GEOTECHNICAL ENGINEERING REPORT

Port Gamble S'Klallam Tribe Little Boston Road Project

Prepared for: Otak, Inc

Project No. 220389-A-005 • APRIL 3, 2024 FINAL

earth + water

Aspect
A Geosyntec Company

GEOTECHNICAL ENGINEERING REPORT

Port Gamble S'Klallam Tribe Little Boston Road Project

Prepared for: Otak, Inc

Project No. 220389-A-005 • APRIL 3, 2024 FINAL

Aspect Consulting, LLC

ERIK O. ANDERSEN
STATE OF WASHINGTON
36468
REGISTERED
PROFESSIONAL ENGINEER

4/03/2024

Erik O. Andersen, PE
Principal Geotechnical Engineer
eandersen@aspectconsulting.com

Samantha Muchongwe, EIT
Staff Geotechnical Engineer
smuchongwe@aspectconsulting.com

V:\220389 Port Gamble S'Kallam Tribe\Deliverables\Geotech Report\Final\Port Gamble Sklallam Tribe Final Geotech Report.docx

Contents

List of Tables

List of Figures

List of Appendices

1 Introduction

Aspect Consulting, LLC (Aspect) prepared this report for Otak Inc, (Otak) to support the construction of the Little Boston Road Pedestrian and Bicycle Walkway (Project) on behalf of the Port Gamble S'Klallam Tribe. The project walkway is located to the east of and runs parallel to Little Boston Road NE (Site, Figure 1).

This report summarizes explorations and geotechnical data collected to date and presents our geotechnical engineering conclusions and recommendations based on the geotechnical data and current design concepts. The information and recommendations presented in this report are intended to assist the design team in the selection of foundation alternatives, stormwater management, and retaining walls along the trail for the Project.

1.1 Project Description

We understand the Project will consist of the design and construction of an approximate one-mile-long pedestrian and bicycle walkway running parallel to Little Boston Road NE (also referred to as the Road in this report) within the Port Gamble S'Klallam Tribe Community. The walkway will be constructed primarily at-existing-grade; and low-cut retaining walls will be utilized where the ground slopes up to the east and permanent cut slopes are infeasible.

Near the southern end of this one-mile alignment, the Road crosses over a stream with a bridge. A parallel pedestrian bridge is anticipated at the stream crossing. Two smaller pedestrian bridges are anticipated along the walkway alignment, to cross over two drainages, which are both presently culverted under Little Boston Road NE.

1.2 Scope of Work

Our scope of work includes conducting subsurface explorations, laboratory testing, and an assessment of the feasibility of stormwater infiltration based on soil laboratory testing. This scope provides the baseline data for geotechnical recommendations for the Project. This report includes:

- Site and Project descriptions
- Distribution and characteristics of subsurface soils
- Description of the field work completed
- Pedestrian bridge foundation design
- Lateral earth pressures for low cut and fill walls
- Stormwater infiltration feasibility
- Earthwork and grading, cut, and fill recommendations

- Reuse of on-site material and structural fill placement considerations

Our work was completed in accordance with the proposal dated August 4, 2022. This final report is provided to summarize our key findings and conclusions in support of the conceptual engineering design by Otak, Inc. As more details are determined and provided to us by Otak, this final report can be expanded to be mutually supportive of the final design concepts.

Our subsurface investigation logs, and laboratory testing results, are attached as Appendices A and B, respectively.

2 Site Conditions

This section presents the Site conditions, including surface conditions, critical area mapping, geologic setting, and subsurface conditions encountered in our reconnaissance. This information provides context for the discussion of types and distribution of geologic soil units and a basis for our geotechnical engineering recommendations.

2.1 Surface Conditions

The Site is through a residential neighborhood in Port Gamble and located adjacent and to the east of a one mile stretch of Little Boston Road NE (Figure 1). The site is within the Port Gamble S'Klallam Tribe and consists of one parcel owned by USA In Trust Port Gamble/S'Klallam. There are at least 78 residences within the parcel and at least 16 residences adjacent to Little Boston Road NE. The shoulder of the Road varies in elevations (EL)[1] ranging between El. 41 and El. 86. The shoulder of the road is vegetated with a combination of grass, brush, and immature trees.

The Site generally has grade changes between 0 and 40 percent on the eastern side of the Road. There are three locations along the pedestrian proposed trail where the ground slopes by greater than 40 percent. At these locations, a parallel pedestrian bridge is anticipated at the Middle Creek crossing (Bridge 1, Sta 17+00), and two smaller pedestrian bridges (Bridge 2, Sta 37+00, and Bridge 3 Sta 47+00) are anticipated along the walkway alignment, to cross over two drainages, which are both presently culverted under the Road (Figure 2). At these locations, the ground slopes into creek banks which are moderately vegetated with trees, ferns, bushes, and other groundcovers.

2.2 Geology

The Site is located at the central portion of the Puget Lowland. The Puget Lowland is a complex tectonic environment and an area of tectonic subsidence flanked by two mountain ranges—the Cascades to the east and the Olympics to the west. The sediments within the Puget Lowland result from repeated cycles of glacial and nonglacial deposition and erosion. During nonglacial cycles, the area was dominated by lowland forests and broad river valleys. During glacial cycles, ice sheets up to 3,000 feet thick occupied the Puget Lowland and surrounding areas, carved out the deep marine waterways and river valleys, and sculpted the uplands. Deposits from these glacial and nonglacial cycles are present in the subsurface of the project vicinity.

The available geologic mapping indicates the Site is underlain by Holocene-age artificial fill and late Pleistocene glacial and non-glacial surfaces (Haugerud, 2009; Contreras, 2013). The geology of the Site generally consists of fill, recessional lacustrine and outwash deposits, and glacial till deposits. The late Pleistocene glacial and non-glacial deposits. Soil units are described in more detail in Section 2.4.3.

[1] All elevations in this report are relative to the North American Vertical Datum of 1988 (NAVD88).

2.3 Seismicity

The Site is in a seismically active area approximately 16 miles north of the Seattle Fault Zone, approximately 5.4 miles southwest of the Southern Whidbey Island Fault Zone, and approximately 11 miles from the Hood Canal Fault Zone. It is also within the zone of potentially very strong shaking from the Cascadia Subduction Zone.

2.4 Subsurface Conditions

Subsurface conditions at the Site were inferred from Aspect's completed field investigation, review of previous explorations completed by EnviroSound Consulting (ESC), our review of applicable geologic literature, our local geologic experience, and geotechnical laboratory and *in situ* testing.

2.4.1 Previous Subsurface Explorations by Others

Aspect reviewed existing subsurface exploration data collected by ESC in November and December 2014 during a preliminary Project phase (ESC, 2014). The explorations conducted by ESC included:

- Two drilled soil borings, designated B-1 and B-2, advanced using hollow stem auger techniques to 36.5 feet below ground surface (bgs) at two locations on either side of the existing stream.
- Nine excavated test pits, designated TP-1 through TP-9, advanced to depths between approximately 4.5 to 7.5 feet bgs, along the proposed pedestrian trail alignment.

The exploration locations are shown on Figure 2. The data from these are included in Appendix A. This data informed Aspect's supplemental subsurface exploration program and provided further context for the subsurface conditions at the Site.

2.4.2 Subsurface Explorations by Aspect

In November 2022, Aspect planned and executed additional subsurface explorations at the Site to supplement the data collected by ESC. These included:

- Thirteen excavated test pits, ATP-01 through ATP-13, advanced on November 16, 2022, to depths between 7.5 and 9.25 feet bgs along the proposed pedestrian trail alignment.

The locations of the supplemental explorations are shown on Figure 2. Exploration logs are included as Appendix A. The geotechnical laboratory testing results were incorporated into the subsurface exploration logs in Appendix A. Further description of the laboratory test methods and results are presented in Appendix B.

2.4.3 General Stratigraphy

Based on the completed subsurface explorations, we grouped the Site soils into five units: topsoil, fill, recessional lacustrine deposits, recessional outwash deposits, and glacial till. Based on our explorations, fill was placed to raise grades for the Road throughout the Site as needed based on the original topography and depth of excavated material.

The composition and distribution of these units are summarized below. For more detailed information regarding the composition and distribution of these units, please refer to the exploration logs provided in Appendix A.

2.4.3.1 Topsoil

Topsoil refers to a unit that contains a high percentage of organics, generally found at the ground surface and containing grass, mulch, and roots. We encountered up to 2 feet of topsoil in all our explorations.

2.4.3.2 Fill

Fill was observed in explorations ATP-02, ATP-07, ATP-12, B-2, TP-3 and TP-7 beneath the topsoil at depths ranging from 0.25 ft bgs to up to 10 ft bgs. The fill typically consisted of loose to dense, moist, brown, silty sand (SM) and sandy silt (ML) with various amounts of gravel and cobbles. Scattered urban debris (bottles), were encountered in most of the fill deposits.

The fill exhibits low to moderate shear strength characteristics, moderate compressibility, low to moderate permeability, and moderate to high moisture sensitivity.

2.4.3.3 Recessional Lacustrine

Recessional lacustrine deposits were observed beneath the fill or topsoil at varying depths between 0.5 and 8 feet bgs in ATP-01, ATP-05, ATP-06, ATP-08 through ATP-13. The recessional lacustrine generally consisted of medium stiff to very stiff, moist, gray brown with oxidized staining, clay or silt with varying amounts of sand (CL, ML).

The recessional lacustrine exhibits low to moderate shear strength characteristics, moderate compressibility, low to permeability, and moderate to high moisture sensitivity.

2.4.3.4 Recessional Outwash

Recessional outwash was observed beneath the fill or topsoil at varying depths between 0.5 and 9.25 feet bgs in ATP-01 through ATP-07 and ATP-11 through ATP-13. The recessional outwash generally consisted of loose to medium dense, moist, gray and brown, silty sand with varying amounts of gravel (SM).

The recessional outwash deposits exhibit low to moderate shear strength characteristics, moderate compressibility, moderate permeability, and moderate moisture sensitivity.

2.4.3.5 Glacial Till

Glacial till was encountered at varying depths between 5.5 and 8 feet bgs in ATP-04 and ATP-05. The glacial till generally consisted of very dense, moist, gray silty sand with gravel and cobbles (SM).

The glacial till exhibits high shear strength characteristics, low compressibility, low permeability and moderate moisture sensitivity.

2.4.4 Proposed Bridge Location Stratigraphy

Based on the test pits and test borings conducted by Aspect and by others, we prepared a bridge location-specific stratigraphy for use in our analyses and recommendations.

2.4.4.1 Stratigraphy at Bridge 1 Location

The stratigraphy at Bridge 1 location was determined from data collected from the explorations B-1, B-2 and ATP-02. Up to 10 feet of fill was encountered overlying interbedded recessional lacustrine and recessional outwash deposits. We interpreted the thicknesses of the fill, recessional lacustrine deposits and recessional outwash deposits from the borings conducted by ESC (ESC, 2014). The fill is medium dense to dense silty sand with gravel, the recessional lacustrine deposits consist of medium dense to dense silt or clay deposits and the recessional outwash deposits consist of medium dense to dense sand material. We interpret the recessional lacustrine and outwash deposits to exhibit moderate to high shear strength characteristics, moderate compressibility and moderate moisture sensitivity.

2.4.4.2 Stratigraphy at Bridge 2 Location

The stratigraphy at the Bridge 2 location was determined from data obtained from ATP-07 and consists of up to 8 feet of fill overlying recessional outwash deposits. The fill consists of medium dense silty sand with gravel (SM) and the recessional outwash deposits consist of medium dense to dense silty sand (SM). We interpret the recessional outwash deposits to exhibit moderate strength characteristics, low to moderate compressibility and low moisture sensitivity.

2.4.4.3 Stratigraphy at Bridge 3 Location

The stratigraphy at the Bridge 3 location was obtained from data collected in test pits ATP-10 and A1P-11. We observed up to 6.5 feet of recessional lacustrine deposits overlying recessional outwash deposits. The recessional lacustrine deposits consist of medium dense to dense clay and sandy clay deposits (CL) and the recessional outwash deposits consist of medium dense to dense silty sand (SM). We interpret the recessional lacustrine deposits to exhibit moderate shear strength characteristics, moderate compressibility and moderate moisture sensitivity and the recessional outwash deposits to exhibit moderate strength characteristics, low to moderate compressibility and low moisture sensitivity.

2.4.5 Groundwater

Groundwater was not encountered in any of the explorations. We observed consistent iron-oxide staining within the fill, weathered recessional deposits and recessional lacustrine deposits, indicating that perched water may be seasonally present in this unit.

Groundwater levels will fluctuate seasonally with precipitation, as well as with changes in Site and near-Site usage.

2.4.6 Laboratory Testing

Selected soil samples were submitted for geotechnical laboratory testing of index properties. Laboratory testing including natural moisture content, Atterberg Limits and grain-size distribution. Further description of the soil samples submitted, test methods, and results are presented in Appendix B.

3 Geologic Hazards

In this section, we describe the relevant geologic hazards to the Site and the Project. This section provides context for Kitsap County requirements related to the development of the Site given typical earthquake engineering considerations at the Site.

3.1 Earthquake Engineering

The Site is located within the Puget Lowland physiographic province, an area of active seismicity that is subject to earthquakes on shallow crustal faults and deeper subduction zone earthquakes. The Site area lies about 16 miles north of the Seattle fault zone, which consists of shallow crustal tectonic structures that are considered active (evidence for movement within the Holocene [since about 15,000 years ago]) and is believed to be capable of producing earthquakes of magnitude 7.3 or greater. The recurrence interval of earthquakes on this fault zone is believed to be on the order of 1,000 years or more. The most recent large earthquake on the Seattle fault occurred about 1,100 years ago (Pratt et al., 2015). There are also several other shallow crustal faults in the region capable of producing earthquakes and strong ground shaking.

The Site area also lies within the zone of strong ground shaking from earthquakes associated with the Cascadia Subduction Zone (CSZ). Subduction zone earthquakes occur due to rupture between the subducting oceanic plate and the overlying continental plate. The CSZ can produce earthquakes up to magnitude 9.3 and the recurrence interval is thought to be on the order of about 500 years. A recent study estimates the most recent subduction zone earthquake occurred around 1700 (Atwater et al., 2015).

Deep intraslab earthquakes, which occur from tensional rupture of the sinking oceanic plate, are also associated with the CSZ. An example of this type of seismicity is the 2001 Nisqually earthquake. Deep intraslab earthquakes typically are magnitude 7.5 or less and occur approximately every 10 to 30 years.

The following sections present descriptions of seismic design considerations for the Project.

3.1.1 Ground Response

The AASHTO seismic design is based on an event with a return period of 1,000 years. The U.S. Geological Survey (USGS) has an online tool for obtaining key design parameters for the AASHTO event using the probabilistic ground motion studies and maps for Washington. Seismic design should be completed with the specific ground motion parameters listed in Table 1 below.

Table 1. Seismic Design Parameters

Design Parameter	Recommended Value
Site Class	D
Peak Ground Acceleration (PGA)	0.402g[1]
Short Period Spectral Acceleration (S_s)	0.909g
1-Second Period Spectral Acceleration (S_1)	0.271g
Site Coefficient (F_{PGA})	1.098
Site Coefficient (F_a)	1.137
Site Coefficient (F_v)	1.859
Design Peak Ground Acceleration (PGA_m)	0.442 g
Design Short Period Spectral Acceleration (S_{DS})	1.033 g
Design 1-Second Period Spectral Acceleration (S_{D1})	0.503 g

Notes:
1. g = gravitational force
2. Based on the latitude and longitude of the Site: 47.8411°N, 122.5652°W.

3.1.2 Surficial Ground Rupture

A trace of an east-west trending thrust fault zone (Seattle fault zone) projects through Bainbridge Island, with the nearest known active fault trace (an unnamed fault) located approximately 16 miles south of the Site (Gower et al., 1985). Due to the suspected long recurrence interval and the proximity of the Site to the mapped fault trace, the potential for surficial ground rupture at the Site is considered low during the expected life of the Project.

3.1.3 Liquefaction

Liquefaction occurs when loose, saturated and relatively cohesionless soil deposits temporarily lose strength as a result of earthquake shaking. Potential effects of soil liquefaction include temporary loss of bearing capacity and lateral soil resistance, liquefaction-induced settlement, flow failure of end- or side-slopes, and lateral spreading, any of which could result in structural damage. Primary factors controlling the development of liquefaction include intensity and duration of strong ground motion, characteristics of subsurface soil, in-situ stress conditions and the depth to groundwater.

Liquefaction evaluations at the Bridge 1 location were conducted using WSliq, a liquefaction analysis software program that was created as part of an extended research project supported by the Washington State Department of Transportation (WSDOT) and authored by Steve Kramer (Wsliq, 2008). The liquefaction analysis was conducted based on the data collected from B-1 and B-2. The results of the analysis indicate that liquefaction will not be triggered during the 1,000-year design earthquake. Therefore, we conclude that liquefaction is not a design consideration at the Site.

3.2 Landslide Hazards

Landslides may be triggered by natural causes, such as precipitation, freeze-thaw cycles, or a seismic event, or be man-made (e.g., broken water pipes). Three types of landslides are common on steep slopes in the Puget Sound: topples, deep-seated rotational slides, and shallow flows (Varnes, 1978).

Recent LiDAR studies (McKenna et al., 2008) do not map landslide headscarps or deposits at or near the Site. During our Site visit, we did not observe evidence of historical, recent, or incipient landslide activity and the stratigraphy of the Site soils is not prone to landslide activity in the context of the Site and Project. We also did not observe evidence of ongoing erosion, scour, or prominent groundwater seepage along the slopes. Given these observations, it is our opinion that landslide hazard at the Site is low and we do not consider landslide hazards to be a significant hazard for the Project.

4 Geotechnical Engineering Conclusions

This section discusses Project design considerations and recommendations for infiltration feasibility, geotechnical engineering analyses in support of low cut and fill walls, stormwater management, pedestrian bridge foundations, buried utilities, luminaire foundations, and related geotechnical matters to inform the 90 percent design submittal (Otak, 2024). Additional engineering analyses and evaluations may be required to support the final design of the Project. Key geotechnical considerations are summarized below and discussed in detail in subsequent sections:

- Below an approximate 10-foot-thick layer of fill at the Bridge 1 location, the Site is underlain by medium dense to dense recessional lacustrine and outwash deposits. We recommend deep foundation elements to support the 135-foot-span end-to-end prefabricated steel truss bridge. Driven pile foundations for B-1 are discussed in more detail in Section 4.1.
- The Sites at Bridges 2 and 3 locations are underlain by 5 to 7 feet of recessional lacustrine deposits overlying recessional outwash deposits. We recommend shallow foundations bearing within the recessional outwash deposits to support the 45-foot and 55-foot span end-to-end prefabricated steel truss bridges, respectively.
- The whole Site is mapped as having low liquefaction susceptibility. The medium dense to dense recessional lacustrine and outwash deposits encountered at the Bridge 1 location of the Site are not susceptible to liquefaction.
- We completed a slope stability analysis at the Bridge 1 location using the data collected from B-1 and B-2 and the topography at the proposed centerline of the pedestrian trail and determined that the Site is not susceptible to landsliding, and/or lateral spreading. Landslide hazards are described in Section 3.2.

4.1 Deep Foundation Recommendations

Current 90 percent drawings show pedestrian bridge B-1 will be a 135-feet span end-to-end prefabricated steel truss bridge. The design loading for the proposed structure per abutment is still to be determined. Through collaborations with the Project team, a deep foundation system was selected to be used to support the proposed bridge replacement.

Based on the results of our geotechnical engineering analyses and experience with similar projects, we recommend the pedestrian bridge be supported on closed-end, concrete-filled steel pipe piles. We recommend 12-inch-nominal-diameter, Schedule 40 steel pipe piles with a 1-inch-thick minimum steel flat plate welded to the tip (i.e., closed-end).

The pipe piles should be driven to fully penetrate all existing fill and be bearing in the recessional deposits. The piles should extend to minimum tip Elevation 35 at both abutments.

Our analyses indicate that, 12-inch-nominal-diameter Schedule 40, ASTM A 252 Grade 3 pipe, driven to tip elevation and acceptable driving resistance can develop ultimate axial compressive capacities as high as 400 kips per pile. These piles should be driven using a diesel impact hammer capable of delivering at least 29,000 foot-pounds of impact energy per blow.

For LRFD strength limit state design, a resistance factor (φ) of 0.4 should be applied to the ultimate (or nominal) axial compressive capacity. For extreme and service limit state design, resistance factors of 1.0 should be used. Piles driven to minimum tip elevation will settle less than ½ inch under service limit state loading conditions.

4.1.1 Design of Piles for Lateral Loading

Lateral loading on the foundation system due to wind, seismic inertial loading, and/or liquefaction-induced flow-failure will be resisted by soil and structural resistance.

Table 2 below presents the recommended LPILE parameters for use in design of the deep foundations.

Table 2. LPILE Parameters

Soil Unit	γ [pcf]	Φ [°]	c [psf]	Approximate Elevations	Soil Model	k [pci]
Fill	115	34	0	55 to 50	Sand (Reese)	50
Recessional Lacustrine Deposits	120	30	125	50 t0 40	Silt/Cemented Soil	50
Recessional Outwash Deposits (saturated)	57	34	0	40 to 35	Sand (Reese)	100
Recessional Lacustrine Deposits (saturated)	57	30	125	35 to termination	Silt/Cemented Soil	50

4.1.2 Abutment Pile Cap and Wall Design

The pile-supported abutment walls will retain several feet of approach fill. If a reinforced concrete "L-shaped" in plan view abutment/pile cap is designed, the abutment walls will behave as restrained walls. In this case the abutment walls should be designed for at-rest equivalent fluid pressure of 55 pounds per cubic foot. To account for pedestrian and/or small motorized vehicle traffic, a 50 psf uniform rectangular pedestrian surcharge should be added to this for non-seismic loading conditions. For seismic inertial loading conditions, the traffic surcharge can be replaced with a uniform rectangular seismic surcharge of 13.6H psf, where H is the retained height of fill measured from final roadway grade down to the bottom of the pile cap.

The abutment walls should be backfilled with relatively clean and freely draining sand and gravel, such as Gravel Borrow for Walls, specified in Section 9-03.12(2) of the WSDOT *Standard Specifications* (WSDOT, 2024).

During construction, Aspect should be on site to observe and evaluate pile driving.

4.2 Strip Footing Foundations

We understand that the two smaller bridges, Bridge 1 and Bridge 2, will be 45 feet and 55 feet end-to-end prefabricated steel trusses, respectively. We recommend that the proposed smaller bridges bear on rectangular strip footings. These footings should be constructed on a crushed rock leveling/bearing pad overlying the recessional outwash. This will require that sub-excavation of existing fine-grained recessional lacustrine clay to expose the underlying recessional sand and gravel. Recommended bearing capacities based on allowable settlement and the width of the footing are presented on Figure 3.

