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INFILTRATION REPORT

Little Lake Forest Park Trailhead Improvements

ENUMCLAW, WASHINGTON

February 14, 2024

Shannon & Wilson No: 106797-003

SHANNON & WILSON

Submitted To: SAGE Architectural Alliance
2006 East Miller Street,
Suite A
Seattle, WA 98112
Attn: Valerie Thiel

Subject: INFILTRATION REPORT, LITTLE LAKE FOREST PARK TRAILHEAD IMPROVEMENTS, ENUMCLAW, WASHINGTON

Shannon & Wilson prepared this report and participated in this project as a subconsultant to SAGE Architectural Alliance. Our scope of services was specified in the Amendment, dated December 5, 2023, to the Original Agreement, dated September 2, 2021, with SAGE for work to be performed under Amendment 5 to the Prime Agreement No. KC000114 between SAGE and King County, dated November 28, 2023. This report presents the findings based on our infiltration testing and analysis 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, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON

Nathan Cutler
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Date: 2024.02.14 10:34:02 -08'00'

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1 INTRODUCTION

This report presents the findings of our site investigation, subsurface exploration, and infiltration testing for the Little Lake Forest Park Trailhead Improvements (project) in Enumclaw, Washington. Our services were conducted in general accordance with the scope of geotechnical services for infiltration described in the Consultant Amendment, dated November 28, 2023.

The objective of our services was to provide SAGE Architectural Alliance with a design infiltration rate for Best Management Practice (BMP) design of the proposed infiltration pond at the trailhead parking lot. We completed the following tasks for this project:

- Coordinated with project team to plan infiltration testing.
- Performed one Small Pilot Infiltration Test (PIT).
- Performed laboratory testing of soil samples.
- Monitored groundwater levels in the two existing monitoring wells.
- Prepared this report.

Our conclusions and recommendations are based on:

- Our understanding of the project from information provided to us by SAGE and King County.
- Subsurface conditions observed in the geotechnical soil borings from the previous phase of the project and the test pit from the current phase of the project.
- Results of the infiltration testing.
- Results of laboratory testing of soils.
- Groundwater conditions observed in the monitoring wells.
- Publicly available geologic maps of the project area.

2 SITE AND PROJECT DESCRIPTION

The project site is located at 29103 SE 434th Street, Enumclaw, Washington 98022, King County Parcel Number 1920079101. The site is bounded to the north and west by private residential lots, to the south by the closed Enumclaw Landfill, and to the east by the remainder of the Little Lake Forest Park property. The project site and vicinity are shown in Figure 1.

The Refined Preferred Alternative plan provided by SAGE shows the proposed infiltration pond at the north end of the new parking lot. The infiltration pond has a bottom elevation of 845 feet North American Vertical Datum of 1988 (NAVD88) and a maximum water surface elevation of 849 feet NAVD88. The Refined Preferred Alternative plan shows a bioswale directing storm water flows from the asphalt and landscaping in the parking area to the north to a sand filter and subsequently, to the infiltration pond.

We understand that the project infiltration BMPs will be designed using the most recently published King County Surface Water Design Manual (KCSWDM) (King County Department of Natural Resources and Parks, 2021).

3 SUBSURFACE CONDITIONS

The geology and subsurface conditions at the project site were interpreted from visual classification and laboratory testing of soil samples obtained from the project borings performed previously (Shannon & Wilson, 2022), from the test pit excavated for the infiltration testing, and from geologic mapping covering the area (Tabor and others, 2000).

3.1 Site Geology

Our understanding of the site geologic conditions is based on the published *Geologic Map of the Snoqualmie Pass 30x60 Minute Quadrangle* (Tabor and others, 2000). The project site is located at the margin of the Puget Lowland and Cascade Mountain physiographic regions. The site is mapped as being underlain by ice contact deposits formed at the end of the most recent glacial advance approximately 15,000 years ago. These deposits are interpreted as ice contact deposits representative of sediment deposited near the margins of glaciation consisting primarily of gravel and sand with lenses of clay and silt (Tabor and others, 2000). Ice contact deposits also commonly contain cobbles and boulders.

3.2 Soil Conditions

The previous project phase subsurface investigation included shallow hand-auger explorations and deeper mechanical soil borings. Detailed information of our observations, including logs of the hand-augers and soil borings, and the results of our laboratory testing is available in our Geotechnical Report (Shannon & Wilson, 2022). For this phase of the project, we observed a test pit, TP-1, excavated by King County Department of Natural Resources and Parks (KCDNRP) for the infiltration test. The approximate locations of the previous explorations and the test pit are shown in Figure 2. Test pit TP-1 was excavated to a depth of approximately 5 feet below ground surface (bgs), at which point the infiltration testing was performed. After the conclusion of the test, test pit TP-1 was excavated further to a total depth of approximately 10 feet bgs.

The soil units observed in test pit TP-1 were consistent with our explorations from the previous investigation. We observed ice contact deposit underlaying the more recent topsoil at the test pit. The ice contact deposit soils consist of Silty Gravel and Well-Graded Gravel with Silt and Sand, with cobbles present. The soil observed generally agrees with the mapped site geology and the previous subsurface investigation.

A log of test pit TP-1 and a discussion of the sampling and classification procedures we used are provided as Appendix A. The results of laboratory testing are provided as Appendix B.

3.3 Groundwater Conditions

During the previous phase of geotechnical exploration, monitoring wells were installed in both soil borings, MW-01 and MW-02, to a depth of approximately 20 feet bgs. No groundwater was observed in the monitoring wells, including in January 2024, indicating that depth to ground water is greater than 20 feet bgs. No evidence of groundwater was observed in test pit TP-1.

The Washington State Department of Ecology (Ecology) well log database contains a well record that appears to match the existing well on the subject property. The well was completed in 1990 and recorded as Well Report ID 90266. The well log indicates that the static groundwater level is approximately 70 feet bgs. The logged lithology suggests that shallower soils with relatively low permeability may be present, perching shallower groundwater above this depth, however this potential confining unit was not observed in any of the project explorations.

4 INFILTRATION TESTING

The 2021 KCSWDM provides guidance for the design of stormwater drainage facilities, including protocols for field testing of infiltration capacity of receptor soils based on the 2014 Stormwater Management Manual for Western Washington (SWMMWW) (Ecology, 2014). Typically, a Large PIT is required for infiltration BMPs with a drainage area larger than 1 acre; however, for sites where previous geotechnical investigation suggests a high infiltration rate causing a Large PIT to be infeasible to conduct, and consistent subsurface conditions exist, a Small PIT may be performed instead. Our observations of coarse soils and no confining layers to a depth of at least 20 feet bgs from the previous subsurface investigation indicated that high infiltration rates were likely at the site.

