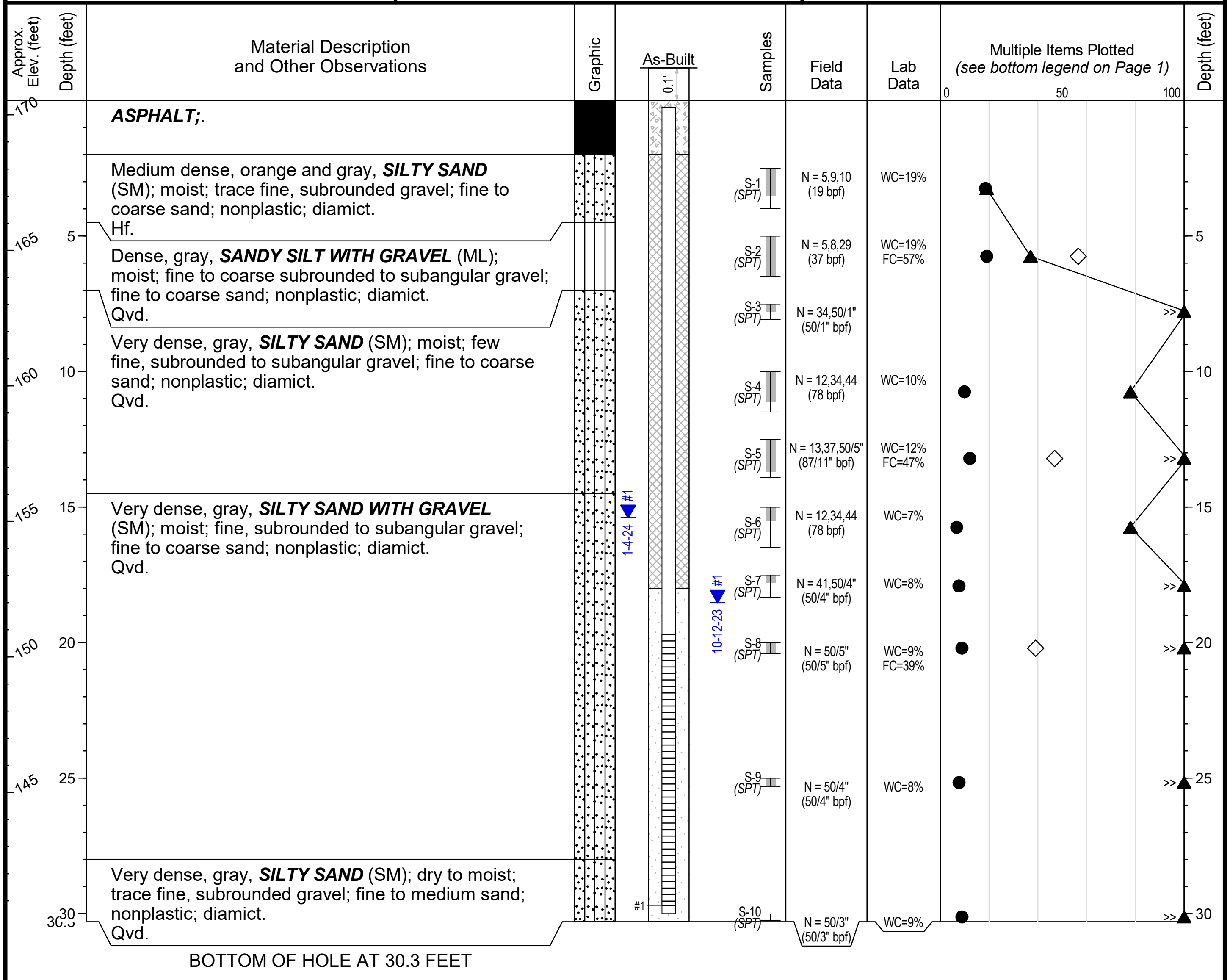
BASIC LEGEND

(See separate LOG KEY for additional symbols, acronyms, and definitions)

Abbreviations

N	Standard Penetration test (blows per 6" increment)
PT	Nonstandard penetration test (blows per 6" incr.)
(bpf)	Blows per foot for penetration test
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
LL/PL	Liquid limit / plastic limit (Atterberg Limits)