The crushed rock leveling/bearing pad should be at least 12 inches thick, and it should extend at least 12 inches feet beyond the outside edges of the footing.

The recommended LRFD resistance factors required to calculate Strength and Extreme Limit State Bearing Resistances from the recommended Nominal Bearing Resistance are provided in Table 3.

Table 3. LRFD Resistance Factors for Shallow Foundations

Limit State	Bearing Resistance, ϕ_b	Shear Resistance to Sliding, ϕ_τ	Passive Pressure Resistance to Sliding, ϕ_{ep}
Service	1.0	-	-
Strength	0.45	0.8	0.5
Extreme	0.9	0.9	0.9

Other parameters for the design of the bridge abutment foundations are included in Table 4.

Table 4. Shallow Foundation Design Parameters

Parameter	Value
Poisson's Ratio, vm	0.35
Soil Subgrade Modulus, k_1	100 pci
Foundation Soil Saturated Unit Weight, γ_{sat}	115 pcf
Effective Shear Modulus Ratio, G/G_0	0.50

Notes: pci = pounds per cubic inch; pcf = pounds per cubic foot

For a 1-foot by 1-foot loaded area, we recommend a modulus of subgrade reaction of 100 pounds per cubic inch (pci). The value should be adjusted for square and rectangular area of loading as follows (NAVFAC, 1986):

$$K_s = K_1 * (\frac{B + 1foot}{2 * B})^2$$

$$K_r = K_s * (\frac{m + 0.5}{1.5 * m})$$

Where:
K_s = modulus of subgrade reaction for a square loaded area
K_1 = modulus for a 1-foot by 1-foot loaded area, from Table 3
B = side length of a square loaded area or the length of the short side of a rectangular loaded area
K_r = modulus of subgrade reaction for a rectangular loaded area
m = ratio of the length of a long side to the length of the short side of a rectangular loaded area

4.2.1 Sliding Resistance

Sliding resistance is developed from the friction occurring between the bottom of the concrete strip footings and the crushed rock pad and the passive resistance developed from the soil around the foundation. The frictional and passive resistance values presented assume the culvert bears a crushed surfacing leveling pad, and that the culvert is backfilled with material meeting the minimum requirements for Gravel Borrow, WSDOT Standard Specification 9-03.14(1), and compacted per our recommendations in Section 5.4.

For passive resistance, we recommend a nominal (ultimate) passive resistance of 400 pounds per cubic foot (pcf). For frictional resistance along the interface between the spread footings and crushed rock fill pad, an unfactored coefficient of 0.70 may be used. LRFD Resistance Factors for determining limit state sliding and passive resistance are provided in Table 2 above.

4.3 Retaining Walls

We understand that the Project will require some tall cut retaining walls, as well as fill retaining walls. Plans and elevation details detailing these walls show retained fill wall heights varying between 3 and 21 feet and cut wall heights varying between 3 and 9 feet. It is our understanding that cut walls (gravity block walls) and fill walls (mechanically stabilized earth walls (MSE)) along the trail will be contractor designed.

4.4 Stormwater Infiltration

Aspect considered stormwater infiltration feasibility along the proposed pedestrian trail at the Site. Based on our explorations (Figure 2), most of the Site is underlain by recessional lacustrine and recessional outwash deposits. The recessional lacustrine deposits are relatively impermeable while the recessional outwash deposits are typically a suitable infiltration receptor. We encountered glacial till at two isolated locations in our explorations and infiltration is not likely to be feasible within glacial till deposits.

Generally, the southern portion of the Site (Sta 14+00 to Sta 36+00) is underlain by moderately permeable recessional outwash deposits at depths near the proposed trail elevation with the exception of a few isolated locations encountered in our explorations. Along this stretch of the proposed pedestrian trail, stormwater infiltration is feasible. The northern portion of the Site (Sta 36+00 to Sta 54+00) is underlain by the impermeable recessional lacustrine deposits at depths near the proposed pedestrian trail. Along this stretch of the proposed pedestrian trail, we recommend stormwater management be accomplished using Low Impact Development (LID) methods combined with conventional methods, including catch basins and storm drainpipes that discharge into an appropriate system. LID methods, such as small rain gardens, bioswales, and permeable pavements, are feasible provided the systems incorporate underdrains and/or overflow redundancy to account for the low permeability and low infiltration capacity of the Site soils.

Best management practice (BMP) investigations, such as pilot infiltration testing, should be performed at Site-specific locations to verify infiltration feasibility. Table 5 provides the design infiltration results for ATP-01 through ATP-05 and ATP-11 through ATP-13 within the recessional outwash deposits.

Table 5. Infiltration Analyses Results and Design Parameters

Test Pit ID	ATP-01	ATP-01	ATP-02	ATP-02	ATP-03	ATP-04	ATP-05	ATP-11	ATP-12	ATP-13
Sample Depth (ft)	4.5	7	3	6.5	3	6	3.5	6	2	6.5
Correction Factor (CF_v)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Correction Factor (CF_t)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Correction Factor (CF_m)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Correction Factor (CF_T)	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Ksat design (in/hr)	0.8	2.5	2.1	4.4	0.8	1.1	0.9	1.1	5.3	8.0

1. CF_v = correction factor accounting for site variability
2. CF_t = correction factor accounting for grain size
3. CF_M = correction factor accounting for degree of influent control
4. CF_T = total correction factor = CFv **X** CFt **X** CFm

5 Earthwork Considerations

Based on the explorations performed across the Site and our understanding of the Project, it is our opinion that the Contractor should be able to complete earthwork and excavations with standard construction equipment. The soils encountered at the Site contain a significant percentage of fines material (particles passing the U.S. Standard No. 200 sieve), making them moisture sensitive and subject to disturbance when wet. We recommend planning the earthwork portions of the Project during the drier summer months.

We recommend that earthwork activities be specified in accordance with the following WSDOT Standard Specifications (WSDOT, 2024). Appropriate erosion control measures should be in accordance with Section 8-01.3 *Erosion Control and Water Pollution Control, Construction Requirements*.

5.1 Temporary Erosion Control

To prevent Site erosion during construction, appropriate temporary erosion and sedimentation control (TESC) measures should be used in accordance with our recommendations and local BMPs. Specific TESC measures may include appropriately placed silt fencing, straw wattles, rock check dams, and plastic covering of soil stockpiles.

5.2 Subgrade Preparation

Subgrade preparation within the proposed foundation areas and hardscapes should include removal of all topsoil, debris, loose fill soils, and any other deleterious materials. For the proposed bridge foundations, we recommend that the bearing soils consist of undisturbed, dense, glacial till or compacted structural fill. Based on our explorations, we estimate suitable bearing soils to be generally near the existing ground surface, typically 1 to 3 feet bgs.

The on-Site soils contain variable amounts of fine-grained particles, which makes them moisture sensitive and subject to disturbance when wet. The Contractor must use care during Site preparation and excavation operations so that any bearing surfaces are not disturbed. If this occurs, the disturbed material should be removed to expose undisturbed material.

All bearing surfaces should be trimmed neatly and carefully prepared. All loose or softened soil should be removed from the bearing surface or compacted in-place prior to placing concrete or structural fill. We recommend that all bearing surfaces be observed by the Geotechnical Engineer to verify that the recommendations of this report have been followed.

If bearing surfaces are exposed during the winter season or periods of wet weather, it may be helpful to provide a layer of crushed rock or gravel to help preserve the subgrade. If gravel is used to protect the bearing surfaces, it should meet the gradation requirements for Class A Gravel Backfill for Foundations, as described in Section 9-03.12(1)A of the Standard Specifications (WSDOT, 2024).

5.3 Structural Fill

Soils placed beneath or around foundations, walls, utilities, or below pavements should be considered structural fill. Structural fill should be placed over subgrades that have been prepared in conformance with the recommendations of this report. Source material should be derived from imported sources. We anticipate structural fill will be required primarily where overexcavation of existing nonengineered fill or soils above the proposed pedestrian walkway grade is required.

5.3.1 Reuse of Site Soils as Structural Fill

From a geotechnical standpoint, the existing coarse grained recessional deposits and glacial till soils appear suitable for reuse as structural fill under the proposed pedestrian walkway. The glacial till soils appear suitable for reuse, provided the materials are excavated during the dry season and are screened to ensure they are relatively free of organics and other deleterious debris, and can be moisture-conditioned for compaction and compacted to a firm and unyielding condition. Due to the presence of debris within the existing nonengineered fill, we do not recommend it for reuse as structural fill.

Excavated material should be visually inspected by Aspect to determine its potential use as structural fill. Excavated material that is unsuitable as structural fill may be suitable as backfill for unimproved areas (i.e., landscaped areas) that are not sensitive to differential settlement over time.

5.3.2 Imported Structural Fill

Soils placed beneath or around foundations, retaining walls, utilities, or below pavements should be considered structural fill. Imported structural fill should consist of relatively clean, free-draining, nonplastic, uniformly graded sand and gravel free from organic matter or other deleterious materials. Structural fill should be placed over subgrades that have been prepared in conformance with the recommendations of this report. Source material should be derived from imported sources. Site-derived soils are unsuitable for reuse as structural fill due to their high fines content (material passing the U.S. No. 200 sieve) and moisture sensitivity.

Detailed recommendations for structural fill material specifications, lift thicknesses, and compaction requirements are shown below in Table 6.

Table 6. Structural Fill and Compaction Recommendations

Application	Specification	Lift Thickness[1] and Compaction[2]
Below Foundations	WSDOT 9-03.9(3) – crushed surfacing base course (CSBC)	6 inches 95 percent
Below Pavements	WSDOT 9-03.9(3) – CSBC	6 inches 95 percent
Behind Walls	WSDOT 9-03.12(2) – Gravel Backfill for Walls	8 inches 90 percent
Utility Pipe Zone Bedding	WSDOT 9-03.12(3) – Gravel Backfill for Pipe Zone Bedding	6 inches 95 percent
Utility Pipe Zone Backfill[3]	WSDOT 9-03.12(3) – Gravel Backfill for Pipe Zone Bedding *or* WSDOT 7-08.3(3) – Pipe Zone Backfill	6 inches 95 percent
Trench Backfill[4]	WSDOT 9-03.15 – Native Material for Trench Backfill *or* WSDOT 9-03.19 – Bank Run Gravel for Trench Backfill	8 inches 95 percent
Unsuitable Material Replacement	WSDOT 9-03.9(3) - CSBC	6 inches 95 percent

Notes:
1. Maximum uncompacted thickness
2. Maximum dry density, as determined by ASTM D1557 (ASTM, 2018)
3. Varies per pipe material. Refer to WSDOT Standard Plan B-55.20-02 (WSDOT, 2024).
4. For trench backfill in roadway prisms: WSDOT 9-03.19, otherwise use WSDOT 9-03.19.

The moisture content of structural fill should be controlled to within 2 to 3 percent of the optimum moisture. Optimum moisture is the moisture content corresponding to the maximum modified proctor dry density.

5.4 Compaction Requirements

Structural fill should be at or near optimum moisture content at the time of placement and should be compacted to a percentage of the maximum dry density (MDD) as determined by test method ASTM International (ASTM) D1557, in accordance with the following recommendations:

- Structural fill beneath foundations and hardscapes should be compacted to at least 95 percent of the MDD.
- In nonstructural areas, fill should be placed and compacted to a moderately firm/dense condition.
- Retaining wall backfill compaction within 5 feet of any wall should be limited to 90 percent of the MDD to avoid damage to the structure. Compaction within 5 feet of a wall should be achieved using small hand-operated equipment in conjunction with thinner soil lifts to achieve the required compaction.

The procedure to achieve the specified minimum relative compaction depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain soil properties. When the size of the excavation restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough lifts to achieve the required compaction. A sufficient number of in-place density tests should be performed as the fill is placed to verify the required relative compaction is being achieved. The frequency of the in-place density testing can be determined at the time of final design, when more details of the Project grading and backfilling plans are available.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with a high percentage of silt or clay are particularly susceptible to becoming too wet, and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried as necessary, or moisture conditioned by mixing with drier materials, or other methods.

When the first fill is placed in a given area, and/or any time the fill material changes, the area should be considered a test section. The test section should be used to establish fill placement and compaction procedures required to achieve proper compaction. Aspect or qualified materials inspection personnel should observe placement and compaction of the test section to assist in establishing an appropriate compaction procedure. Once a placement and compaction procedure is established, the Contractor’s operations should be monitored, and periodic density tests performed to verify that proper compaction is being achieved.

5.5 Temporary Excavations and Slopes

Temporary excavations may be required where excavation to bearing stratum is needed or where existing nonengineered fill should be overexcavated and replaced with structural fill. Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the Contractor. All temporary cuts in excess of 4 feet in height that are not protected by trench boxes or otherwise shored should be sloped in accordance with Part N of the Washington Administrative Code (WAC) 296-155 (WAC, 2020) as shown in the table below:

Table 7. Temporary Excavation Cut Slope Recommendations

Soil Unit	OSHA Soil Classification	Maximum Temporary Slope	Maximum Height (ft)
Existing Nonengineered Fill	C	1.5H:1V	20

Notes:
OSHA = Occupational Safety and Health Administration
H:V = Horizontal : Vertical

The estimated maximum cut slope inclinations are provided for planning purposes only and are applicable to excavations without groundwater seepage or runoff, and assume dry to moist conditions. Flatter slopes will likely be necessary in areas where groundwater seepage exists, or where construction equipment surcharges are placed in close proximity with the crest of the excavation.

With time and the presence of seepage and/or precipitation, the stability of temporary unsupported cut slopes can be significantly reduced. Therefore, all temporary slopes should be protected from erosion by installing a surface water diversion ditch or berm at the top of the slope. In addition, the Contractor should monitor the stability of the temporary cut slopes and adjust the construction schedule and slope inclination accordingly. Vibrations created by traffic and construction equipment may cause caving and raveling of the temporary slopes. In such an event, lateral support for the temporary slopes should be provided by the Contractor to prevent loss of ground support.

5.5.1 Permanent Slopes

In our opinion, permanent cut and fill slopes within the recessional deposits up to 1.5H:1V are possible provided BMPs are followed. We recommend that cut and fill slopes be permanently seeded. Permanent seeding may be native plants and grasses (applied by hydroseed with tackifier) with a temporary biodegradable erosion control blanket to cover the hydroseed and provide temporary protection until the grasses grow through the blanket. Where possible, the native topsoil should be retained and incorporated into the slopes prior to seeding. The Washington State Department of Ecology (Ecology) *2019 Stormwater Management Manual for Western Washington* recommends permanent seeding and erosion control blankets be designed and installed in accordance with its Best Management Practices C120 and C122, respectively (Ecology, 2019).

5.6 Wet Weather Construction

The soils encountered across the Site are generally moisture sensitive and may be difficult to handle, prepare, or compact with construction equipment during periods of wet weather. Earthwork is typically most economical when performed under dry weather conditions. If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions, the following recommendations should be incorporated into the contract specifications:

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation or the removal of unsuitable soils should be followed promptly by the placement and compaction of clean structural fill. The size and type of construction equipment used may need to be limited to prevent soil disturbance.
- Materials used as structural fill should consist of clean, granular soil containing less than 7 percent fines. The fines should be nonplastic.
- The ground surface within the construction area should be sealed by a smooth drum vibratory roller (or equivalent) and under no circumstances should be left uncompacted and exposed to moisture. Soils which become too wet for compaction should be removed and replaced with clean granular materials.
- Excavation and placement of structural fill should be observed by the Geotechnical Engineer to verify that all unsuitable materials are removed, and suitable compaction is achieved.
- Local BMPs for erosion protection should be strictly followed.

5.7 Construction Dewatering

Groundwater was not encountered in the Site explorations; however, minor seepage and surficial runoff may be encountered at shallow depths. The Contractor should be prepared to adequately dewater foundation subgrade and excavations. We anticipate that strategically placed sumps and pumps will sufficiently control water inflow. Sumps are often constructed by placing a short section of perforated corrugated steel pipe (or surplus 8- to 12-inch-diameter well screen) in a small hole excavated below the subgrade elevation/excavation. The annular space around the pipe is backfilled with drain rock, with several inches placed inside the casing to help control the pumping of fines. Submersible pumps (trash pumps) are then placed inside the casing and connected to a central discharge pipe.

The Contractor should be responsible for design, implementation, and any necessary permits associated with any construction dewatering system used for the Project.

6 Recommendations for Continuing Geotechnical Services

This report is provided to summarize our key findings and conclusions in support of the future walkway design. Site grading, civil plans, and construction methods have not been finalized, and the recommendations presented herein are based on conceptual design information. As design and construction details are advanced, this report can be expanded to support the final design concepts. Throughout this report, we have provided recommendations where we consider it would be appropriate for Aspect to provide additional geotechnical input to the design and construction process. Additional recommendations are summarized in this section.

6.1 Additional Construction Services

We are available to provide geotechnical engineering and monitoring services during construction. The integrity of the geotechnical elements depends on proper Site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent.

During the construction phase of the Project, we recommend that Aspect be retained to perform the following tasks:

- Review applicable submittals
- Observe and evaluate subgrade preparation and structural fill placement for pavement and retaining walls
- Attend meetings, as needed
- Address other geotechnical engineering considerations that may arise during construction

The purpose of our observations is to verify compliance with design concepts and recommendations and to allow design changes or evaluation of appropriate construction methods in the event that subsurface conditions differ from those anticipated prior to the start of construction.

7 References

Contreras, T.A., K.A Stone, and G.L. Paulin, 2013, Geologic Map of the Lofall 7.5-minute Quadrangle, Jefferson and Kitsap Counties, Washington, Scale: 1:24000, October 2013.

EnviroSound Consulting, Inc (ESC), 2014, Geotechnical Engineering Report, Little Boston Trail Phase II, Mile 2, March 11, 2015.

Mckenna, J. P.; Lidke, D. J.; and Coe, J. A., 2008, Landslides Mapped from LIDAR, Kitsap County, Washington: U.S. Geological Survey Open File Report 2008-1292, 81 p. Electronic document, available at http://pubs.usgs.gov/of/ 2008/1292/

Otak, Inc. (Otak), 2022, Port Gamble S'Klallam Tribe, Little Boston Road Pedestrian Trail 60 % Plans, Drawings, August 2022.

Varnes, D.J. (1978) Slope Movement Types and Processes. In: Schuster, R.L. and Krizek, R.J., Eds., Landslides, Analysis and Control, Transportation Research Board, Special Report No. 176, National Academy of Sciences, 11-33.

Washington Department of Ecology (Ecology), 2019, Stormwater Management Manual for Western Washington, Publication Number 14-10-055, December 2019.

Washington State Department of Transportation (WSDOT), 2024, Standard Specifications for Road, Bridge and Municipal Construction, Document M 41-10.

Washington Administrative Code (WAC), 2020, Chapter 296-155, Part N - Excavation, Trenching, and Shoring, April 20, 2020.

WSliq, 2008, Washington Department of Transportation Liquefaction Hazard Evaluation System.

8 Limitations

Work for this project was performed for Port Gamble S'Klallam Tribe (Client), and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting, LLC (Aspect).

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Client. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations.

Risks are inherent with any site involving slopes and no recommendations, geologic analysis, or engineering design can assure slope stability. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the Client.

It is the Client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, design plans and construction methods have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this report should be revised and/or expanded upon.

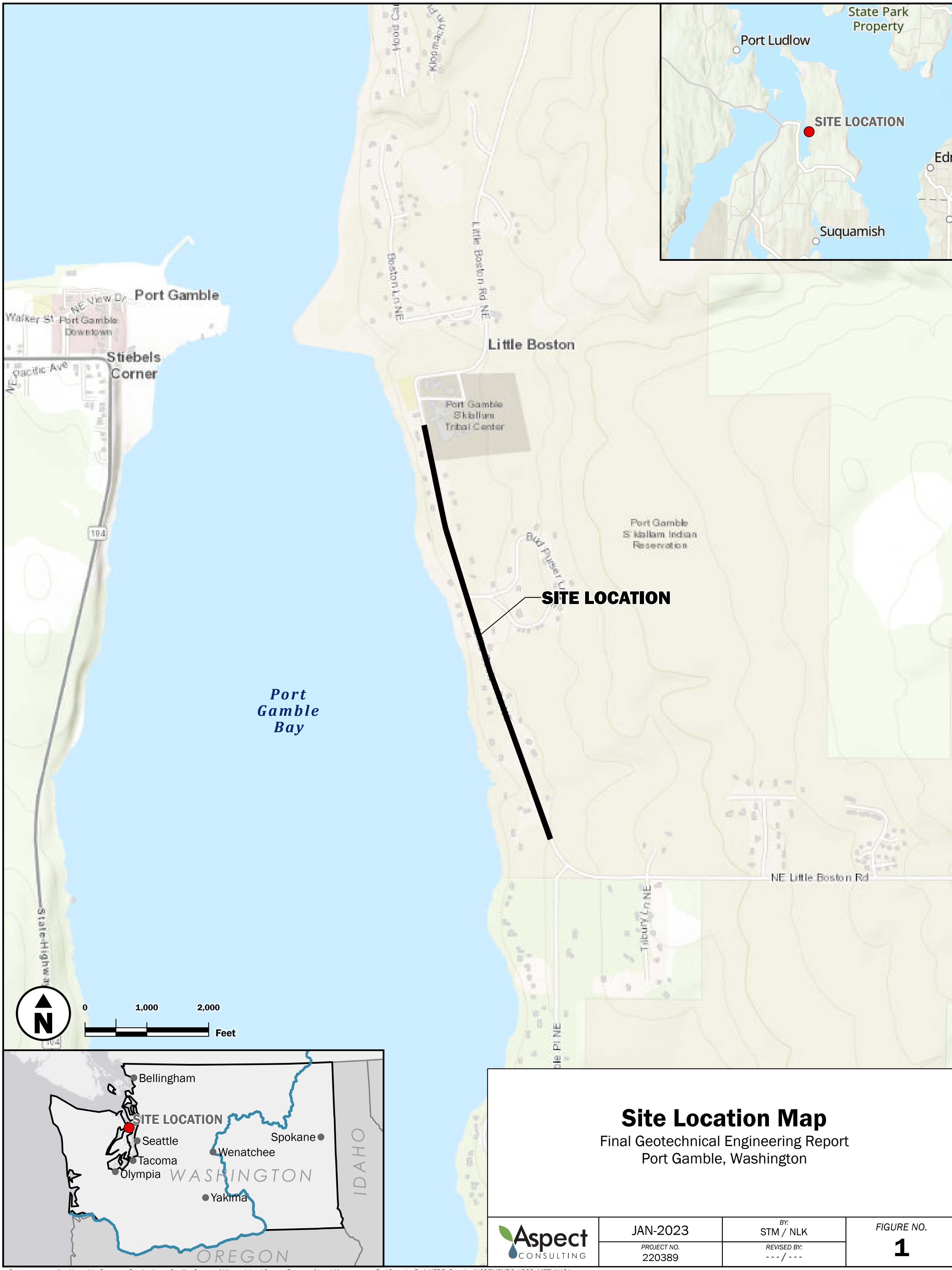
The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor's site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

All reports prepared by Aspect for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect. Aspect's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix C titled "Report Limitations and Guidelines for Use" for additional information governing the use of this report.