A Small PIT was conducted on January 10, 2024, in general accordance with the KCSWDM and SWMMWW. The PIT was conducted in a test pit at the approximate location and with a floor elevation consistent with the pond bottom elevation of the proposed infiltration pond shown in the Refined Preferred Alternative plan. The test pit was excavated, and the location and elevation were verified by KCDNRP.

The PIT included excavating the test pit to the target infiltration test depth, followed by saturating the bottom of the test pit for approximately seven hours, with approximately 1 foot of water ponded in the bottom of the test pit. We monitored PIT water levels via manual readings of temporarily installed staff gages and by using datalogging pressure transducers. We monitored water inflow rates using a flow meter and by timing the filling of a graduated bucket. During the last approximately one hour of PIT saturation, we performed a constant head test, during which the water level and inflow rate were both held approximately constant. After completing the constant head test, we allowed the test pit to drain until empty (falling head test). Due to the high infiltration rate and the lack of a constant water source, the duration of inflow to the test pit during the PIT was limited by the volume of the water tank truck. To adhere to the PIT guidance provided by the KCSWDM and SWMMWW, the water tank truck was refilled twice during the saturation "pre-soak" phase that precedes the constant head and falling head periods. A plot showing the PIT and infiltration rate results is displayed in Figure 3.

4.1 Measured Infiltration Rates

The PIT guidance presented in the KCSWDM and SWMMWW describe the calculation of the measured infiltration rate ($I_{measured}$) as the constant head infiltration rate, but they also refer to the falling head rate as the infiltration rate. The constant head infiltration rate calculation is dependent, among other factors, on the accuracy of the measurement of the dimensions of the test pit as well as the accuracy of the measurement of the inflow rate. The falling head infiltration rate is simply the measured head drop over time. In our experience, the falling head infiltration rate tends to decrease with time as the driving head declines and, in some cases, as fines settle out on the base of the test pit floor. In our opinion, the later-stage falling head $I_{measured}$ from this PIT is reasonable to use for a conservative design. The observed falling head $I_{measured}$ for the period of water level decline from 6 to 0 inches is 51.1 inches per hour.

4.2 Design Infiltration Rate

Correction factors are applied to the $I_{measured}$ value to determine the maximum design infiltration rate (I_{design}), since long-term full scale infiltration performance is often lower than the measured results from relatively small-scale testing. We applied correction factors in accordance with the PIT guidance provided in the KCSWDM. The correction factors account for uncertainties in testing, depth to the water table or impervious strata, infiltration receptor (the soils underlaying the facility) geometry, and long-term reductions in the permeability of the soils underlying the infiltration facility due to biological activity and accumulation of fines. Values for each of the correction factors were applied as follows:

- Uncertainty in testing methods correction factor ($F_{testing}$): 0.50 (for Small PIT)
- Influence of facility geometry and depth to water table or impervious strata correction factor ($F_{geometry}$): 1.0 (no correction applied due to calculation below)

Exhibit 4-1: Geometry Correction Factor Equation

Equation	Variable	Definition
$F_{geometry} = 4 * D/W + 0.05$	$F_{geometry}$	facility geometry correction factor
	D	depth from the bottom of facility to maximum wet-season water table or nearest impervious layer
	W	width of facility

- The calculation for determining the $F_{geometry}$ value is provided in the KCSWDM. A value of 15 feet was used for variable D, which is the maximum depth observed in the project soil borings from the bottom of the proposed infiltration pond, since no impervious strata or evidence of the water table were observed in the explorations. This represents a conservative value, since evidence from the existing water well on-site suggests the groundwater table may be as deep as 70 feet bgs. The value of variable W, 12.25 feet, is from the Refined Preferred Alternative infiltration pond size. The resulting value for $F_{geometry}$ is 4.9, so the maximum correction factor, 1.0 was used.
- Reduction in long-term infiltration rate due to plugging of soils correction factor ($F_{plugging}$): 0.7 or 1.0 (two alternatives were used; 0.7 was used if the final design includes no water quality facility, and 1.0 if a water quality facility precedes flow to the infiltration pond). The value 0.7 was applied in accordance with the KCSWDM guidance for sandy loam, the USDA soil texture classification most applicable to the infiltration receptor soils. No correction is applied if a water quality facility, such as a sand filter, is utilized.

The value of the I_{design} is derived from the equation below.

Exhibit 4-2: Design Infiltration Rate Equation

Equation	Variable	Definition
$I_{design} = I_{measured} * F_{testing} * F_{geometry} * F_{plugging}$	I_{design}	design infiltration rate
	$I_{measured}$	measured infiltration rate
	$F_{testing}$	uncertainty of testing method correction factor
	$F_{geometry}$	facility geometry correction factor
	$F_{plugging}$	soil plugging correction factor

After applying the correction factors described above to the measured rate, we provide two recommended maximum design infiltration rates: one if a water quality facility is utilized and one if not. The raw I_{design} calculated with a water quality facility is greater than 20.0 inches per hour; however, the greatest design infiltration rate allowed by the KCSWDM is 20.0 inches per hour.

Exhibit 4-3: Recommended Maximum Design Infiltration Rates

Variable	With Water Quality Facility	Without Water Quality Facility
$I_{measured}$ (in/hr)	51.1	51.1
$F_{testing}$	0.5	0.5
$F_{geometry}$	1.0	1.0
$F_{plugging}$	1.0	0.7
I_{design} (in/hr)	**20.0**	**17.9**

in/hr = inches per hour

5 GROUNDWATER PROTECTION

Infiltration facilities are required by the KCSWDM to provide groundwater protection from pollutants in the stormwater to be infiltrated. The requirements may be met by the natural in situ soils if certain requirements are met, including the cation exchange capacity and organic content of the infiltration receptor soils, and the measured infiltration rate. The requirements are related to the physical, chemical, biological processes that remove pollutants from infiltrated stormwater and ensure sufficient residence time in the shallow subsurface for those processes to occur. Soil samples collected during the excavation after the conclusion of the PIT from the infiltration receptor soils were analyzed for cation exchange capacity and organic content.

The cation exchange capacity testing was performed by Fremont Analytical and results are provided in the Analytical Report dated January 26, 2024, included as Appendix C. The organic content testing was performed by our laboratory and the results are included in Appendix B.