Symbols



Depth (feet)	Material Description and Other Observations	Samples	Field Data	Lab Data
0	***ASPHALT;*.**			
	Medium dense, orange and gray, ***SILTY SAND*** (SM); moist; trace fine, subrounded gravel; fine to coarse sand; nonplastic; diamict. Hf.	S-1 (SPT)	N = 5,9,10 (19 bpf)	WC=19%
5	Dense, gray, ***SANDY SILT WITH GRAVEL*** (ML); moist; fine to coarse subrounded to subangular gravel; fine to coarse sand; nonplastic; diamict. Qvd.	S-2 (SPT)	N = 5,8,29 (37 bpf)	WC=19% FC=57%
		S-3 (SPT)	N = 34,50/1" (50/1" bpf)	
10	Very dense, gray, ***SILTY SAND*** (SM); moist; few fine, subrounded to subangular gravel; fine to coarse sand; nonplastic; diamict. Qvd.	S-4 (SPT)	N = 12,34,44 (78 bpf)	WC=10%
		S-5 (SPT)	N = 13,37,50/5" (87/11" bpf)	WC=12% FC=47%
15	Very dense, gray, ***SILTY SAND WITH GRAVEL*** (SM); moist; fine, subrounded to subangular gravel; fine to coarse sand; nonplastic; diamict. Qvd.	S-6 (SPT)	N = 12,34,44 (78 bpf)	WC=7%
		S-7 (SPT)	N = 41,50/4" (50/4" bpf)	WC=8%
20		S-8 (SPT)	N = 50/5" (50/5" bpf)	WC=9% FC=39%
25		S-9 (SPT)	N = 50/4" (50/4" bpf)	WC=8%
30	Very dense, gray, ***SILTY SAND*** (SM); dry to moist; trace fine, subrounded gravel; fine to medium sand; nonplastic; diamict. Qvd.	S-10 (SPT)	N = 50/3" (50/3" bpf)	WC=9%

BOTTOM OF HOLE AT 30.3 FEET

NOTES:
- Refer to LOG KEY for explanation of symbols, codes, abbreviations, and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- Group symbol is based on visual-manual identification and selected lab testing.
- Report text contains limitations and information needed to contextually understand this log.

▲ Uncorrected N-value, bpf
▼ Uncorrected, Nonstandard N-value, bpf
● = WC% ◇ = FC%

FINAL

Logged by:	PMH
Review by:	ECS
Version:	1

APPENDIX B: GEOTECHNICAL LABORATORY TESTING

Appendix B

Geotechnical Laboratory Testing

CONTENTS

GRAIN SIZE DISTRIBUTION TEST RESULTS

Kitsap County Hauled Waste Upgrades
Kitsap County, Washington

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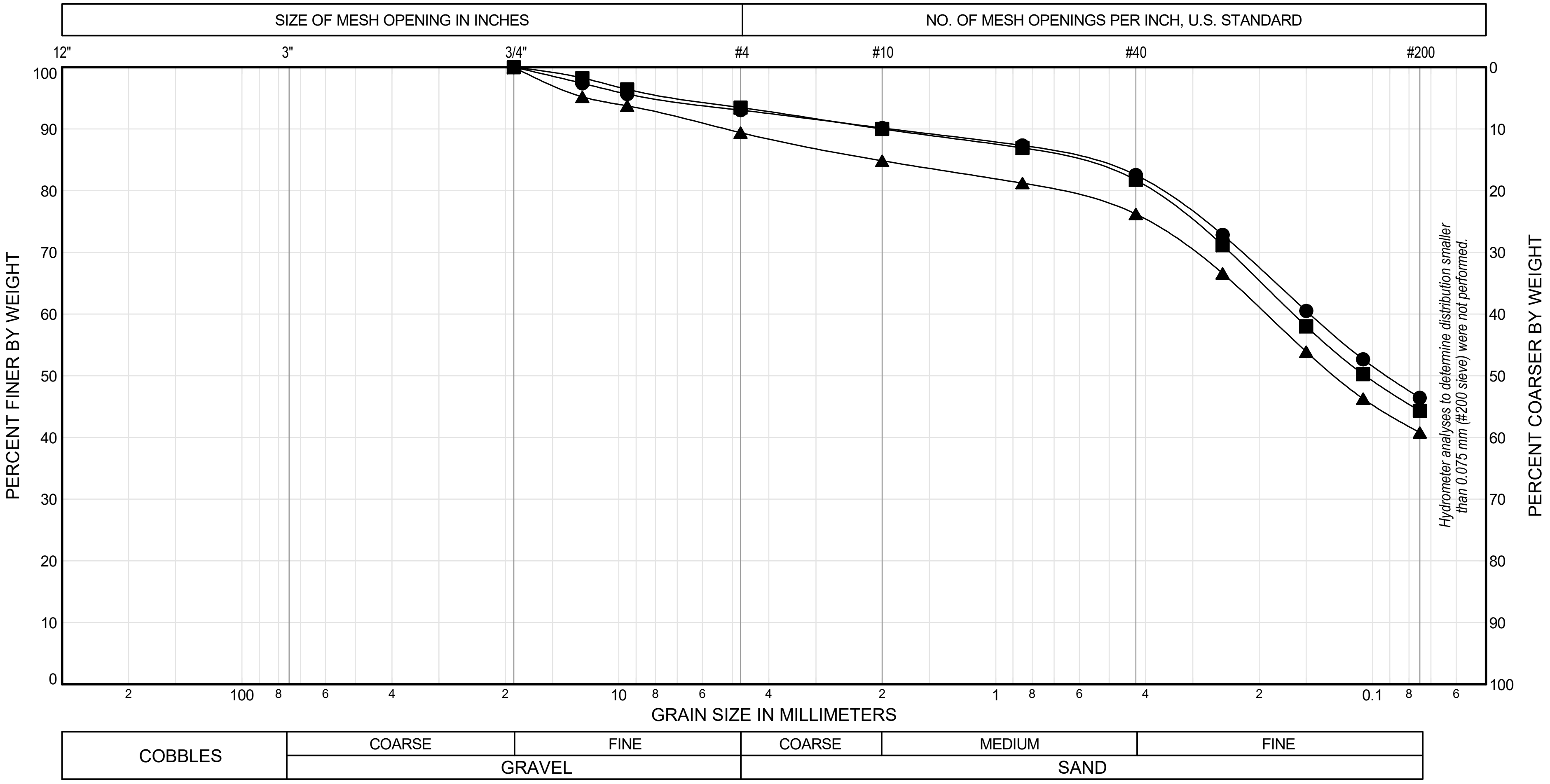

