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GEOTECHNICAL REPORT
MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

HWA Project No. 2020-144-21

Prepared for
KPFF, Inc & City of MUKILTEO

November 4, 2022

HWA GEOSCIENCES INC.
DBE/MWBE

Geotechnical Engineering
Pavement Engineering
Geoenvironmental
Hydrogeology
Inspection & Testing

November 4, 2022
HWA Project No. 2020-144-21

KPFF Inc.
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101

Attention: John McMillan, P.E., PMP

Subject: **GEOTECHNICAL REPORT**
Mukiltoe 5th Street
Bicycle and Pedestrian Improvements
Mukilteo, Washington

Mr. McMillan:

In accordance with your request, HWA GeoSciences Inc. (HWA) completed a geotechnical engineering investigation in support of the 5th Steet Bicycle and Pedestrian Improvements project in Mukilteo, Washington. This report presents the results of our field explorations and laboratory testing along with our recommendations pertaining to infiltration feasibility, earthwork, and luminaire & signal pole foundations. The attached report summarizes the results of our study and presents our conclusions and recommendations.

We appreciate the opportunity to provide geotechnical engineering services on this project. If you have any questions regarding this report or require additional information or services, please contact the undersigned at your convenience.

Sincerely,

HWA GEOSCIENCES INC.

Bryan Hawkins, P.E.
Senior Geotechnical Engineer

Ali Sirjani, P.E.
Geotechnical Engineer

Enclosure: Geotechnical Report

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GEOTECHNICAL REPORT
MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

1. INTRODUCTION

1.1 GENERAL

This report summarizes the results of a geotechnical engineering investigation performed by HWA GeoSciences Inc. (HWA) for the 5th Steet Bicycle and Pedestrian Improvements project in Mukilteo, Washington. The approximate location of the project site is shown on the Site and Vicinity Map, Figure 1, and on the Site and Exploration Plans, Figures 2A through 2K. Our field work investigation consisted of logging the drilling of six boreholes to evaluate subsurface soil and groundwater conditions. Laboratory tests were conducted on select soil samples obtained from the boreholes to determine relevant engineering properties of the subsurface soils. Engineering analyses were performed to develop the recommendations presented in this report.

1.2 PROJECT UNDERSTANDING

The project alignment is located along 5th Street and West Mukilteo Boulevard, from Lincoln Avenue to the Everett city limit, as shown on Figure 1, Site & Vicinity Map. Within the boundaries of the project, 5th Street and West Mukilteo Boulevard consists of an asphalt-paved, two lane (one travel lane in each direction) collector arterial running east-west. No curb, gutter or sidewalk currently exists on either side of the roadway. Asphalt or gravel shoulders exist on both sides of the alignment. We understand this project includes roadway widening to add bicycle lanes; new curb, gutter, and sidewalk; new planters and medians; stormwater drainage upgrades; and new luminaires.

2. FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD EXPLORATIONS

A geotechnical engineer from HWA logged the drilling of 6 machine-drilled geotechnical borings, designated BH-1 through BH-6, to assess subsurface conditions along the alignment. The locations of the explorations are shown on the Site and Exploration Plans, Figures 2A through 2K. The borings were drilled by Geologic Dill Partners of Bellevue, Washington on February 1, 2022, under subcontract to HWA, using a limited access Bobcat track-mounted drill rig equipped with hollow-stem augers. The boring depths varied from approximately 16 to 21.5 feet below ground surface (bgs).

In each boring, Standard Penetration Test (SPT) sampling was performed using a 2-inch outside diameter split-spoon sampler driven by a 140-pound hammer raised using a rope and cathead system. During the SPT, samples were obtained by driving the sampler 18 inches into the soil with the hammer free-falling 30 inches. The numbers of blows required for each 6 inches of penetration were recorded. The Standard Penetration Resistance ("N-value") of the soil is calculated as the number of blows required for the final 12 inches of penetration. This resistance, or N-value, provides an indication of relative density of granular soils and the relative consistency of cohesive soils; both indicators of soil strength.

A geotechnical engineer from HWA logged the explorations and recorded all pertinent information. Soil samples obtained from the borings were classified in the field and representative portions were sealed in plastic bags. Pertinent information including soil sample depths, stratigraphy, soil engineering characteristics, and groundwater occurrence was recorded. These soil samples were then taken to our Bothell, Washington, laboratory for further examination and testing.

The stratigraphic contacts shown on the individual exploration logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific date and location reported and, therefore, are not necessarily representative of other locations and times. A legend of the terms and symbols used on the exploration logs is presented in Appendix A, Figure A-1. Summary logs of the explorations are presented in Figures A-2 through A-7.

2.2 LABORATORY TESTING

Representative soil samples obtained from the drilled boreholes were taken to the HWA laboratory for further examination and testing. Laboratory tests, as described below, were conducted on selected soil samples to characterize relevant engineering properties of the on-site soils.

Moisture Content of Soil: The moisture content (percent by dry mass) of selected soil samples was determined in accordance with ASTM D 2216. The results are shown at the sampled intervals on the appropriate exploration logs in Appendix A and on the laboratory test reports presented in Appendix B

Particle Size Analysis of Soils: Selected samples were tested to determine the particle size distribution of material in accordance with ASTM D6913/D7928. The results are summarized on the attached Particle-Size Analysis of Soils reports, Figures B-1 through B-6, Appendix B, which also provide information regarding the classification of the samples and the moisture content at the time of testing.

3. SITE CONDITIONS

3.1 General Geologic Conditions

The project alignment is located within the Puget Lowland. The Puget Lowland has repeatedly been occupied by a portion of the continental glaciers that developed during the ice ages of the Quaternary period. During at least four periods, portions of the ice sheet advanced south from British Columbia into the lowlands of Western Washington. The southern extent of these glacial advances was near Olympia, Washington. Each major advance included numerous local advances and retreats, and each advance and retreat resulted in its own sequence of erosion and deposition of glacial lacustrine, outwash, till, and drift deposits. Between and following these glacial advances, sediments from the Olympic and Cascade Mountains accumulated in the Puget Lowland.

Specific geologic information along the project alignment was obtained from the 1:24,000-scale *Preliminary Surficial Geologic Map of the Mukilteo and Everett Quadrangles* (Smith, 1976). According to the geologic mapping, the project vicinity is underlain by combination of Quaternary Vashon Till and Whidbey Formation deposits. It is important to note that the Geologic Unit boundaries presented by geologic mapping are inferred from limited surface observations and topography and may not match the soil conditions encountered in the geotechnical explorations in the area. As indicated by the units presented on our boring logs, the Geologic Units presented by geologic mapping are inconsistent with the surface and subsurface conditions encountered in our explorations. Further discussions of geologic and subsurface conditions encountered are presented below.

3.2 Subsurface Soil Conditions

The soils encountered in our soil borings consist of near surface topsoil and fill soils; weathered and unweathered advance outwash; and Whidbey formation deposits. Further descriptions of soils encountered in our explorations are presented below in order of deposition, beginning with the most recently deposited. The exploration logs in Appendix A provide more detailed description of subsurface conditions observed at specific locations and depths.

Topsoil: Loose topsoil was encountered at ground surface in in borings BH-1 and BH-3. This material was brown to dark brown and consisted of gravelly, silty to very silty, sand with abundant organics/rootlets. The topsoil layer extended from ground surface to a depth of approximately 2.5 feet below ground surface (bgs).

Fill: Fill was encountered in boring BH-4 from the ground surface to depth of about 7.5 feet bgs. The fill consisted of medium dense, slightly silty sand, with varying amounts of gravel. We expect that the fill was placed during construction of West Mukilteo Boulevard at the location of BH-4.

Weathered Advance Outwash: Weathered advance outwash soils consisting of medium dense, slightly silty to silty sand with varying amount of gravel were encountered from surface or below topsoil at the locations all borings except BH-4. Weathered advance outwash ranged in thickness from 2.5 feet to about 17.5 feet.

Advance Outwash: Advance outwash soils were encountered below fill soils at the location of boring BH-4 and below weathered advance outwash at the locations of borings BH-1 through BH-3. These borings were terminated in advance outwash, which generally consisted of dense to very dense, olive gray, clean to slightly silty, sand with varying amounts of gravel. Advance outwash soils were deposited by streams issuing from the glacial front as the ice sheet advanced. They have been overridden and densified by the weight of glacial ice and are typically dense to very dense.

Whidbey Formation: Thin to medium-bedded hard clays and silts were encountered below weathered advance outwash deposits at the locations of BH-5 and BH-6. This soil unit was not fully penetrated in our borings but explored thicknesses ranged from 12 feet in BH-5 to 19 feet in BH-6. These fine-grained deposits, known as the Whidbey formation, are interpreted as being deposited within an alluvial floodplain environment during the last interglacial period. Consequently, these deposits were covered by glacial deposits and were overridden during the last glaciation. This soil unit exhibits low permeability except at locations where it is highly jointed or contains sand lenses.

3.3 GROUNDWATER CONDITIONS

Groundwater seepage was encountered in borings BH-2 through BH-5 at the time of drilling, which occurred on February 1, 2022. In boring BH-2, seepage was encountered at a depth of about 5 feet within the weathered advance outwash and the soils below, to the termination depth of 16.5 feet, were wet. In boring BH-3, seepage was encountered at a depth of about 7.5 feet at the contact between weathered advance outwash and advance outwash and soils were wet to the termination depth of 16.5 feet. In boring BH-4, seepage was encountered at a depth of about 14.5 feet in the last sample for this boring. In boring BH-5, seepage was encountered at a depth of about 5 feet within the weathered advance outwash and the water was perched above the Whidbey formation deposit encountered at 10 feet.

We anticipate groundwater levels vary with rainfall and that levels are highest during the wet winter months.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL

The following is a summary of our conclusions and geotechnical recommendations based on the results of our investigations, laboratory testing and analyses. Further discussion is presented in subsequent report sections.

- Near surface soils encountered in the explorations primarily consist of medium dense to very dense, slightly silty to silty sand with gravel (outwash or fill) and are generally suitable for support of the proposed shallow bearing improvements (pavement, sidewalk, curb, gutter, and median) provided the recommendations presented in this report are incorporated into design and construction. In some locations, topsoil/organic-rich soils will need to be excavated to reach soils suitable for supporting these structures.

- The subsurface soils will provide adequate lateral resistance for the proposed luminaire foundations and WSDOT Standard Plan foundations can be utilized for design and construction.

- Use of infiltration for stormwater design is not recommended for the project given the presence of glacially-consolidated soils and nearby steep slopes.

- We anticipate that much of the native outwash soils, consisting of relatively clean sand and gravel, will be suitable for reuse as trench backfill. Sufficient sampling and testing will need to be performed during construction to develop adequate grain-size distribution and compaction criteria.

4.2 LUMINAIRE FOUNDATIONS

We understand that new luminaires will be constructed as part of the proposed improvements for this project. We anticipate that WSDOT Standard Plans for construction of luminaire and signal pole foundations will be applicable. Table 17-2 of the *WSDOT Geotechnical Design Manual* (WSDOT, 2021), provides allowable lateral bearing pressures based on Standard Penetration Test (SPT) Resistance N-values (blows/foot). Based on the results of the drilled borings, we recommend using an allowable lateral bearing pressure of 1,500 psf for design of luminaire foundations along the project corridor.

Drilled shaft luminaire and signal pole foundations can be constructed using conventional methods using flighted augers. It is likely that cobbles and boulders could be present. Per the Unified Soil Classification System (USCS), cobbles are defined as a rock with a dimension between 3 and 12 inches; boulders are defined as rock with a minimum dimension of 12 inches. The contractor should be prepared to encounter cobbles and boulders during drilling of shafts.

The contractor should also be prepared to control groundwater, perched water, and/or surface water entering and collecting inside the drilled shaft excavation. The contractor should be prepared to prevent caving of the drilled shaft sidewalls using temporary casing. The concrete should be placed using a tremie pipe from the bottom of the shaft if water inside the drilled shaft excavation is over a depth of 6 inches.

A qualified geotechnical engineer should observe shaft excavation and concrete placement. This will also provide the opportunity to confirm conditions assumed in the design and provide corrective recommendations as necessary to adapt to conditions observed during construction.

4.3 STORMWATER MANAGEMENT

According to the 2019 Stormwater Management Manual for Western Washington (SWMMWW), estimation of infiltration rates using the grain size analysis method is only applicable to soils unconsolidated by glacial advance. As indicated above and on our borehole logs, the native subsurface soils encountered have been glacially consolidated, though the weathered portion of the advance outwash is less dense than the unweathered portion. Given the presence of glacially consolidated soils, steep slopes, and localized shallow perched groundwater, we do not recommend stormwater infiltration be utilized. If stormwater infiltration is to be considered, Pilot Infiltration Testing (PIT) would need to be performed in locations where infiltration is proposed.

4.4 GENERAL EARTHWORK

4.4.1 Subgrade Preparation

Subgrade preparation for pavement, sidewalks, ramps, curbs and other improvements founded near surface should begin with the removal of all topsoil, deleterious materials and vegetation to expose dense, competent native soils or adequately compacted structural fill. A smooth bucket should be used to limit disturbance. We recommend that in areas accessible to construction equipment, the exposed subgrade be proof-rolled under the observation of the geotechnical engineer using a fully-loaded dump truck to identify any areas of loose, pumping, or otherwise unsuitable soils. If such soils are encountered, they should be over-excavated as directed by the geotechnical engineer and replaced with properly compacted structural fill. In areas inaccessible to large equipment, the subgrade soils should be evaluated by the geotechnical engineer using a T-handled probe. Subgrade soils should be compacted to a dense condition prior to placement of structural fill or construction of improvements.

4.4.2 Structural Fill

Structural fill should consist of relatively clean, free-draining, granular soils free from organic matter or other deleterious materials. Such materials should be less than 4 inches in maximum particle dimension, with less than 10 percent fines (portion passing the U.S. Standard No. 200 sieve). Imported structural fill for areas of over-excavation and for pavement base course should consist of Crushed Surfacing Base Course, as described in Section 9-03.9(3) of the WSDOT *Standard Specifications* (WSDOT, 2022). Structural fill used to raise site grades could consist of CSBC or Gravel Borrow, as specified in Section 9-03.14(1) of the *WSDOT Standard Specifications* (WSDOT, 2022). The fine-grained portion of structural fill soils should be non-plastic.

We anticipate that much of the cleaner sand and gravel outwash soils can be used for utility trench backfill. A sufficient number of samples for grain size and Proctor testing should be obtained during construction and tested to determine the compaction characteristics.

We do not recommend the reuse of native fine-grained Whidbey formation soils as structural fill due to the very high fines content and moisture sensitivity.

4.4.3 Compaction

Structural fill should be moisture conditioned and compacted to at least 95% of the maximum dry density (MDD) determined by test method ASTM D 1557 (Modified Proctor). Structural fill should be placed and compacted in loose, horizontal lifts of not more than 8 inches in thickness.

At the time of placement, the moisture content of structural fill should be at or near optimum. Achievement of proper density of a compacted fill depends on the size and type of compaction equipment, the number of passes, thickness of the layer being compacted, and soil moisture-density properties. In areas where limited space restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough layers and at the proper moisture content to achieve the required relative compaction. Generally, loosely compacted soils result from poor construction technique and/or improper soil moisture content. Soils with high fines contents are particularly susceptible to becoming too wet and coarse-grained materials easily become too dry for proper compaction.

4.4.4 Temporary Excavations

Maintenance of safe working conditions, including temporary excavation stability is the responsibility of the contractor. All excavations should have adequate safety systems that meet the requirements of the Washington Industrial Safety and Health Act, Chapter 49.17 RCW. In accordance with Part N of Washington Administrative Code (WAC) 296-155, all temporary cuts in excess of 4 feet in height must be either sloped or shored prior to entry by personnel. The fill and weathered advance outwash soils encountered classify as Type C soils per WAC 296-155 and should be sloped no steeper than 1.5H:1V (horizontal:vertical). The dense and very dense advance outwash soils encountered at depth below weathered deposits classify as Type B soils per WAC 296-155 and should be sloped no steeper than 1H:1V (horizontal:vertical). The hard Whidbey Formation soils encountered at the locations of borings BH-5 and BH-6 classify as

Type A soils per WAC 296-155 and should be sloped no steeper than 3/4H:1V (horizontal:vertical).

The contractor should monitor the stability of temporary excavations and adjust the slope inclination accordingly. The contractor should be responsible for control of ground and surface water and should employ sloping, slope protection, ditching, sumps, dewatering, and other measures, as necessary, to prevent sloughing of soils.

4.4.5 Wet Weather Earthwork

General recommendations relative to earthwork performed in wet weather or in wet conditions are presented below. These recommendations should be incorporated into the contract specifications.

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation of unsuitable and/or softened soil should be followed promptly by placement and compaction of clean structural fill. The size and type of construction equipment used may need to be limited to prevent soil disturbance. Under some circumstances, it may be necessary to excavate soils with a backhoe to minimize subgrade disturbance caused by equipment traffic.

- Any backfill material used in wet weather should consist of clean granular soil with less than 5 percent passing the U.S. No. 200 sieve, based on wet sieving the fraction passing the ¾-inch sieve. The fines should be non-plastic. It should be noted this is an additional restriction on the structural fill materials specified.

- The ground surface within the construction area should be graded to promote surface water run-off and to prevent ponding.

- Within the construction area, the ground surface should be sealed on completion of each shift by a smooth drum vibratory roller, or equivalent, and under no circumstances should soil be left uncompacted and exposed to moisture infiltration.

- Excavation and placement of backfill materials should be monitored by a geotechnical engineer experienced in wet weather earthwork to determine that the work is being accomplished in accordance with the project specifications and the recommendations contained herein.

- Bales of straw combined with other best management practices such as geotextile silt fences should be strategically located to control erosion and the movement of soil.

5. CONDITIONS AND LIMITATIONS

HWA prepared this draft report for KPFF Inc. and the City of Mukilteo for use in design and construction of this project. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Experience has shown that soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations and may not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, HWA should be notified for review of the recommendations of this report, and revision of such if necessary.

HWA recommends it be retained to review the plans and specifications to verify that HWA's recommendations have been interpreted and implemented as intended. Sufficient geotechnical monitoring, testing, and consultation should be provided during construction to confirm the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should conditions revealed during construction differ from those anticipated, and to verify that the geotechnical aspects of construction comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, HWA attempted to execute these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology in the area at the time the report was prepared. No warranty, express or implied, is made. The scope of HWA's work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

HWA does not practice or consult in the field of safety engineering. HWA does not direct the contractor's operations and cannot be responsible for the safety of personnel other than HWA's own on the site. As such, the safety of others is the responsibility of the contractor(s). The contractor(s) should notify the owner if it is considered that any of the recommended actions presented herein are unsafe.

We appreciate the opportunity to provide geotechnical services on this project. Should you have any questions or comments, or if we may be of further service, please do not hesitate to call.

Sincerely,

HWA GEOSCIENCES INC.

BRYAN KEITH HAWKINS
STATE OF WASHINGTON
39862
REGISTERED
PROFESSIONAL ENGINEER

Ali Sirjani, P.E.	Bryan K. Hawkins, P.E
Geotechnical Engineer	Senior Geotechnical Engineer

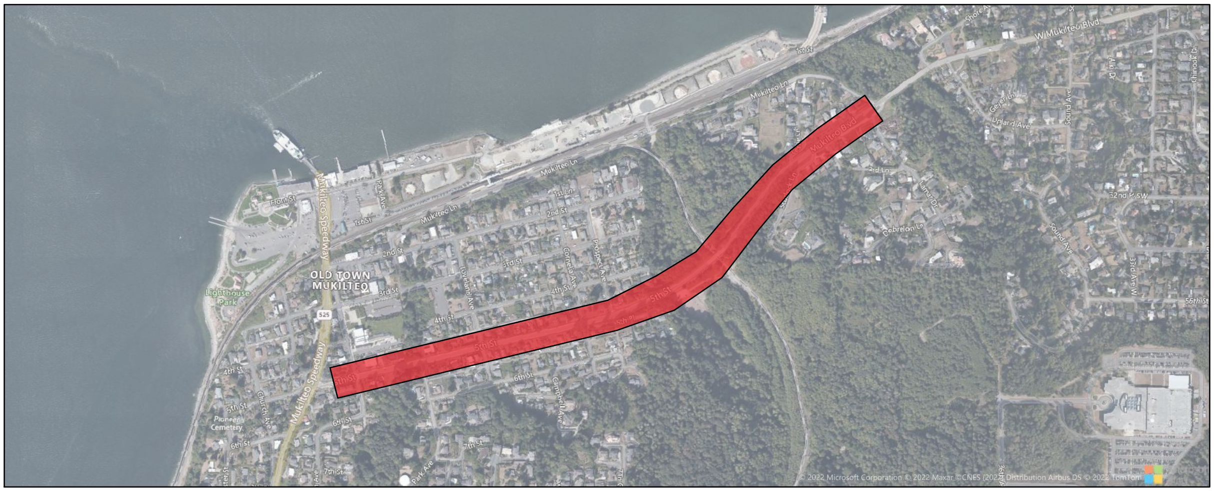
6. REFERENCES

Smith,1976, *Preliminary Surficial Geologic Map of the Mukilteo and Everett Quadrangles*, Snohomish County, Washington, State of Washington Department of Natural Resources, Division of Geology and Earth Resources, Geologic Map GM-20.

Washington State Department of Ecology, 2019, *Stormwater Management Manual for Western Washington*, Water Quality Program, Publication Number 19-10-021, July 2019.

WSDOT, 2021, *Geotechnical Design Manual*, Washington State Department of Transportation M 46-03.14, June 2021.

WSDOT, 2022, *Standard Specifications for Road, Bridge and Municipal Construction*, Washington State Department of Transportation, M41-10.



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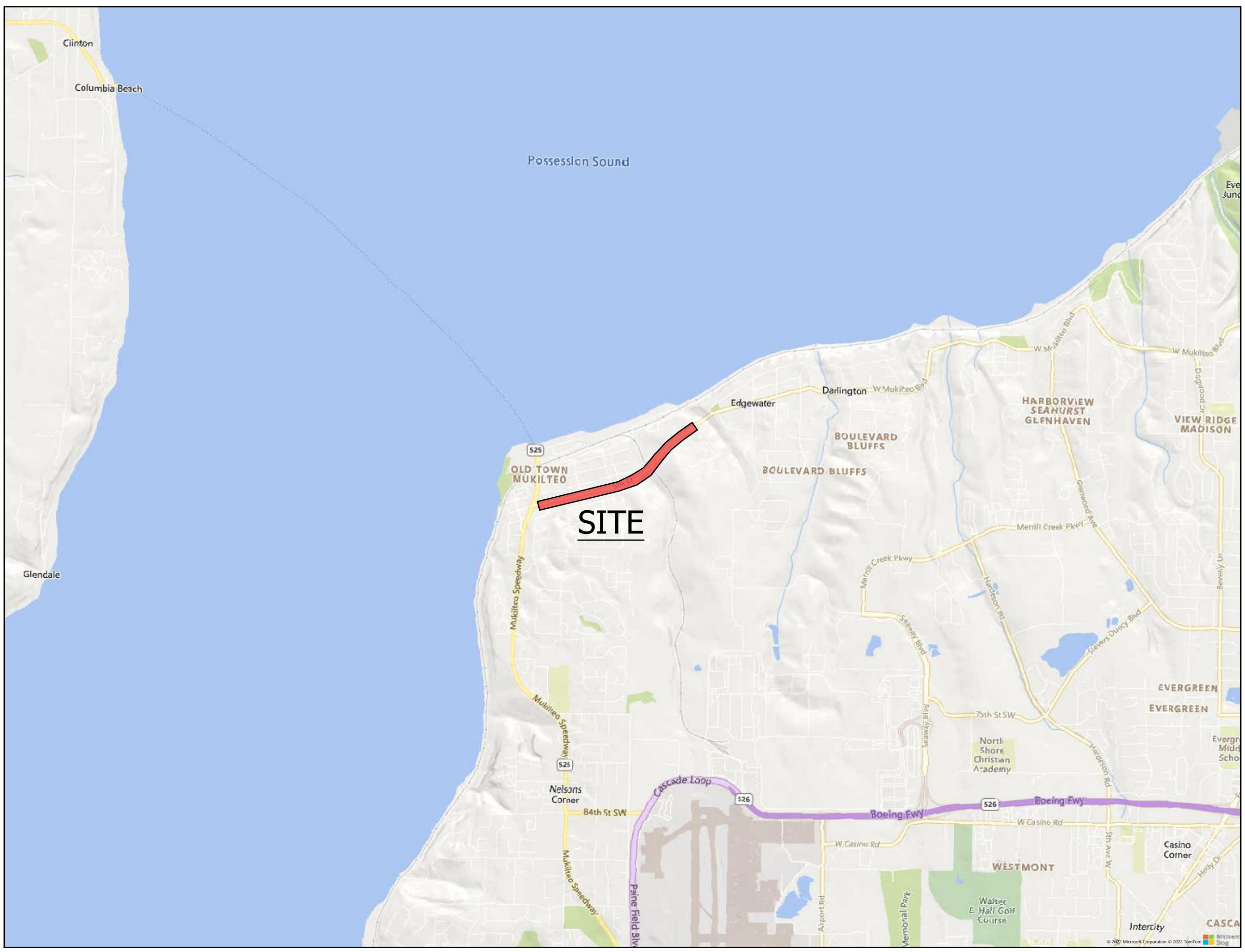

VICINITY MAP

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HWA GEOSCIENCES INC.
DBE/MWBE

SITE AND VICINITY MAP

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

FIGURE NO.:	
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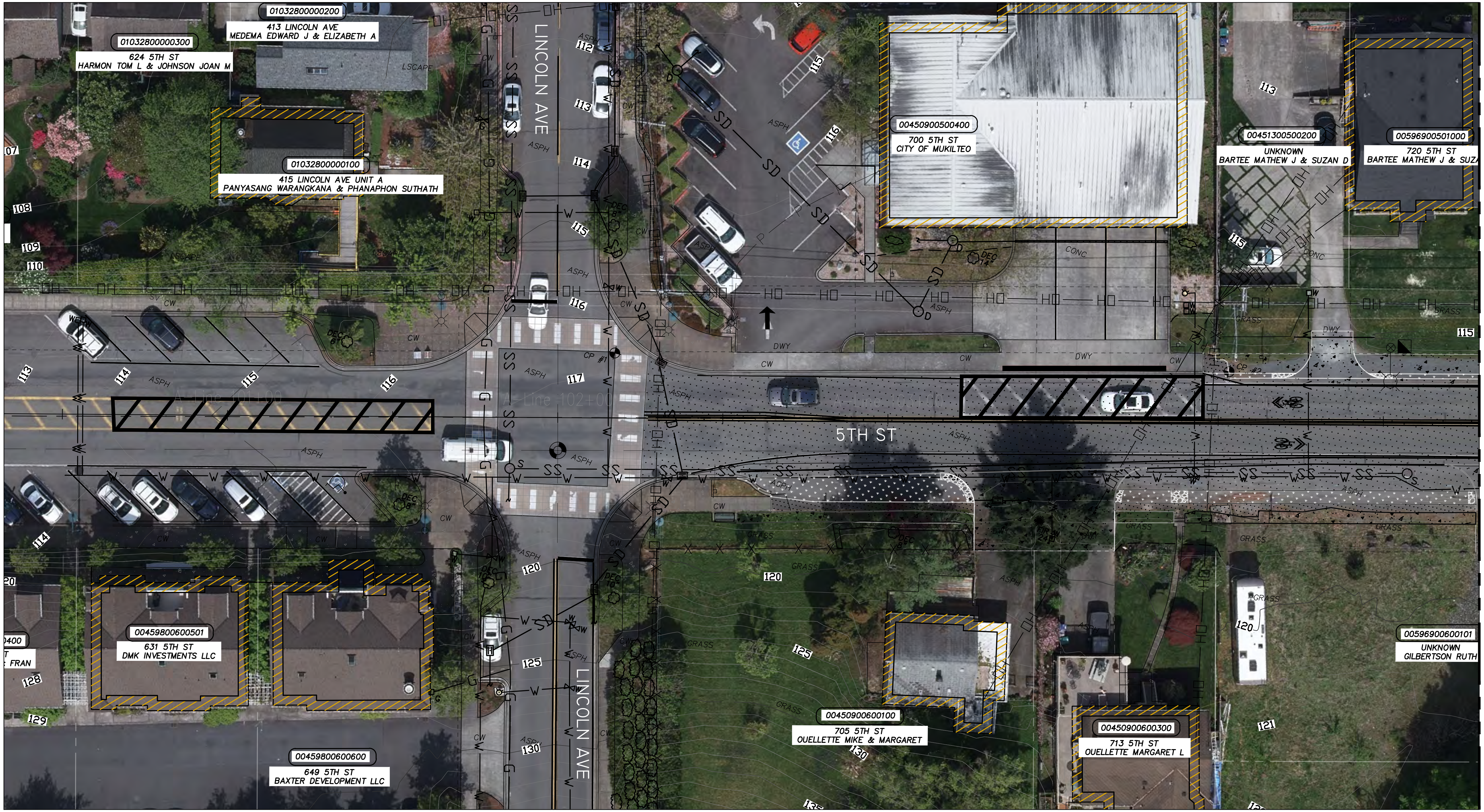

5TH STREET

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0 15 30 45 60

SCALE: 1" = 30'

AERIAL & BASE MAP PROVIDED BY: KPFF 03.02.2022

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MUKILTEO 5TH STREET BICYCLE AND PEDESTRIAN IMPROVEMENTS MUKILTEO, WASHINGTON	SITE & EXPLORATION PLAN	DRAWN BY: CF	FIGURE NO.: 2A	
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5TH STREET

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MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

SITE &
EXPLORATION PLAN

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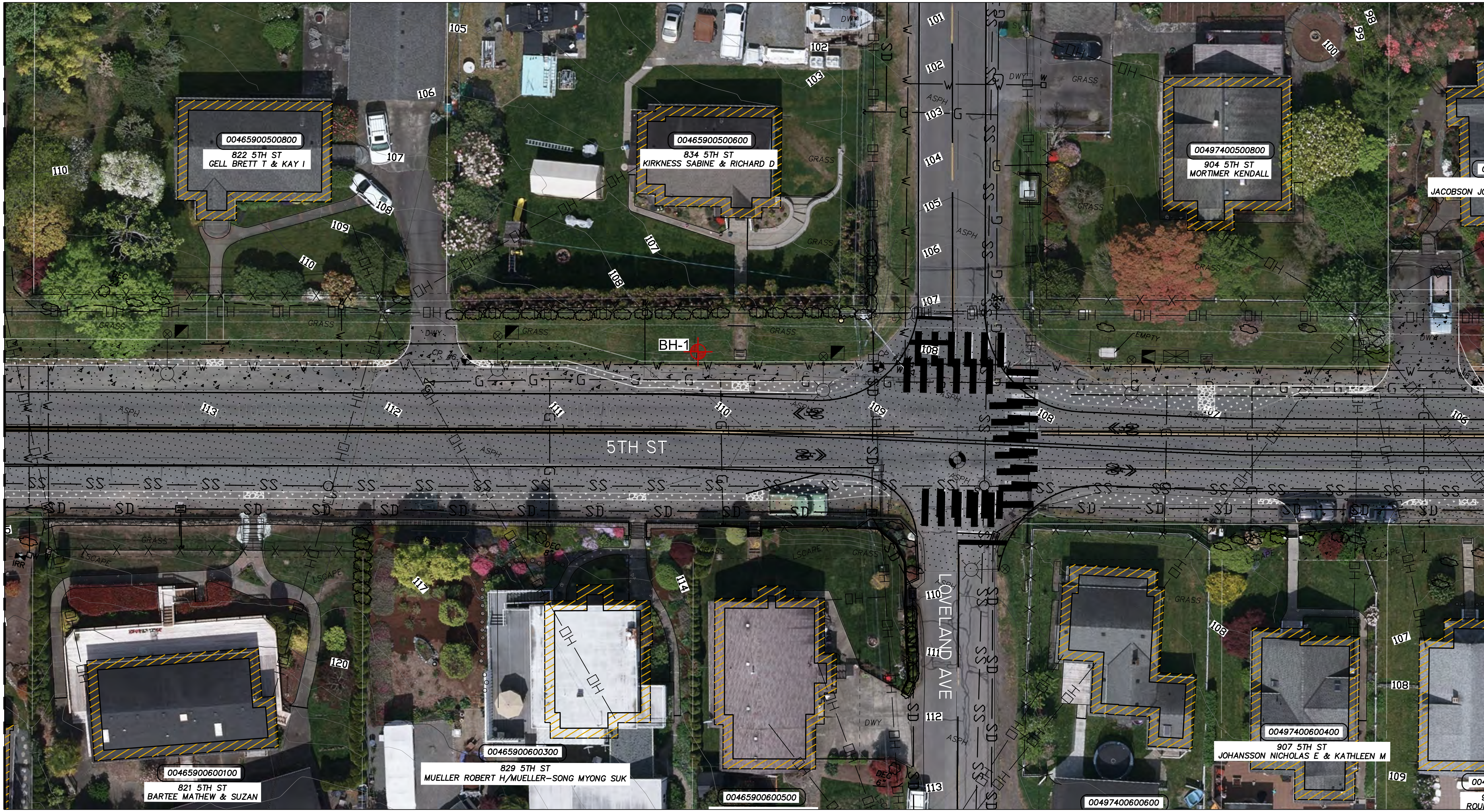

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EXPLORATION LEGEND

BH-1 BOREHOLE DESIGNATION AND APPROXIMATE LOCATION

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HWA GEOSCIENCES INC. DBE/MWBE

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

SITE &
EXPLORATION PLAN

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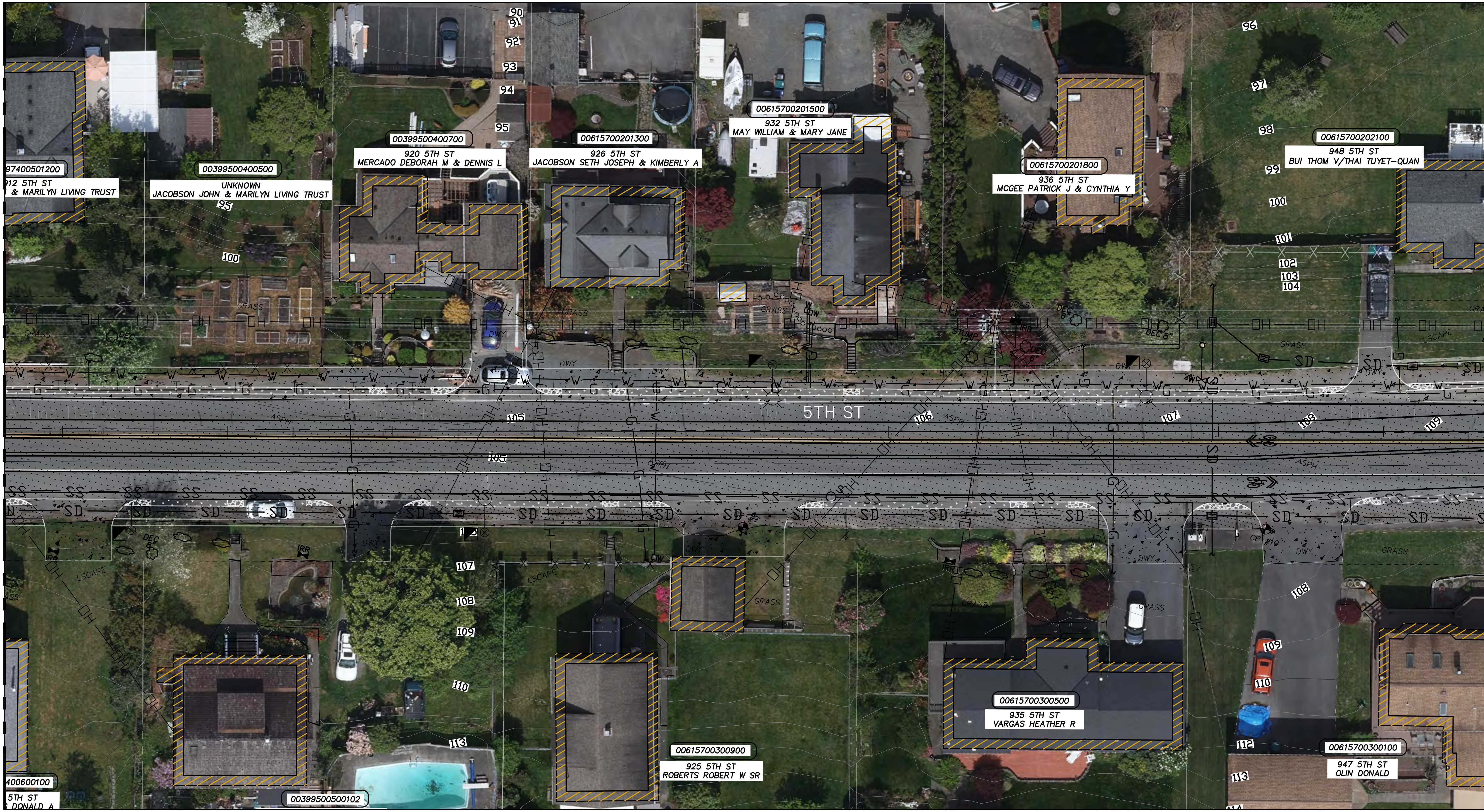

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SCALE: 1" = 30'

HWA GEOSCIENCES INC. DBE/MWBE

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

SITE &
EXPLORATION PLAN

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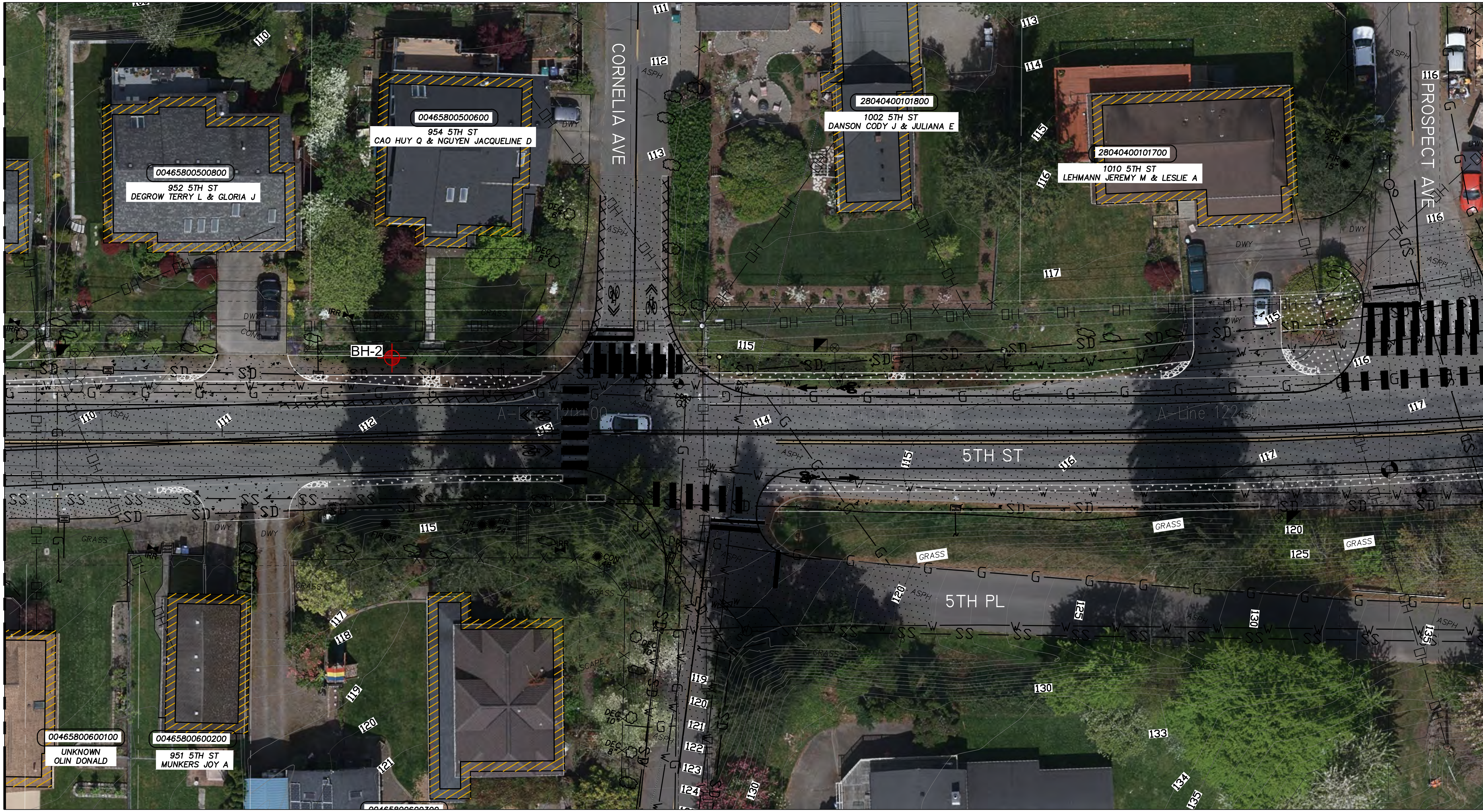

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EXPLORATION LEGEND

BH-2 ⌖ BOREHOLE DESIGNATION AND APPROXIMATE LOCATION

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SCALE: 1" = 30'

AERIAL & BASE MAP PROVIDED BY: KPFF 03.02.2022

HWA GEOSCIENCES INC.
DBE/MWBE

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

SITE &
EXPLORATION PLAN

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5TH STREET
Scale: 1" = 30'-0"

EXPLORATION LEGEND

BH-3 ⌖ BOREHOLE DESIGNATION AND APPROXIMATE LOCATION

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SCALE: 1" = 30'

HWA GEOSCIENCES INC.
DBE/MWBE

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

SITE &
EXPLORATION PLAN

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5TH STREET

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HWA GEOSCIENCES INC. DBE/MWBE

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

SITE & EXPLORATION PLAN

DRAWN BY: CF	FIGURE NO.: 2G
CHECK BY: AS/BKH	PROJECT NO.: 2020-144-21

AERIAL & BASE MAP PROVIDED BY: KPFF 03.02.2022

C:\USERS\CFRY\DESKTOP\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN.DWG <2G> Plotted: 3/4/2022 9:18 AM

5TH STREET
Scale: 1" = 30'-0"

EXPLORATION LEGEND

BH-5 BOREHOLE DESIGNATION AND APPROXIMATE LOCATION

0 15 30 45 60
SCALE: 1" = 30'

HWA GEOSCIENCES INC. DBE/MWBE

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

SITE & EXPLORATION PLAN

DRAWN BY:	FIGURE NO.:
CF	2H
CHECK BY:	PROJECT NO.:
AS/BKH	2020-144-21

AERIAL & BASE MAP PROVIDED BY: KPFF 03.02.2022

C:\USERS\CFRY\DESKTOP\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN.DWG <2H> Plotted: 3/4/2022 9:19 AM

5TH STREET
Scale: 1" = 30'-0"

EXPLORATION LEGEND

BH-6 ⌖ BOREHOLE DESIGNATION AND APPROXIMATE LOCATION

0 15 30 45 60
SCALE: 1" = 30'

HWA GEOSCIENCES INC. DBE/MWBE

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

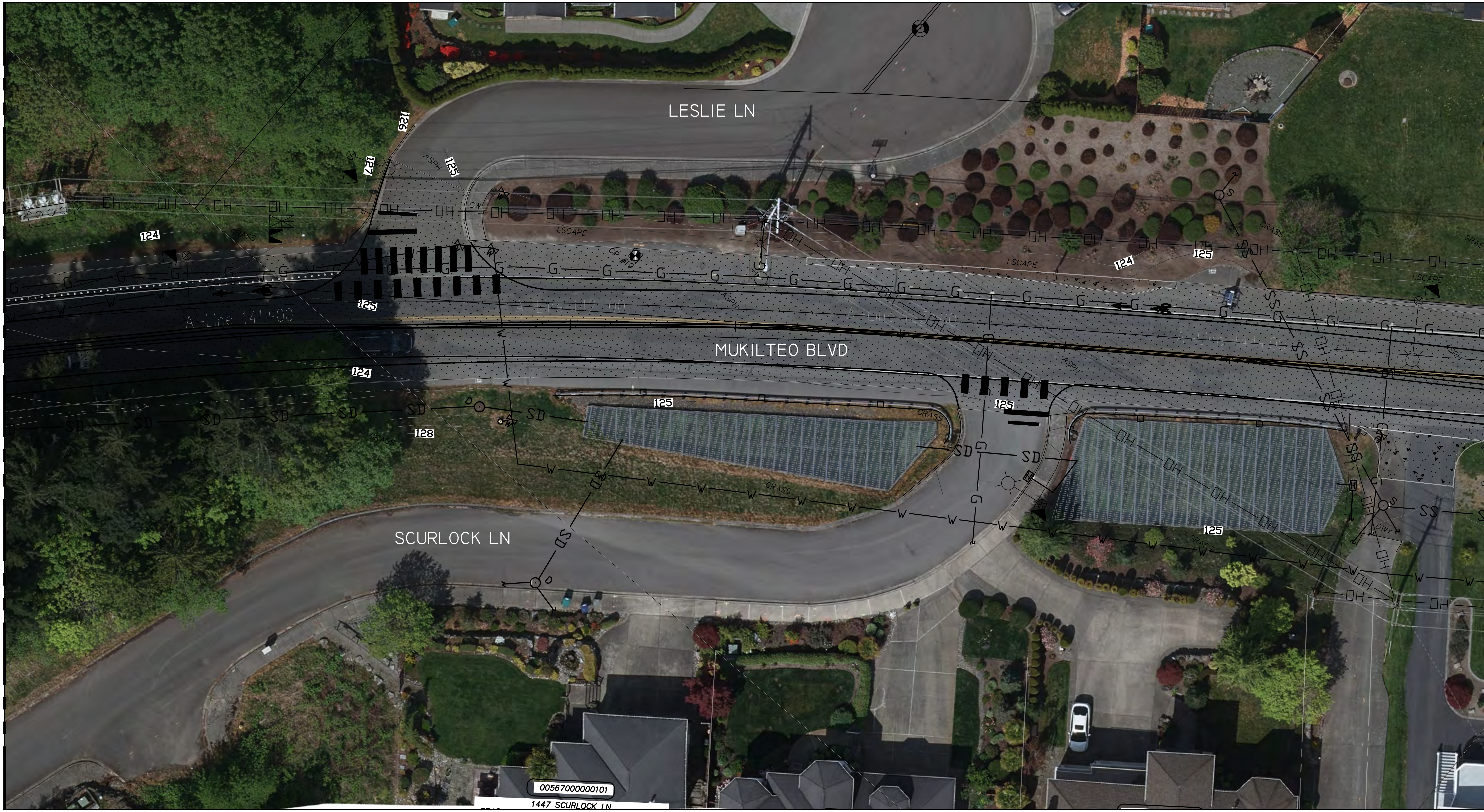
SITE &
EXPLORATION PLAN

DRAWN BY: CF	FIGURE NO.: 2I
CHECK BY: AS/BKH	PROJECT NO.: 2020-144-21

AERIAL & BASE MAP PROVIDED BY: KPFF 03.02.2022

C:\USERS\CFRY\DESKTOP\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN.DWG <2I> Plotted: 3/4/2022 9:19 AM

MATCHLINE SEE 2I



MATCHLINE SEE 2K

5TH STREET/MUKILTEO BLVD

Scale: 1" = 30'-0"

0 15 30 45 60

SCALE: 1" = 30'

HWA GEOSCIENCES INC.
DBE/MWBE

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

SITE &
EXPLORATION PLAN

DRAWN BY:	FIGURE NO.:
CF	2J
CHECK BY:	PROJECT NO.:
AS/BKH	2020-144-21

AERIAL & BASE MAP PROVIDED BY: KPFF 03.02.2022

C:\USERS\CFRY\DESKTOP\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN.DWG <2J> Plotted: 3/4/2022 9:19 AM

MUKILTEO BLVD
Scale: 1" = 30'-0"

0 15 30 45 60
SCALE: 1" = 30'

AERIAL & BASE MAP PROVIDED BY: KPFF 03.02.2022

HWA GEOSCIENCES INC. DBE/MWBE

MUKILTEO 5TH STREET
BICYCLE AND PEDESTRIAN IMPROVEMENTS
MUKILTEO, WASHINGTON

SITE &
EXPLORATION PLAN

DRAWN BY:	FIGURE NO.:
CF	2K
CHECK BY:	PROJECT NO.:
AS/BKH	2020-144-21

C:\USERS\CFRY\DESKTOP\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN\2020-144-21 5TH STREET BICYCLE & PEDESTRIAN.DWG <2K> Plotted: 3/4/2022 9:20 AM

APPENDIX A

HWA FIELD EXPLORATIONS

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	over 30	>4000

USCS SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse Grained Soils More than 50% Retained on No. 200 Sieve Size	Gravel and Gravelly Soils More than 50% of Coarse Fraction Retained on No. 4 Sieve	Clean Gravel (little or no fines)	GW	Well-graded GRAVEL
			GP	Poorly-graded GRAVEL
		Gravel with Fines (appreciable amount of fines)	GM	Silty GRAVEL
			GC	Clayey GRAVEL
	Sand and Sandy Soils 50% or More of Coarse Fraction Passing No. 4 Sieve	Clean Sand (little or no fines)	SW	Well-graded SAND
			SP	Poorly-graded SAND
		Sand with Fines (appreciable amount of fines)	SM	Silty SAND
			SC	Clayey SAND
Fine Grained Soils 50% or More Passing No. 200 Sieve Size	Silt and Clay	Liquid Limit Less than 50%	ML	SILT
			CL	Lean CLAY
			OL	Organic SILT/Organic CLAY
	Silt and Clay	Liquid Limit 50% or More	MH	Elastic SILT
			CH	Fat CLAY
			OH	Organic SILT/Organic CLAY
Highly Organic Soils			PT	PEAT

TEST SYMBOLS

%F	Percent Fines
AL	Atterberg Limits: PL = Plastic Limit, LL = Liquid Limit
CBR	California Bearing Ratio
CN	Consolidation
DD	Dry Density (pcf)
DS	Direct Shear
GS	Grain Size Distribution
K	Permeability
MD	Moisture/Density Relationship (Proctor)
MR	Resilient Modulus
OC	Organic Content
pH	pH of Soils
PID	Photoionization Device Reading
PP	Pocket Penetrometer (Approx. Comp. Strength, tsf)
Res.	Resistivity
SG	Specific Gravity
CD	Consolidated Drained Triaxial
CU	Consolidated Undrained Triaxial
UU	Unconsolidated Undrained Triaxial
TV	Torvane (Approx. Shear Strength, tsf)
UC	Unconfined Compression

SAMPLE TYPE SYMBOLS

- 2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
- Shelby Tube
- Non-standard Penetration Test (3.0" OD Split Spoon with Brass Rings)
- Small Bag Sample
- Large Bag (Bulk) Sample
- Core Run
- 3-1/4" OD Split Spoon

GROUNDWATER SYMBOLS

- Groundwater Level (measured at time of drilling)
- Groundwater Level (measured in well or open hole after water level stabilized)

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

COMPONENT PROPORTIONS

PROPORTION RANGE	DESCRIPTIVE TERMS
< 5%	Clean
5 - 12%	Slightly (Clayey, Silty, Sandy)
12 - 30%	Clayey, Silty, Sandy, Gravelly
30 - 50%	Very (Clayey, Silty, Sandy, Gravelly)
Components are arranged in order of increasing quantities.	

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation. Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content. Proportion, gradation, and angularity of constituents, additional comments. (GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

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Bicycle and Pedestrian Improvements
Mukilteo, Washington

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

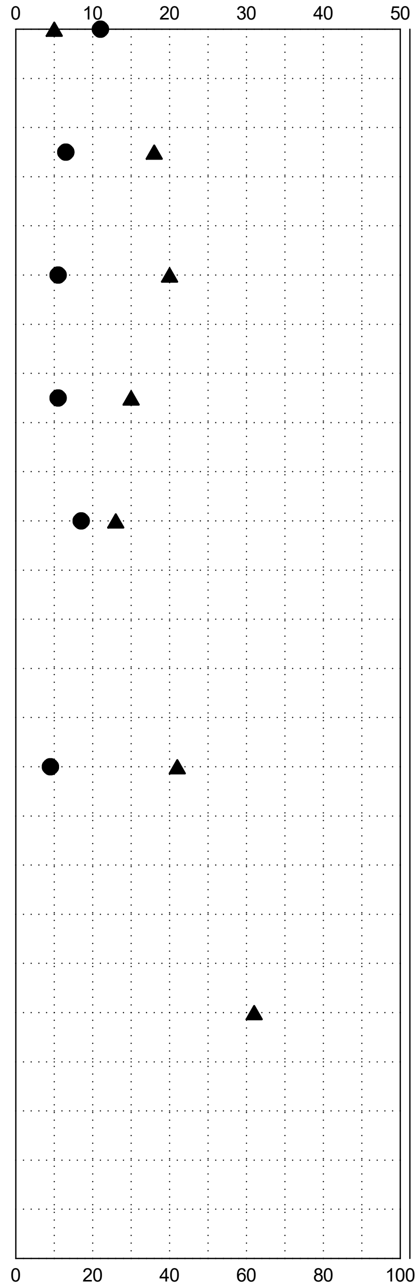
PROJECT NO.: 2020-144-21 FIGURE: A-1

DRILLING COMPANY: Geologic Drill Partners
DRILLING METHOD: HSA with mini-track
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2C

DATE STARTED: 2/1/2022
DATE COMPLETED: 2/1/2022
LOGGED BY: A. Sirjani

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Loose, dark-brown, slightly gravelly, silty SAND, moist. Rootlets observed. **(TOPSOIL)**	S-1	2-3-2	GS	
	SM	Medium dense, dark olive-brown, silty, gravelly SAND, moist. Rootlets observed. **(WEATHERED ADVANCE OUTWASH)**	S-2	3-7-11		
5		Medium dense, olive-brown, silty, gravelly SAND, moist.	S-3	16-11-9	GS	
		Medium dense, olive-brown, silty, gravelly, SAND, moist.	S-4	6-7-8	GS	
10		Medium dense, olive-brown, slightly gravelly, silty SAND, moist. Rust mottling and silt banding observed.	S-5	5-6-7		
15		Medium dense, olive-brown, slightly gravelly, silty, SAND, moist.	S-6	8-10-11		
20	SM	Dense, olive-brown, silty SAND, moist. **(ADVANCE OUTWASH)**	S-7	8-14-17		
25						

Boring terminated at 21.5 feet below ground surface.
Groundwater seepage was not observed during the drilling.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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Bicycle and Pedestrian Improvements
Mukilteo, Washington

BORING:
BH-1

PAGE: 1 of 1

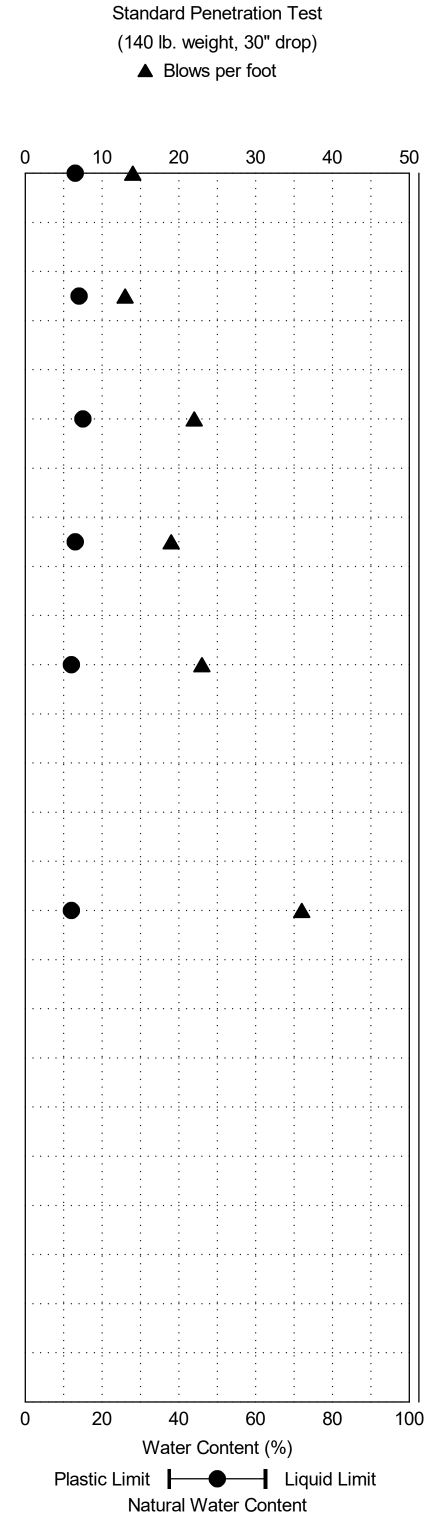
PROJECT NO.: 2020-144-21 FIGURE: A-2

DRILLING COMPANY: Geologic Drill Partners
DRILLING METHOD: HSA with mini-track
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2E

DATE STARTED: 2/1/2022
DATE COMPLETED: 2/1/2022
LOGGED BY: A. Sirjani

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER	ELEVATION (feet)
0		SM	Medium dense, dark olive-brown, silty, gravelly SAND, moist. Rootlets observed. **(WEATHERED ADVANCE OUTWASH)**	SPT	S-1	3-8-6	GS		
2.5			Medium dense, olive-brown, slightly gravelly, very silty, SAND, moist. Poor recovery at 2.5 feet bgs.	SPT	S-2	4-5-8			
5			Medium dense, olive-gray, slightly gravelly, silty SAND, wet.	SPT	S-3	8-10-12	GS	▽	
7.5			Medium dense, olive-brown, silty, gravelly, SAND,wet.	SPT	S-4	7-9-10	GS		
10				SPT	S-5	8-10-13			
15		SM	Dense, gravelly, silty, SAND, wet. **(ADVANCE OUTWASH)**	SPT	S-6	10-16-20			

Boring terminated at 16.5 feet below ground surface (bgs). Groundwater seepage was observed at 5 feet bgs during the drilling.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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Mukilteo 5th Street
Bicycle and Pedestrian Improvements
Mukilteo, Washington

BORING:
BH-2

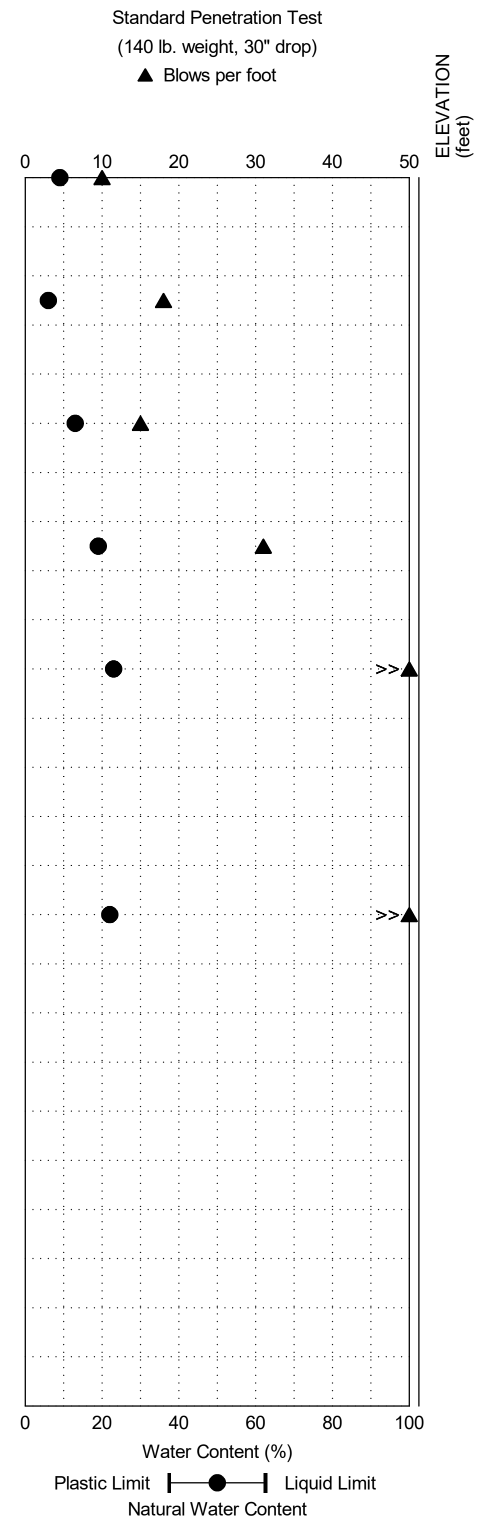
PROJECT NO.: 2020-144-21 FIGURE: A-3

DRILLING COMPANY: Geologic Drill Partners
DRILLING METHOD: HSA with mini-track
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2F

DATE STARTED: 2/1/2022
DATE COMPLETED: 2/1/2022
LOGGED BY: A. Sirjani

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Loose, dark olive-brown, silty, gravelly SAND, moist. Rootlets observed. **(TOPSOIL)**	S-1	3-3-7		
	SP SM	Medium dense, olive-brown, slightly silty, gravelly SAND, moist. **(WEATHERED ADVANCE OUTWASH)**	S-2	7-8-10	GS	
5	SM	Medium dense, olive-gray, slightly gravelly, very silty SAND, moist.	S-3	7-8-7	GS	
	SM	Dense, olive-gray, silty SAND,wet. **(ADVANCE OUTWASH)**	S-4	4-14-17	GS	∇
10	SP SM	Very dense, olive-gray, slightly silty, SAND, moist to wet.	S-5	18-34-35		
15			S-6	15-35-39		

Boring terminated at 16.5 feet below ground surface (bgs). Groundwater seepage likely from perched water was observed at 7.5 feet bgs during the drilling.



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Mukilteo 5th Street
Bicycle and Pedestrian Improvements
Mukilteo, Washington

BORING:
BH-3

PAGE: 1 of 1

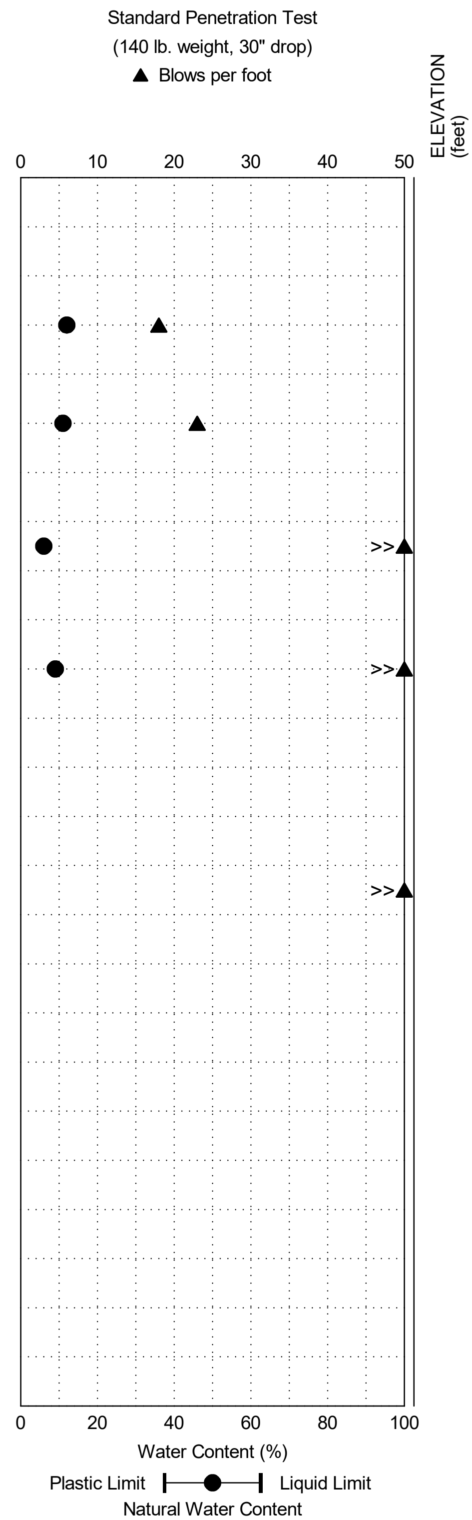
PROJECT NO.: 2020-144-21 FIGURE: A-4

DRILLING COMPANY: Geologic Drill Partners
DRILLING METHOD: HSA with mini-track
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2H

DATE STARTED: 2/1/2022
DATE COMPLETED: 2/1/2022
LOGGED BY: A. Sirjani

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	0 to 3 feet bgs was hand excavated to assure boring location is clear of utilities. Medium dense, olive-brown, slightly gravelly, silty SAND, moist. **(FILL)**				
3	SM	Medium dense, olive-brown, slightly gravelly, silty SAND, moist.	S-1	7-11-7	GS	
5	SW SM	Medium dense, olive-brown, slightly silty, well-graded SAND, moist.	S-2	7-8-15	GS	
7.5	SM	Very dense, olive-gray, gravelly, silty, SAND, moist. **(ADVANCE OUTWASH)**	S-3	14-24-40		
10			S-4	22-32-28	GS	
14.5		Poor recovery at 14.5 feet bgs. Large broken gravel was stuck at the tip of the sampler.	S-5	22-40-32		∇

Boring terminated at 16 feet below ground surface (bgs) due to practical refusal. Groundwater seepage was observed at 14.5 feet bgs during the drilling.



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Mukilteo 5th Street
Bicycle and Pedestrian Improvements
Mukilteo, Washington

BORING:
BH-4

PAGE: 1 of 1

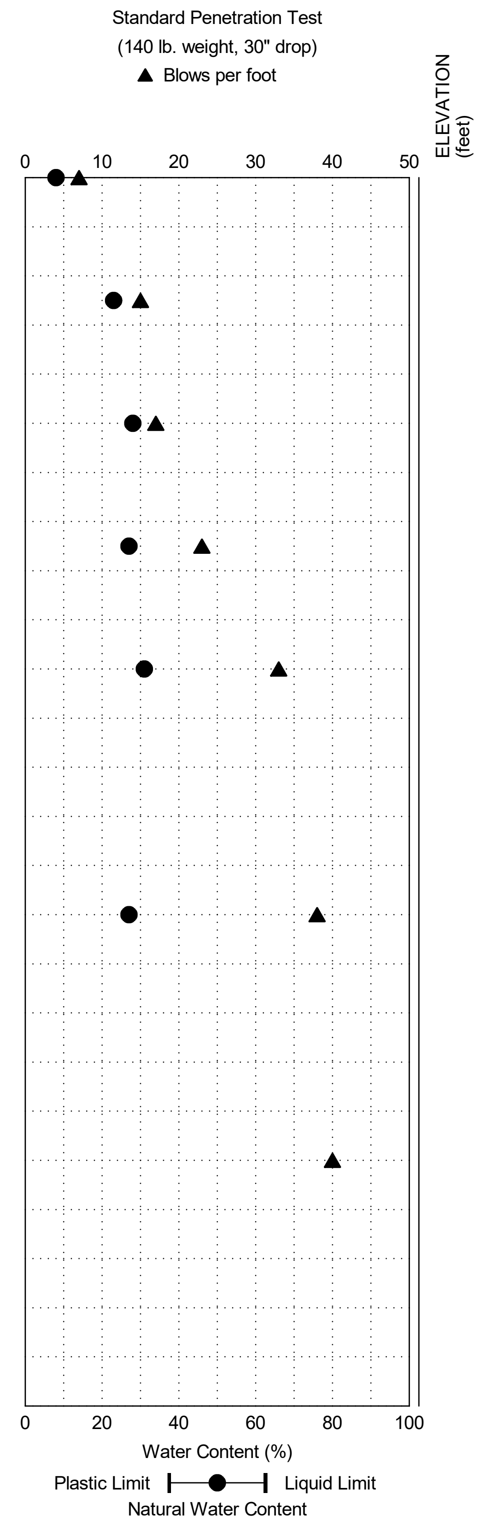
PROJECT NO.: 2020-144-21 FIGURE: A-5

DRILLING COMPANY: Geologic Drill Partners
DRILLING METHOD: HSA with mini-track
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2H

DATE STARTED: 2/1/2022
DATE COMPLETED: 2/1/2022
LOGGED BY: A. Sirjani

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SP SM	Loose, olive-brown, slightly silty, SAND, moist. Tree root fragments observed. **(WEATHERED ADVANCE OUTWASH)**	S-1	2-3-4		
	SM	Medium dense, olive-brown, silty SAND, moist.	S-2	5-7-8	GS	
5	SP SM	Medium dense, dark olive-gray, slightly silty, poorly graded SAND, wet.	S-3	5-9-8	GS	∇
			S-4	9-11-12		
10	ML	Hard, light olive-brown, SILT, moist to dry. Rust mottling observed. **(WHIDBEY FORMATION)**	S-5	10-15-18		
15	ML	Hard, olive-gray, SILT, moist to dry.	S-6	12-18-20		
20		Becomes dark gray.	S-7	12-17-23		
25						

Boring terminated at 21.5 feet below ground surface (bgs). Groundwater seepage likely from perched water was observed at 5 feet bgs during the drilling.



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Mukilteo 5th Street
Bicycle and Pedestrian Improvements
Mukilteo, Washington

BORING:
BH-5

PAGE: 1 of 1

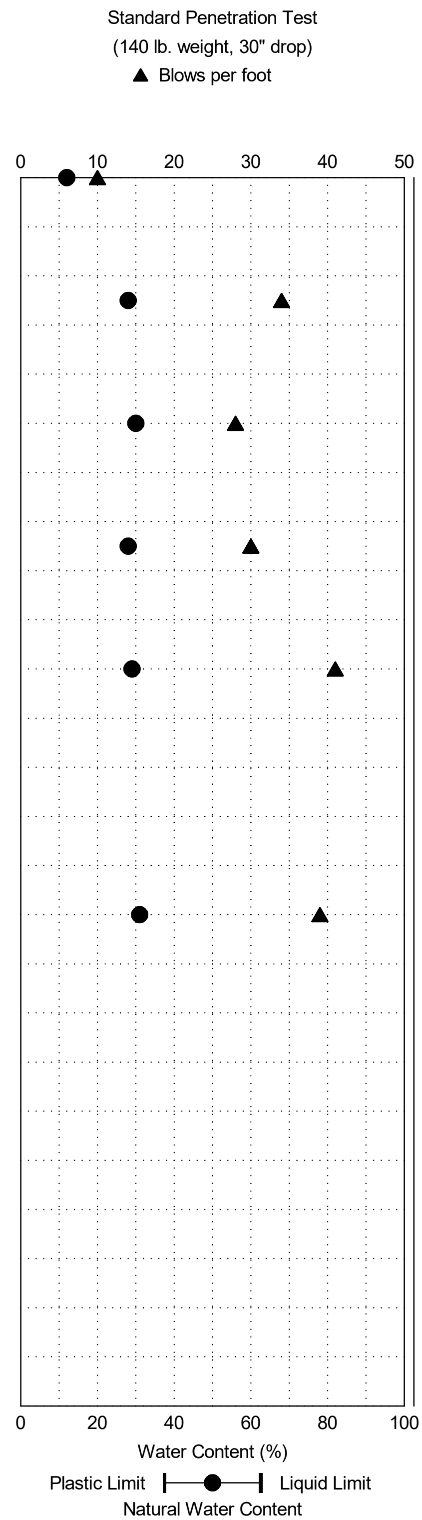
PROJECT NO.: 2020-144-21 FIGURE: A-6

DRILLING COMPANY: Geologic Drill Partners
DRILLING METHOD: HSA with mini-track
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2I

DATE STARTED: 2/1/2022
DATE COMPLETED: 2/1/2022
LOGGED BY: A. Sirjani

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	SM	Loose to medium dense, olive-brown, slightly gravelly, silty, SAND, moist. **(WEATHERED ADVANCE OUTWASH)**	S-1	2-4-6	
	ML	Hard, light olive-brown, slightly sandy, SILT, moist to dry. **(WHIDBEY FORMATION)**	S-2	12-16-18	GS
5			S-3	10-13-15	GS
		Becomes dark gray.	S-4	8-14-16	
10	CL	Becomes olive-gray.	S-5	10-17-24	GS
15		Hard, light gray, lean CLAY, moist to dry.	S-6	10-18-21	
20		Becomes dark gray.			

Boring terminated at 21.5 feet below ground surface (bgs).
Groundwater seepage was not observed during the drilling.



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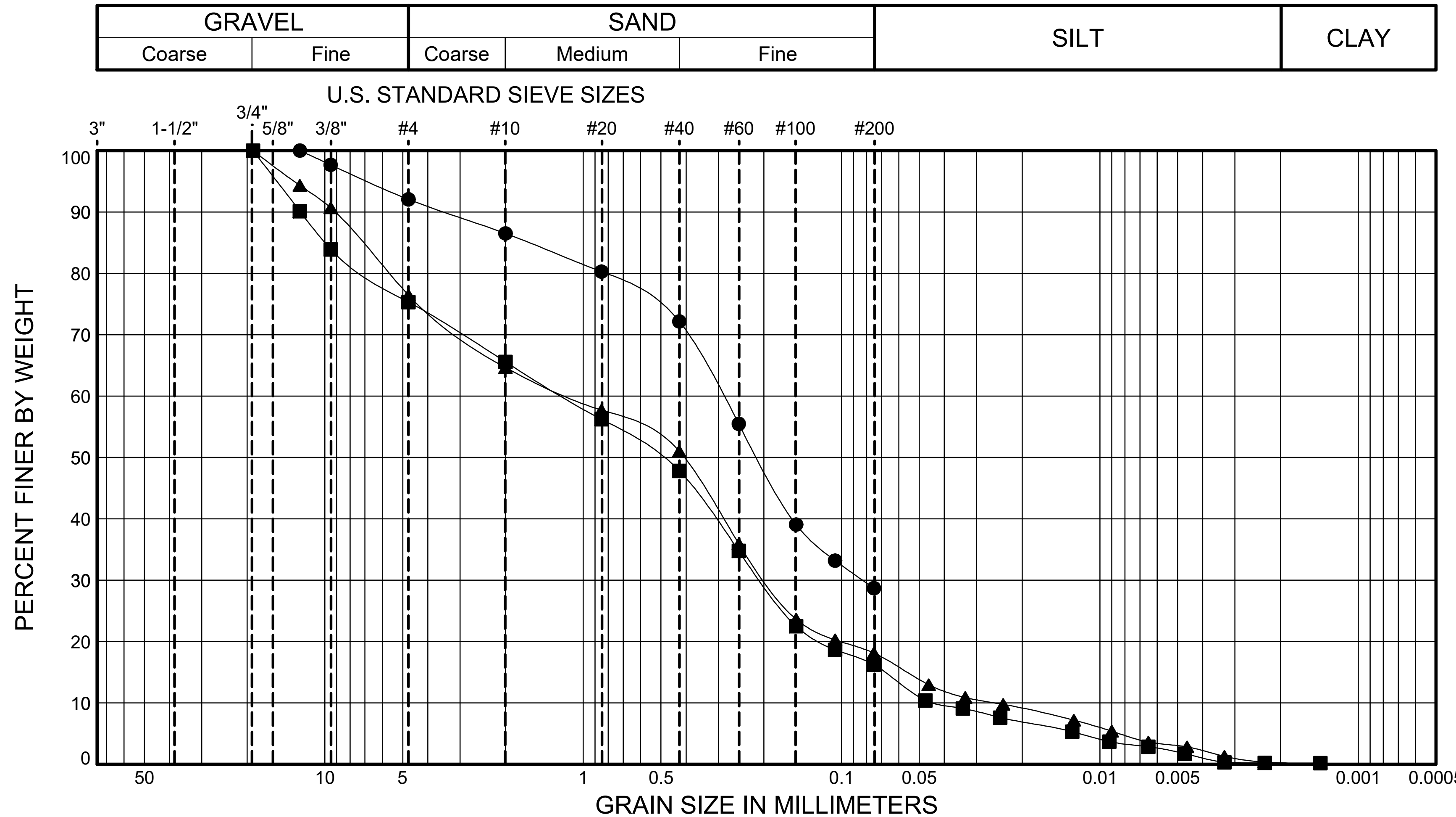
BORING:
BH-6

PAGE: 1 of 1

PROJECT NO.: 2020-144-21 FIGURE: A-7

APPENDIX B

LABORATORY INVESTIGATION



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH-1	S-1	0.0 - 1.5	(SM) Dark grayish-brown, silty SAND	22				7.9	63.4	28.7
■	BH-1	S-3	5.0 - 6.5	(SM) Olive-brown, silty SAND with gravel	11				24.7	59.1	16.2
▲	BH-1	S-4	7.5 - 9.0	(SM) Olive-brown, silty SAND with gravel	11				23.5	58.3	18.1

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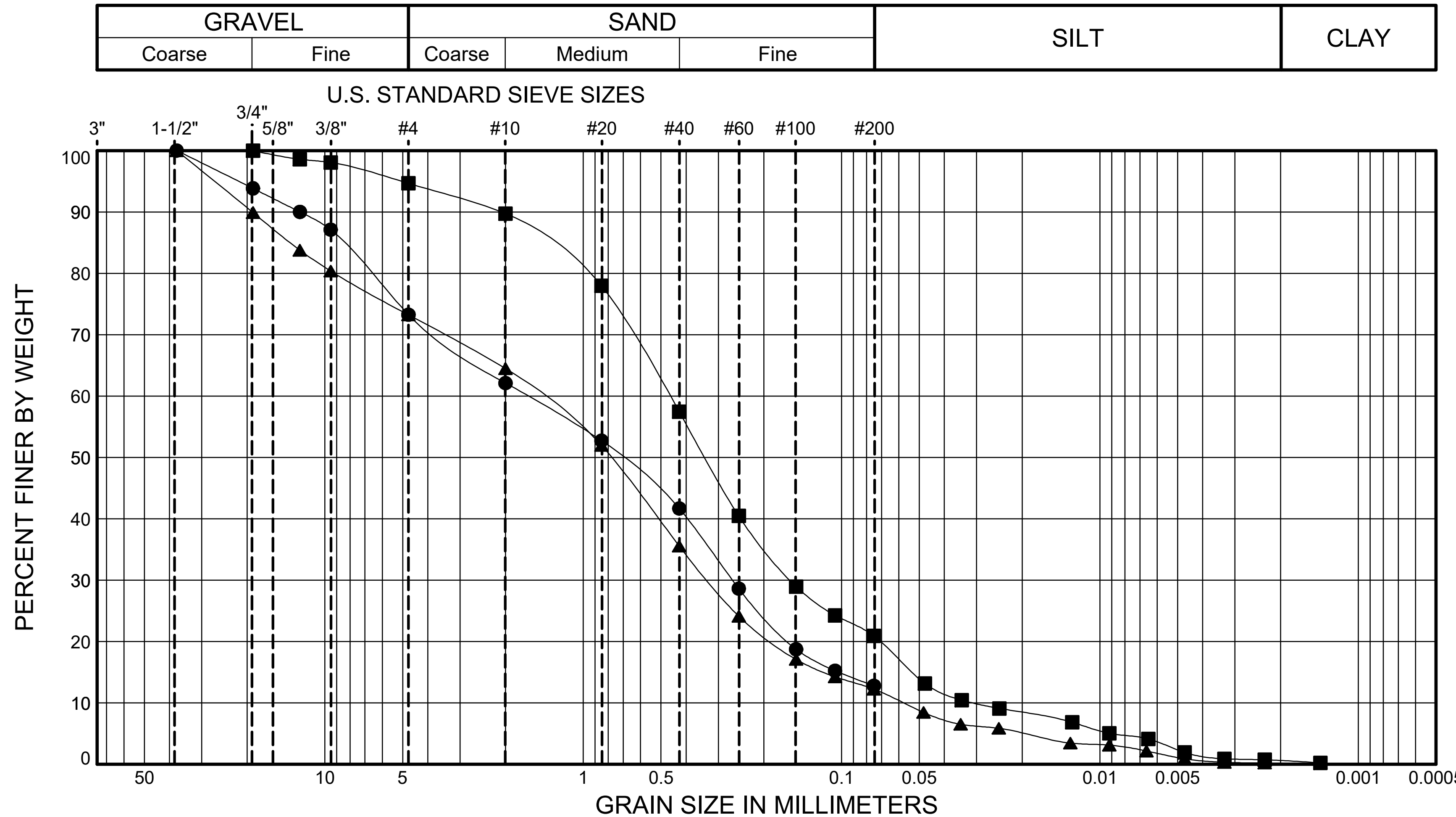
Mukilteo, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2020-144-21 FIGURE: B-1



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH-2	S-1	0.0 - 1.5	(SM) Very dark grayish-brown, silty SAND with gravel	13				26.7	60.5	12.8
■	BH-2	S-3	5.0 - 6.5	(SM) Olive-brown, silty SAND	15				5.3	73.8	20.9
▲	BH-2	S-4	7.5 - 9.0	(SM) Light olive-brown, silty SAND with gravel	13				26.8	61.0	12.2

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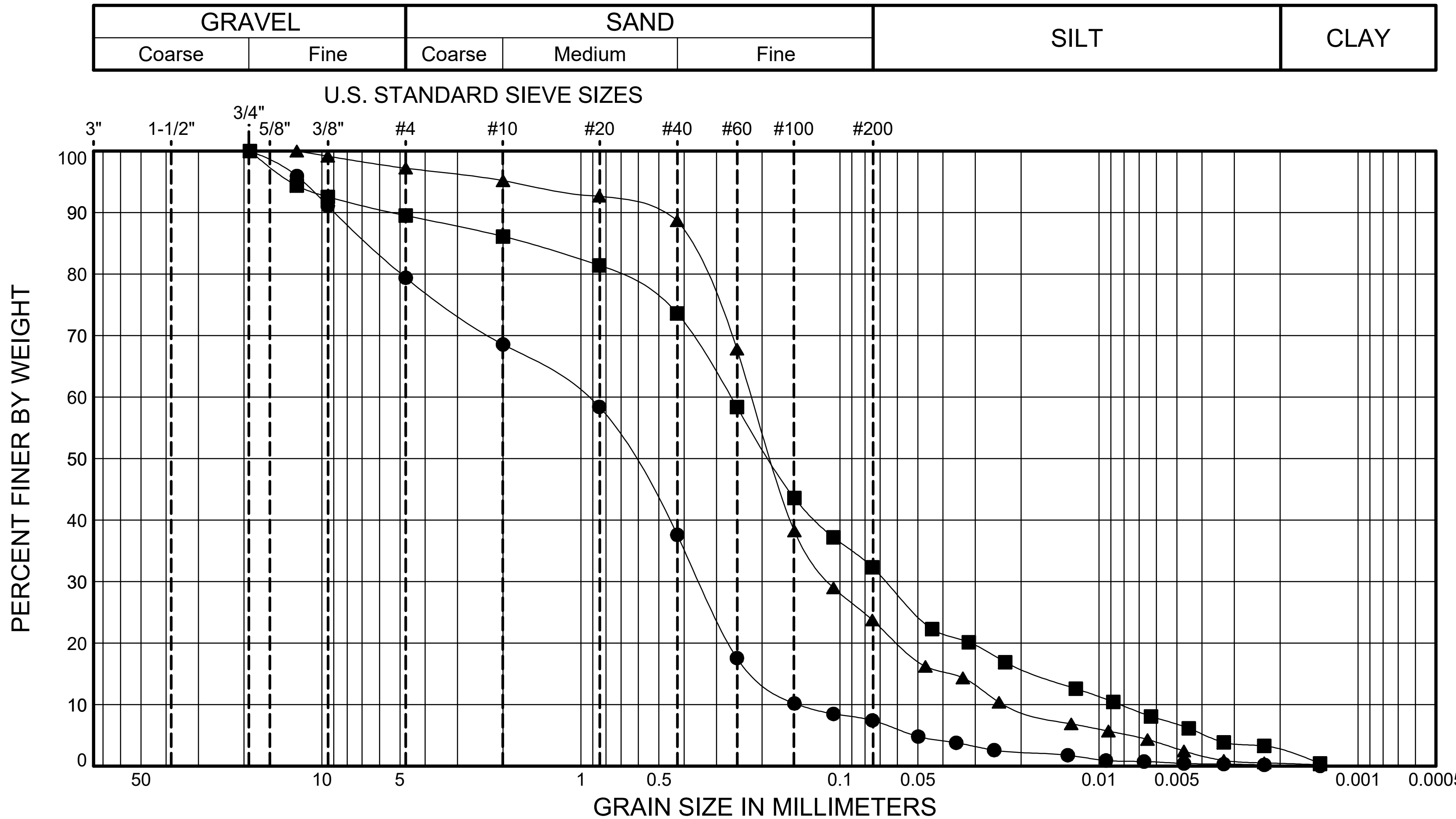
Bicycle and Pedestrian Improvements
Mukilteo, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2020-144-21 FIGURE: B-2



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH-3	S-2	2.5 - 4.0	(SP-SM) Olive-brown, poorly graded SAND with silt and gravel	6				20.6	72.0	7.4
■	BH-3	S-3	5.0 - 6.5	(SM) Olive-gray, silty SAND	13				10.5	57.2	32.3
▲	BH-3	S-4	7.5 - 9.0	(SM) Olive-gray, silty SAND	19				2.8	73.5	23.7

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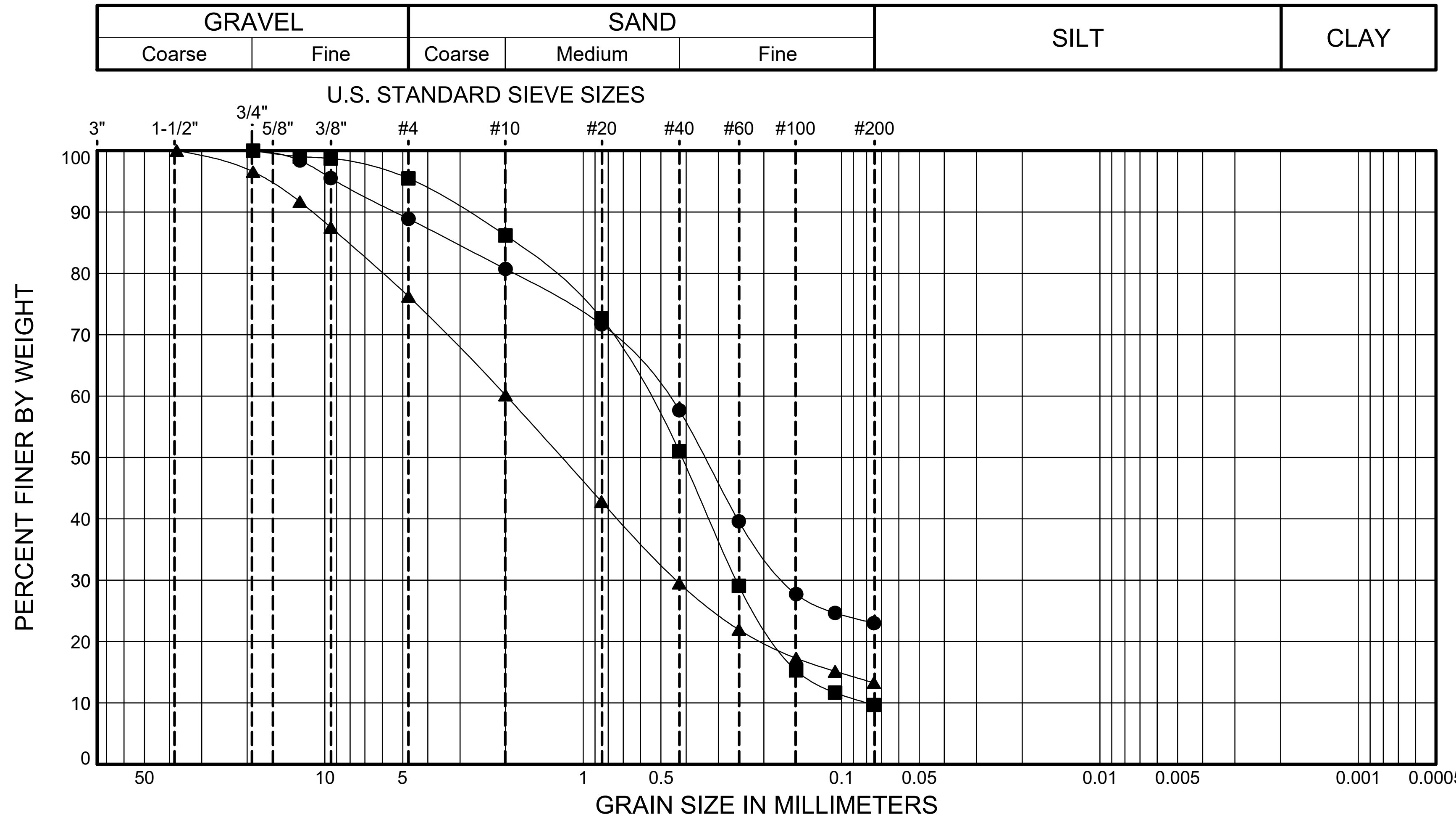
Mukilteo 5th Street
Bicycle and Pedestrian Improvements
Mukilteo, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2020-144-21 FIGURE: B-3



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH-4	S-1	3.0 - 4.5	(SM) Olive-brown, silty SAND	12				11.1	65.9	23.0
■	BH-4	S-2	5.0 - 6.5	(SW-SM) Olive-brown, well-graded SAND with silt	11				4.5	85.8	9.7
▲	BH-4	S-4	10.0 - 11.5	(SM) Dark grayish-brown, silty SAND with gravel	9				23.8	63.0	13.3

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Mukilteo 5th Street
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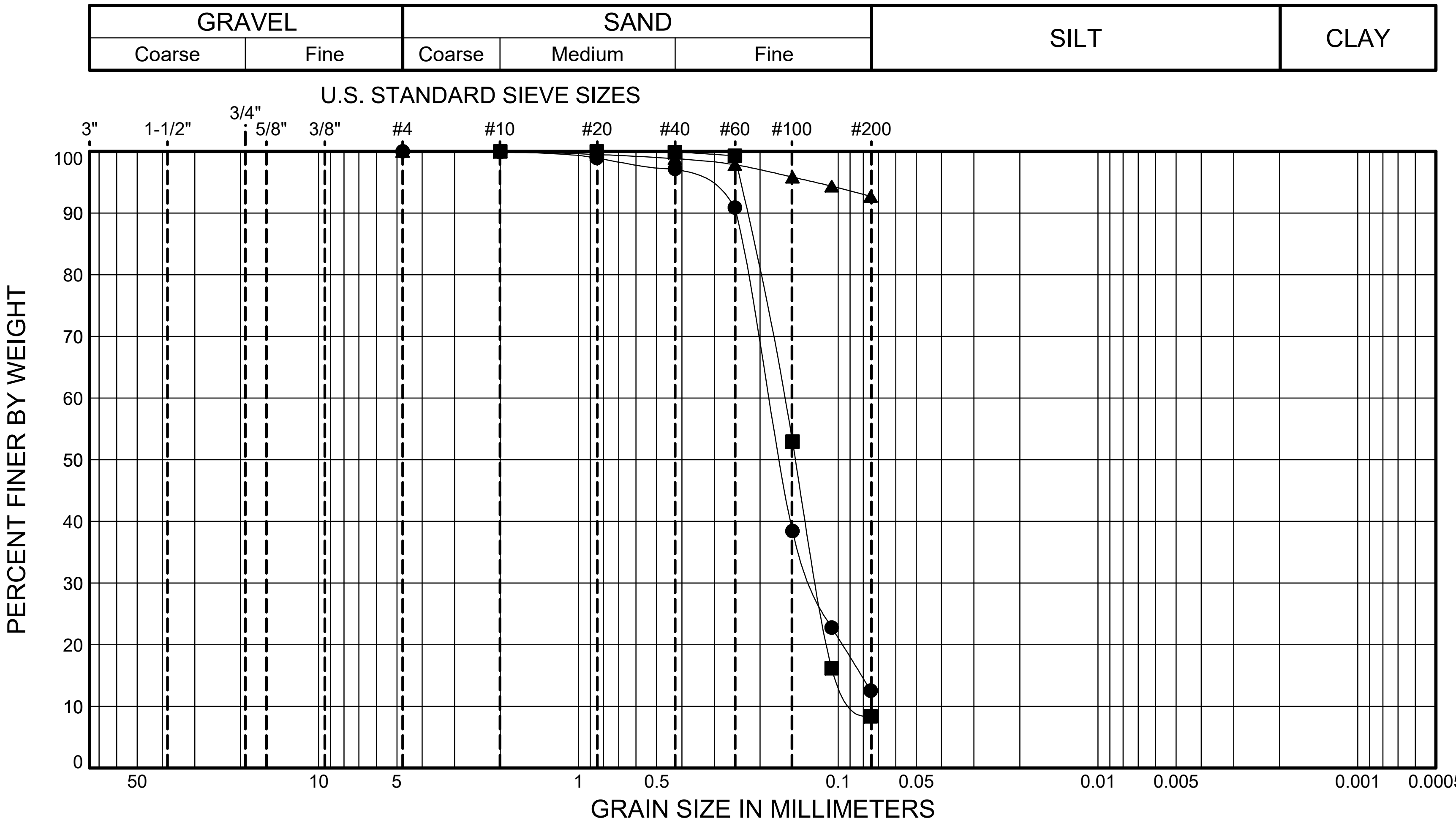
Mukilteo, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2020-144-21 FIGURE: B-4



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH-5	S-2	2.5 - 4.0	(SM) Dark grayish-brown, silty SAND	23					87.5	12.5
■	BH-5	S-3	5.0 - 6.5	(SP-SM) Olive-brown, poorly graded SAND with silt	28					91.6	8.4
▲	BH-6	S-2	2.5 - 4.0	(ML) Olive-brown, SILT	28					7.3	92.7

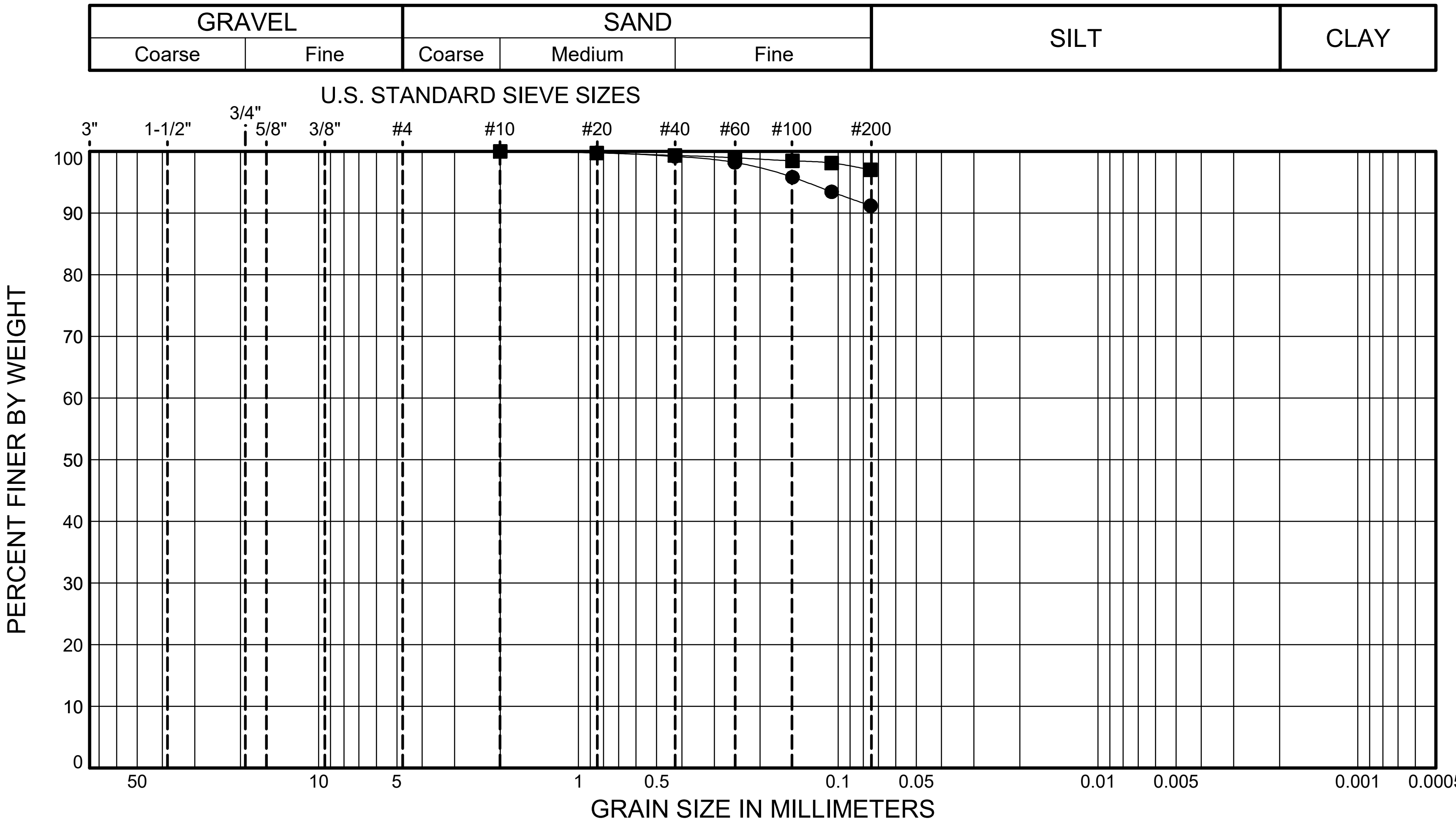
HWA GEOSCIENCES INC.

Mukilteo 5th Street
Bicycle and Pedestrian Improvements
Mukilteo, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

PROJECT NO.: 2020-144-21 FIGURE: B-5

HWAGRSZ 2020-144 - RESTORED FROM 3-7-22 0801.GPJ 3/16/22



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH-6	S-3	5.0 - 6.5	(ML) Olive-brown, SILT	30					8.8	91.2
■	BH-6	S-5	10.0 - 11.5	(CL) Light olive-brown, lean CLAY	29					3.0	97.0

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PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D422

PROJECT NO.: 2020-144-21 FIGURE: B-6