The specific groundwater protection criteria depend on whether the site is located within a groundwater protection area, including Critical Aquifer Recharge Areas, as defined in King County Code 21A, and wellhead protection areas mapped by the Washington State Department of Health (WDOH). According to the WDOH web map service, the project site is located within the Wellhead Protection Areas (Ten-Year Travel Time) of three community water system supply wells. As a result, the infiltration facility must be designed with groundwater protection features in accordance with the KCSWDM guidance, unless the infiltration receptor soils have a cation exchange capacity greater than 5%, an organic content of 1% or greater, and a combination of a relatively low measured infiltration rate and certain soil textures and grain-size distributions. Due to the relatively high measured infiltration rate at the test pit TP-1 PIT, a groundwater protection feature, such as a treatment liner, will be required in accordance with the KCSWDM.

6 ADDITIONAL SERVICES

We recommend that Shannon & Wilson be retained during subsequent phases of the project, including development of design alternatives and the construction phase to review those portions of the plans and specifications that pertain to geotechnical elements of the project. This will allow us to confirm they are consistent with our initial findings and provide further geotechnical recommendations, if necessary. We also recommend that we be retained to observe the geotechnical aspects of construction, such as fill placement or ground improvement. This observation will allow us to verify the subsurface conditions as they are exposed during construction and to determine that the work is accomplished in accordance with our recommendations.

7 LIMITATIONS

The analyses, conclusions, and recommendations contained in this report are based on site conditions as they presently exist and further assume that the explorations are representative of the subsurface conditions at the project site; that is, the subsurface conditions everywhere are not significantly different from those disclosed by the explorations. Within the limitations of the scope, schedule, and budget, the analyses, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice in this area at the time this report was prepared. We make no other warranty, either express or implied. Our conclusions and recommendations are based on our understanding of the project as described in this report and the site conditions as interpreted from the explorations.

If, during construction, subsurface conditions different from those encountered in the recent field explorations are observed or appear to be present, we should be advised at once so that we could review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed because of natural forces or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of the conclusions and recommendations concerning the changed conditions or the time lapse.

This report was prepared for the exclusive use of SAGE, other members of the design team, and King County and other members of the project team. It should be made available to prospective contractors for information on factual data only and not as a warranty of subsurface conditions, such as those interpreted from the exploration logs and presented in the discussions of subsurface conditions included in this report.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by taking soil samples from a limited number of soil explorations. Such unexpected conditions frequently require that additional expenditures be made to attain properly constructed projects. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

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

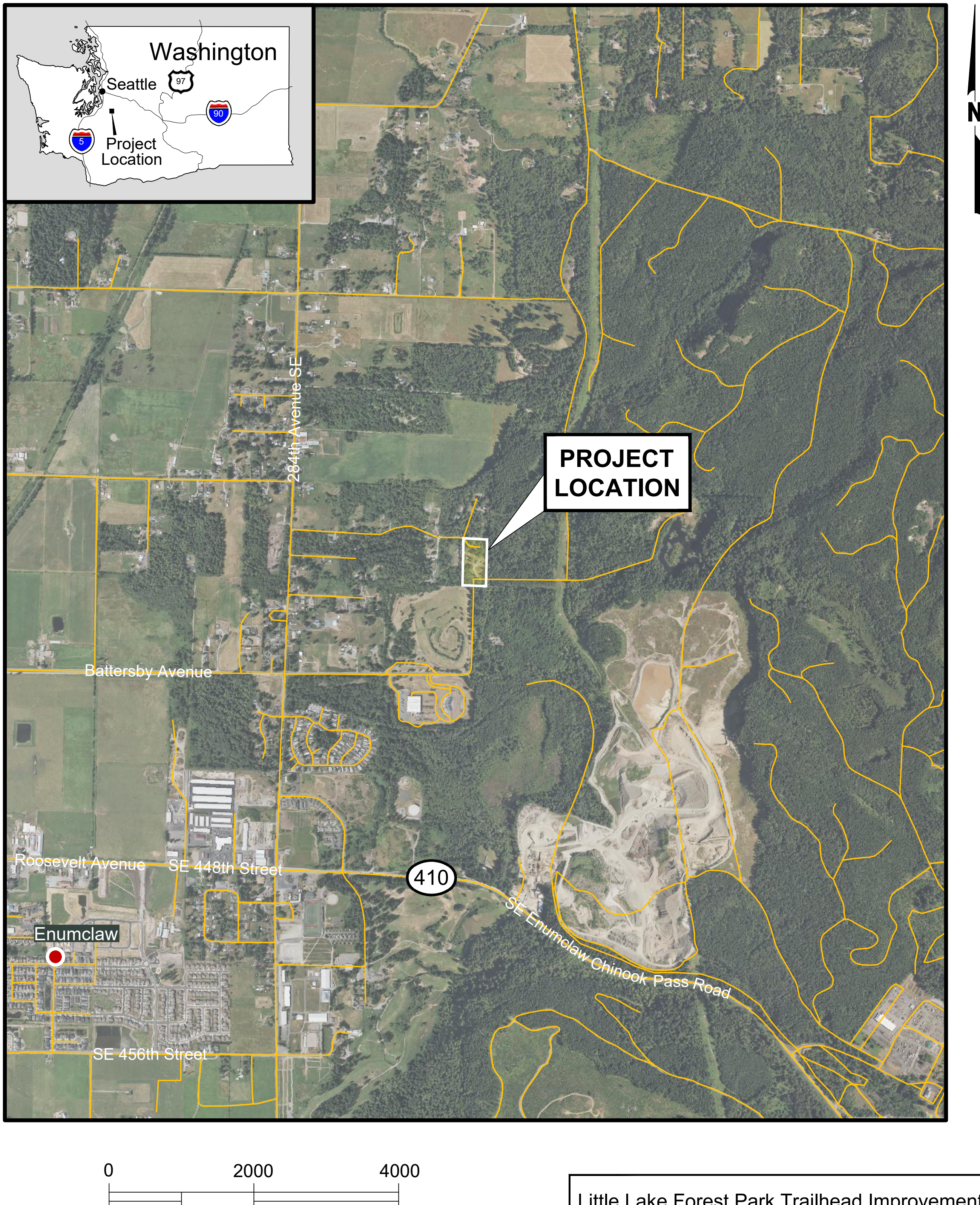
8 REFERENCES

King County Department of Natural Resources and Parks, 2021, King County, Washington, surface water design manual: Seattle, Wash., King County, July, 1132 p., available: https://kingcounty.gov/en/dept/dnrp/nature-recreation/environment-ecology-conservation/stormwater-surface-water-management/surface-water-design-manual/surface-water-design-manual-2021.