We appreciate the opportunity to perform these services. If you have any questions please call Erik Andersen, Principal Geotechnical Engineer, at 425-772-4705.

FIGURES



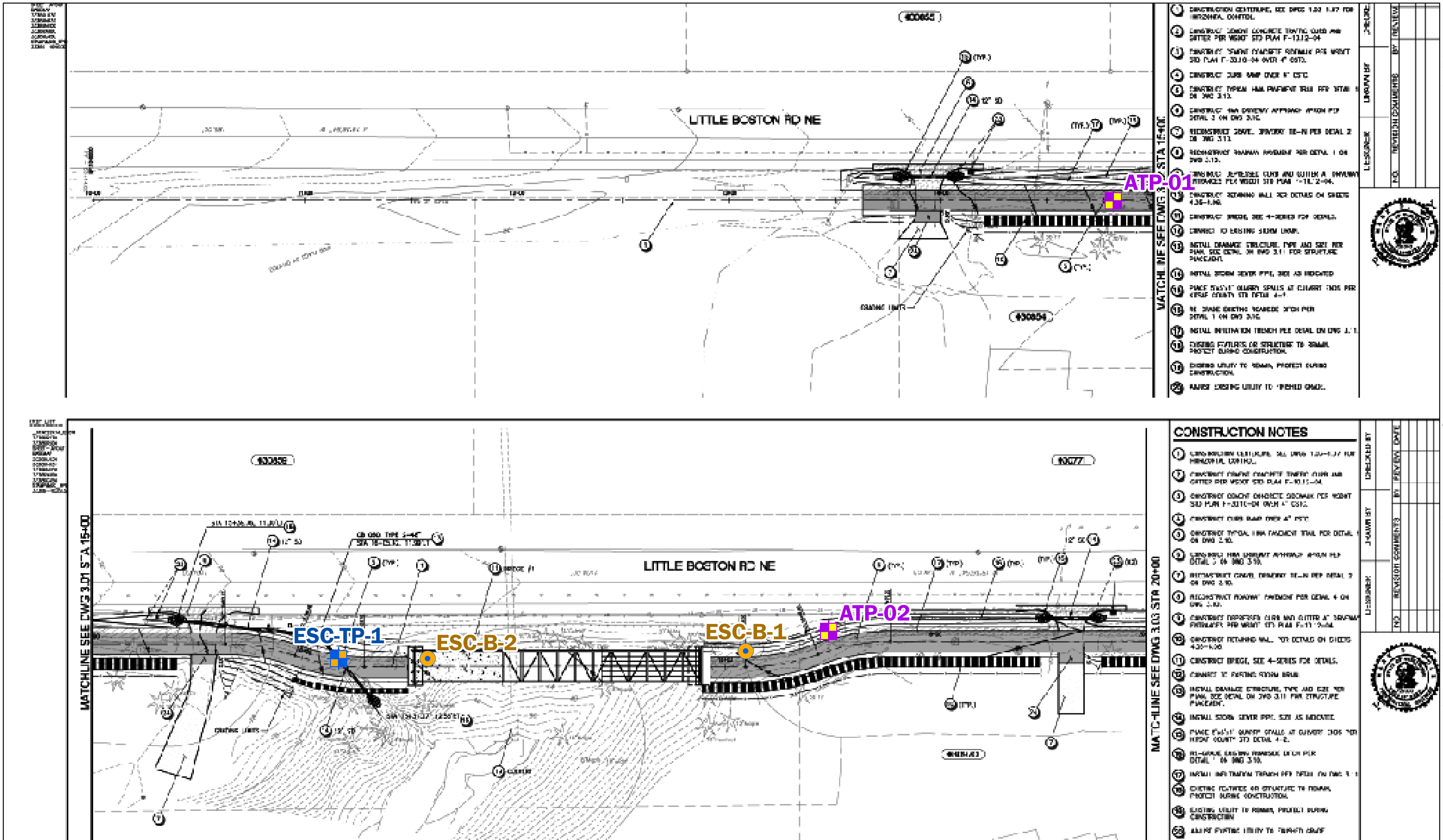
Site Location Map

Final Geotechnical Engineering Report
Port Gamble, Washington

Aspect CONSULTING	JAN-2023	BY: STM / NLK	FIGURE NO.
	PROJECT NO. 220389	REVISED BY: - - - / - - -	1

GIS Path: G:\projects\PortGambleSkallum_220389\PortGambleSkallum_220389.aprx: 01 Site Location Map | | User: nkochie | | Print Date: 1/12/2023

Data source credits: None || Basemap Service Layer Credits: County of Kitsap, Island County, Bureau of Land Management, Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA, Esri, CGIAR, USGS, County of Kitsap, Island County, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, Esri, HERE, Garmin, USGS, EPA, NPS



Test Pit Explorations by Aspect

Test Pit Explorations by Others

Boring Explorations by Others

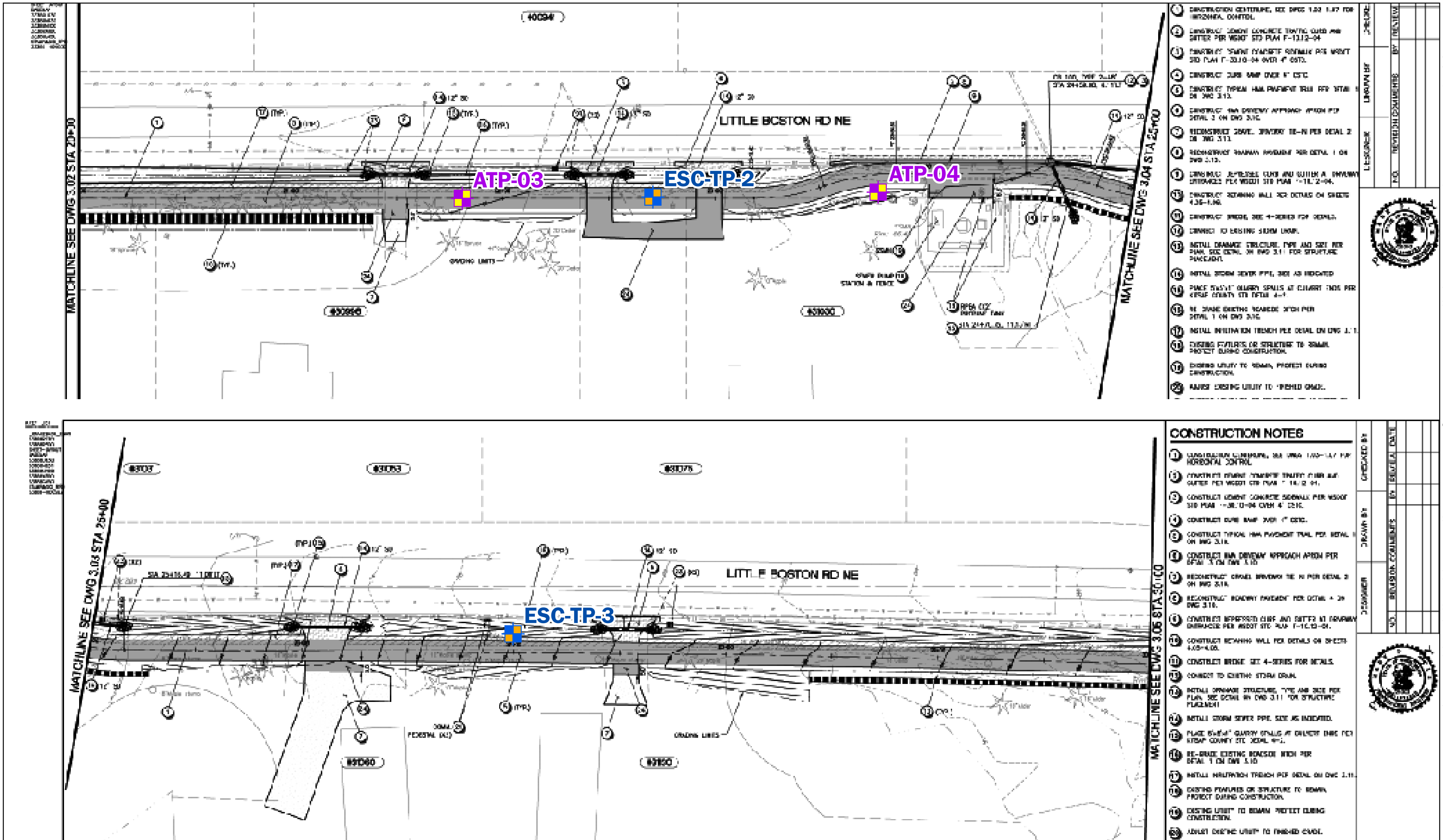
Site and Exploration Map

Final Geotechnical Engineering Report
Port Gamble, Washington

Aspect CONSULTING	FEB-2023	BY: STM / NLK	FIGURE NO.
	PROJECT NO. 220389	REVISED BY: --- / ---	2

Data source credits: None || Basemap Service Layer Credits: NA

ArcGIS Pro: G:\projects\PortGambleSkallium_220389\PortGambleSkallium_220389.aprx || NAD 1983 2011 StatePlane Washington North FIPS 4601 Ft US || Date Saved: 2/3/2023 || Exported 2/3/2023 09:44 by nkochie



Test Pit Explorations by Aspect

Test Pit Explorations by Others

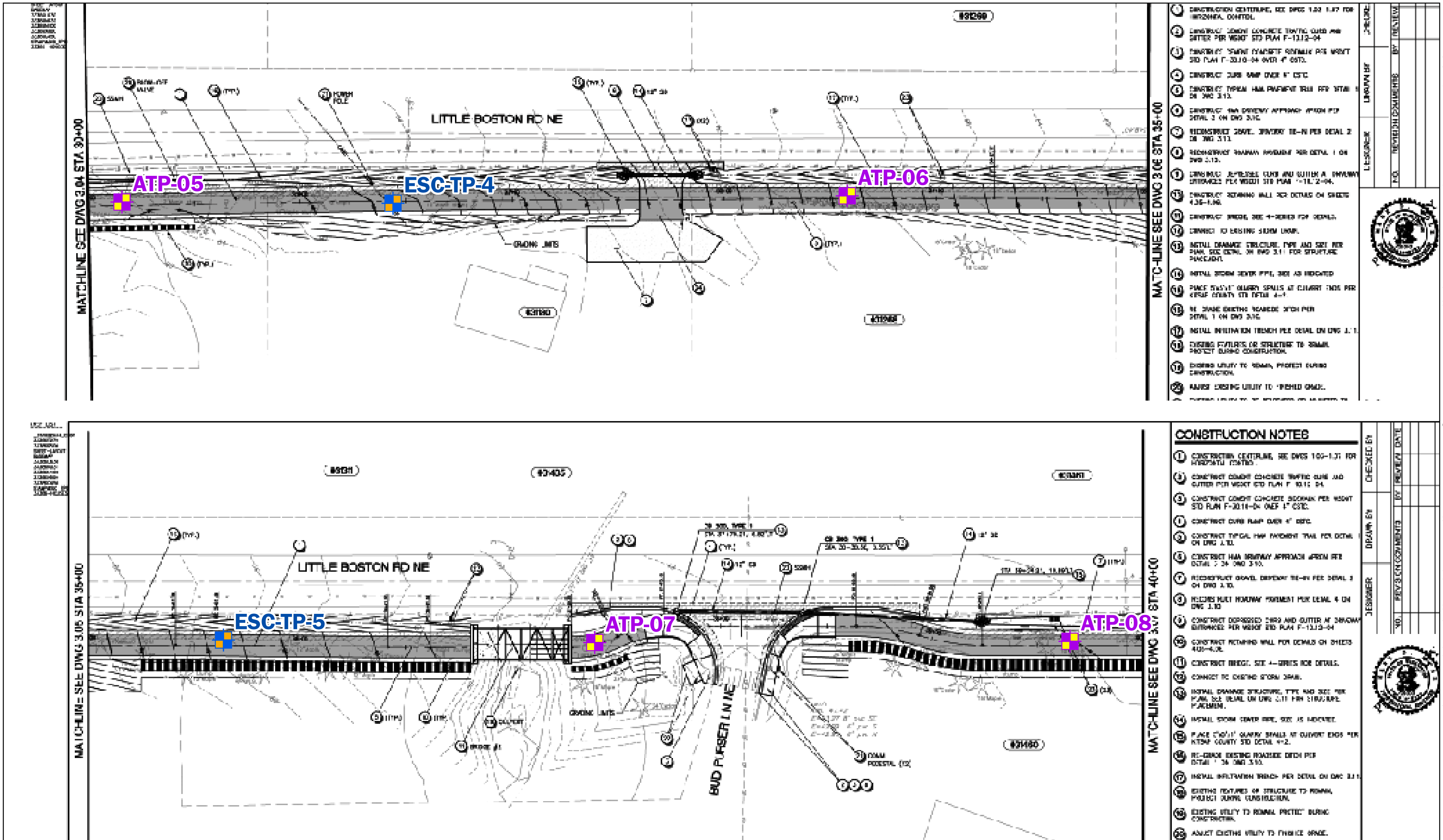
Site and Exploration Map

Final Geotechnical Engineering Report
Port Gamble, Washington

Aspect CONSULTING	FEB-2023	BY: STM / NLK	FIGURE NO.
	PROJECT NO. 220389	REVISED BY: - - - / - - -	2

ArcGIS Pro: G:\projects\PortGambleSkallum_220389\PortGambleSkallum_220389.aprx || NAD 1983 2011 StatePlane Washington North FIPS 4601 Ft US || Date Saved: 2/3/2023 || Exported 2/3/2023 09:40 by nkoche

Data source credits: None || Basemap Service Layer Credits: NA



Test Pit Explorations by Aspect

Test Pit Explorations by Others

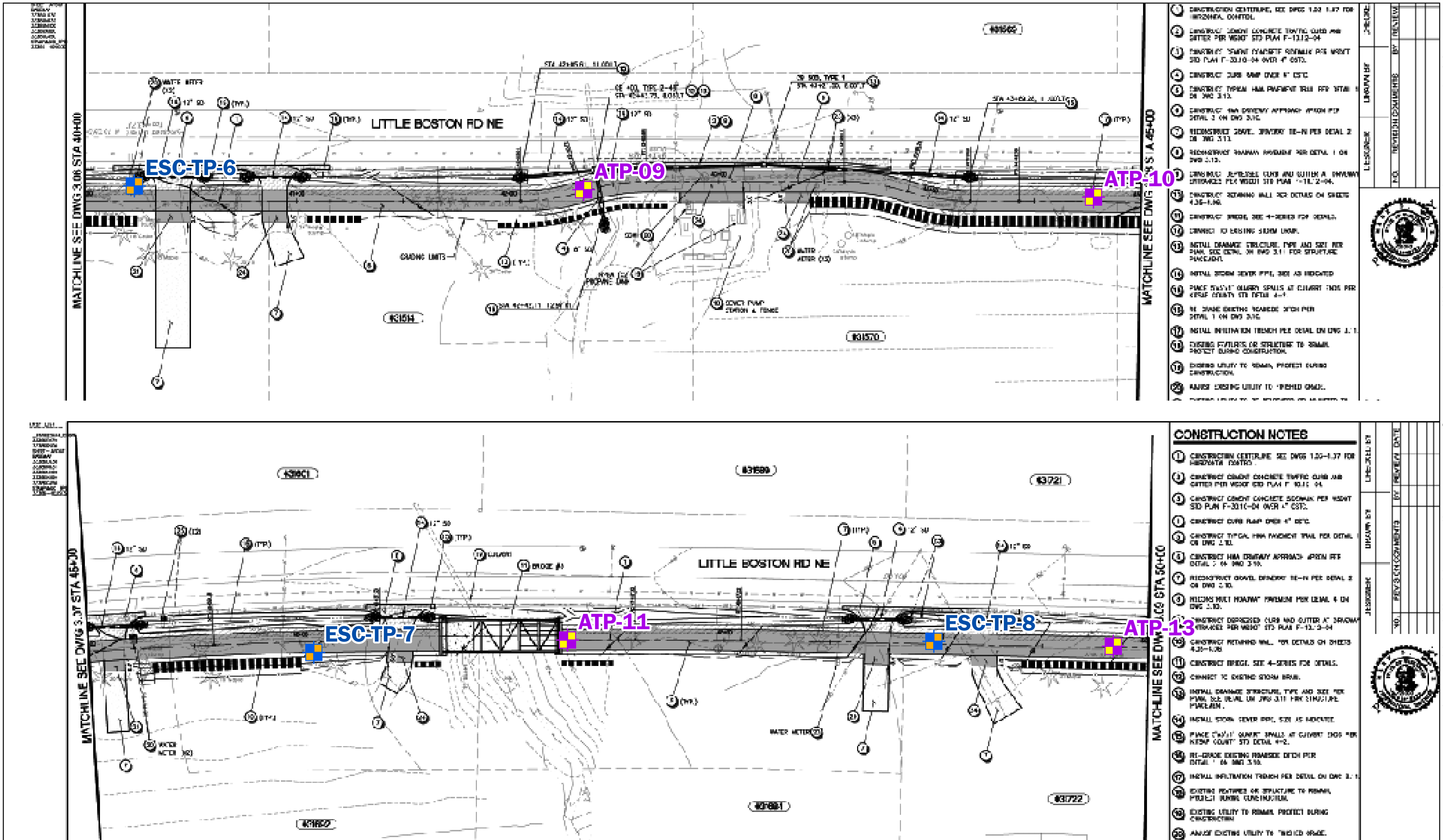
Site and Exploration Map

Final Geotechnical Engineering Report
Port Gamble, Washington

Aspect CONSULTING	FEB-2023	BY: STM / NLK	FIGURE NO. 2
	PROJECT NO. 220389	REVISED BY: --- / ---	

Data source credits: None || Basemap Service Layer Credits: NA

ArcGIS Pro: G:\projects\PortGambleSkallum_220389\PortGambleSkallum_220389.aprx || NAD 1983 2011 StatePlane Washington North FIPS 4601 Ft US || Date Saved: 2/3/2023 || Exported 2/3/2023 09:39 by nkoche



Test Pit Explorations by Aspect

Test Pit Explorations by Others

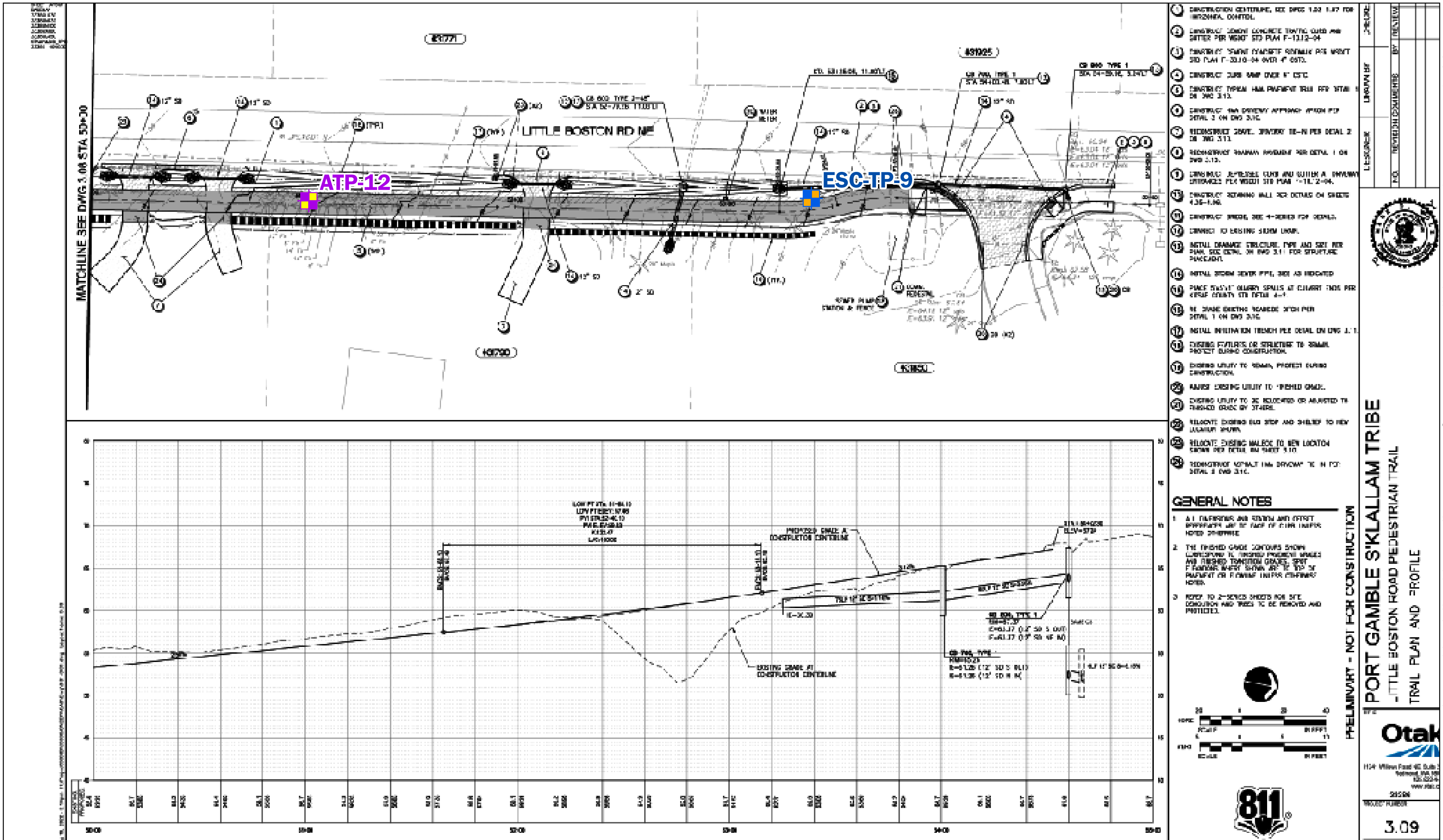
Site and Exploration Map

Final Geotechnical Engineering Report
Port Gamble, Washington

Aspect CONSULTING	FEB-2023	BY: STM / NLK	FIGURE NO.
	PROJECT NO. 220389	REVISED BY: - - - / - - -	2

ArcGIS Pro: G:\projects\PortGambleSkallum_220389\PortGambleSkallum_220389.aprx || NAD 1983 2011 StatePlane Washington North FIPS 4601 Ft US || Date Saved: 2/3/2023 || Exported 2/3/2023 09:39 by nkoche