Hydrometer analyses to determine distribution smaller than 0.075 mm (#200 sieve) were not performed.

EXPLORATION AND SAMPLE NUMBER	DEPTH (feet)	UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) GROUP NAME	USCS SYMBOL	GRAVEL %	SAND %	FINES %	NAT WC %	TEST BY/RVW	TEST STD	TEST NOTE
● KT-9, S-2	5.0	*Sieve analysis only - no Atterberg Limits: Group Name not estimated*		7	47	46	8.9	SJD NLP	D6913	*The sample did not meet test standard's minimum requirements*
■ KT-9, S-4	10.0	*Sieve analysis only - no Atterberg Limits: Group Name not estimated*		7	49	44	9.8	SJD NLP	D6913	*The sample did not meet test standard's minimum requirements*
▲ KT-9, S-9	25.0	*Sieve analysis only - no Atterberg Limits: Group Name not estimated*		11	49	41	8.9	SJD NLP	D6913	*The sample did not meet test standard's minimum requirements*

* Sample was assumed to be nonplastic based on visual-manual examination procedures. Therefore, the USCS Group Name is estimated based on the grain size distribution only.
ABBREVIATIONS: NAT WC = natural moisture content; RVW = reviewed by; STD = Standard; USCS = Unified Soil Classification System coder; ~ = approximately (used when measured but not greater than 0.5%)

GRAIN SIZE DISTRIBUTION TEST RESULTS

Kitsap County Hauled Waste Upgrades
Kitsap County, Washington

KT-10
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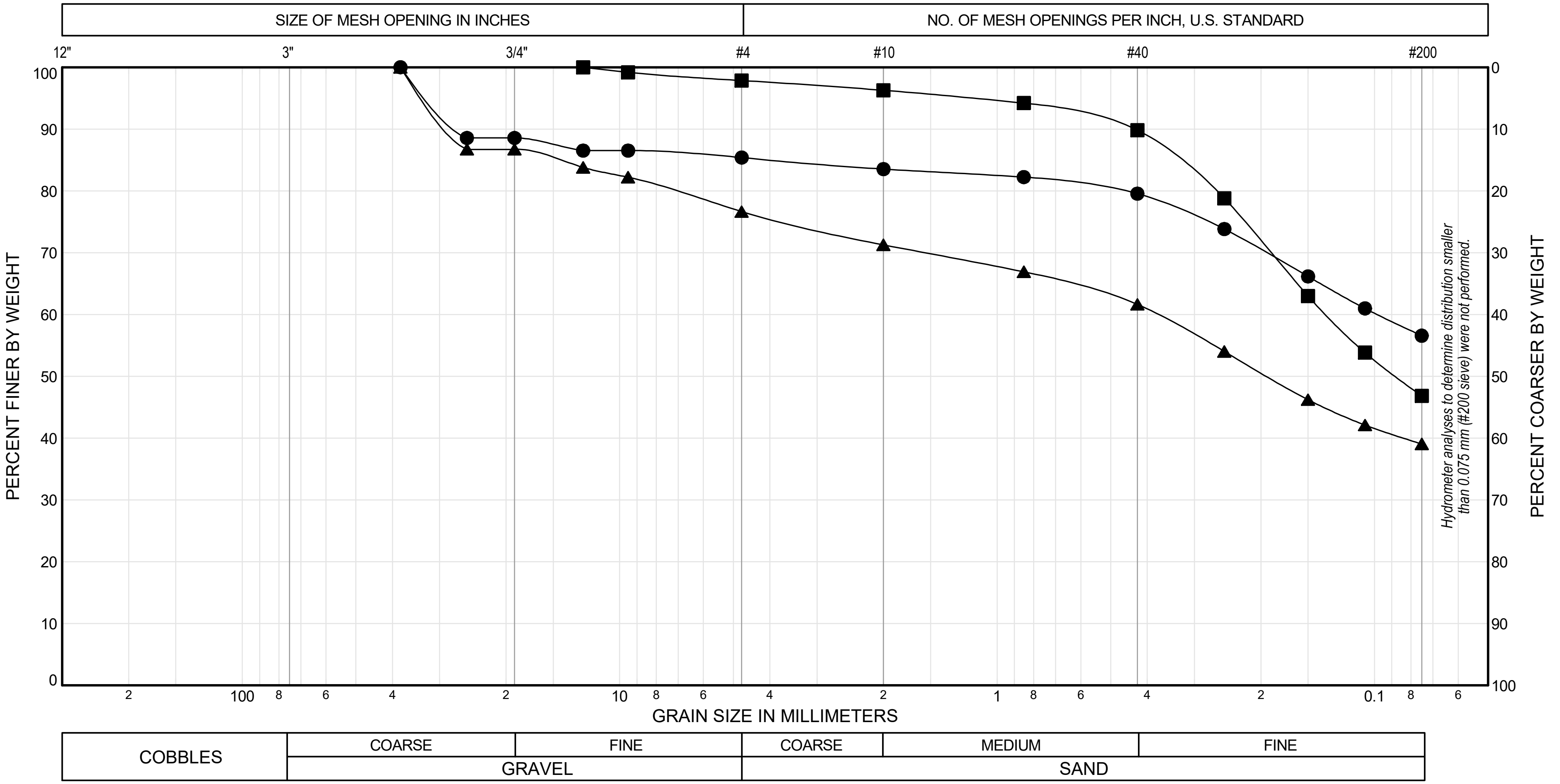

EXPLORATION AND SAMPLE NUMBER	DEPTH (feet)	UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) GROUP NAME	USCS SYMBOL	GRAVEL %	SAND %	FINES %	NAT WC %	TEST BY/RVW	TEST STD	TEST NOTE
● KT-10, S-2	5.0	*Sieve analysis only - no Atterberg Limits: Group Name not estimated*		15	29	57	19.0	SJD NLP	D6913	*The sample did not meet test standard's minimum requirements*
■ KT-10, S-5	12.5	*Sieve analysis only - no Atterberg Limits: Group Name not estimated*		2	51	47	12.1	SJD NLP	D6913	*The sample did not meet test standard's minimum requirements*
▲ KT-10, S-8	20.0	*Sieve analysis only - no Atterberg Limits: Group Name not estimated*		23	38	39	8.9	SJD NLP	D6913	*The sample did not meet test standard's minimum requirements*

* Sample was assumed to be nonplastic based on visual-manual examination procedures. Therefore, the USCS Group Name is estimated based on the grain size distribution only.
ABBREVIATIONS: NAT WC = natural moisture content; RVW = reviewed by; STD = Standard; USCS = Unified Soil Classification System coder; ~ = approximately (used when measured but not greater than 0.5%)

Job#: 110699 | Template Ver:1 | File: 110699.GPJ | Library: SW GINT LIBRARY.GLB | Date: 16/10/23

NORTON CORROSION LIMITED

DATA SHEET: 1 OF 1
DATE IN: 02 OCT 2023
DATE OUT: 11 OCT 2023
BY: H. DUFFY

SOIL ANALYSIS

N.C.L. Job#: E-24231
CUSTOMER: Shannon & Wilson
PROJECT: Kitsap WWTP Maintenance Building
Client P.O.: 110699-009

NCL SAMPLE NO.	SAMPLE I.D.	Soil Wt. Native	Soil Wt. Dry	PERCENT MOISTURE	pH	SULFIDE SCREEN (ppm)	CHLORIDES (ppm)	REDOX (VOLTS)
1 & 2 Combo	KT9 & KT10 2.5'-10'	35.311	31.654	10.36	5.1	ND	166	395
TESTING METHOD					ASTM 4972	EPA P376.2-1 Method 376.2	EPA 300.0	ASTM D1498

ND Analyte NOT DETECTED at or above the reporting limit

IMPORTANT INFORMATION

Important Information

About Your Geotechnical Report

IMPORTANT INFORMATION

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the Geoprofessional Business Association (https://www.geoprofessional.org)