Tabor, R.W.; Frizzell, V.A.; Booth, D.B.; and Waitt, R.B., 2000, Geologic map of the Snoqualmie Pass 30 x 60 minute quadrangle, Washington: U.S. Geological Survey Geologic Investigations Series Map I-2538, scale 1:100,000.

Shannon & Wilson, Inc., 2022, Geotechnical report, Little Lake Forest Park trailhead improvements: Report prepared by Shannon & Wilson, Inc., Seattle, Wash., job no. 106797, for SAGE Architectural Alliance, Seattle, Wash., May, 43 p.

Washington State Department of Ecology (Ecology), 2014, Stormwater management manual for Western Washington: Olympia, Wash., Washington State Department of Ecology Publication no. 14-10-055, 5 v., available: https://fortress.wa.gov/ecy/madcap/wq/2014SWMMWWinteractive/2014%20SWMMWW.htm.



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Little Lake Forest Park Trailhead Improvements
Enumclaw, Washington

SITE VICINITY MAP

January 2024 106797-003

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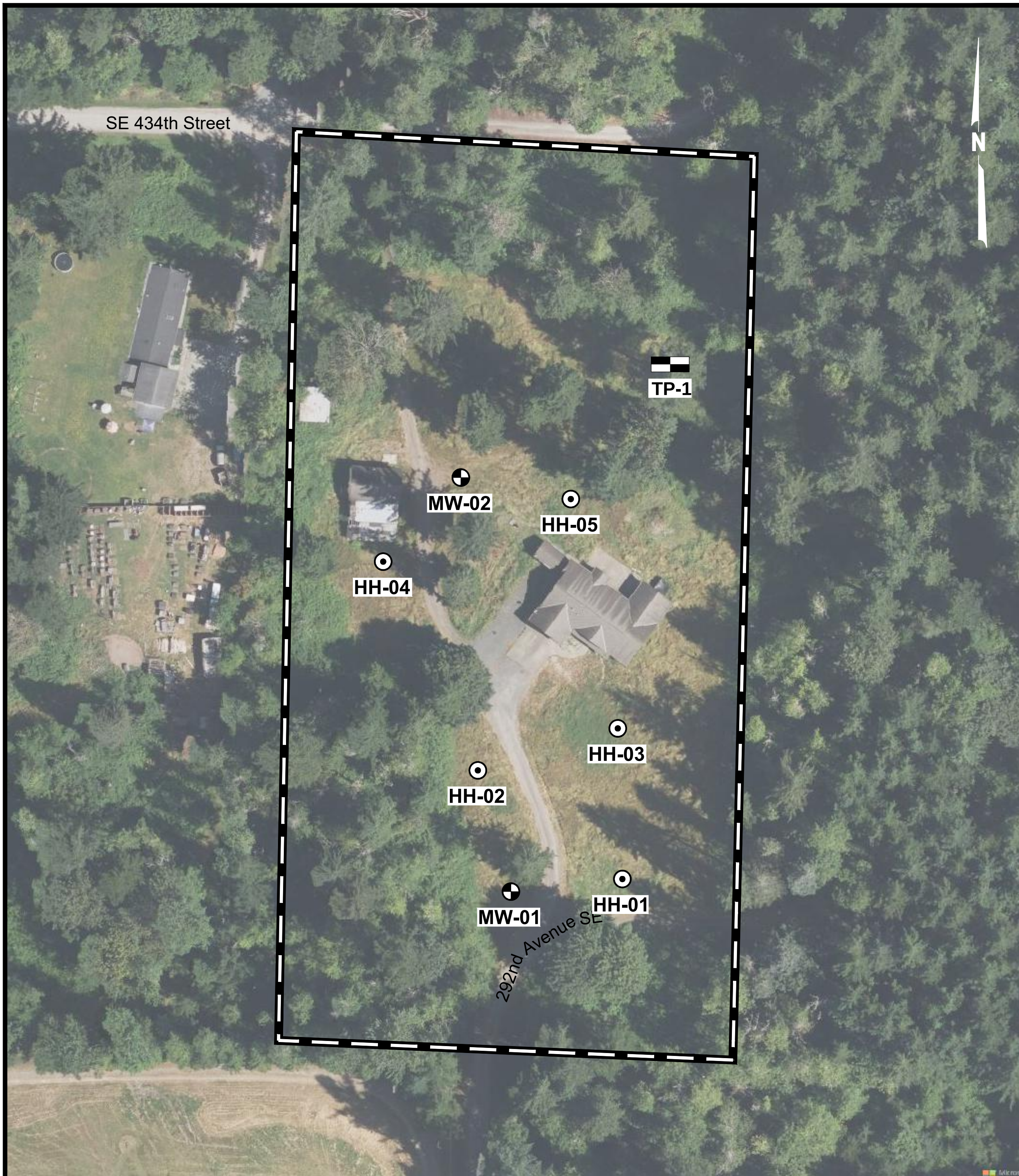
FIG. 1



LEGEND

HH-01	⊙	Dynamic Cone Penetrometer Designation and Approximate Location
MW-01	⊕	Monitoring Well Designation and Approximate Location
TP-1		Test Pit Designation and Approximate Location