Data source credits: None || Basemap Service Layer Credits: NA



Test Pit Explorations by Aspect

Test Pit Explorations by Others

Site and Exploration Map

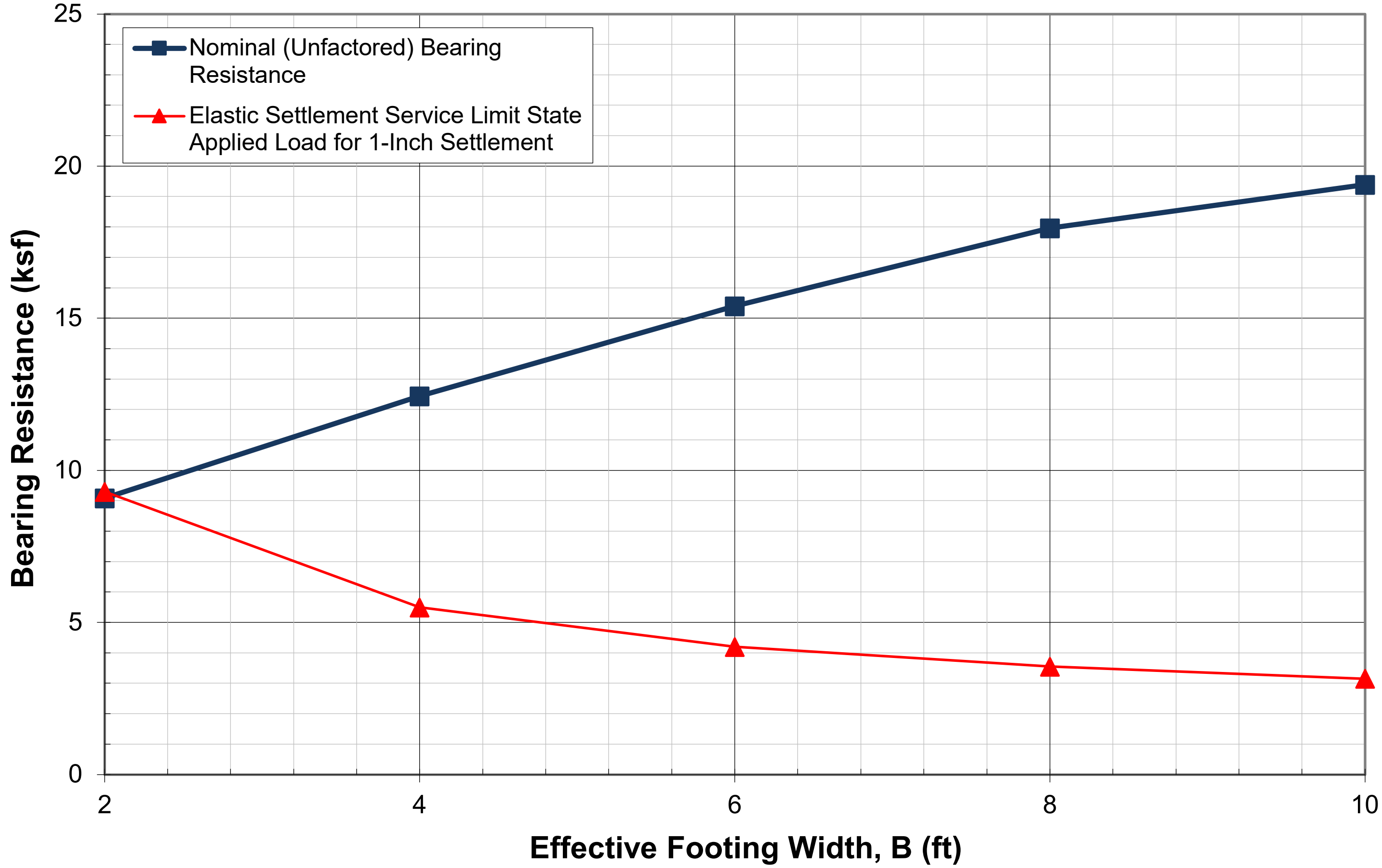
Final Geotechnical Engineering Report
Port Gamble, Washington

Aspect CONSULTING	FEB-2023	BY: STM / NLK	FIGURE NO.
	PROJECT NO. 220389	REVISED BY: - - - / - - -	2

Data source credits: None || Basemap Service Layer Credits: NA

ArcGIS Pro: G:\projects\PortGambleSkallam_220389\PortGambleSkallam_220389.aprx || NAD 1983 2011 StatePlane Washington North FIPS 4601 Ft US || Date Saved: 2/3/2023 || Exported 2/3/2023 09:38 by nkoche

Bearing Resistance For Shallow Rectangle Footings



Notes:

1. Assumes shallow strip foundations on medium dense to dense recessional outwash deposits.
2. Recommended resistance factors of 0.45 and 1.0 for Strength Limit State and Extreme Event Limit State, respectively.
3. Assumes a rectangular footing that is 14 feet long and with varying widths.

Port Gamble S'Klallam Tribe: Little Boston Road Pedestrian Trail
Kingston, Washington

Bearing Resistance For Shallow Square Footings Atop Recessional Outwash

220389 STM Feb-23

Aspect CONSULTING

Figure **3**

APPENDIX A

Subsurface Exploration Logs

A.1 Subsurface Explorations by Aspect

A field exploration program was performed on November 16, 2022, to determine the geotechnical and hydrogeological properties of materials at the Site. High Meadows Excavating LLC, under subcontract to Aspect, completed thirteen test pits, designated ATP-01, through ATP-13. Excavation was conducted using a Hitachi 85USB track excavator to depths ranging between 7.5 and 9.25 feet bgs. The test pits were excavated using a Hitachi 85USB tracked excavator. The test pits were backfilled with excavated soils, tamped into place using the excavator bucket.

An Aspect engineer-in-training was present throughout the program to observe the excavation procedures, assist in sampling, and prepare descriptive logs of the explorations. Soils were classified in general accordance with ASTM International (ASTM) D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. The relative density/consistency of the soils was evaluated qualitatively with a 0.5-inch-diameter steel T probe and observation of digging difficulty.

The exploration logs are provided within this appendix and exploration locations are shown on Figure 2. The summary exploration logs represent our interpretation of the contents of the field logs. The stratigraphic contacts shown on the individual summary logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The subsurface conditions depicted are only for the specific date and locations reported and are not necessarily representative of other locations and times.

Major Divisions		Fines	Group	Group Name
Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines	GW	Well-graded GRAVEL Well-graded GRAVEL WITH SAND
			GP	Poorly-graded GRAVEL Poorly-graded GRAVEL WITH SAND
		≥15% Fines	GM	SILTY GRAVEL SILTY GRAVEL WITH SAND
			GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines	SW	Well-graded SAND Well-graded SAND WITH GRAVEL
			SP	Poorly-graded SAND Poorly-graded SAND WITH GRAVEL
		≥15% Fines	SM	SILTY SAND SILTY SAND WITH GRAVEL
			SC	CLAYEY SAND CLAYEY SAND WITH GRAVEL
Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50%		ML	SILT SANDY or GRAVELLY SILT SILT WITH SAND SILT WITH GRAVEL
			CL	LEAN CLAY SANDY or GRAVELLY LEAN CLAY LEAN CLAY WITH SAND LEAN CLAY WITH GRAVEL
			OL	ORGANIC SILT SANDY or GRAVELLY ORGANIC SILT ORGANIC SILT WITH SAND ORGANIC SILT WITH GRAVEL
	Silts and Clays Liquid Limit 50% or More		MH	ELASTIC SILT SANDY or GRAVELLY ELASTIC SILT ELASTIC SILT WITH SAND ELASTIC SILT WITH GRAVEL
			CH	FAT CLAY SANDY or GRAVELLY FAT CLAY FAT CLAY WITH SAND FAT CLAY WITH GRAVEL
			OH	ORGANIC CLAY SANDY or GRAVELLY ORGANIC CLAY ORGANIC CLAY WITH SAND ORGANIC CLAY WITH GRAVEL
Highly Organic Soils			PT	PEAT and other mostly organic soils

"WITH SILT" or "WITH CLAY" means 5 to 15% silt and clay, denoted by a "-" in the group name; e.g., SP-SM • "SILTY" or "CLAYEY" means >15% silt and clay • "WITH SAND" or "WITH GRAVEL" means 15 to 30% sand and gravel. • "SANDY" or "GRAVELLY" means >30% sand and gravel. • "Well-graded" means approximately equal amounts of fine to coarse grain sizes • "Poorly graded" means unequal amounts of grain sizes • Group names separated by "/" means soil contains layers of the two soil types; e.g., SM/ML.

Soils were described and identified in the field in general accordance with the methods described in ASTM D2488. Where indicated in the log, soils were classified using ASTM D2487 or other laboratory tests as appropriate. Refer to the report accompanying these exploration logs for details.

1. Estimated or measured percentage by dry weight
2. (SPT) Standard Penetration Test (ASTM D1586)
3. Determined by SPT, DCPT (ASTM STP399) or other field methods. See report text for details.

GEOTECHNICAL LAB TESTS

MC	=	Natural Moisture Content
PS	=	Particle Size Distribution
FC	=	Fines Content (% < 0.075 mm)
GH	=	Hydrometer Test
AL	=	Atterberg Limits
C	=	Consolidation Test
Str	=	Strength Test
OC	=	Organic Content (% Loss by Ignition)
Comp	=	Proctor Test
K	=	Hydraulic Conductivity Test
SG	=	Specific Gravity Test

CHEMICAL LAB TESTS

Organic Chemicals

BTEX	=	Benzene, Toluene, Ethylbenzene, Xylenes
TPH-Dx	=	Diesel and Oil-Range Petroleum Hydrocarbons
TPH-G	=	Gasoline-Range Petroleum Hydrocarbons
VOCs	=	Volatile Organic Compounds
SVOCs	=	Semi-Volatile Organic Compounds
PAHs	=	Polycyclic Aromatic Hydrocarbon Compounds
PCBs	=	Polychlorinated Biphenyls

Metals

RCRA8	=	As, Ba, Cd, Cr, Pb, Hg, Se, Ag, (d = dissolved, t = total)
MTCA5	=	As, Cd, Cr, Hg, Pb (d = dissolved, t = total)
PP-13	=	Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn (d=dissolved, t=total)

FIELD TESTS

PID	=	Photoionization Detector
Sheen	=	Oil Sheen Test
SPT[2]	=	Standard Penetration Test
NSPT	=	Non-Standard Penetration Test
DCPT	=	Dynamic Cone Penetration Test

COMPONENT DEFINITIONS

Descriptive Term		Size Range and Sieve Number
Boulders	=	Larger than 12 inches
Cobbles	=	3 inches to 12 inches
Coarse Gravel	=	3 inches to 3/4 inches
Fine Gravel	=	3/4 inches to No. 4 (4.75 mm)
Coarse Sand	=	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	=	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	=	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	=	Smaller than No. 200 (0.075 mm)

ESTIMATED[1] PERCENTAGE

% by Weight		Modifier	% by Weight		Modifier
<1	=	Subtrace	15 to 25	=	Little
1 to <5	=	Trace	30 to 45	=	Some
5 to 10	=	Few	>50	=	Mostly

MOISTURE CONTENT

Dry	=	Absence of moisture, dusty, dry to the touch
Slightly Moist	=	Perceptible moisture
Moist	=	Damp but no visible water
Very Moist	=	Water visible but not free draining
Wet	=	Visible free water, usually from below water table

RELATIVE DENSITY

Non-Cohesive or Coarse-Grained Soils

Density[3]		SPT[2] Blows/Foot	Penetration with 1/2" Diameter Rod
Very Loose	=	0 to 4	≥ 2'
Loose	=	5 to 10	1' to 2'
Medium Dense	=	11 to 30	3" to 1'
Dense	=	31 to 50	1" to 3"
Very Dense	=	> 50	< 1"

CONSISTENCY

Cohesive or Fine-Grained Soils

Consistency[3]		SPT[2] Blows/Foot	Manual Test
Very Soft	=	0 to 1	Penetrated >1" easily by thumb. Extrudes between thumb & fingers.
Soft	=	2 to 4	Penetrated 1/4" to 1" easily by thumb. Easily molded.
Medium Stiff	=	5 to 8	Penetrated >1/4" with effort by thumb. Molded with strong pressure.
Stiff	=	9 to 15	Indented ~1/4" with effort by thumb.
Very Stiff	=	16 to 30	Indented easily by thumbnail.
Hard	=	> 30	Indented with difficulty by thumbnail.

GEOLOGIC CONTACTS

Observed and Distinct	Observed and Gradual	Inferred

Aspect CONSULTING

Exploration Log Key

AI Path: Q:_ACAD Standards\FIELD REFERENCE\MASTERS\Exploration Log Key-2018.ai // user: jinman // last saved: 12/31/2018

Aspect CONSULTING	Port Gamble Sklallum Tribe - 220389			Geotechnical Exploration Log	
	Project Address & Site Specific Location			*Coordinates (Lat,Lon WGS84)*	*Exploration Number*
	31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.			47.8411, -122.5652 (est)	**ATP-01**
Contractor	*Equipment*	*Sampling Method*		*Ground Surface Elev.*	
High Meadows Excavating	Deere 35D	Grab		74' (est)	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*		*Top of Casing Elev.*	*Depth to Water (Below GS)*
Andrew Monsaas	Backhoe or trackhoe	11/16/2022		NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								TOPSOIL; loose, moist, dark brown; fine to coarse sand; trace organics and tree roots.	
								RECESSIONAL OUTWASH DEPOSITS SILTY SAND WITH GRAVEL (SM); medium dense to dense, moist, brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel, subtrace organics.	
1	73								1
2	72		S1						2
3	71					T-probe =1" to 2"			3
4	70	Backfilled with excavated material.							4
			S2	27.8		PS FC=30.1%		SILTY SAND WITH GRAVEL (SM); medium stiff to stiff, moist, gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel, iron-oxide staining.	
5	69								5
6	68							SILTY SAND (SM); loose to medium dense, moist, gray; fine to coarse sand; trace, fine to coarse, subangular to rounded gravel.	6
7	67		S3	20		FC=25.9%			7
8	66		S4					Becomes dark gray.	8
								Test pit sidewalls standing vertically with no caving. Bottom of exploration at 8.5 ft. bgs.	
9	65								9

Legend

Sample Type: Grab sample

Plastic Limit ⊢—⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-01

Sheet 1 of 1

Port Gamble Sklallum Tribe - 220389

Geotechnical Exploration Log

Aspect CONSULTING

Project Address & Site Specific Location	Coordinates (Lat,Lon WGS84)	Exploration Number
31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.	47.8420, -122.5655 (est)	ATP-02

Contractor	Equipment	Sampling Method	Ground Surface Elev.
High Meadows Excavating	Deere 35D	Grab	64' (est)

Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev.	Depth to Water (Below GS)
Andrew Monsaas	Backhoe or trackhoe	11/16/2022	NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ●	Blows/6"	Tests	Description	Depth (ft)
0	64						**TOPSOIL** SILTY SAND WITH GRAVEL (SM); loose, moist, dark brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; trace to few organics and rootlets; trace urban debris.	
1	63						**FILL** SILTY SAND WITH GRAVEL (SM); medium dense to dense, moist, brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; trace organics and urban debris.	1
2	62							2
3	61		Grab S1	8.3 ●		PS FC=12.5% T-probe =1" to 3"		3
4	60	Backfilled with excavated material.						4
5	59							5
6	58							6
6.5			Grab S2	10.4 ●		PS FC=12.9%	**RECESSIONAL OUTWASH DEPOSITS** SILTY SAND (SM); medium dense; fine to coarse sand; fine to coarse, subrounded to rounded gravel. Minor iron-oxide staining.	
7	57							7
7.5			Grab S3					
8	56						Test pit sidewalls standing vertically with no caving. Bottom of exploration at 8 ft. bgs.	8
9	55							9

Plastic Limit ⊢—⊣ Liquid Limit

Legend

Sample Type: Grab sample

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-02

Sheet 1 of 1

Port Gamble Sklallum Tribe - 220389

Geotechnical Exploration Log

Project Address & Site Specific Location	Coordinates (Lat,Lon WGS84)	Exploration Number
31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.	47.8430, -122.5660 (est)	ATP-03

Contractor	Equipment	Sampling Method	Ground Surface Elev.
High Meadows Excavating	Deere 35D	Grab	67' (est)

Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev.	Depth to Water (Below GS)
Andrew Monsaas	Backhoe or trackhoe	11/16/2022	NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ●	Blows/6"	Tests	Description
0	67						**TOPSOIL** SILTY SAND (SM); loose, moist, brown; little organics.
							ADVANCE OUTWASH DEPOSITS SILTY SAND (SM); dense, moist, gray-brown; fine to coarse sand.
1	66						
2	65						
3	64		Grab, S1	13 ●		T-probe =0.5" to 1.5" FC=48.8%	
4	63	Backfilled with excavated material.					
4.5							SILTY SAND WITH GRAVEL (SM); medium dense to dense, moist, brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; subtrace organics.
5	62						
6	61		Grab, S2				
7	60						SILTY SAND (SM); medium dense to dense, moist, gray to dark gray; fine to coarse sand.
8	59		Grab, S3				
9	58						
9.25							Test pit sidewalls standing vertically with no caving. Bottom of exploration at 9.25 ft. bgs.

Plastic Limit ⊢—⊣ Liquid Limit

Legend

Sample Type: Grab sample

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-03

Sheet 1 of 1

Aspect CONSULTING	Port Gamble Sklallum Tribe - 220389			Geotechnical Exploration Log	
	Project Address & Site Specific Location			*Coordinates (Lat,Lon WGS84)*	*Exploration Number*
	31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.			47.8439, -122.5664 (est)	**ATP-04**
Contractor	*Equipment*	*Sampling Method*		*Ground Surface Elev.*	
High Meadows Excavating	Deere 35D	Grab		65' (est)	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*		*Top of Casing Elev.*	*Depth to Water (Below GS)*
Andrew Monsaas	Backhoe or trackhoe	11/16/2022		NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								TOPSOIL SILTY SAND WITH GRAVEL (SM); loose, moist, brown to dark brown; fine to coarse sand; fine to coarse, angular to rounded gravel.	
1	64								1
2	63		S1			T-probe =2"to 4"		**RECESSIONAL OUTWASH DEPOSITS** SILTY SAND (SM); loose to medium dense, moist, red-brown; fine to coarse sand; trace, fine to coarse, subangular to rounded gravel; trace organics.	2
3	62					T-probe =0" to 2"			3
4	61	Backfilled with excavated material.	S2					SILTY SAND (SM); medium dense to dense, moist, brown to gray-brown; fine to coarse sand; trace, fine to coarse, subangular to rounded gravel; subtrace organics.	4
5	60								5
								GLACIAL TILL SILTY SAND (SM); very dense, moist, gray; fine to coarse sand; trace, fine to coarse, subrounded to rounded gravel.	
6	59		S3	9.9		FC=42.3%			6
7	58								7
8	57							Test pit sidewalls standing vertically with no caving. Bottom of exploration at 8 ft. bgs.	8
9	56								9

Legend

Sample Type: Grab sample

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-04

Sheet 1 of 1

Aspect CONSULTING	Port Gamble Sklallum Tribe - 220389			Geotechnical Exploration Log	
	Project Address & Site Specific Location			*Coordinates (Lat,Lon WGS84)*	*Exploration Number*
	31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.			47.8451, -122.5672 (est)	**ATP-05**
Contractor	*Equipment*	*Sampling Method*		*Ground Surface Elev.*	
High Meadows Excavating	Deere 35D	Grab		86' (est)	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*		*Top of Casing Elev.*	*Depth to Water (Below GS)*
Andrew Monsaas	Backhoe or trackhoe	11/16/2022		NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Description
0–2	86–84						**TOPSOIL** SILTY SAND WITH GRAVEL AND COBBLES (SM); loose, moist, brown to dark brown; fine to coarse sand; fine to coarse, angular to rounded gravel; trace urban debris; trace organics.
2–5	84–81					T-probe =3" to 5"	**RECESSIONAL OUTWASH DEPOSITS** SILTY SAND (SM); medium dense, slightly moist, gray-brown with iron-oxide staining; fine to coarse sand; fine to coarse, subrounded to rounded gravel; trace organics.
3.5–4		Backfilled with excavated material.	S1 (Grab)	5.8 ●		T-probe =1" to 2" FC=46.9%	
5–7	81–79		S2 (Grab)				SILTY SAND WITH GRAVEL (SM); dense, slightly moist, gray-brown with iron-oxide staining; fine to coarse sand; fine to coarse, subangular to rounded gravel; subtrace organics.
7–8	79–78		S3 (Grab)				**GLACIAL TILL** SILTY SAND WITH GRAVEL (SM); very dense, slightly moist, gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel.
8	78						Test pit sidewalls standing vertically with no caving. Bottom of exploration at 8 ft. bgs.
9	77						

Legend

Sample Type: Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-05

Sheet 1 of 1

Port Gamble Sklallum Tribe - 220389

Geotechnical Exploration Log

Aspect CONSULTING

Project Address & Site Specific Location				*Coordinates (Lat,Lon WGS84)*	*Exploration Number*
31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.				47.8460, -122.5676 (est)	**ATP-06**
Contractor	*Equipment*	*Sampling Method*		*Ground Surface Elev.*	
High Meadows Excavating	Deere 35D	Grab		70' (est)	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*		*Top of Casing Elev.*	*Depth to Water (Below GS)*
Andrew Monsaas	Backhoe or trackhoe	11/16/2022		NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0–0.3								**TOPSOIL** SILTY SAND (SM); loose, moist, dark brown; fine to coarse samd; trace organics and rootlets.	
0.3–5								**RECESSIONAL LACUSTRINE DEPOSITS** CLAY (CL); medium stiff, moist, gray-brown with iron-oxide staining; low plasticity clay; trace organics.	
1	69								1
2	68								2
3	67		S1 (Grab)	26.1		T-probe =1" to 2" AL, FC FC=61.7% LL=45% PL=26%			3
4	66	Backfilled with excavated mayterial.							4
5	65		S2 (Grab)					SANDY CLAY (CL); stiff, moist, gray-brown with iron-oxide staining; low plasticity clay.	5
6	64								6
7	63		S3 (Grab)					**RECESSIONAL OUTWASH DEPOSITS** SILTY SAND (SM); medium dense, moist, brown; fine to coarse sand.	7
8	62		S4 (Grab)						8
8.5								Test pit sidewalls standing vertically with no caving. Bottom of exploration at 8.5 ft. bgs.	
9	61								9

Legend

Sample Type: Grab sample

Plastic Limit ⊢—⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-06

Sheet 1 of 1

Aspect CONSULTING	Port Gamble Sklallum Tribe - 220389		Geotechnical Exploration Log	
	Project Address & Site Specific Location		Coordinates (Lat,Lon WGS84)	Exploration Number
	31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.		47.8469, -122.5680 (est)	ATP-07
Contractor	Equipment	Sampling Method	Ground Surface Elev.	
High Meadows Excavating	Deere 35D	Grab	48' (est)	
Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev.	Depth to Water (Below GS)
Andrew Monsaas	Backhoe or trackhoe	11/16/2022	NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Description	Depth (ft)
0	48						**TOPSOIL** SILTY SAND WITH GRAVEL AND COBBLES (SM); loose, moist, dark brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; few tree roots and organics.	
1	47						**FILL** SILTY SAND (SM); loose, slightly moist, brown; fine to coarse sand; trace, fine to coarse, subangular to rounded gravel; trace urban debris (asphalt, glass); trace organics.	1
2	46						SANDY CLAY (CL); stiff, moist, gray-brown; fine to coarse sand; trace, fine to coarse, subangular to rounded gravel; trace urban debris (asphalt); trace organics.	2
3	45		Grab S1			T-probe =1" to 2.5"		3
4	44	Backfilled with excavated material.					SILTY SAND WITH GRAVEL AND COBBLES (SM); medium dense to dense, moist, brown to gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; trace urban debris (asphalt, glass); trace organics.	4
5	43							5
6	42		Grab S2	5.9 ●		FC FC=26.1%		6
7	41							7
8	40		Grab S3				**RECESSIONAL OUTWASH DEPOSITS** SILTY SAND WITH GRAVEL (SM); medium dense to dense, moist, gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel.	8
9	39						Test pit sidewalls standing vertically with no caving. Bottom of exploration at 9 ft. bgs.	9

Legend

Sample Type: Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-07

Sheet 1 of 1

Port Gamble Sklallum Tribe - 220389

Geotechnical Exploration Log

Aspect CONSULTING

Project Address & Site Specific Location	Coordinates (Lat,Lon WGS84)	Exploration Number
31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.	47.8474, -122.5683 (est)	ATP-08

Contractor	Equipment	Sampling Method	Ground Surface Elev.
High Meadows Excavating	Deere 35D	Grab	50' (est)

Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev.	Depth to Water (Below GS)
Andrew Monsaas	Backhoe or trackhoe	11/16/2022	NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ●	Blows/6"	Tests	Description	Depth (ft)
0	50						**TOPSOIL** SILTY SAND (SM); loose, moist, brown to dark brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; trace organics.	
1	49							1
2	48						**RECESSIONAL LACUSTRINE DEPOSITS** SANDY CLAY (CL); stiff to very stiff, moist, gray to gray-brown; fine to coarse sand; trace organics.	2
3	47		Grab S1	18.8 ●		T-probe =0.5" to 1.5" FC FC=67.3%		3
4	46	Backfilled with excavated material.						4
4.5							SANDY CLAY (CL); medium stiff, moist, gray to gray-brown with iron-oxide staining.; fine to coarse sand.	
5	45		Grab S2					5
6	44							6
7	43							7
8	42		Grab S3					8
8.25							Test pit sidewalls standing vertically with no caving. Bottom of exploration at 8.25 ft. bgs.	
9	41							9

Blows/foot scale: 0 10 20 30 40 50

Legend

Sample Type: Grab sample

Plastic Limit ├─┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-08

Sheet 1 of 1

Port Gamble Sklallum Tribe - 220389

Geotechnical Exploration Log

Aspect CONSULTING

Project Address & Site Specific Location	Coordinates (Lat,Lon WGS84)	Exploration Number
31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.	47.8484, -122.5687 (est)	ATP-09

Contractor	Equipment	Sampling Method	Ground Surface Elev.
High Meadows Excavating	Deere 35D	Grab	41' (est)

Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev.	Depth to Water (Below GS)
Andrew Monsaas	Backhoe or trackhoe	11/16/2022	NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ●	Blows/6"	Tests	Description
0	41						**TOPSOIL** SILTY SAND (SM); loose, moist, dark brown; fine to coarse sand; trace, fine to coarse, subrounded to gravel; trace organics.
1	40						**RECESSIONAL LACUSTRINE DEPOSITS** CLAY (CL); stiff to very stiff, moist, gray-brown with iron-oxide staining; low plasticity clay.
2	39						
3	38		S1 (Grab)	23.3		T-probe =2" to 3" AL LL=43% PL=26%	
4	37	Backfilled with excavated material.					
5	36		S2 (Grab)				
6	35						
7	34						CLAY WITH SAND (CL); medium stiff, moist, gray-brown with iron-oxide staining; low plasticity clay; fine to coarse sand.
7.5			S3 (Grab)				
8	33						Test pit sidewalls standing vertically with no caving. Bottom of exploration at 8 ft. bgs.
9	32						

Plastic Limit ├──┤ Liquid Limit

Legend

Sample Type: Grab sample

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-09

Sheet 1 of 1

Port Gamble Sklallum Tribe - 220389

Geotechnical Exploration Log

Aspect CONSULTING

Project Address & Site Specific Location	Coordinates (Lat,Lon WGS84)	Exploration Number
31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.	47.8491, -122.5690 (est)	ATP-10

Contractor	Equipment	Sampling Method	Ground Surface Elev.
High Meadows Excavating	Deere 35D	Grab	49' (est)

Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev.	Depth to Water (Below GS)
Andrew Monsaas	Backhoe or trackhoe	11/16/2022	NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Description	Depth (ft)
0	49						**TOPSOIL** SILTY SAND (SM); loose, moist, dark brown; fine to coarse sand; trace organics.	
1	48							1
1.5							**RECESSIONAL LACUSTRINE DEPOSITS** CLAY (CL); very stiff, moist, gray to gray-brown with iron-oxide staining; low plasticity clay, trace organics.	
2	47					T-probe =0" to 1"		2
2.5–3			Grab S1					
3	46							3
4	45	Backfilled with excavated material.				T-probe =0" to 1"		4
5	44						SANDY CLAY (CL); stiff, moist, gray to gray-brown with iron-oxide staining; low plasticity clay.	5
6	43		Grab S2	31.5 ●		FC FC=86.1%		6
6.5							**RECESSIONAL OUTWASH DEPOSITS** SILTY SAND (SM); medium dense, moist, gray to gray-brown; fine to medium sand; subtrace organics.	
7	42							7
8	41							8
8.5–9			Grab S3					
9	40						Test pit sidewalls standing vertically with no caving. Bottom of exploration at 9 ft. bgs.	9

Legend

Sample Type: Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-10

Sheet 1 of 1

Port Gamble Sklallum Tribe - 220389

Geotechnical Exploration Log

Aspect CONSULTING

Project Address & Site Specific Location	Coordinates (Lat,Lon WGS84)	Exploration Number
31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.	47.8495, 122.5693 (est)	ATP-11

Contractor	Equipment	Sampling Method	Ground Surface Elev.
High Meadows Excavating	Deere 35D	Grab	47' (est)

Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev.	Depth to Water (Below GS)
Andrew Monsaas	Backhoe or trackhoe	11/16/2022	NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Description	Depth (ft)
0	47						**TOPSOIL** SILTY SAND (SM); loose, moist, dark brown; fine to coarse sand; trace organics.	
1	46						**RECESSIONAL LACUSTRINE DEPOSITS** CLAY (CL); medium stiff, moist, gray with iron-oxide staining; low plasticity clay; trace organics.	1
2	45		S1			T-probe =3" to 4"		2
3	44							3
4	43	Backfilled with excavated material.				T-probe =2" to 4"		4
			S2				SANDY CLAY (CL); medium stiff, moist, gray-brown with iron-oxide staining; low plasticity clay; subtrace organics.	
5	42							5
							RECESSIONAL OUTWASH DEPOSITS SILTY SAND (SM); medium dense, moist, brown; fine to medium sand.	
6	41		S3	23.6 ●		PS FC=43.1%		6
7	40							7
							Test pit sidewalls standing vertically with no caving. Bottom of exploration at 7.5 ft. bgs.	
8	39							8
9	38							9

Legend

Sample Type: Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-11

Sheet 1 of 1

Port Gamble Sklallum Tribe - 220389

Geotechnical Exploration Log

Aspect CONSULTING

Project Address & Site Specific Location	Coordinates (Lat,Lon WGS84)	Exploration Number
31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.	47.8505, -122.5695 (est)	**ATP-12**

Contractor	Equipment	Sampling Method	Ground Surface Elev.
High Meadows Excavating	Deere 35D	Grab	57' (est)

Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev.	Depth to Water (Below GS)
Andrew Monsaas	Backhoe or trackhoe	11/16/2022	NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Description
0	57						**TOPSOIL** SILTY SAND (SM); loose, moist, dark brown; trace organics.
1	56						**FILL** SAND WITH SILT (SP-SM); dense, moist, brown with iron-oxide staining.; trace, subangular to rounded gravel; trace organics.
2	55		S1	4.3 ●		T-probe =1" to 3" PS FC=10.1%	
2.5							**RECESSIONAL LACUSTRINE DEPOSITS** SANDY CLAY (CL); stiff to very stiff, moist, gray-brown with iron-oxide staining.; low plasticity clay; trace organics.
3	54		S2			T-probe =0" to 0.5"	
4	53	Backfilled with excavated material.					**RECESSIONAL OUTWASH DEPOSITS** SILTY SAND (SM); medium dense, slightly moist, gray-brown with iron-oxide staining; fine to coarse sand.
5	52		S3				
6	51						Becomes moist.
7	50						
8	49		S4				
8.5							Test pit sidewalls standing vertically with no caving. Bottom of exploration at 8.5 ft. bgs.
9	48						

Legend

Sample Type: Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-12

Sheet 1 of 1

Aspect CONSULTING	Port Gamble Sklallum Tribe - 220389			Geotechnical Exploration Log	
	Project Address & Site Specific Location			*Coordinates (Lat,Lon WGS84)*	*Exploration Number*
	31912 Little Boston Rd NE, Kingston, WA 98346, See Figure 2.			47.8502, -122.5694 (est)	**ATP-13**
Contractor	*Equipment*	*Sampling Method*		*Ground Surface Elev.*	
High Meadows Excavating	Deere 35D	Grab		54' (est)	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*		*Top of Casing Elev.*	*Depth to Water (Below GS)*
Andrew Monsaas	Backhoe or trackhoe	11/16/2022		NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	54							**TOPSOIL** SILTY SAND (SM); loose, moist, dark brown; fine to coarse sand; trace, subangular to rounded gravel; trace organics.	
1	53							**RECESSIONAL LACUSTRINE DEPOSITS** CLAY WITH SAND (CL); stiff to very stiff, moist, gray with iron-oxide staining; low plasticity clay; trace organics.	1
2	52		S1 (Grab)						2
3	51					T-probe =0.5" to 1.5"			3
								SANDY CLAY (CL); stiff to very stiff, moist, gray to gray-brown with iron-oxide staining; low plasticity clay; subtrace organics.	
4	50	Backfilled with excavated material.	S2 (Grab)						4
5	49							**RECESSIONAL OUTWASH DEPOSITS** SAND (SP); loose to medium dense, moist, gray-brown with iron-oxide staining.; fine to medium sand.	5
6	48								6
			S3 (Grab)	6.1 ●		PS FC=4.7%			
7	47								7
8	46								8
9	45								9
								Test pit sidewalls standing vertically with no caving. Bottom of exploration at 9.25 ft. bgs.	

Legend

Sample Type: Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: STM
Approved by: EOA

Exploration Log ATP-13

Sheet 1 of 1

A.2 Subsurface Explorations by Others

EnviroSound Consulting (ESC) conducted a field exploration program consisting of 2 borings, B-1 and B-2 and 9 test pits, TP-1 through TP-9 in November and December of 2014. The boring and test pit logs are attached to this appendix.

Log of Test Boring B-1

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam Tribe
Project Number: ESC014-G068

Boring Elevation: @ 60.0'
Boring Location: @ 20.0' north of Station 66 + 00
Depth to Groundwater: @ 20.0'

DEPTH (FT.)	USCS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	DEPTH (FEET)	SAMPLE TYPE	BLOW COUNTS PER 6 INCHES	N VALUE	RECOVERY (INCHES)	LAB TESTING RESULTS FOR SAMPLE
0		0- 0.25' Forest duff							
	SM	0.25'-5.0' Upper 0.25' Black, medium dense, sandy SILT, moist. Lower 4.25' Tan, medium, silty SAND. Moist with scattered gravels, trace organics.	S-1	1.5'	SPT	1/3/4	7	11	
5	SP	5.0'-10.0' Tan, fine to coarse, medium dense SAND, scattered gravels, wet.	S-2	5.0'	SPT	5/9/12	21	15	
10	SP	10.0'-10.6'Light iron staining in upper 8". Fine to medium grained, medium dense SAND, wet.	S-3	10.0'	SPT	7/8/10	18	17	M.C.= 17% Gravel = 3.7% Sand =67.3% Silt/Clay = 29.0%
	SM	10.6'-11.0' Tan, stiff, sandy SILT.							
	SM	11.0'-15.0' Gray, stiff, sandy SILT, trace clay, iron staining.							
15	SM	15.0'-20.0' Gray, slightly sandy, dense SILT, trace clay, moist.	S-4	15.0'	SPT	7/14/21	35	22	P. L. = 22% L. L. = 28% P. I. = 6%

Drill Contractor: Geologic Drill
Equipment: Bobcat
Sampling Method: SPT
Driller: ARN

Excavation Date: 12/01/2014
ESC Representative: SEW

Log of Test Boring B-1

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam Tribe
Project Number: ESC014-G068

Boring Elevation: @ 60.0'
Boring Location: @ 20.0' north of Station 66 + 00
Depth to Groundwater: @ 20.0'

DEPTH (FT.)	USCS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	DEPTH (FEET)	SAMPLE TYPE	BLOW COUNTS PER 6 INCHES	N VALUE	RECOVERY (INCHES)	LAB TESTING RESULTS FOR SAMPLE
20	SP	20.0'-25.0' Gray, medium coarse, dense SAND, wet.	S-5	20.0'	SPT	15/20/20	40	30	Gravel = 0.0% Sand =88.3% Silt/Clay = 11.7%
25	SM	25.0'-30.0' Gray, dense, SANDY silt, trace organics, moist.	S-6	25.0'	SPT	13/18/25	43	30	
30	SM	30.0'-36.5' Gray, dense, SILT, moist, water in sampler	S-7	30.0'	SPT	12/16/24	40	30	
35			S-8	35.0'	SPT	13/18/24	42	16	
		TD: 36.5' Groundwater seepage: Approximately 15.0'-20.0' feet.							

Drill Contractor: Geologic Drill
Equipment: Bobcat
Sampling Method: SPT
Driller: ARN

Excavation Date: 12/01/2014
ESC Representative: SEW

Log of Test Boring B-2

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam Tribe
Project Number: ESC014-G068

Boring Elevation: @ 60.0'
Boring Location: @80.0' north of Station 64 + 00
Depth to Groundwater: @ 20.0'

DEPTH (FT.)	USCS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	DEPTH (FEET)	SAMPLE TYPE	BLOW COUNTS PER 6 INCHES	N VALUE	RECOVERY (INCHES)	LAB TESTING RESULTS FOR SAMPLE
0		0- 0.25' Forest duff							
	SM	0.25'-5.0' Tan, very loose, silty fine SAND, (Fill) moist.	S-1	1.5'	SPT	4/1/2	3	6	
5	SM	5.0'-10.0' Mottled, tan and gray, medium dense sandy SILT (Fill?). Scattered gravels, moist.	S-2	5.0'	SPT	4/8/18	26	22	
10	SM	10.0'-15.0' Gray, very dense slightly sandy SILT, moist, fractured, some crumbling, scattered gravels.	S-3	10.0'	SPT	13/19/34	53	24	
15	SP	15.0'-20.0' Gray, medium grained, medium dense SAND, wet, with iron staining, medium dense, mottled tan and gray sandy SILT in shoe.	S-4	15.0'	SPT	5/7/13	20	22	M.C.=15%

Drill Contractor: Geologic Drill
Equipment: Bobcat
Sampling Method: SPT
Driller: ARN

Excavation Date: 12/01/2014
ESC Representative: SEW

Log of Test Boring B-2

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam Tribe
Project Number: ESC014-G068

Boring Elevation: @ 60.0'
Boring Location: @ 80.0' north of Station 64 + 00.
Depth to Groundwater: @ 20.0'

DEPTH (FT.)	USCS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	DEPTH (FEET)	SAMPLE TYPE	BLOW COUNTS PER 6 INCHES	N VALUE	RECOVERY (INCHES)	LAB TESTING RESULTS FOR SAMPLE
20	SM	20.0'-25.0' Tan, medium dense, slightly sandy SILT, moist. Lower 7 inches Gray, sandy SILT, moist.	S-5	20.0'	SPT	7/12/12	24	24	Tan: P. L. = 20% L. L. = 39% P. I. = 19% Grey: P. L. = 21% L. L. = 48% P. I. = 27%
25	SM	25.0'-30.0' Gray, medium dense, slightly sandy SILT, moist, fractured, some crumbling, scattered gravels.	S-6	25.0'	SPT	6/7/13	20	24	
30	SM	30.0'-35.0' Upper 10" Gray, medium dense, SILT, Lower 14" Tan sandy SILT	S-7	30.0'	SPT	7/13/15	28	24	
35	SM	35.0'-36.5' Gray, dense, SILT, with gravels, wet.	S-8	35.0'	SPT	10/16/30	46	24	
		TD: 36.5' Groundwater seepage: Approximately 15.0'- 20.0' feet.							

Drill Contractor: Geologic Drill
Equipment: Bobcat
Sampling Method: SPT
Driller: ARN

Excavation Date: 12/01/2014
ESC Representative: SEW

TEST PIT TP- 1

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam
Project Number: ESC14-G068

Test Pit Elevation: @66.0'
Test Pit Location: @ 80' north of Station 63 + 00
Depth to Groundwater: Not Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.6" Forest duff, roots, rootlets, organic material				
	SM	0.6"-1.0' Tan, sandy SILT, dry.				
	SP	1.0'-3.0' Loose to medium dense, gravelly, medium grained SAND, slightly moist.	S-1	Grab	1.5'	
5	SP	3.0'-5.0' Medium dense to dense, gravelly, compact SAND, gravel content increasing with depth. Thin silt layer at 4.75'				
10		TD 5.0' Groundwater seepage: none encountered Minimal sloughing				
15						

Excavation Contractor: Bullseye Contractors
Excavation Equipment: Mini Trackhoe
Operator: Al

Excavation Date: 11/18/2014
ESC Representative: SEW
Page 1 of 1

TEST PIT TP- 2

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam
Project Number: ESC14-G068

Test Pit Elevation: @ 66.0'
Test Pit Location: @ 80' north of Station 70 + 00
Depth to Groundwater: Not Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.6" Grass, topsoil				
	SM	0.5"-1.5' Reddish tan, sandy SILT, moist with scattered roots, loose.	S-1	Grab	1.5'	
	SM	1.5'-2.5' Mottled tan and gray sandy SILT with trace clay, stiff.				
	SP	2.5'-5.0' Tan, medium grained SAND, compact, moist.	S-2	Grab	3.0'	
5		TD 5.0' Groundwater seepage: none encountered Minimal sloughing				
10						
15						

Excavation Contractor: Bullseye Contractors
Excavation Equipment: Mini Trackhoe
Operator: Al

Excavation Date: 11/18/2014
ESC Representative: SEW
Page 1 of 1

TEST PIT TP- 3

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam
Project Number: ESC14-G068

Test Pit Elevation: @ 77.0'
Test Pit Location: @ 25' north of Station 75 + 00
Depth to Groundwater: Not Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0	SM	0-0.6" Black, fine grained, sandy SILT, topsoil with scattered rootlets, moist.				
	SM	0.6"-2.0' Reddish tan, sandy SILT (fill), bunt embers, debris present (bottles, cans), loose.	S-1	Grab	1.5'	
	SC-SM	2.0'-3.5' Mottled, tan and gray sandy SILT-CLAY, moist, stiff.	S-2	Grab	2.5'	M.C = 17% P.L. = 5.0% L.L. = 21% P.L. = 16% 44% passing 75 micron
	SP	3.5'-4.5'- Cemented, gray, silty SAND, trace gravel, dense.				
5		TD 4.5' Groundwater seepage: none encountered Minimal sloughing				
10						
15						

Excavation Contractor: Bullseye Contractors
Excavation Equipment: Mini Trackhoe
Operator: Al

Excavation Date: 11/18/2014
ESC Representative: SEW

TEST PIT TP- 4

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam
Project Number: ESC14-G068

Test Pit Elevation: @ 86.0'
Test Pit Location: @ 50.0' north of Station 79 + 00
Depth to Groundwater: Not Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0	SM	0-0.6" Black, sandy SILT with roots, rootlets.				
	SM	0.6"-1.5' Gray, sandy SILT, moist, medium dense.	S-1	Grab	1.0'	
	SP	1.5'-2.5' Weathered, gray cemented silty SAND, moist, dense.				
5	SP	2.5'-6.5' Gray cemented, silty SAND, slightly moist, very dense.				
10		TD 6.5' Groundwater seepage: none encountered Minimal sloughing				
15						

Excavation Contractor: Bullseye Contractors
Excavation Equipment: Mini Trackhoe
Operator: Al

Excavation Date: 11/18/2014
ESC Representative: SEW
Page 1 of 1

TEST PIT TP- 5

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam
Project Number: ESC14-G068

Test Pit Elevation: @58.0'
Test Pit Location: Station 84 + 00
Depth to Groundwater: Not Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0	SM	0-0.6" Black, sandy SILT, topsoil with small to large scattered roots.				
	SM	0.6"-4.0' Mottled, tan and gray silty SAND, scattered large cobbles, soil compact at 2.0, moist with rootlets, loose to medium dense.	S-1	Grab	1.5'	20% passing 75 micron
5	SP	4.0'-4.5' Weathered, gray, cemented silty SAND, dense.				
		TD 4.5' Groundwater seepage: none encountered Minimal sloughing				
10						
15						

Excavation Contractor: Bullseye Contractors
Excavation Equipment: Mini Trackhoe
Operator: Al

Excavation Date: 11/18/2014
ESC Representative: SEW
Page 1 of 1

TEST PIT TP- 6

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam
Project Number: ESC14-G068

Test Pit Elevation: @ 46.0'
Test Pit Location: @ 30' north of Station 88 + 00
Depth to Groundwater: Not Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.6" Black topsoil with large roots in upper 1.5'				
	SM	0.6"-1.5' Reddish tan, sandy SILT, moist with scattered gravels, loose.				
	SP	1.5'- 4.0' Mottled, tan and gray silty SAND, moist with scattered gravels, loose to medium dense.				
5	SM	4.0'-6.5' Mottled, tan and gray sandy SILT, moist, medium dense.	S-1	Grab	5.0'	
10		TD 6.5' Groundwater seepage: none encountered Minimal sloughing				
15						

Excavation Contractor: Bullseye Contractors
Excavation Equipment: Mini Trackhoe
Operator: Al

Excavation Date: 11/18/2014
ESC Representative: SEW
Page 1 of 1

TEST PIT TP- 7

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam
Project Number: ESC14-G068

Test Pit Elevation: @ 48'
Test Pit Location: @ 75' north of Station 92 + 00
Depth to Groundwater: Not Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0	SM	0-0.6" Dark brown, sandy SILT, moist with scattered roots.				
	SM	0.6"-3.0' Reddish tan, sandy SILT (fill), embers and debris (bottled) present, scattered gravels, moist, loose.				
	SM	3.0'-4.5' Mottled tan and gray silty SAND, moist, medium dense.				
5	SM	4.5'-5.5' Mottled, tan and gray sandy CLAY, moist, medium dense.				
	SM	5.5'-6.5' Mottled, weathered tan and gray silty SAND, moist, medium dense.				
	SM	6.5'-7.5' Gray, silty SAND, moist, medium dense.				
10		TD 7.5' Groundwater seepage: none encountered Minimal sloughing				
15						

Excavation Contractor: Bullseye Contractors
Excavation Equipment: Mini Trackhoe
Operator: Al

Excavation Date: 11/18/2014
ESC Representative: SEW

TEST PIT TP- 8

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam
Project Number: ESC14-G068

Test Pit Elevation: @ 51.0'
Test Pit Location: Station 97 + 00
Depth to Groundwater: Not Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.6" Dark brown, sandy SILT, topsoil, moist with small to mid sized roots in upper 1.0'.				
	SM	0.6"-3.0' Tan, sandy SILT, slightly compact, moist.	S-1	Grab	1.0'	
	SM	3.0'-4.0' Mottled, tan and gray sandy SILT, moist, slightly compact.	S-2	Grab	3.0'	Sand = 33.3% Silt/Clay = 66.7% Gravel = 0.0%
5	SM	4.0'-5.5' Mottled, interlayered tan and gray silty SAND and medium dense, stiff, sandy SILT, moist.				
10		TD 5.5' Groundwater seepage: none encountered Minimal sloughing				
15						

Excavation Contractor: Bullseye Contractors
Excavation Equipment: Mini Trackhoe
Operator: Al

Excavation Date: 11/18/2014
ESC Representative: SEW
Page 1 of 1

TEST PIT TP- 9

Project Name: Little Boston Trail
Client: Port Gamble S'Klallam
Project Number: ESC14-G068

Test Pit Elevation: @ 62.0'
Test Pit Location: @ 50 north of Station 101 + 00
Depth to Groundwater: Not Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0	SM	0-0.6" Black, sandy SILT topsoil.				
	SM	0.6"-1.5' Tan, silty SAND.	S-1	Grab	1.0'	
	SM	1.5'-3.0' Tan, silty SAND with scattered roots, moist, loose to medium dense.				
5	SM	3.0'-5.0' Tan, slightly silty medium SAND, moist, medium dense.	S-2	Grab	3.5'	Sand = 93.4% Silt/Clay = 6.6% Gravel = 0.0%
10		TD 5.0' Groundwater seepage: none encountered Minimal sloughing				
15						

Excavation Contractor: Bullseye Contractors
Excavation Equipment: Mini Trackhoe
Operator: Al

Excavation Date: 11/18/2014
ESC Representative: SEW
Page 1 of 1

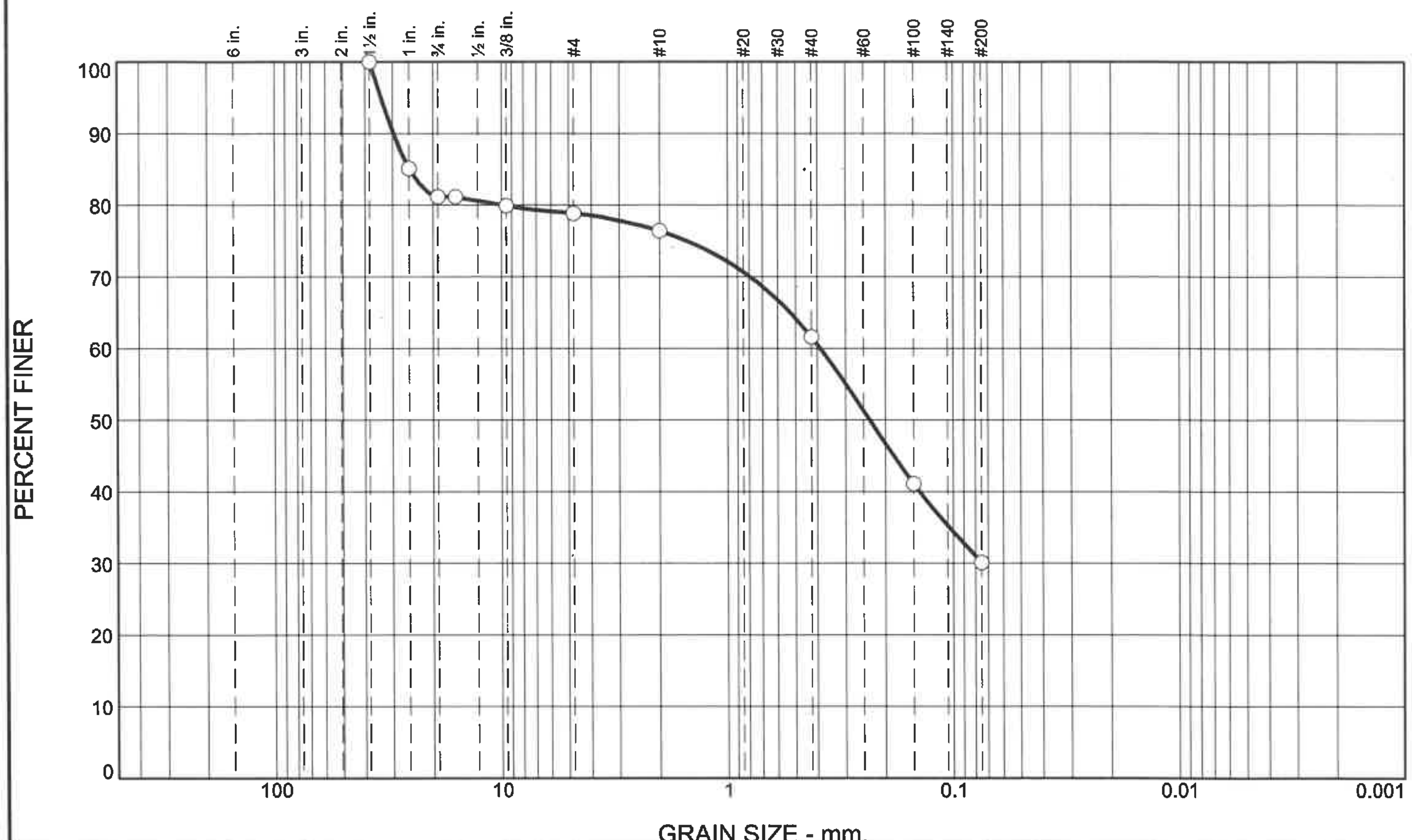
APPENDIX B

Geotechnical Laboratory Analysis Results

B. Geotechnical Laboratory Analysis Results

Aspect subcontracted Hayre McElroy and Associates, LLC to conduct laboratory tests on selected soil samples to characterize certain engineering (physical) properties of the Site soils. Laboratory testing included determination of natural moisture content, Atterberg Limits, grain-size distribution, and fines content in accordance with ASTM test methods D2216, D4318, D6913, and D1140. The results of the laboratory tests are presented in this appendix; moisture content and Atterberg Limit results are also presented graphically on the boring logs in Appendix A. The results of the grain-size distribution tests are presented as curves in this appendix, plotting percent finer by weight versus grain size.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	18.8	2.3	2.5	14.8	31.5	30.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	85.1		
3/4"	81.2		
5/8"	81.2		
3/8"	79.9		
#4	78.9		
#10	76.4		
#40	61.6		
#100	41.1		
#200	30.1		

* (no specification provided)

Soil Description

Silty SAND with gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 29.7360 D_{85}= 25.2789 D_{60}= 0.3882

D_{50}= 0.2348 D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: ATP-01 / S-2 **Depth:** 4.5

Sample Number: 8611

Date: 1/16/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting

Project: Port Gamble Sklallam Tribe

Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-01 / S-2
Depth: 4.5 **Sample Number:** 8611
Material Description: Silty SAND with gravel
Date: 1/16/23
USCS Classification: SM
Tested by: AD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 320.90
Tare Wt. = 12.90
Minus #200 from wash = 28.3%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
442.30	12.90	0.00	1.5"	0.00	100.0
			1"	63.90	85.1
			3/4"	80.80	81.2
			5/8"	80.80	81.2
			3/8"	86.10	79.9
			#4	90.80	78.9
			#10	101.30	76.4
			#40	164.90	61.6
			#100	252.90	41.1
			#200	300.10	30.1

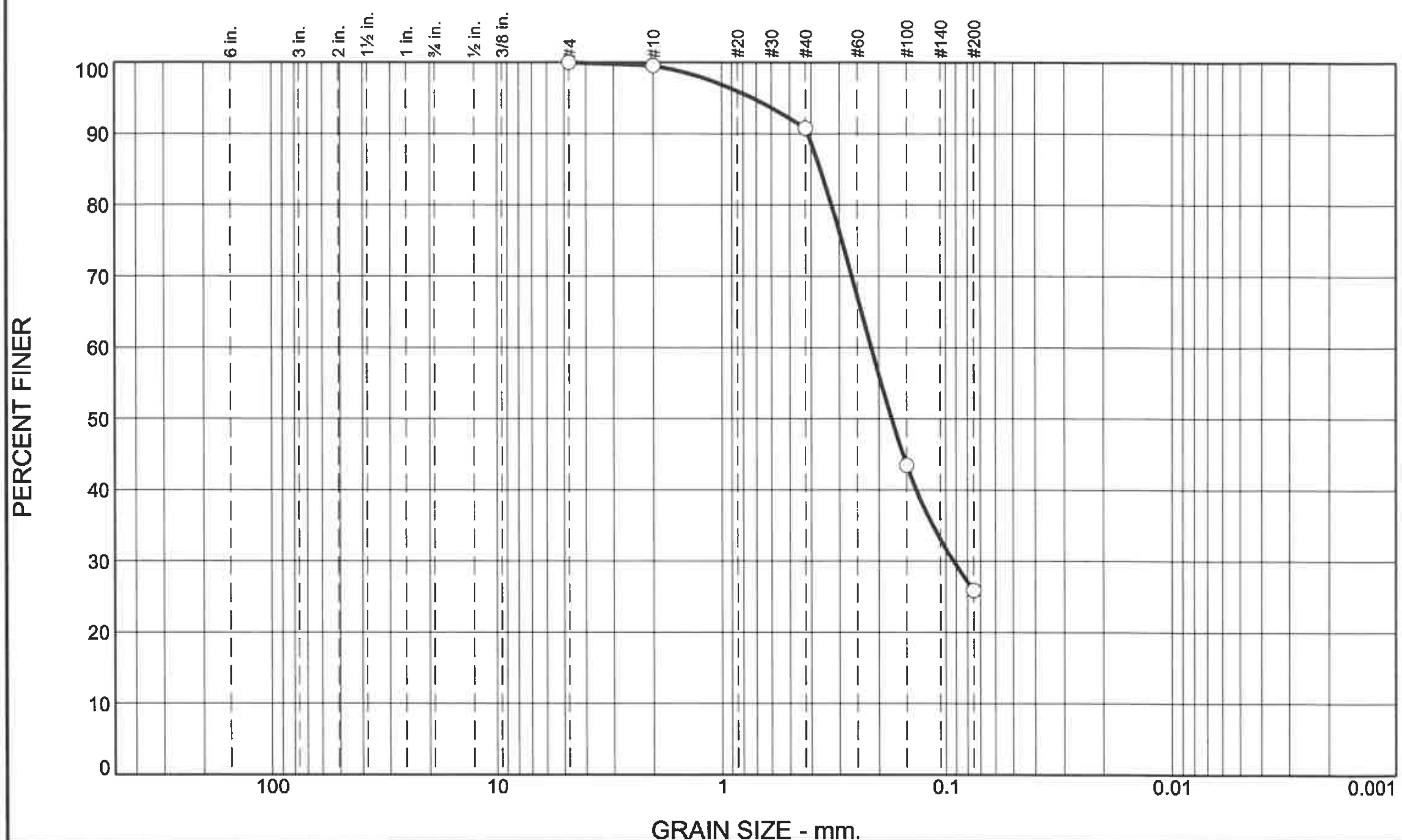
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	18.8	2.3	21.1	2.5	14.8	31.5	48.8			30.1

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
					0.1411	0.2348	0.3882	9.7629	25.2789	29.7360	33.8257

Fineness Modulus
2.47

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	8.8	64.9	25.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.6		
#40	90.8		
#100	43.4		
#200	25.9		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4149 D_{85}= 0.3644 D_{60}= 0.2169
D_{50}= 0.1758 D_{30}= 0.0924 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: ATP-01 / S-3 **Depth:** 7
Sample Number: 8611
Date: 1/16/23

Hayre McElroy & Associates, LLC
Redmond, WA

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-01 / S-3
Depth: 7 **Sample Number:** 8611
Material Description: Silty SAND
Date: 1/16/23
USCS Classification: SM
Tested by: AD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 417.20
Tare Wt. = 16.00
Minus #200 from wash = 23.0%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
537.10	16.00	0.00	#4	0.00	100.0
			#10	2.10	99.6
			#40	47.80	90.8
			#100	294.70	43.4
			#200	386.20	25.9

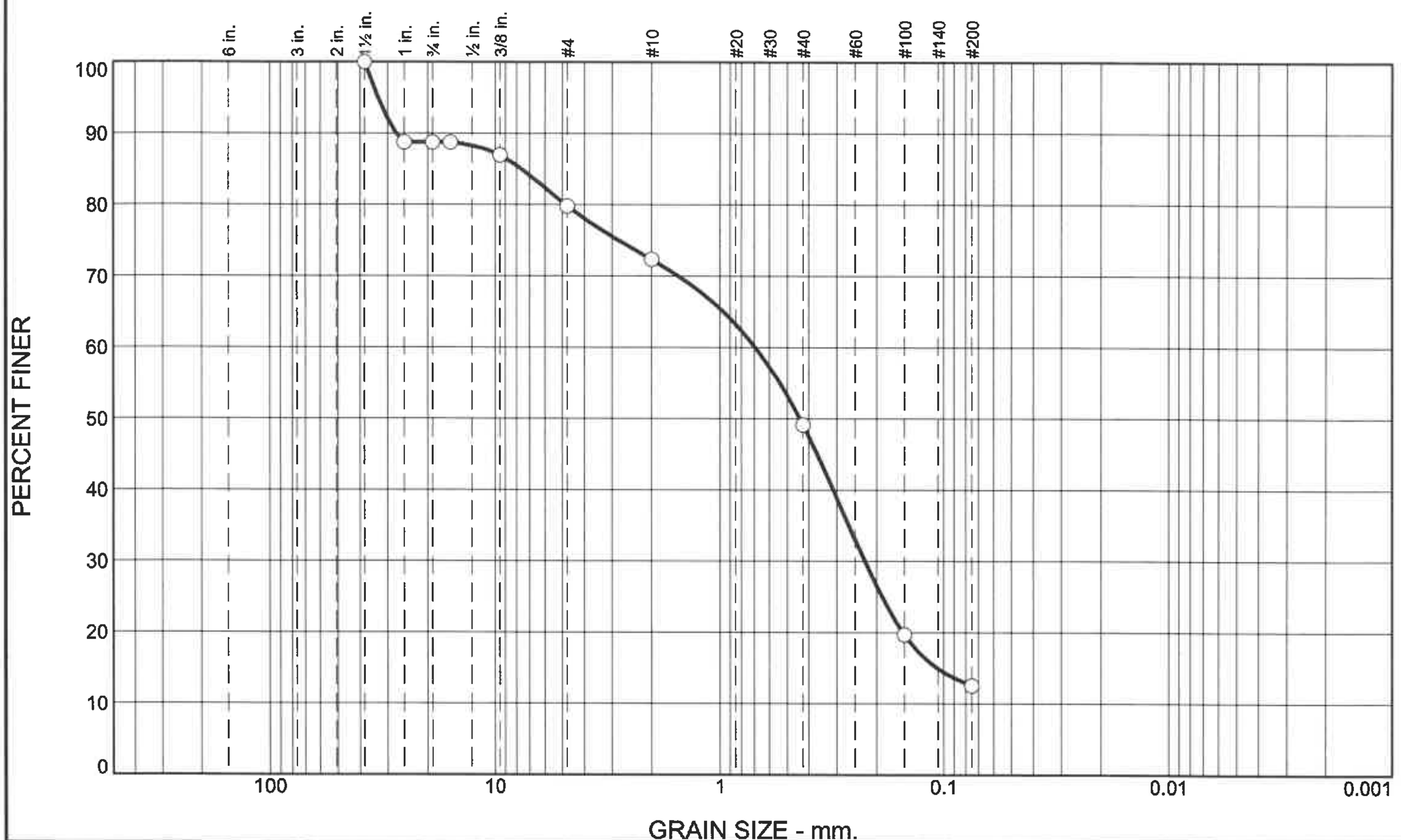
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.4	8.8	64.9	74.1			25.9

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0924	0.1360	0.1758	0.2169	0.3252	0.3644	0.4149	0.7231

Fineness Modulus
0.89

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.3	8.9	7.4	23.2	36.7	12.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	88.7		
3/4"	88.7		
5/8"	88.7		
3/8"	86.9		
#4	79.8		
#10	72.4		
#40	49.2		
#100	19.7		
#200	12.5		

* (no specification provided)

Soil Description

Silty SAND with gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 27.5707 D_{85}= 7.6094 D_{60}= 0.6940
D_{50}= 0.4387 D_{30}= 0.2260 D_{15}= 0.1064
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: ATP-02 / S-1 **Depth:** 3
Sample Number: 8611

Date: 1/16/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-02 / S-1
Depth: 3
Sample Number: 8611
Material Description: Silty SAND with gravel
Date: 1/16/23
USCS Classification: SM
Tested by: AD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 629.90
Tare Wt. = 16.00
Minus #200 from wash = 11.6%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
710.60	16.00	0.00	1.5"	0.00	100.0
			1"	78.20	88.7
			3/4"	78.20	88.7
			5/8"	78.20	88.7
			3/8"	90.70	86.9
			#4	140.20	79.8
			#10	192.00	72.4
			#40	353.20	49.2
			#100	557.90	19.7
			#200	607.60	12.5

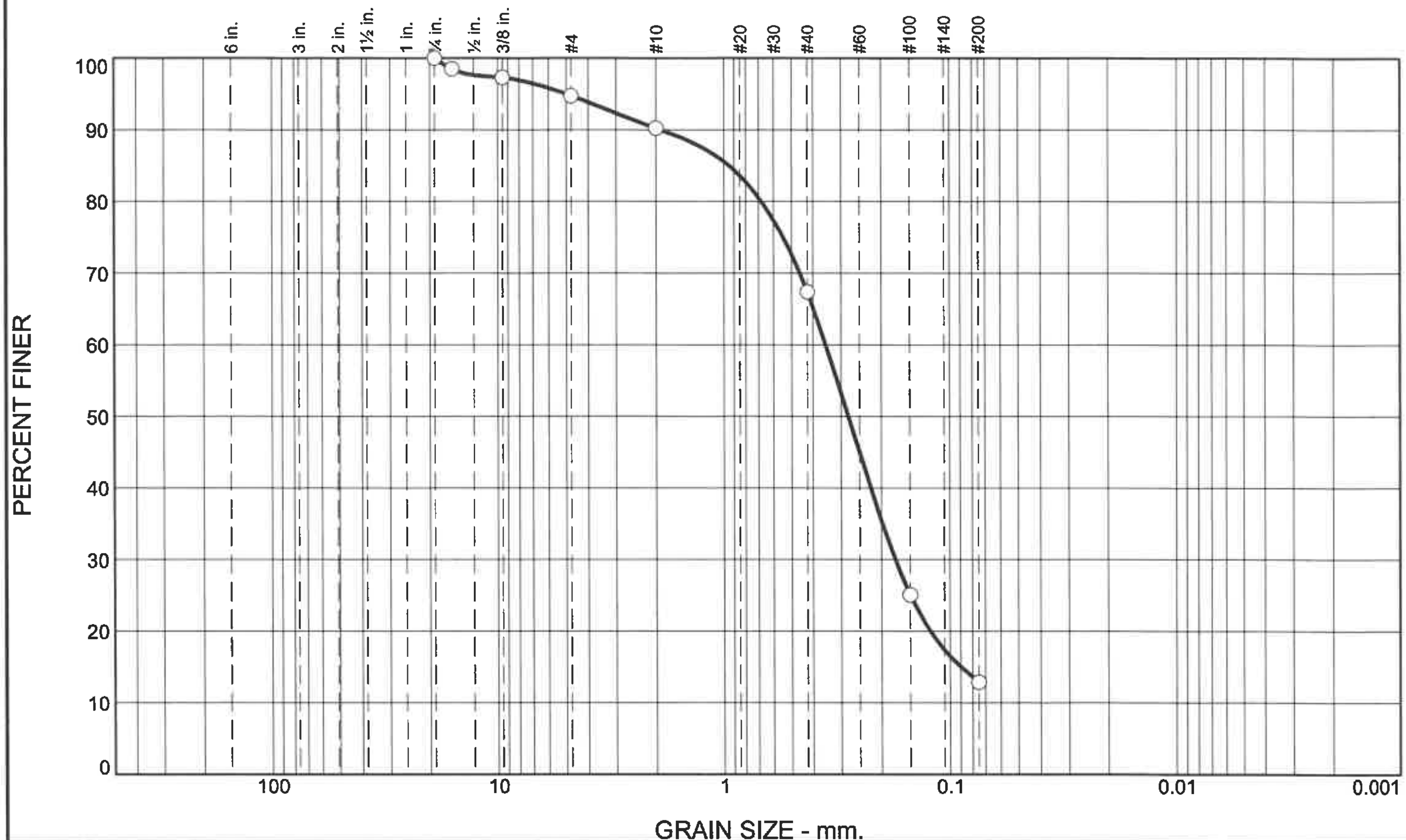
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	11.3	8.9	20.2	7.4	23.2	36.7	67.3			12.5

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.1064	0.1525	0.2260	0.3121	0.4387	0.6940	4.8331	7.6094	27.5707	33.0782

Fineness Modulus
2.88

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.2	4.6	22.8	54.5	12.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
5/8"	98.5		
3/8"	97.3		
#4	94.8		
#10	90.2		
#40	67.4		
#100	25.1		
#200	12.9		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.9039 D_{85}= 0.9451 D_{60}= 0.3515
D_{50}= 0.2794 D_{30}= 0.1740 D_{15}= 0.0895
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: ATP-02 / S-2 **Depth:** 6.5
Sample Number: 8611
Date: 1/16/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-02 / S-2
Depth: 6.5
Sample Number: 8611
Material Description: Silty SAND
Date: 1/16/23
USCS Classification: SM
Tested by: AD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 514.90
Tare Wt. = 12.60
Minus #200 from wash = 11.6%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
580.50	12.60	0.00	3/4"	0.00	100.0
			5/8"	8.50	98.5
			3/8"	15.20	97.3
			#4	29.70	94.8
			#10	55.40	90.2
			#40	185.30	67.4
			#100	425.50	25.1
			#200	494.70	12.9

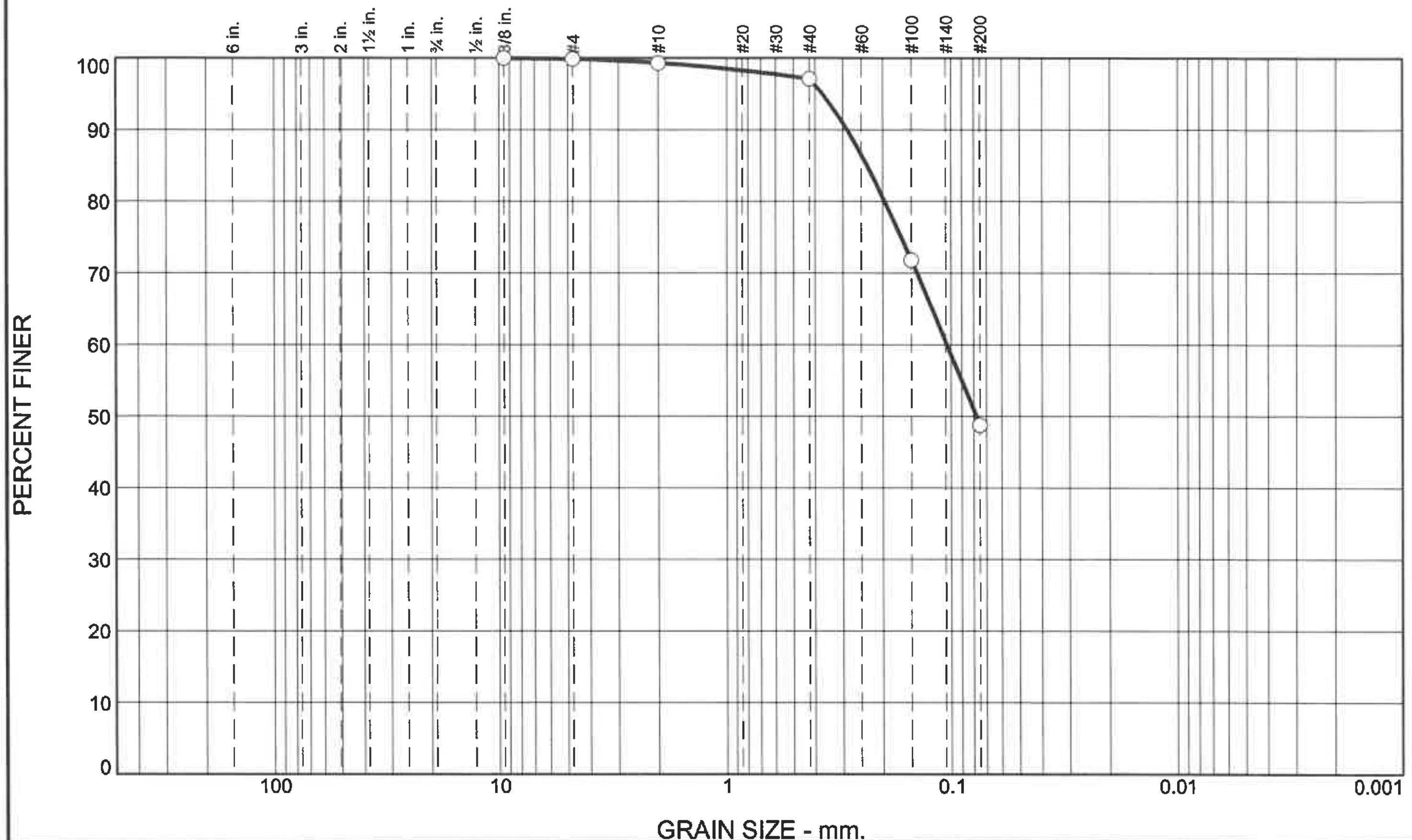
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	5.2	5.2	4.6	22.8	54.5	81.9			12.9

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0895	0.1223	0.1740	0.2231	0.2794	0.3515	0.6799	0.9451	1.9039	4.9729

Fineness Modulus
1.74

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.6	2.2	48.3	48.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100.0		
#4	99.9		
#10	99.3		
#40	97.1		
#100	71.8		
#200	48.8		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2882 D_{85}= 0.2352 D_{60}= 0.1045
D_{50}= 0.0778 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: ATP-03 / S-1 **Depth:** 3
Sample Number: 8611 **Date:** 1/16/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-03 / S-1
Depth: 3 **Sample Number:** 8611
Material Description: Silty SAND
Date: 1/16/23
USCS Classification: SM
Tested by: AD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 294.70
Tare Wt. = 12.70
Minus #200 from wash = 42.7%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
505.20	12.70	0.00	3/8"	0.00	100.0
			#4	0.60	99.9
			#10	3.30	99.3
			#40	14.20	97.1
			#100	138.80	71.8
			#200	252.40	48.8

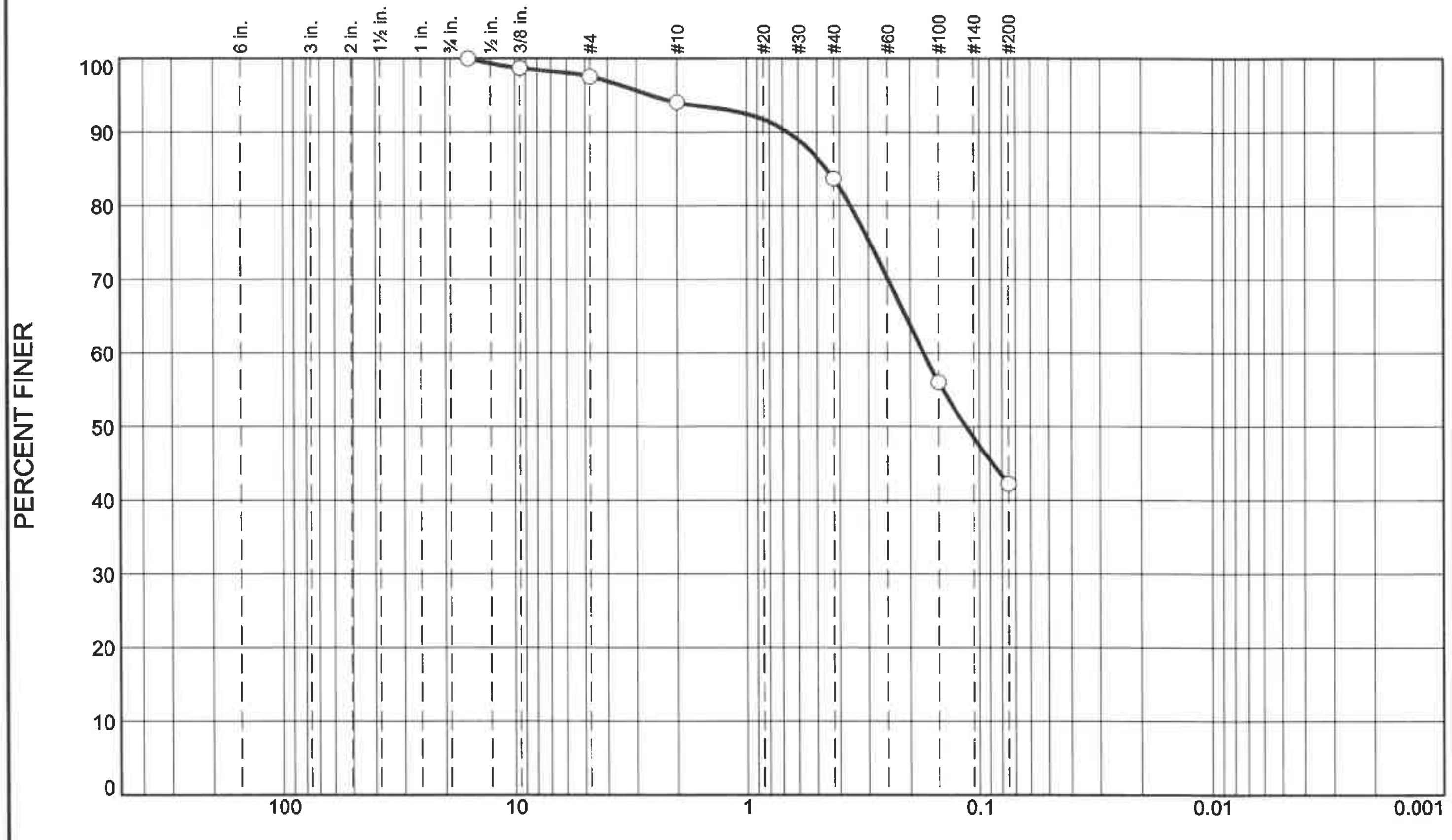
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.1	0.1	0.6	2.2	48.3	51.1			48.8

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.0778	0.1045	0.1964	0.2352	0.2882	0.3701

Fineness Modulus
0.41

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.5	3.4	10.4	41.4	42.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
5/8"	100.0		
3/8"	98.7		
#4	97.5		
#10	94.1		
#40	83.7		
#100	56.0		
#200	42.3		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6626 D_{85}= 0.4550 D_{60}= 0.1747
D_{50}= 0.1142 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: ATP-04 / S-3 **Depth:** 6
Sample Number: 8611
Date: 1/16/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-04 / S-3
Depth: 6
Sample Number: 8611
Material Description: Silty SAND
Date: 1/16/23
USCS Classification: SM
Tested by: AD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 354.30
Tare Wt. = 12.70
Minus #200 from wash = 39.2%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
574.40	12.70	0.00	5/8"	0.00	100.0
			3/8"	7.40	98.7
			#4	13.80	97.5
			#10	33.40	94.1
			#40	91.50	83.7
			#100	246.90	56.0
			#200	324.30	42.3

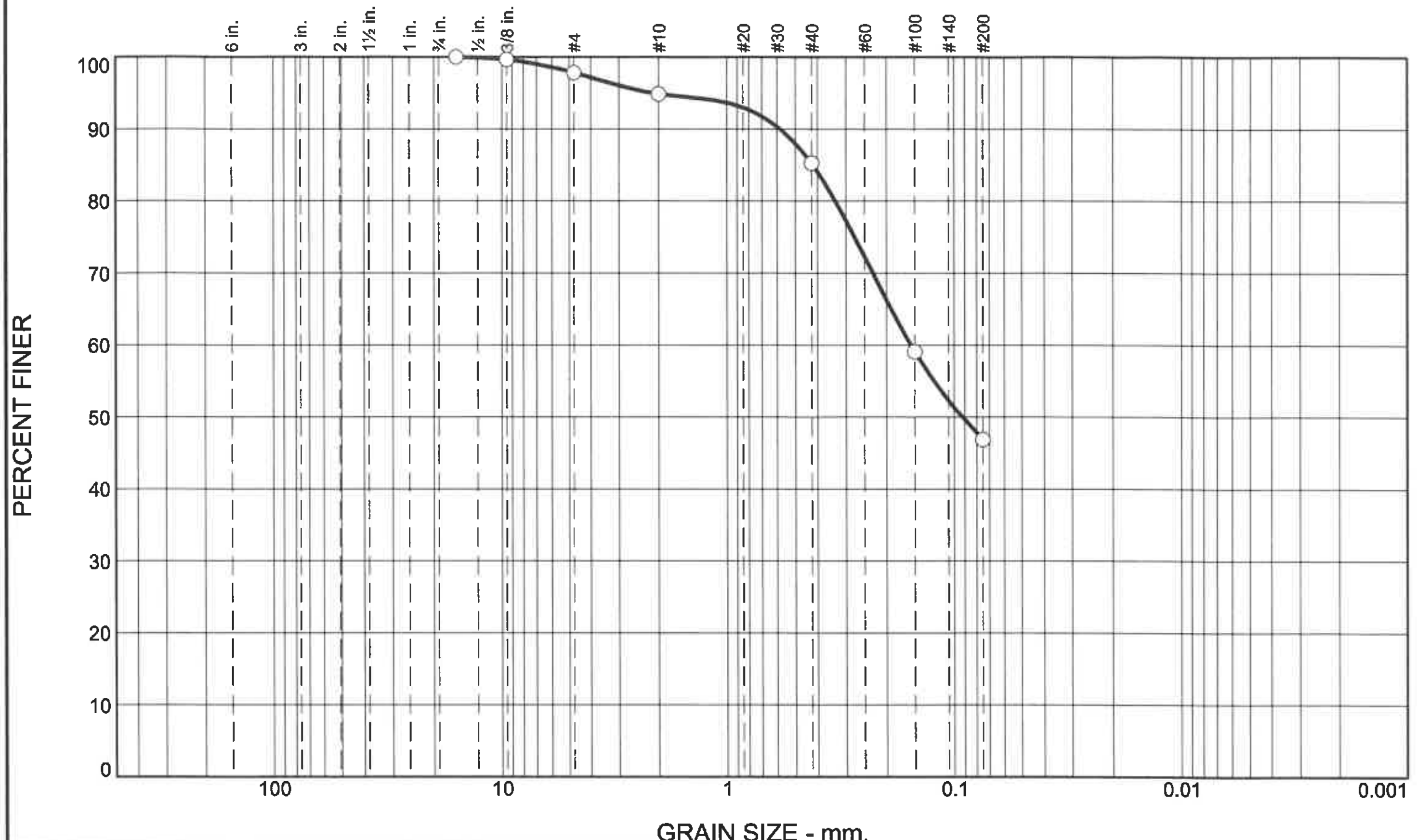
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	2.5	2.5	3.4	10.4	41.4	55.2			42.3

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.1142	0.1747	0.3594	0.4550	0.6626	2.5757

Fineness Modulus
0.96

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.2	2.9	9.6	38.4	46.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
5/8"	100.0		
3/8"	99.7		
#4	97.8		
#10	94.9		
#40	85.3		
#100	59.1		
#200	46.9		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5803 D_{85}= 0.4189 D_{60}= 0.1562
D_{50}= 0.0919 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: ATP-05 / S-1 **Depth:** 3.5
Sample Number: 8611

Date: 1/16/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe

Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-05 / S-1
Depth: 3.5
Sample Number: 8611
Material Description: Silty SAND
Date: 1/16/23
USCS Classification: SM
Tested by: AD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 304.00
Tare Wt. = 16.10
Minus #200 from wash = 44.5%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
534.50	16.10	0.00	5/8"	0.00	100.0
			3/8"	1.80	99.7
			#4	11.20	97.8
			#10	26.50	94.9
			#40	76.30	85.3
			#100	212.20	59.1
			#200	275.30	46.9

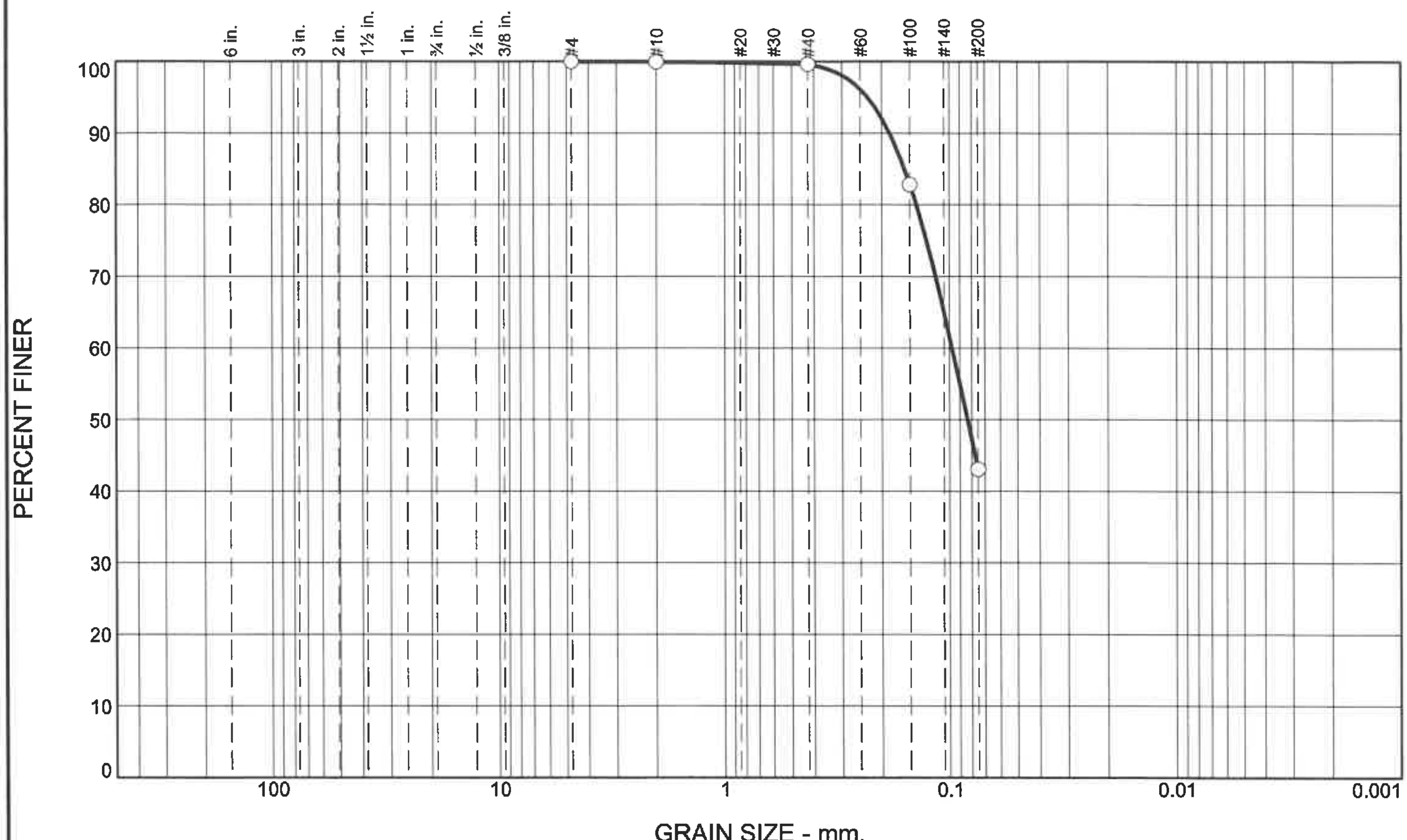
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	2.2	2.2	2.9	9.6	38.4	50.9			46.9

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.0919	0.1562	0.3346	0.4189	0.5803	2.1057

Fineness Modulus
0.86

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.4	56.5	43.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#40	99.6		
#100	82.9		
#200	43.1		

* (no specification provided)

Soil Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1846 D_{85}= 0.1584 D_{60}= 0.0976
D_{50}= 0.0834 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: ATP-11 / S-3 **Depth:** 6
Sample Number: 8611
Date: 1/16/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-11 / S-3
Depth: 6
Sample Number: 8611
Material Description: Silty SAND
Date: 1/16/23
USCS Classification: SM
Tested by: AD
Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 347.10
Tare Wt. = 16.10
Minus #200 from wash = 31.0%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
495.50	16.10	0.00	#4	0.00	100.0
			#10	0.20	100.0
			#40	1.80	99.6
			#100	82.20	82.9
			#200	272.90	43.1

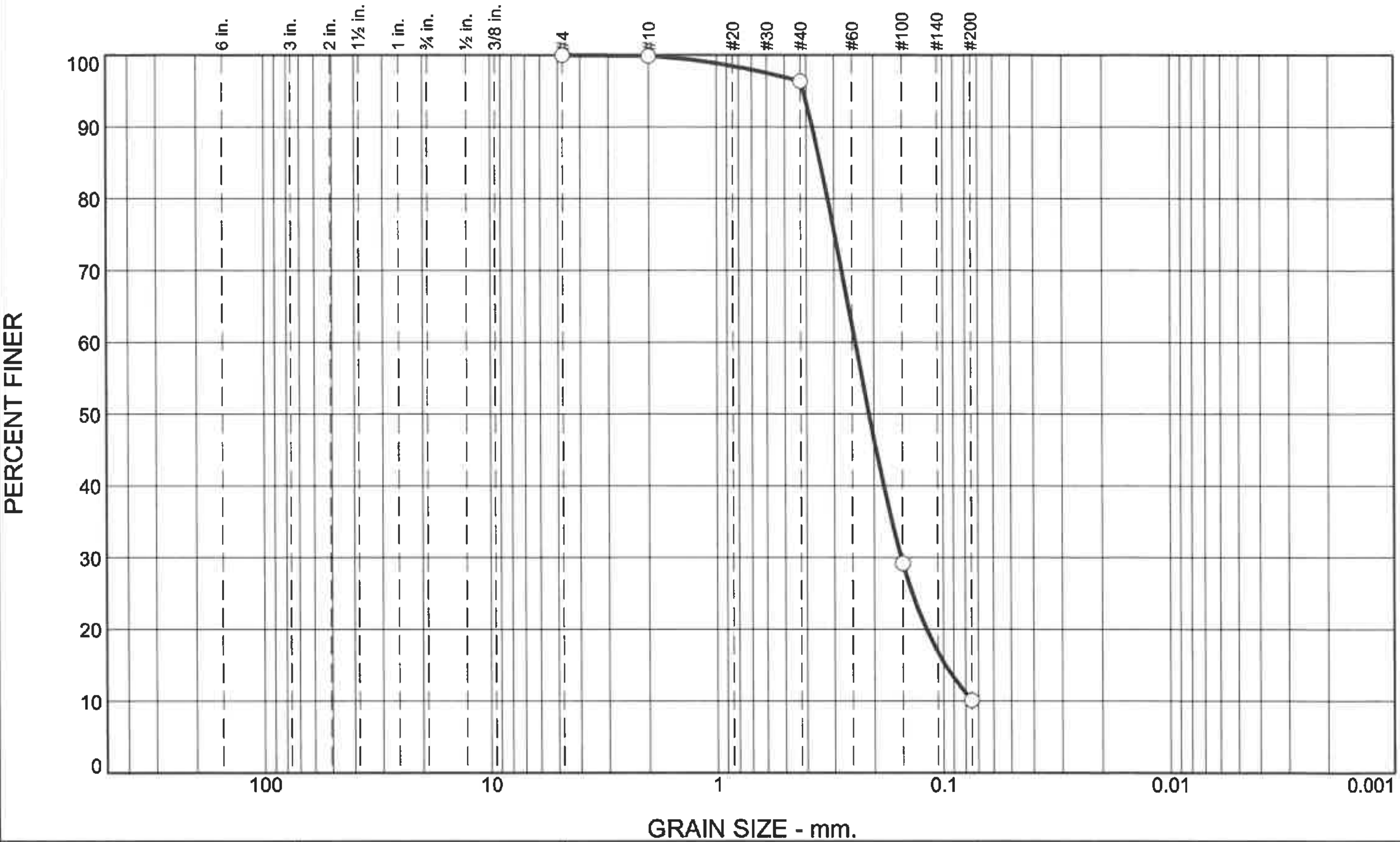
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.4	56.5	56.9			43.1

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.0834	0.0976	0.1405	0.1584	0.1846	0.2314

Fineness Modulus
0.19

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	3.5	86.3	10.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#40	96.4		
#100	29.2		
#200	10.1		

* (no specification provided)

Soil Description

Poorly graded SAND with silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3758 D_{85}= 0.3457 D_{60}= 0.2417
D_{50}= 0.2103 D_{30}= 0.1525 D_{15}= 0.0980
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Source of Sample: ATP-12 / S-1 **Depth:** 2
Sample Number: 8611 **Date:** 1/16/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-12 / S-1
Depth: 2 **Sample Number:** 8611
Material Description: Poorly graded SAND with silt
Date: 1/16/23
USCS Classification: SP-SM
Tested by: AD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 515.30
Tare Wt. = 12.80
Minus #200 from wash = 8.8%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
563.80	12.80	0.00	#4	0.00	100.0
			#10	0.50	99.9
			#40	19.90	96.4
			#100	390.20	29.2
			#200	495.30	10.1

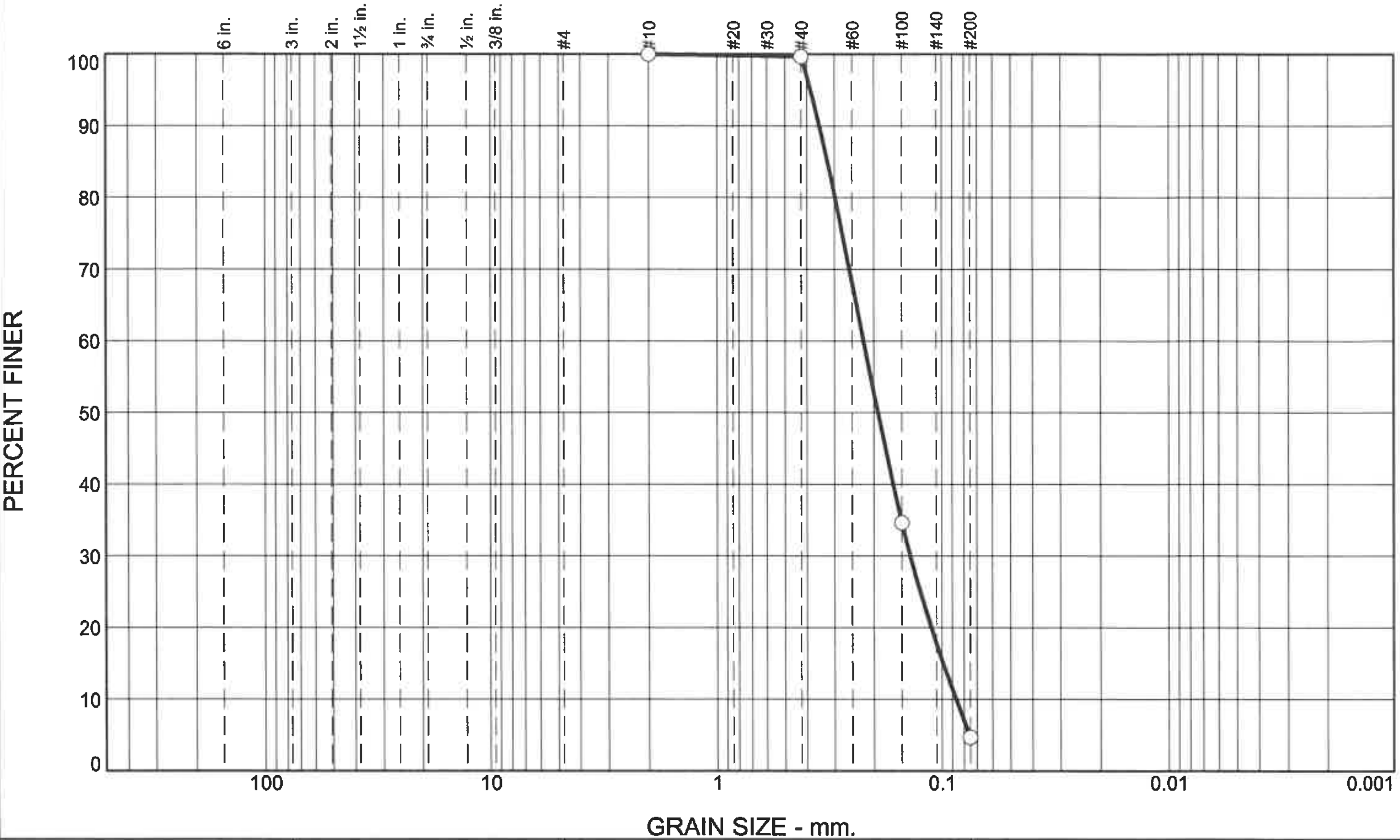
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.1	3.5	86.3	89.9			10.1

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0980	0.1189	0.1525	0.1813	0.2103	0.2417	0.3202	0.3457	0.3758	0.4128

Fineness Modulus
0.99

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	95.0	4.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.7		
#100	34.6		
#200	4.7		

* (no specification provided)

Soil Description

Poorly graded SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3511 D_{85}= 0.3227 D_{60}= 0.2221
D_{50}= 0.1918 D_{30}= 0.1378 D_{15}= 0.0988
D_{10}= 0.0867 C_u= 2.56 C_c= 0.99

Classification

USCS= SP AASHTO=

Remarks

Source of Sample: ATP-13 / S-3 **Depth:** 6.5
Sample Number: 8611 **Date:** 1/16/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project No: 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-13 / S-3
Depth: 6.5 **Sample Number:** 8611
Material Description: Poorly graded SAND
Date: 1/16/23
USCS Classification: SP
Tested by: AD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 513.50
Tare Wt. = 15.90
Minus #200 from wash = 3.6%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
532.10	15.90	0.00	#10	0.00	100.0
			#40	1.60	99.7
			#100	337.50	34.6
			#200	492.00	4.7

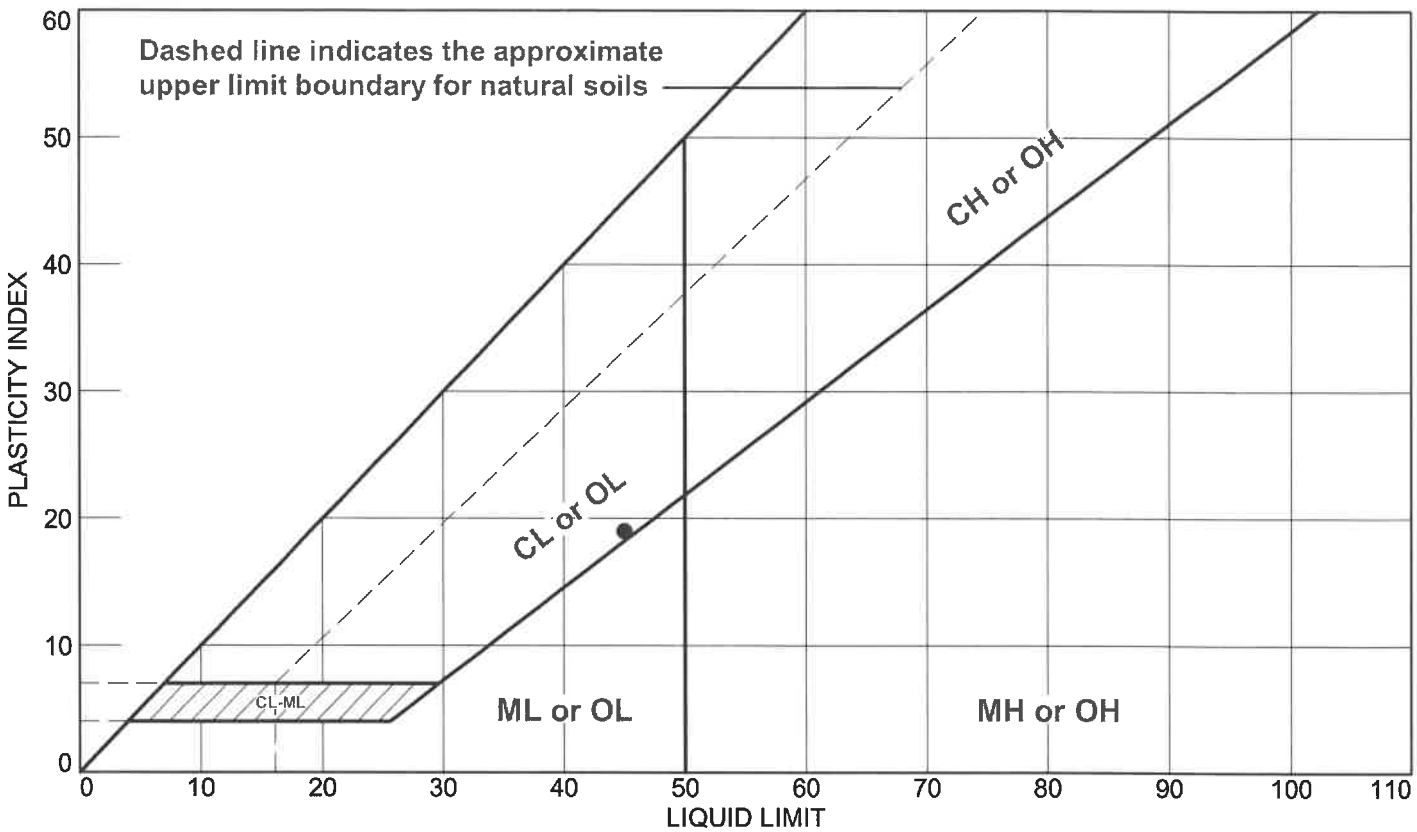
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.3	95.0	95.3			4.7

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0756	0.0867	0.0988	0.1115	0.1378	0.1643	0.1918	0.2221	0.2981	0.3227	0.3511	0.3850

Fineness Modulus	C_u	C_c
0.85	2.56	0.99

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	ATP-06 / S-1	8611	3	26.1	26	45	19	0.0	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Aspect Consulting **Project:** Port Gamble Sklallam Tribe **Project No.:** 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

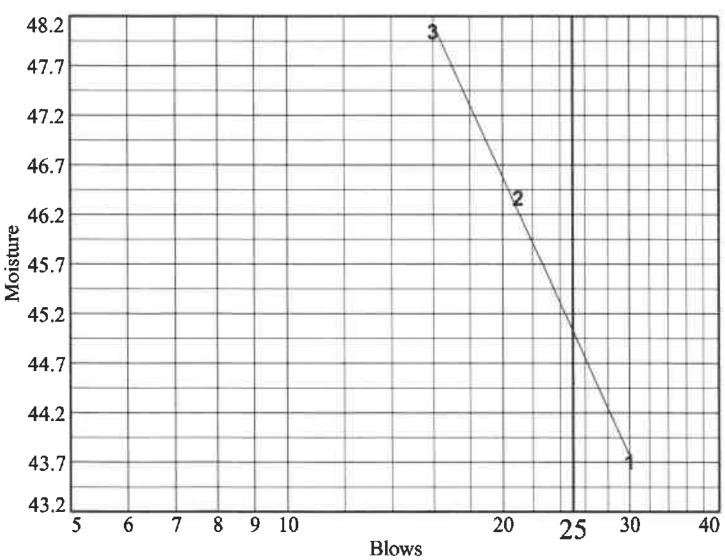
LIQUID AND PLASTIC LIMIT TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-06 / S-1
Depth: 3
Sample Number: 8611
Material Description: Lean CLAY
USCS: CL
Tested by: AD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	29.84	28.43	28.48			
Dry+Tare	24.87	23.77	23.67			
Tare	13.50	13.72	13.66			
# Blows	30	21	16			
Moisture	43.7	46.4	48.1			



Liquid Limit= 45
Plastic Limit= 26
Plasticity Index= 19
Natural Moisture= 26.1
Liquidity Index= 0.0

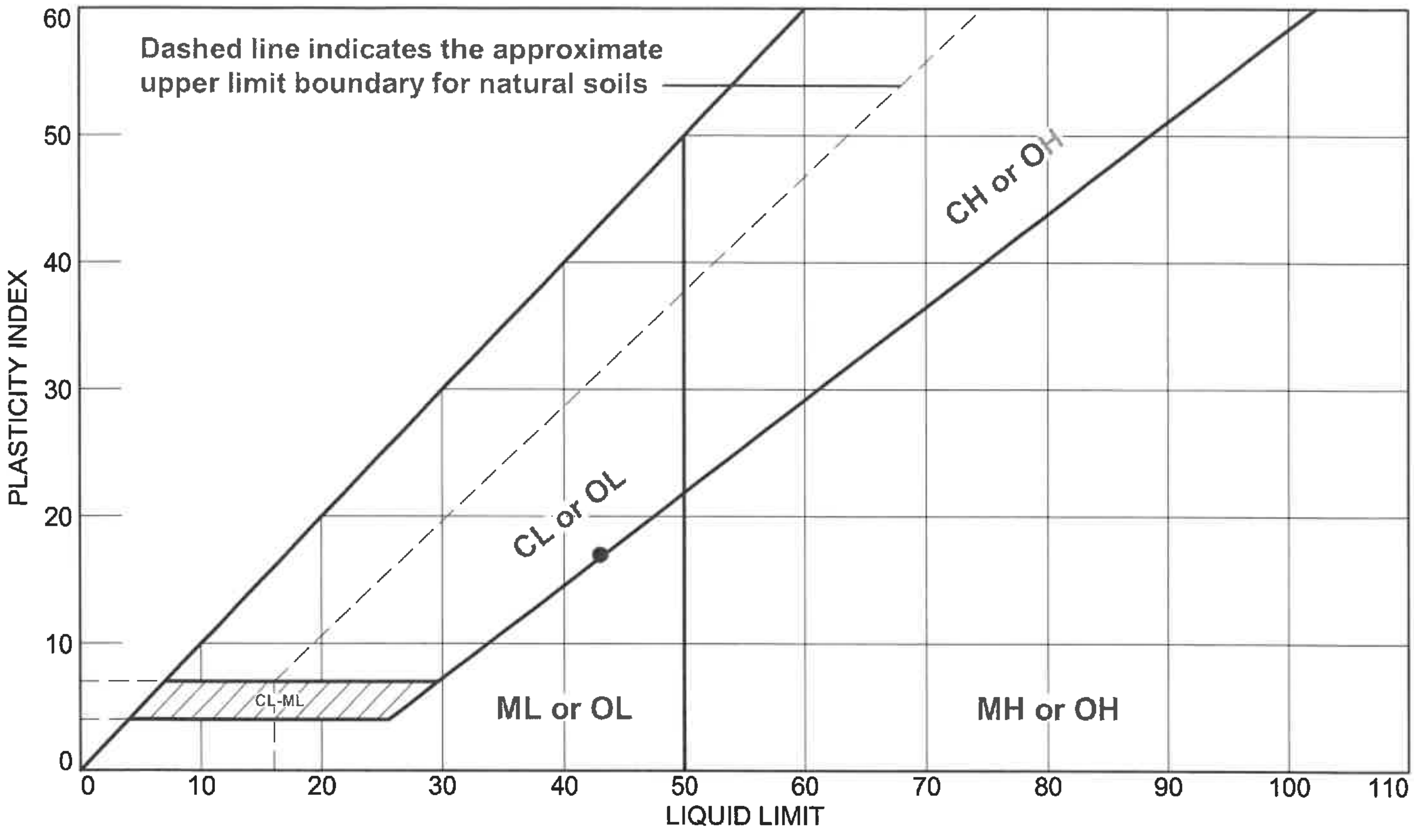
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	19.30				
Dry+Tare	18.15				
Tare	13.72				
Moisture	26.0				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
436.2	348.5	13	26.1

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	ATP-09 / S-1	8611	3	23.3	26	43	17	-0.2	CL

Hayre McElroy & Associates, LLC **Redmond, WA**	**Client:** Aspect Consulting **Project:** Port Gamble Sklallam Tribe **Project No.:** 08-175 / 220389 **Figure**

Tested By: AD **Checked By:** JAM

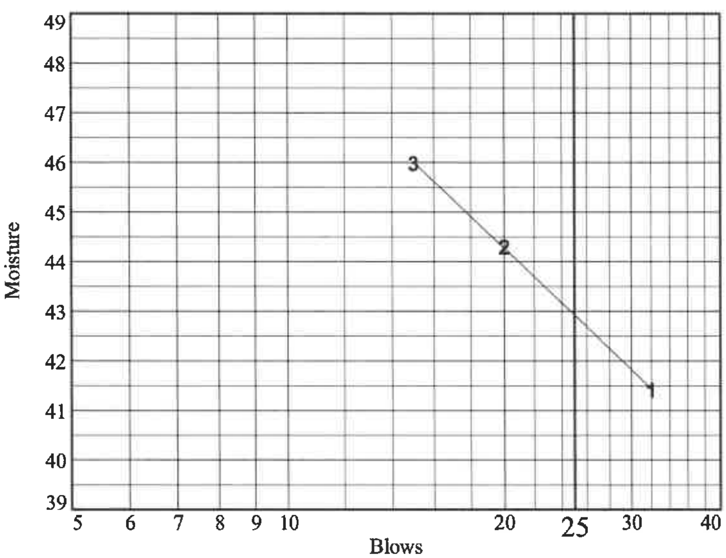
LIQUID AND PLASTIC LIMIT TEST DATA

1/17/2023

Client: Aspect Consulting
Project: Port Gamble Sklallam Tribe
Project Number: 08-175 / 220389
Location: ATP-09 / S-1
Depth: 3
Sample Number: 8611
Material Description: Lean CLAY
USCS: CL
Tested by: AD
Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	26.44	25.97	28.15			
Dry+Tare	21.95	21.42	22.82			
Tare	11.11	11.15	11.23			
# Blows	32	20	15			
Moisture	41.4	44.3	46.0			



Liquid Limit= 43
Plastic Limit= 26
Plasticity Index= 17
Natural Moisture= 23.3
Liquidity Index= -0.2

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.39				
Dry+Tare	19.79				
Tare	13.71				
Moisture	26.3				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
423.5	346	12.7	23.3

hayremcelroy & associates, llc

9644 153rd Ave NE
Redmond, WA 98052
425.869.6750

Moisture Content

ASTM D-2216

Project Number: 08-175 / 220389
Project Name: Port Gamble Sklallam Tribe
Lab Number: 8611

Received Date: 1/6/2023
Start Date: 1/9/2023
Finish Date: 1/16/2023
Technician: AD

HMA Lab #	Boring	Sample	Depth (ft)	Weight of Moist Soil + Tare (g)	Weight of Dry Soil + Tare (g)	Tare Weight (g)	**Moisture Content (%)**
8611	ATP-01	S-2	4.5	561.5	442.3	12.9	**27.8**
8611	ATP-01	S-3	7	641.4	537.1	16	**20.0**
8611	ATP-02	S-1	3	768.5	710.6	16	**8.3**
8611	ATP-02	S-2	6.5	639.8	580.5	12.6	**10.4**
8611	ATP-03	S-1	3	569.1	505.2	12.7	**13.0**
8611	ATP-04	S-3	6	630.1	574.4	12.7	**9.9**
8611	ATP-05	S-1	3.5	564.4	534.5	16.1	**5.8**
8611	ATP-06	S-1	3	436.2	348.5	13	**26.1**
8611	ATP-07	S-2	6	471.4	446	16	**5.9**
8611	ATP-08	S-1	3	476.6	403.3	12.7	**18.8**
8611	ATP-09	S-1	3	423.5	346	12.7	**23.3**
8611	ATP-10	S-2	6	483.8	371.1	12.8	**31.5**
8611	ATP-11	S-3	6	608.6	495.5	16.1	**23.6**
8611	ATP-12	S-1	2	587.4	563.8	12.8	**4.3**
8611	ATP-13	S-3	6.5	563.5	532.1	15.9	**6.1**

hayremcelroy & associates, llc

9644 153rd Ave NE
Redmond, WA 98052
425-869-6750

Minus No. 200 Wash

ASTM C117
Method: A

Project Number: 08-175 / 220389

Technician: AD

Project Name: Port Gamble Sklallam Tribe
Lab Number: 8611

Received: 1/6/2023
Start Date: 1/9/2023
Finish Date: 1/16/2023

HMA LAB NO	Boring No	Sample Number	Depth (ft)	Tare Weight (g)	Tare+Dry Weight Before Wash (g)	Tare+Dry Weight After Wash (g)	% Retained	% PASSING
8611	ATP-06	S-1	3	13	348.5	141.4	38.3	**61.7**
8611	ATP-07	S-2	6	16	446	333.9	73.9	**26.1**
8611	ATP-08	S-1	3	12.7	403.3	140.6	32.7	**67.3**
8611	ATP-10	S-2	6	12.8	371.1	62.7	13.9	**86.1**

APPENDIX C

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND GUIDELINES FOR USE

Geoscience is Not Exact

The geoscience practices (geotechnical engineering, geology, and environmental science) are far less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or property, you should contact Aspect Consulting, LLC (Aspect).

This Report and Project-Specific Factors

Aspect's services are designed to meet the specific needs of our clients. Aspect has performed the services in general accordance with our agreement (the Agreement) with the Client (defined under the Limitations section of this project's work product). This report has been prepared for the exclusive use of the Client. This report should not be applied for any purpose or project except the purpose described in the Agreement.

Aspect considered many unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you;
- Not prepared for the specific purpose identified in the Agreement;
- Not prepared for the specific subject property assessed; or
- Completed before important changes occurred concerning the subject property, project, or governmental regulatory actions.

If changes are made to the project or subject property after the date of this report, Aspect should be retained to assess the impact of the changes with respect to the conclusions contained in the report.

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared

Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope instability, or groundwater fluctuations. If any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical, Geologic, and Environmental Reports Are Not Interchangeable

The equipment, techniques, and personnel used to perform a geotechnical or geologic study differ significantly from those used to perform an environmental study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions, or recommendations (e.g., about the likelihood of encountering underground storage tanks or regulated contaminants). Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions please contact the Aspect Project Manager for this project.