0 100 200

Scale in Feet

Little Lake Forest Park Trailhead Improvements
Enumclaw, Washington

SITE AND EXPLORATION PLAN

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2

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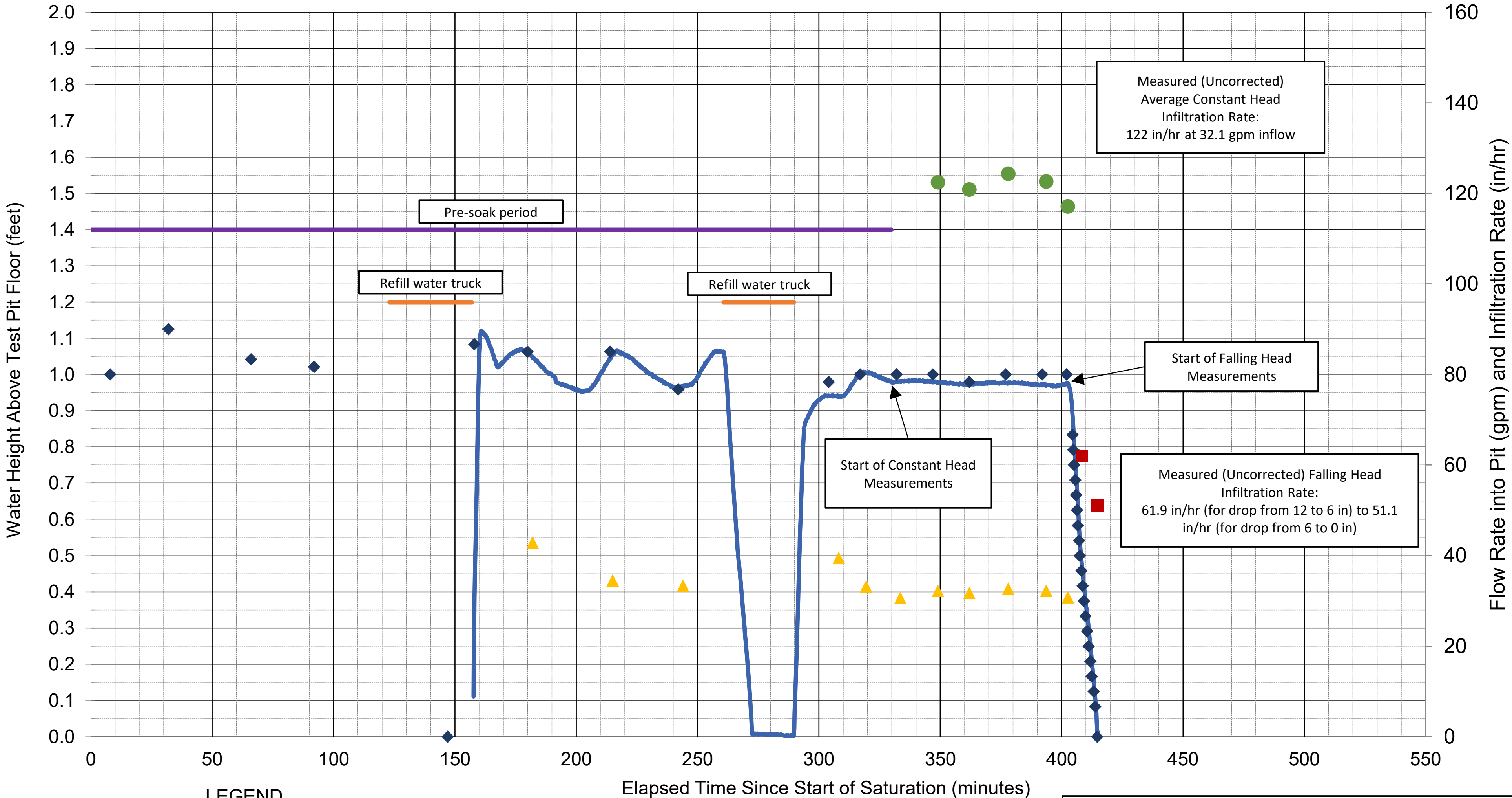

LEGEND

- Transducer Water Level Reading (feet)
- Manual Water Level Reading (feet)
- Flow Rate (gpm)
- Measured Constant Head Infiltration Rate (in/hr)
- Measured Falling Head Infiltration Rate (in/hr)

NOTES

1. NAVD88 = North American Vertical Datum of 1988; gpm = gallons per minute; in = inches; hr = hour; CH = Constant Head; FH = Falling Head.
2. A small Pilot Infiltration Test (PIT) was performed 1/10/2024. Approximate test pit floor dimensions: 4.6 feet by 5.5 feet, depth 5.2 feet below ground surface. Average inflow rate approximately 32.1 gpm during CH test period.
3. Ground surface elevation was approximately 850 feet NAVD88. After the PIT, the test pit was overexcavated to 10.4 feet below ground surface, with no seepage or perched water observed.
4. The pre-soak period was interrupted twice by the water truck running out of water; the test pit temporarily drained during those intervals. Transducer water level readings were collected starting with the second truckload of water.
5. Black and white reproduction of this color original may lead to incorrect interpretation.

Little Lake Forest Park Trailhead Improvements
Enumclaw, Washington

TEST PIT TP-1
PILOT INFILTRATION TEST PLOT

January 2024 106797-003

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Geotechnical and Environmental Consultants

FIG. 3

FIG. 3

APPENDIX A: SUBSURFACE EXPLORATION AND TESTING

Appendix A

Subsurface Exploration and Testing

Field Exploration Details and Exploration Log

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APPENDIX A: SUBSURFACE EXPLORATION AND TESTING

A.1 GENERAL

The subsurface exploration program consisted of excavating one test pit. The purpose of the program was to conduct infiltration testing, collect soil samples, and confirm our understanding of the subsurface geologic and hydrogeologic conditions observed from the previous phase of the project.

A.2 GEOTECHNICAL EXPLORATION

The test pit was excavated to approximately 10 feet below ground surface (bgs). The test pit location, and the previously conducted explorations are shown in the Site and Exploration Plan, Figure 2, in the main report.

King County Department of Natural Resources and Parks (KCDNRP) excavated the test pit on January 8 and 10, 2024, under subcontract to Shannon & Wilson. KCDNRP used a Deere 135 track-mounted excavator to advance the test pit to a depth of approximately 5 feet bgs on January 8, 2024. After the infiltration testing was completed at this depth, the test pit was excavated further to a total depth of approximately 10 feet bgs. The test pit log is presented in Figure A-2.

A.3 SAMPLING AND CLASSIFICATION

A representative from Shannon & Wilson was present when the test pit was advanced from 5 to 10 feet bgs to observe excavation, retrieve representative soil samples for subsequent laboratory testing, and prepare descriptive field logs of the exploration. We obtained disturbed grab samples of the excavated soils at three intervals, as shown on the test pit log presented in Figure A-2. We based soil sample classification on the ASTM Designation D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM, 2017a), and ASTM Designation D2488, Standard Practice for Description and Identification of Soils (Visual/Manual Procedure) (ASTM, 2017b). We used the Unified Soil Classification System, as described in Figure A-1 of this appendix, to classify the material encountered.

A.4 REFERENCES

ASTM International, 2017a, Standard practice for classification of soils for engineering purposes (unified soil classification system), D2487-17: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 10 p., available: www.astm.org.

ASTM International, 2017b, 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.

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 retained on 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).

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

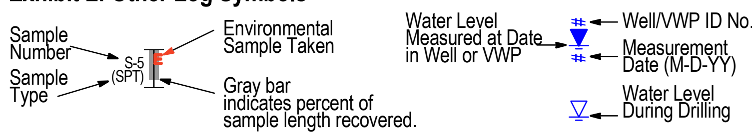
Exhibit J: Sample and Run Graphics

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 %	$100\% \times \dfrac{\text{Length of Core Recovered}}{\text{Length of Core Run}}$
Rock Quality Designation (RQD) in %	$100\% \times \dfrac{\text{Length of Core in Pieces} > 4 \text{ in}}{\text{Length of Core Run}}$

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		

Little Lake Forest Park Trailhead Improvements
Enumclaw, WA

TP-1

Date Completed: *January 10, 2024*
Top Elevation: *~850 feet*
Vertical Datum: *NAVD88*
Excavation Company/Equipment: *King County / Deere 135*
Northing: *~79,132 feet*
Easting: *~1,362,263 feet*
Horizontal Datum: *WA-N SP [NAD 1983]*
Maximum Depth: *10.4 feet*
TP Top Length: *11.1 feet*
TP Top Width: *5.7 feet*

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

Abbreviations

TP	Test pit
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
LL/PL	Liquid limit / plastic limit

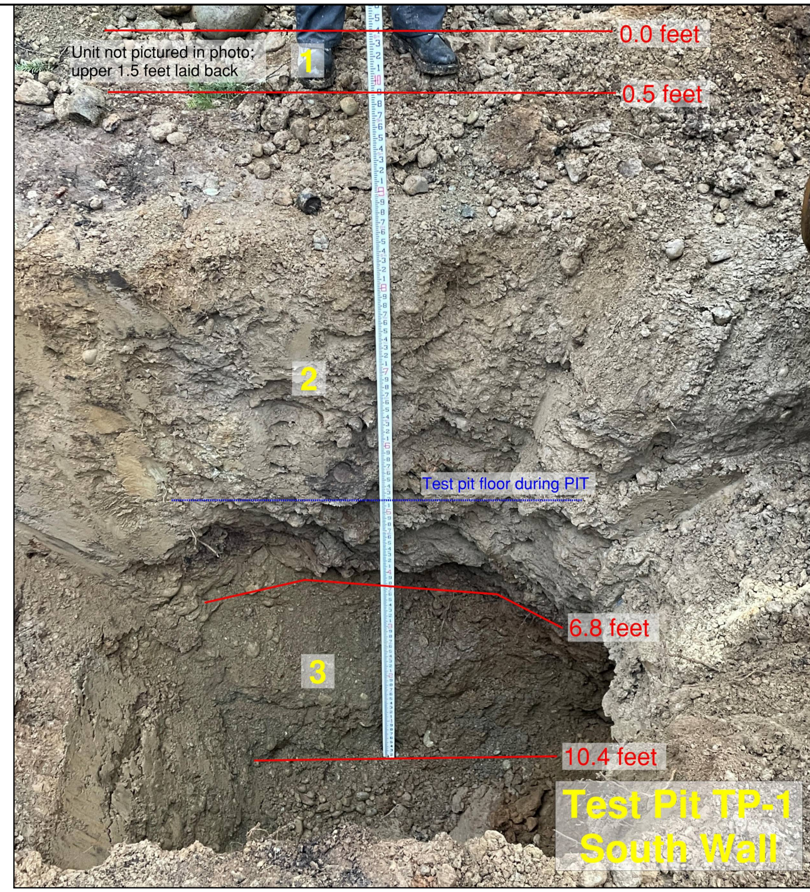
Symbols

Sample Number → S-5
Observed Seepage →
Observed Water Level →

Approx. Elev. (feet)	Depth (feet)	Material Description and Other Observations	Samples	Test Results
850–849.5	0–0.5	Dark brown, ***SANDY SILT*** (ML); moist; organics, roots.. (Topsoil)		
849.5–843.2	0.5–6.8	Gray-brown, ***SILTY GRAVEL WITH SAND WITH COBBLES*** (GM); moist; rounded to subrounded gravel; fine to coarse sand; nonplastic; some roots. (Qvi)	S-1	
			S-2	WC=21% FC=20%
843.2–839.6	6.8–10.4	Gray-brown, ***WELL-GRADED GRAVEL WITH SILT AND SAND*** (GW-GM); moist; rounded to subrounded gravel; fine to coarse sand; nonplastic; few roots. (Qvi)	S-3	WC=8% FC=6%

BOTTOM OF HOLE AT 10.4 FEET

Test Pit Diagram or Photograph
South Side of Test Pit



NOTES:
- Refer to LOG KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date of excavation and may vary.
- Relative consistency or relative density estimates were made with a T-probe and observations of excavation action.
- Group symbol is based on visual-manual identification and selected lab testing.
- Report text contains limitations and information needed to understand this log.

DRAFT

Logged by:	NAC
Review by:	NAC
Version:	0.7

APPENDIX B: LABORATORY TESTING RESULTS

Appendix B

Laboratory Testing Results

CONTENTS

Tables

Figures

APPENDIX B: LABORATORY TESTING RESULTS

B.1 GENERAL

We performed geotechnical laboratory testing on selected soil samples retrieved from the test pit in order to classify the soil and provide data for infiltration analysis. Our laboratory testing program included visual classification, water content determinations, organic content determinations, and grain-size distribution analyses.

B.2 VISUAL CLASSIFICATION

We visually classified soil samples retrieved from the borings using a system based on ASTM Designation D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM, 2017a), and ASTM Designation D2488, Standard Practice for Description and Identification of Soils (Visual/Manual Procedure) (ASTM, 2017b). We assigned a Unified Soil Classification System (USCS) group name and symbol based on our visual classification of particles finer than 76.2 millimeters (3 inches). We revised visual classifications, shown in our Appendix A test pit log, using results of the index tests discussed below.

B.3 WATER CONTENT DETERMINATION

We tested the water content of selected samples in accordance with ASTM D2216-10, Standard Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM, 2010). Comparison of the water content of a soil with its index properties can be useful in characterizing soil unit weight, consistency, compressibility, and strength. We present water content test results graphically in the Appendix A boring logs and in this appendix as Table B-1.

B.4 ORGANIC CONTENT DETERMINATION

We tested the organic content of selected samples in accordance with ASTM D2974, Standard Test Methods for Determining the Water (Moisture) Content, Ash Content, and Organic Material of Peat and Other Organic Soils (ASTM, 2020) for the fraction passing the #40 sieve. The organic content of a soil is useful for characterizing the infiltration receptor's ability to provide water quality treatment and groundwater protection. We present the organic content test results in this appendix in Table B-1.

B.5 GRAIN-SIZE DISTRIBUTION ANALYSIS

Grain-size distribution analyses separate soil particles through mechanical or sedimentation processes. 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. We plot grain-size distribution analysis results in this appendix as Figure B-1. Grain-size distribution plots provide tabular information about each specimen, including water content, constituent (i.e., cobble, gravel, sand, and fines) percentages, coefficients of uniformity and curvature, personnel initials, ASTM standard designation, and testing remarks. We performed mechanical sieve analyses on selected soil specimens to determine the grain-size distribution of coarse-grained soil particles in accordance with ASTM C136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates (ASTM, 2014).

B.6 REFERENCES

ASTM International, 2010, Standard test methods for laboratory determination of water (moisture) content of soil and rock by mass, D2216-10: 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, 2014, Standard test method for sieve analysis of fine and coarse aggregates, C136-14: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.02, concrete and aggregates, 5 p., available: www.astm.org.

ASTM International, 2017a, Standard practice for classification of soils for engineering purposes (unified soil classification system), D2487-17: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 10 p., available: www.astm.org.

ASTM International, 2017b, 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, 2020, Standard Test Methods for Determining the Water (Moisture) Content, Ash Content, and Organic Material of Peat and Other Organic Soils, D2974-20: West Conshohocken, Pa., ASTM International, Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, 13 p., available: www.astm.org.

Table B-1 - Summary of Laboratory Testing

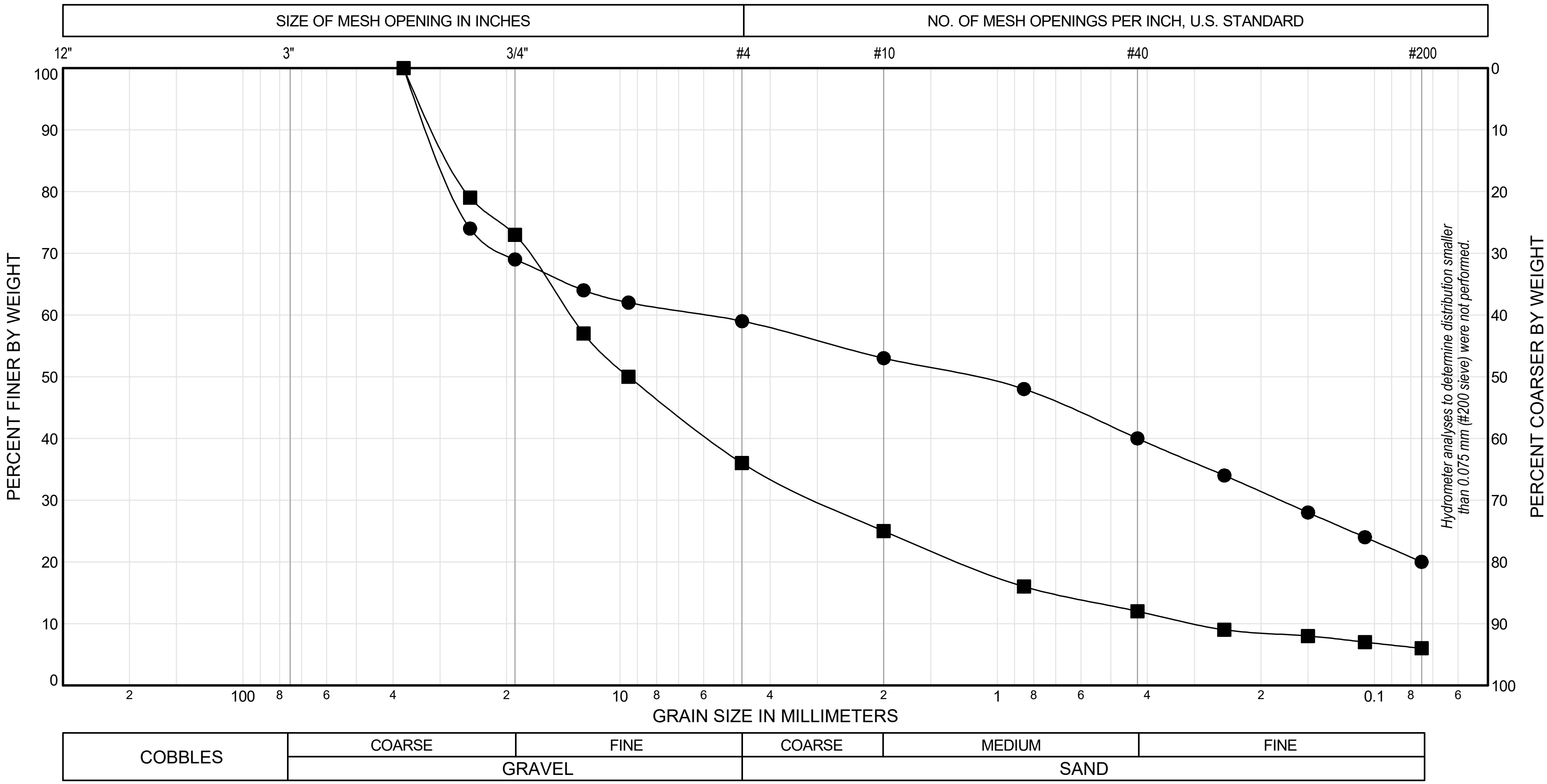
Exploration Designation	Top Depth (feet)	Sample Number	Sample Type	Water Content (%)	Organic Content (%)	Gravel Percent (%)	Sand Percent (%)	Fines Percent (%)	Coefficient of Uniformity, C_u	Coefficient of Curvature, C_c
TP-1	5.5	S-2	GB	21.3	1.1	41*	39*	20*		
TP-1	9	S-3	GB	7.6	0.6	64*	30*	6*	45.3	2.2

NOTES:

* Sample specimen weight did not meet required minimum mass for the test

GRAIN SIZE DISTRIBUTION TEST RESULTS

Little Lake Forest Park Trailhead Improvements
Enumclaw, WA



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
● TP-1, S-2	5.5	*Sieve analysis only - no Atterberg Limits: Group Name not estimated*		41	39	20	21.3	SJD DJB	D6913	*The sample did not meet test standard's minimum requirements*
■ TP-1, S-3	9.0	*Sieve analysis only - no Atterberg Limits: Group Name not estimated*		64	30	6	7.6	SJD DJB	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%)

APPENDIX C: ANALYTICAL REPORT

Appendix C
Analytical Report

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Shannon & Wilson
Nathan Cutler
400 N. 34th Street, Suite 100
Seattle, WA 98103

RE: Little Lake Forest Park Trailhead
Work Order Number: 2401285

January 26, 2024

Attention Nathan Cutler:

Fremont Analytical, Inc. received 3 sample(s) on 1/12/2024 for the analyses presented in the following report.

Cation Exchange Capacity by EPA 9081

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Brianna Barnes
Project Manager

CC:
Martin Page

DoD-ELAP Accreditation #79636 by PJLA, ISO/IEC 17025:2017 and QSM 5.3 for Environmental Testing
ORELAP Certification: WA 100009 (NELAP Recognized) for Environmental Testing
Washington State Department of Ecology Accredited for Environmental Testing, Lab ID C910

CLIENT:	Shannon & Wilson
Project:	Little Lake Forest Park Trailhead
Work Order:	2401285

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2401285-001	S-1	01/10/2024 8:30 AM	01/12/2024 4:10 PM
2401285-002	S-2	01/10/2024 3:40 PM	01/12/2024 4:10 PM
2401285-003	S-3	01/10/2024 3:45 PM	01/12/2024 4:10 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

Case Narrative

WO#: **2401285**
Date: **1/26/2024**

CLIENT: Shannon & Wilson
Project: Little Lake Forest Park Trailhead

I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
DUP - Sample Duplicate
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MCL - Maximum Contaminant Level
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
REP - Sample Replicate
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **2401285**
Date Reported: **1/26/2024**

CLIENT: Shannon & Wilson
Project: Little Lake Forest Park Trailhead

Lab ID: 2401285-001 **Collection Date:** 1/10/2024 8:30:00 AM
Client Sample ID: **S-1** **Matrix:** Soil

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Cation Exchange Capacity by EPA 9081				Batch ID: R89241		Analyst: SLL
Cation Exchange Capacity	ND	1.00		meq/100g	1	1/26/2024 1:28:00 PM

Lab ID: 2401285-002 **Collection Date:** 1/10/2024 3:40:00 PM
Client Sample ID: **S-2** **Matrix:** Soil

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Cation Exchange Capacity by EPA 9081				Batch ID: R89241		Analyst: SLL
Cation Exchange Capacity	ND	1.00		meq/100g	1	1/26/2024 1:33:00 PM

Lab ID: 2401285-003 **Collection Date:** 1/10/2024 3:45:00 PM
Client Sample ID: **S-3** **Matrix:** Soil

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Cation Exchange Capacity by EPA 9081				Batch ID: R89241		Analyst: SLL
Cation Exchange Capacity	ND	1.00		meq/100g	1	1/26/2024 1:36:00 PM

Work Order: 2401285
CLIENT: Shannon & Wilson
Project: Little Lake Forest Park Trailhead

QC SUMMARY REPORT

Cation Exchange Capacity by EPA 9081

Sample ID: **MB CEC** SampType: **MBLK** Units: **meq/100g** Prep Date: **1/26/2024** RunNo: **89241**
Client ID: **MBLKS** Batch ID: **R89241** Analysis Date: **1/26/2024** SeqNo: **1863956**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Cation Exchange Capacity	ND	1.00									

Sample ID: **LCS CEC** SampType: **LCS** Units: **µg/L** Prep Date: **1/26/2024** RunNo: **89241**
Client ID: **LCSS** Batch ID: **R89241** Analysis Date: **1/26/2024** SeqNo: **1863957**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sodium	1,100	200	1,000	0	110	75	125				

Sample ID: **2401285-001ADUP** SampType: **DUP** Units: **meq/100g** Prep Date: **1/26/2024** RunNo: **89241**
Client ID: **S-1** Batch ID: **R89241** Analysis Date: **1/26/2024** SeqNo: **1863959**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Cation Exchange Capacity	ND	1.00						0		30	

Sample Log-In Check List

Client Name:	SW	Work Order Number:	2401285
Logged by:	Morgan Wilson	Date Received:	1/12/2024 4:10:00 PM

Chain of Custody

1. Is Chain of Custody complete? — Yes ☑ No ☐ Not Present ☐
2. How was the sample delivered? — Client

Log In

3. Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact) — Yes ☐ No ☐ Not Present ☑
4. Was an attempt made to cool the samples? — Yes ☐ No ☑ NA ☐

Unknown prior to receipt.

5. Were all items received at a temperature of >2°C to 6°C * — Yes ☐ No ☐ NA ☑
6. Sample(s) in proper container(s)? — Yes ☑ No ☐
7. Sufficient sample volume for indicated test(s)? — Yes ☑ No ☐
8. Are samples properly preserved? — Yes ☑ No ☐
9. Was preservative added to bottles? — Yes ☐ No ☑ NA ☐
10. Is there headspace in the VOA vials? — Yes ☐ No ☐ NA ☑
11. Did all samples containers arrive in good condition(unbroken)? — Yes ☑ No ☐
12. Does paperwork match bottle labels? — Yes ☑ No ☐
13. Are matrices correctly identified on Chain of Custody? — Yes ☑ No ☐
14. Is it clear what analyses were requested? — Yes ☑ No ☐
15. Were all hold times (except field parameters, pH e.g.) able to be met? — Yes ☑ No ☐

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? — Yes ☐ No ☐ NA ☑

Person Notified: Date:
By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:

Item Information

Item #	Temp ºC
Sample	16.2

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
An Alliance Technical Group Company
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790

Client: Shannon & Wilson	**Date:** 1/10/24 **Page:** 1 **of:** 1
	Project Name: Little Lake Forest Park Trailhead
Address: 400 N 34th St #100	**Project No:** 106797-007
	Collected by: NAC
City, State, Zip: Seattle, WA 98103	**Location:** Enumclaw, WA
Telephone: 206-632-8020	**Report To (PM):** Nathan Cutler
Email(s): nathan.cutler@shanwil.com	

Laboratory Project No (internal): 2401285

Special Remarks:

Disposal: Samples will be disposed in 30 days unless otherwise requested.
☐ Retain volume (specify above) ☐ Return to client

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) / Dissolved (D)	Anions (IC)***	EDB (8011)	EPA 9081				Comments
1	S-1	1/10/24	0830	S	1													X				
2	S-2	1/10/24	1540	S	1													X				
3	S-3	1/10/24	1545	S	1													X				
4																						
5																						
6																						
7																						
8																						
9																						
10																						

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

Turn-around Time:
☒ Standard ☐ Next Day
☐ 3 Day ☐ Same Day
☐ 2 Day ____ (specify)

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished (Signature)	Print Name	Date/Time	Received (Signature)	Print Name	Date/Time
x [signature]	Nathan Cutler	1/12/24 1600	x [signature]	1/12/24	1610
x			x		

IMPORTANT INFORMATION

Important Information

About Your Geotechnical Report

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

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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 ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland.