PRELIMINARY GEOTECHNICAL REPORT

Lake Forest Park
Lakefront Improvements
Lake Forest Park, Washington

HWA Project No. 2024-069-21
Facet Reference: 2303.0384.02

Prepared for:
Facet NW, Inc.

September 19, 2025

HWA GEOSCIENCES INC.
DBE/MWBE

Geotechnical Engineering
Pavement Engineering
Geoenvironmental Hydrogeology
Inspection & Testing

September 19, 2025
HWA Project No. 2024-069-21
Facet Reference: 2303.0384.02

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Attention: **Amber Mikluscak, PLA, GISP**
Principal of Landscape Architecture

Subject: **PRELIMINARY GEOTECHNICAL REPORT**
Lake Forest Park
Lakefront Improvements
Lake Forest Park, Washington

Dear Amber:

We are pleased to submit this updated preliminary geotechnical report for the City of Lake Forest Park's Lakefront Improvements project. This draft report includes the logs of our field explorations, laboratory testing results, and geotechnical design recommendations for the design and construction of the proposed improvements for the project.

We appreciate the opportunity to provide geotechnical services on this project. Should you have any questions, please contact us.

Sincerely,

HWA GEOSCIENCES INC.

William R. Rosso, P.E.
Geotechnical Engineer

Steven R. Wright, P.E.
Geotechnical Engineer, Vice President

Enclosure: Lakefront Improvements - Preliminary Geotechnical Report

TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1
1.1 GENERAL 1
1.2 PROJECT DESCRIPTION 1
2.0 FIELD AND LABORATORY TESTING 2
2.1 GEOTECHNICAL SUBSURFACE EXPLORATIONS 2
2.2 LABORATORY TESTING 3
2.3 EXISTING GEOTECHNICAL INFORMATION 3
3.0 SITE CONDITIONS 3
3.1 SITE SURFACE CONDITIONS 3
3.2 GENERAL GEOLOGIC CONDITIONS 4
3.3 SITE SOIL CONDITIONS 5
3.4 GROUNDWATER 6
4.0 GEOTECHNICAL RECOMMENDATIONS 6
4.1 GENERAL 6
4.2 SEISMIC DESIGN 7
4.2.1 Code-Based Seismic Design Criteria Using 2021 International Building Code 7
4.2.2 Seismic Hazards 9
4.2.3 Liquefaction 9
4.2.4 Liquefaction Induced Settlement 10
4.2.5 Liquefaction Induced Lateral Spreading 10
4.2.6 Liquefaction Mitigation 10
4.3 FOUNDATIONS 11
4.3.1 Foundation Options 11
4.3.2 Shallow Mat Foundations 12
Ground Improvements for Mat Foundations 13
Mat Foundation Bearing Capacity 13
Subgrade Preparation for Mat Foundations 14
Construction Considerations for Mat Foundations 14
4.3.3 Driven Piles 14
Foundation Piles Vertical Capacity 15
Vertical Capacity Group Reduction Factors 15
Lateral Driven Pile Design Parameters 15
Driven Pile Construction Recommendations 17
Driven Pile Verification Testing 18
4.3.4 Temporary Support Piles 19
4.3.5 Diamond Piers 19
4.3.6 Utility Connections 19
4.4 STORMWATER INFILTRATION 20
4.4.1 Feasibility 20

4.5 PAVEMENT DESIGN 20
4.5.1 Pavement Subgrade 20
4.5.2 New Hot Mix Asphalt (HMA) Pavement Design 21
4.5.3 HMA Design Considerations 21
4.5.4 HMA Binder Selection 22
4.5.5 Placement of HMA 22
4.5.6 Drainage 23
4.6 EARTHWORK 23
4.6.1 Temporary Excavation Slopes 23
4.6.2 Dewatering 23
4.6.3 Structural Fill 24
4.6.4 Backfill and Compaction 24
4.6.5 Wet Weather Earthwork 25
5.0 CONDITIONS AND LIMITATIONS 26
6.0 REFERENCES 28

LIST OF TABLES (IN TEXT)

Table 1: Design Seismic Coefficients for IBC 2021
Table 2: Qualitative Seismic Hazard Assessments
Table 3: LPILE Parameters for Static Conditions based on HWA-3-24
Table 4: LPILE Parameters for Liquefied Conditions based on HWA-3-24
Table 5: P-Multipliers for Center-to-Center Spacing of 2.0 Pile Diameters
Table 6: P-Multipliers for Center-to-Center Spacing of 3.0 Pile Diameters

LIST OF FIGURES (FOLLOWING TEXT)

Figure 1 Site and Vicinity Map
Figure 2 Site and Exploration Plan
Figures 3A and 3B Geologic Cross Sections
Figure 4 Groundwater Monitoring Data

APPENDICES

Appendix A: Field Exploration

Figure A-1 Legend of Terms and Symbols Used on Exploration Logs
Figures A-2 – A-6 Logs of Borings HWA-1p-24 through HWA-5p-24

Appendix B: Laboratory Testing

Figures B-1 – B-4 Summary of Material Properties
Figures B-5 – B-17 Particle-Size Analysis of Soils
Figure B-18 Liquid Limit, Plastic Limit and Plasticity Index of Soils

Appendix C: Existing Information

PRELIMINARY GEOTECHNICAL REPORT
LAKE FOREST PARK
LAKEFRONT IMPROVEMENTS
LAKE FOREST PARK, WASHINGTON

1.0 INTRODUCTION

1.1 GENERAL

This preliminary geotechnical report provides general representations of the subsurface conditions anticipated at the proposed site for the City of Lake Forest Park's Lakefront Improvement Project (project), and also summarizes the preliminary results of the geotechnical study and geotechnical analysis performed by HWA Geosciences Inc. The approximate site location for the proposed improvements is shown on the Site and Vicinity Map, **Figure 1**. The baseline statements in this report are not applicable to other alternate locations for the project features. This report will be updated prior to finalization for future building permits based on plans provided to HWA for review, as needed.

1.2 PROJECT DESCRIPTION

The project encompasses three neighboring properties currently owned by the City of Lake Forest Park (City) on the shoreline of Lake Washington, located just east of Bothell Way Northeast (SR 522) and Ballinger Way Northeast. The properties include the Lyon Creek Waterfront Preserve and two former-residential parcels to the northeast of the preserve. The residential properties are developed with a number of residential structures that were part of a campground operated by the previous owners.

Our understanding is that the City has a strong desire to preserve the history of the property, and the project team intends for the overall design of the park to conserve some of these residential properties so that they can be used by the public. The properties that cannot be reused are to be deconstructed and their building materials are to be preserved, where possible, as part of the early works project. The remaining structures are anticipated to be retrofitted as part of the project. The project is also anticipated to consist of constructing new pavements, luminaries, small shelter and restroom structures, viewing platforms, and a new dock.

HWA's scope of services in support of the proposed project included a desktop study to review available information, conducting a geotechnical field exploration program, geotechnical laboratory testing, geotechnical engineering analyses, and an evaluation of the geotechnical risks and hazards at the site. This information was used to support developing recommendations for rehabilitation, retrofit, and/or reconstruction of the existing structures and for the construction of new improvements. This report includes summaries of the data collected and our recommendations, as well as figures and graphics to support the presentation of our findings.

2.0 FIELD AND LABORATORY TESTING

2.1 GEOTECHNICAL SUBSURFACE EXPLORATIONS

HWA completed a field subsurface investigation program that consisted of five geotechnical soil borings at the project site, designated HWA-1p-24 through HWA-5-24. These explorations follow an exploration and sample identification system established by HWA. For example, in exploration HWA-1p-24, "HWA" denotes that the exploration was advanced by HWA GeoSciences, "1" denotes the exploration number, "p" denotes that a monitoring well piezometer was installed within the exploration, and "24" denotes the year the exploration was completed. The locations of these explorations are shown on the Site and Exploration Plan, **Figure 2**.

The explorations were drilled by Geologic Drill Partners, Inc., operating out of North Bend, Washington, under subcontract to HWA, using an Acker Recon drilling rig equipped with Hollow Stem Auger (HSA) tooling. The borings were able to be advanced up to termination depths from approximately 30 to 70 feet bgs. 2-inch diameter PVC monitoring well piezometers were installed with flush mount covers within HWA-1p-24 and HWA-4p-24. Borings that were not completed as monitoring wells were decommissioned and backfilled with 3/8 inch bentonite chips per Department of Ecology requirements.

Standard Penetration Test (SPT) sampling was performed in each boring at selected depth intervals of between 2½ and 5 feet and the SPT resistance ("N-value") of the soil was logged. SPT was performed using a 2-inch outside diameter split-spoon sampler driven by a 140-pound auto hammer. During the test, a sample was obtained by driving the sampler 18 inches into the soil with the hammer free-falling 30 inches. The number of blows required for each 6 inches of penetration was recorded. If a total of 50 blows was recorded within a single 6-inch interval, the test was terminated, and the blow count was recorded as 50 blows for the number of inches of penetration. This resistance, or N-value, provides an indication of relative density of granular soils and the relative consistency of cohesive soils.

A representative from HWA logged the explorations and recorded pertinent information, including sample depths, stratigraphy, soil descriptions, and groundwater occurrences. Soil samples obtained from the explorations were classified in the field and representative portions were placed in plastic bags, for transport to our Bothell, Washington, laboratory for further examination and testing. Soils were classified in general accordance with the classification system described on Figure A-1 in Appendix A, which also provides a key to the exploration log symbols. The boring logs are presented on Figures A-2 through A-6 in Appendix A.

The stratigraphic contacts shown on the 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 locations reported and, therefore, are not necessarily representative of other locations and times.

2.2 Laboratory Testing

Laboratory tests were conducted on selected samples from the explorations to characterize relevant engineering and index properties of the soils encountered at the site. The laboratory testing program included visual classification of the soil sample by laboratory staff and testing to evaluate the samples natural moisture content, grain size distribution, and Atterberg Limits (plasticity characteristics). The tests were conducted in the HWA laboratory in general accordance with appropriate ASTM International (ASTM) standards. Test procedures are discussed in further detail in **Appendix B**. The test results are presented in **Appendix B** and/or displayed on the exploration logs in **Appendix A**, as appropriate.

2.3 Existing Geotechnical Information

Explorations and reports for projects in the general vicinity were collected by HWA for review prior to conducting the field exploration program. This information was used to support planning the subsurface exploration program, but existing information was not available at the project site.

Most of the information collected was not used to support our geotechnical engineering analysis or recommendations; however, HWA did acquire a copy of a 1964 report developed by Metropolitan Engineers (Metro) for Section 2 of the Kenmore Interceptor. This report included two explorations and a test pile log in the general vicinity of the project site, which provided additional information utilized by HWA to support developing recommendations for the proposed offshore dock platform.

Sources of information obtained and reviewed for this project are listed in **Section 6.0, References** of this report. Copies of pertinent information used by HWA in our study are provided in **Appendix C**.

3.0 SITE CONDITIONS

3.1 Site Surface Conditions

The site is currently split between three lots located at 17337, 17345, and 17347 Beach Drive Northeast (Beach Dr) in Lake Forest Park, Washington.

17337 Beach Dr is the Lyon Creek Waterfront Preserve, which is generally undeveloped or landscaped with various vegetation including small to large trees. The property does include a small asphalt paved parking lot that includes a single paved parking space marked for ADA, which provides access to a gravel trail that generally follows Lyon Creek and includes a bridge and a viewing platform over the creek. The trail leads to a pile supported platform dock at the shoreline that extends about 100 feet onto Lake Washington. The parking lot is located at the northwest corner of the property and is at an elevation of about 26 feet. The site gradually slopes down from the lot along the trail to the shoreline, which is at an elevation of about 19 feet.

17345 and 17347 Beach Dr are the location of the former campground on the east side of the preserve. A fence surrounds the campground property and prevents access from the campground to the preserve. There are currently nine residential structures at this site, which include small cabin type buildings, garages, and a two story residential structure referred to as "the big house." These houses are mostly located on the northern half of the site and the south half of the site is an open grassy area with a single structure on the western boundary. Landscaping at the site includes a gravelly area at the center of the structures to the north, an open grassy area along the shoreline, and numerous small to large bushes and trees. Similar to the preserve, the campground site gradually slopes down from a high elevation of about 25 feet along Beach Dr to a low elevation of about 19 feet along the shoreline of Lake Washington.

Additionally, HWA was made aware that there is at least one underground storage tank located on the western side of "the big house." Based on information provide to us by the City, the tank is estimated to be approximately 500 gallons and is located below the brick walkway between "the big house" and the garage structure to the west.

3.2 General Geologic Conditions

The project is located within the Puget Lowland, which 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 Tenino, 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.

General geologic information specific to the project area was obtained from the *Geologic Map of the Edmonds East and Part of the Edmonds West Quadrangles, Washington* (Minard, 1983). The near-surface deposits in the vicinity of the project are mapped as Alluvium. The alluvium mapped at the site consists of both a young (Qyal) and an older (Qoal) alluvium from the Holocene Epoch. The younger alluvium is described as poorly drained fluvial sediments that consist mostly of sand and gravel with some organic-rich mud around Lake Washington. The older alluvium is described as stratified sand and gravel with some sandy, pebbly, organic-rich silt. Colluvium from land sliding and glacially consolidated soils such as glacial till or advance outwash are mapped in the vicinity of the site.

3.3 SITE SOIL CONDITIONS

Our interpretations of subsurface conditions are based on the results of our field explorations, review of available geologic and geotechnical data, and our experience in similar geologic settings. Borings HWA-1p-24 through HWA-5-24 were drilled to depths up to approximately 70½ feet bgs. The surficial soils encountered during our explorations were generally consistent with the mapped geologic unit (alluvium); however, the soils at deeper depths below the alluvium were glacially consolidated. HWA developed geologic cross sections based on the subsurface information collected from our explorations at the site, which are presented in **Figure 3A** and **Figure 3B**. Brief descriptions of these soil units are presented below in order of deposition, beginning with the most recently deposited.

Fill: Fill was encountered below the ground surface in each of the explorations advanced by HWA at the site. The fill started at the surface and continued up to a depth of approximately 2 to 5 feet bgs. The fill consisted of loose to medium dense sands with varying silt content and medium stiff silts with varying sand content. Organics consisting of dark soil, rootlets, and wood fragments were encountered in this unit at various depths and in various borings.

Alluvium: Alluvium and alluvial soils were encountered beneath the fill in each of the explorations advanced by HWA at the site. The alluvium was encountered just below the fill and generally consisted of loose to dense sands with varying amounts of silt. Soils consistent with both younger and older alluvium were encountered in our borings; however, HWA generally did not distinguish these units as they are similar from a geotechnical engineering perspective at this site. These alluvial soils are a liquefaction hazard at the site as they are not consolidated and were generally encountered below the groundwater table.

Pre-Fraser Deposits: Pre-Fraser Deposits were encountered beneath the alluvium in each of the explorations advanced by HWA at the site. The Pre-Fraser deposits consisted of either hard silt or clay, or very dense sands that appeared to have been glacially consolidated. The unit was encountered below the alluvium at shallower depths, about 30 feet bgs, in HWA-1p-24 near Beach Dr and at deeper depths, about 62 feet bgs, in HWA-3-24 near the Lake Washington Shoreline.

3.4 GROUNDWATER

Groundwater was observed at depths of approximately 1 to 7 feet bgs during drilling. HWA installed groundwater monitoring wells and data logging transducers in borings HWA-1p and HWA-4p. Groundwater monitoring is in progress and the data collected from September to October is presented in **Figure 4**.

The water level in Lake Washington is controlled by the United States Army Corps of Engineers (USACE) and is typically maintained within a 2-foot range between 20.0 feet and 22.0 feet (USACE Datum). Based on the USACE's *Lake Washington Summary Hydrograph* (USACE, 2024), water levels in Lake Washington are typically at their peak in the late spring through summer, from roughly April to August, and reach the lowest levels in the winter, around December to February. Based on this hydrograph, the water level of Lake Washington during the current monitoring period is likely close to the minimum level maintained by the USACE, and the current groundwater data likely represents deeper groundwater levels for the site. HWA anticipates that groundwater will rise to shallower depths over the spring season as the lake is refilled by the USACE.

Based on the current available information, HWA recommends the preliminary high groundwater level be estimated to be approximately elevation 22±2 feet for the site. The site topography gradually slopes down from a higher surface elevation near Beach Drive NE to a lower elevation near the Lake Washington shoreline. The groundwater gradient will vary with the site topography and groundwater levels may range from a few feet below the ground surface (Elev. 24) near Beach Drive NE to within a few inches below the surface (Elev. 20) closer to the Lake Washington shoreline.

The groundwater elevation estimates are based on topographic information provided by Facet to HWA, Lake Washington water levels are based on USACE datum. Groundwater monitoring is in progress and recommendations for the high groundwater elevation will need to be updated after a full year of data has been collected. Groundwater levels at the site are expected to be strongly influenced by the water level in Lake Washington. High groundwater elevations may also vary with weather conditions, particularly during and following the wet season, and may also be influenced by Lyon Creek.

4.0 GEOTECHNICAL RECOMMENDATIONS

4.1 GENERAL

The site is underlain by generally loose to medium dense silty to sandy fill and alluvial soils, and groundwater was observed at shallow depths in our explorations.

Under static conditions, the soils at the site are sufficient to support the proposed improvements. However, due to the presence of unconsolidated and saturated alluvium, risks related to seismic hazards, such as a liquefaction induced settlement and lateral spreading, should be considered high.

To preserve life safety, liquefaction mitigation measures such as ground improvement, mat foundations, or deep foundations will be required for the proposed improvements.

Permeable pavement is unlikely to be feasible due to the shallow groundwater conditions and low permeability of the fill soils at the site.

4.2 SEISMIC DESIGN

We understand that this project will likely be designed in accordance with the 2021 International Building Code (IBC). The IBC requires above-grade structures to be designed for the inertial forces induced by a "Maximum Considered Earthquake" (MCE), which corresponds to an earthquake with a 2 percent probability of exceedance (PE) in 50 years (approximately 2,475-year return period).

4.2.1 Code-Based Seismic Design Criteria Using 2021 International Building Code

The contribution of potential earthquake-induced ground motion from known sources is included in the probabilistic ground motion maps developed by the USGS. Design data based on USGS mapping and analysis are implemented in the 2021 International Building Code (IBC). As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site.

As part of the procedure to evaluate seismic forces, the 2021 IBC (which implements ASCE 7-16) requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile 100 feet below the proposed foundation. Based on the obtained SPT blow counts noted in our explorations and extrapolated to a depth of 100 feet, the site classifies as a site class "D"; however, because the site is underlain by potentially liquefiable soil the site classifies as Site Class "F" as defined in Table 20.3-1 of ASCE 7-16.

Exception in Section 20.3.1 of ASCE 7-16 permits the Site Class to be determined in accordance with Section 20.3 and the corresponding values of Fa and Fv determined from Tables 11.4-1 and 11.4-2 provided the fundamental period of the building (T) is equal to or less than ½ second. Additionally, for sites classifying as site class "D", Section 11.4.8 of ASCE 7-16, Supplement 3, states that a site-specific ground motions hazard analysis is required for Site Class D where values of S1 are greater than or equal to 0.2.

Based on the value of S1 for the site, the above requirement would necessitate performing a site-specific ground motions hazard analysis for this site. However, the exception in section 11.4.8 of ASCE 7-16, Supplement 3, allows for the determination of seismic design parameters without performing a site-specific ground motions hazard analysis if the value of parameter SM1 determined by Equation 11.4-2, of ASCE 7-16, is increased by 50 percent for all applications of SD1 in the standard. Based on this, the values of SM1 and SD1 have been increase by 50 percent in **Table 1**, below.

Should the information used as a basis for this design be incorrect, HWA should be notified to provide appropriate recommendations. The associated probabilistic ground acceleration values and site coefficients for the general site area were obtained from the OSHPD Seismic Design Maps. The risk targeted seismic values and coefficient are presented in Table 1.

Table 1: Design Seismic Coefficients for IBC 2021 Code Based Evaluation for Risk Category II

Period (sec)	Mapped MCE Spectral Response Acceleration (g)		Site Coefficients		Adjusted MCE Spectral Response Acceleration (g)		Design Spectral Response Acceleration (g)		Transition Point	Period (sec)
0.0	PGA	0.537	F_{PGA}	1.100	PGA_M	0.591	-	-	T0	0.195
0.2	S_s	1.265	F_a	1.000	S_{Ms}	1.265	S_{Ds}	0.843	Ts	0.974
1.0	S_1	0.442	F_v	1.858	S_{M1}	1.232	S_{D1}	0.821	TL	6

Notes: *2% Probability of Exceedance in 50 years for Latitude 47.7531° and Longitude -122.2750°*
PGA = Peak ground acceleration
F_{PGA} = PGA site coefficient
PGA_M = Maximum considered earthquake geometric mean peak ground acceleration adjusted for Site Class effects
S_S = Short period (0.2 second) Mapped Spectral Acceleration
S_1 = 1.0 second period Mapped Spectral Acceleration
S_{MS} = Spectral Response adjusted for site class effects for short period = $F_a \bullet S_S$
S_{M1} = Spectral Response adjusted for site class effects for 1-second period = $Fv \bullet S_1$ (increased by 50 percent per the exception in Section 11.4.8 of ASCE 7-16 Supplement 3)
S_{DS} = Design Spectral Response Acceleration for short period =$2/3 \bullet S_{MS}$
S_{D1} = Design Spectral Response Acceleration for 1-second period =$2/3 \bullet S_{M1}$
F_a = Short Period Site Coefficients
F_v = Long Period Site Coefficients
$T_0 = 0.2 \bullet S_{D1}/S_{DS}$
$Ts = S_{D1}/S_{DS}$
T_L = Long Period Transition period

Based on ASCE 7-16 Tables 11.6-1 and 11.6-2, the Seismic Design Category for the site is “D.”

4.2.2 Seismic Hazards

Earthquake-induced geologic hazards typically include land sliding, fault rupture, and liquefaction phenomena and their associated effects (loss of shear strength, bearing capacity failures, settlements, loss of lateral support, ground oscillations, lateral spreading, etc.). **Table 2** presents a qualitative assessment of these issues considering the site class, the subsurface soil properties, the groundwater elevation, and probabilistic ground motions.

Table 2: Qualitative Seismic Hazard Assessments

Liquefaction-Induced Settlement	High	The alluvium and fill soils are susceptible to liquefaction and the potential for liquefaction-induced settlement at the site should be considered high. Liquefaction and liquefaction induced settlement are discussed in greater detail in **Section 4.2.3** and **Section 4.2.4**, respectively.
Slope Stability / Lateral Spreading	Moderate	The site is relatively flat and the potential for land sliding under static or seismic conditions is low. However, there is potential for liquefaction-induced lateral spreading, which is discussed in greater detail in **Section 4.2.5**.
Surface Rupture	Low	There is a mapped trace of the southern Whidbey Island fault zone approximately ¼ mile northeast of the site; however, it is not mapped as crossing the site. Therefore, we consider the potential for fault rupture at the site to be low.

4.2.3 Liquefaction

The groundwater table is generally near the surface at the site and the fill and alluvium is generally comprised of cohesionless loose to medium dense sands or cohesionless soft to medium stiff silts. These soils are typically at a high risk of liquefaction during a seismic event.

Liquefaction is a temporary loss of soil shear strength within saturated, generally cohesionless, unconsolidated soils due to earthquake shaking. Primary factors controlling the development of liquefaction include the intensity and duration of strong ground motions, the characteristics of subsurface soils, in-situ stress conditions and the depth to groundwater. The simplified procedure originally developed by Seed and Idriss (1971), updated by Youd et al 2001, and also by Idriss and Boulanger (2004, 2006, 2008) was used to evaluate the liquefaction susceptibility of the soils at the project site.

Our analyses indicate that the alluvium encountered at the site is likely to liquefy during the design earthquake. The surficial fill soils at the site are generally not likely to liquify as they were generally encountered above the groundwater table and the Pre-Fraser deposits are also unlikely to liquefy as they appear to be sufficiently dense and/or sufficiently cohesive to resist pore pressure build up. The thickness of the alluvium varies across the site and therefore the depth to which liquefaction is anticipated to occur also varies. **Figure 3B** presents a cross section of the soils that appear likely to liquefy during the design earthquake based on current data.

4.2.4 Liquefaction Induced Settlement

The potential for liquefaction-induced settlement was evaluated at each exploration location using methodologies developed by Idriss and Boulanger (2008), which is generally based on the relationship between shear wave velocity, corrected SPT blow counts, cyclic stress ratio, and volumetric strain. Using these methods, we estimate liquefaction induced settlements of approximately 2 to 12 inches could occur across the site following the design seismic event, a magnitude 7.11 earthquake with a return period of 2,475 years (USGS, 2024).

4.2.5 Liquefaction Induced Lateral Spreading

Lateral spreading often occurs due to the loss of soil strength during liquefaction. When the soil is fully liquefied the soil shear strength is at its lowest level, which is referred to as the "residual shear strength." This residual value can represent a significant reduction in shear strength, which in turn can cause a drastic reduction in the resistances available to support a sloped or restrained soil, such as soil restrained by a retaining wall, and manifest as slope failures, lateral spreading events, or as flow failures.

The results of our lateral spreading analysis for the site range from zero to a few inches in the vicinity of Beach Dr to potentially several feet of horizontal movement near the shoreline of Lake Washington and along Lyon Creek. However, our analysis is based on widely spaced borings and displacement estimates under these conditions can vary greatly from one method to another. The actual magnitude of displacement can also be influenced by unknown subsurface and/or offshore topography, soil units or characteristics, and earthquake loading. A lateral spreading event of any magnitude event can result in movement of the partially liquefied soils and/or the overlying crust of non-liquefied soils.

4.2.6 Liquefaction Mitigation

There are a variety of liquefaction mitigation techniques that can be implemented to reduce the severity of liquefaction hazards or to reduce the risks associated with a liquefaction event.

Common liquefaction mitigation techniques to reduce liquefaction hazards can include:

- Cementation of the subsurface soils, such as jet grouting, deep soil mixing, or using microbial technology;
- Densification, such as preloading or dynamic compaction; or,
- Deep ground improvements, such as aggregate piers, Geopiers®, rigid inclusions, stone columns, etc.

Each of these methods are typically used to improve the footprints for large structures or an overall site area, and likely could be used to improve the subsurface across the site. However, they typically require larger shares of a project budget, and costs can be difficult to scale down when limiting the work to smaller specific site areas. Additionally, many of these methods are likely to be incompatible with the City's desire to preserve some of the existing structures at the site.

Common liquefaction mitigation techniques to reduce liquefaction risks can include:

- Deep foundation systems, such as driven or cast-in-place piles; or,
- Shallow ground improvements, such as gravel rafts, mat foundations, or horizontal soil mixed beams.

HWA believes that these options can be used to reduce the risks to life safety while also being generally compatible with the City's desire to preserve some of the existing structures.

Recommendations for these options are discussed in the Foundations section, **Section 4.3**, of this report.

4.3 FOUNDATIONS

4.3.1 Foundation Options

Our understanding is that the City will not require structures at the site to survive the design seismic event, but structures and improvements should be able to preserve life safety. As part of the design process, we have considered different applicable foundation options for the different structures anticipated to be constructed at the site. Each of these foundation types are discussed below.

Shallow Mat Footing Foundation: HWA anticipates up to several inches of liquefaction settlement may occur below structures at the site during a seismic event. This settlement will likely to be differential in nature, which would increase the potential for failures in structures supported by traditional shallow spread footing foundations. Additionally, we understand that there is a large fireplace and chimney within "the big house" that the project team intends to preserve. Liquefaction settlement of any kind can result in total failure or collapse of unreinforced masonry structures, such as chimneys and fireplaces.

We anticipate that shallow foundations with ground improvements will be the most cost effect option for new construction such as the restroom building and other small structures, but we also anticipate that it will be the preferred option for retrofitting existing structures. Shallow ground improvements can be implemented to create a liquefaction resistant "crust" below structures at the site. This crust should help to attenuate the liquefaction settlement and preserve life safety within structures at the site. Tying structures to a mat foundation will improve their overall rigidity and improve their resistance to impacts from liquefaction induced settlement.

Recommendations for shallow mat footings with ground improvements are discussed in **Section 4.3.2**.

Driven Pile Foundations: Driven pile foundations are an alternative deep foundation technique that consists of driving steel or precast concrete piles below the ground surface, and they are commonly used in the area for dock platform foundations. Our understanding is that the design team has chosen driven piles using a vibratory hammer as the preferred foundation system for the proposed dock platform.

Driven piles are feasible at the site, however, vibratory methods may not provide sufficient driving force to advance the piles into the Pre-Fraser deposits, which will be the bearing unit for these piles. Furthermore, based on mapped geology, there is potential for the presence of gravel, cobbles, and boulders, within the subsurface soils that may cause piles to be damaged, pushed out of vertical alignment, or obstructed. Additionally, there is potential for large lateral and downdrag loading at the site due to liquefaction, which must be accounted for in the pile design.

Recommendations for driven pile foundations are discussed in **Section 4.3.3**.

4.3.2 Shallow Mat Foundations

HWA anticipates up to several inches of liquefaction-induced settlement may occur below structures at the site during a design seismic event. Mat foundations are more resistant to damage from differential settlement compared to traditional spread footing foundations. In addition to mat foundations, HWA recommends a ground improvement program be implemented, where feasible, below the proposed structures.

Ground Improvements for Mat Foundations

Recent research by the Earthquake Commission (EQC, 2015) indicates that the greater the depth to liquefying soils, the lesser the effects observed at the surface. The severity of damage from liquefaction generally depends on the strength and the thickness of the non-liquefiable "crust" at the ground surface, which can attenuate settlement and act as a protective raft for lightly loaded structures. Liquefiable soils are anticipated at shallow depths at the Lakefront site, starting at the groundwater table and continuing to depths of between approximately 15 to 60 feet below the ground surface, as shown on **Figure 3B**.

HWA recommends that shallow ground improvements be utilized below mat foundations for new construction and, where possible, below the existing structures to be retrofitted at the Lakefront site. These ground improvement options may consist of either Controlled Density Fill (CDF) or Crushed Surface Base Course (CSBC) reinforced with geogrid. Where CSBC is utilized, it should be reinforced with geogrid, such as Tensar InterAx NX 850, which should first be placed at the base of the excavation on the existing soils and then every foot thereafter.

We recommend ground improvements extend at least 2 feet below the base of mat foundations for all structures and extend horizontally by 1 foot for every foot of total excavation depth. CDF is recommended where excavations are anticipated to reach the groundwater table. CDF and CSBC should conform to the recommendations in **Section 4.4.4**

Mat Foundation Bearing Capacity

We anticipate that the maximum total load combination at each foundation will be on the order of 100 kips or less and have used this information to develop our recommendations. If the anticipated final loading for the foundations exceeds 100 kips at any of the foundations, we should be contacted to review our recommendations. Our foundation recommendations were developed using the allowable strength design method as outlined by the 2021 IBC.

Mat foundations should have a minimum thickness of 12-inches, and they should be embedded a minimum 12 inches below finished grade for frost protection in heated structures; foundations for non-heated structures should be embedded 18 inches below the ground surface. Where ground improvements are not utilized, mat foundations should be placed over a 1-foot-thick leveling pad comprised of CSBC. The CSBC for the leveling pad should be placed as structural fill following the recommendations in **Section 4.6.3** and extend a minimum of 1 foot in each direction beyond the perimeter of the mat foundation.

Mat foundations bearing on improved ground such as compacted structural fill or CDF can be designed assuming a maximum allowable bearing pressure of 2,000 pounds per square foot (psf) or a modulus of subgrade reaction of approximately 500 pounds per cubic inch (pci). Mat foundations bearing on the existing soils can be designed assuming a maximum allowable bearing pressure of 500 psf and a modulus of subgrade reaction of 150 pci. The allowable bearing values represent factored capacities using a factor of safety of 3.

Assuming construction is accomplished as recommended herein, we anticipate that a majority of settlement will occur during construction as the loads are applied. We estimate that the total settlements of the foundations of less than 1 inch and differential settlements between adjacent load-bearing components of less than ½ inch under static conditions.

Subgrade Preparation for Mat Foundations

We recommend a representative from HWA be present during excavations and subgrade preparation to evaluate the exposed subgrade and verify that the assumptions made for design of mat foundations are met.

Foundation excavations should limit disturbance. Where excavations will be conducted using machinery, excavating equipment should employ a smooth edge (toothless) bucket. The exposed existing soil at the base of excavations should be compacted and inspected by a representative from the geotechnical engineer, or a qualified earthworks inspector, prior to placement of ground improvements or structural fill below foundation elements.

Construction Considerations for Mat Foundations

Due to the high groundwater table, we recommend that excavations for foundations take place in the late summer to early fall. It may be feasible to perform earthwork related to constructing foundations during wet weather or wetter seasons; however, due to the proximity to Lake Washington, achieving a fully dewatered excavation is expected to be extremely challenging, if not impossible, for excavations attempting to extend below the groundwater table. Excavations that are anticipated to extend below the groundwater table should be prepared to be conducted in saturated conditions and sloped appropriately, or dewatered.

4.3.3 Driven Piles

It is our understanding that the project team intends to utilize tubular steel pipe piles to support the proposed offshore dock structure. Due to the anticipated depths of liquefaction, the existing fill and alluvium generally will not provide sufficient axial and lateral capacity for these piles. Piles will therefore need to be embedded into the Pre-Fraser deposits, which could be challenging due to the high relative density/consistency of these soils.

Foundation Piles Vertical Capacity

The design team may assume a maximum ultimate axial capacity of 60 kips for 12-inch diameter open ended steel pipe piles for static and seismic conditions, provided the recommendations within this report are followed. This capacity assumes that the piles are able to be embedded a minimum of 5 feet into non-liquefiable soils using an impact hammer and that a soil plug forms within the driven piles or they are backfilled with a suitable material such as concrete.

This ultimate axial capacity has also been reduced to account for downdrag loading caused by liquefaction, which we estimate may be up to approximately 270 kips. We have assumed that the piles can be driven with an impact hammer and that a CAPWAP analysis can be performed; therefore, we recommend a minimum factor of safety of 2 be applied to this ultimate capacity. If different pile diameters are anticipated to be used or the piles cannot be driven with an impact hammer, HWA should be contacted to provide revised recommendations for vertical capacity and the factor of safety. If the piles cannot be driven with an impact hammer, we anticipate that the axial capacity will decrease and that the factor of safety will increase.

Piles used at the site should be free from any obvious defects. Due to the density of the Pre-Fraser deposits, we recommend that all foundation piles be designed as thick-walled piles, with a minimum side wall thickness of 5/8 inches. Due to these dense conditions the ends of the piles will likely also need to be equipped with a drive shoe.

Vertical Capacity Group Reduction Factors

For pile spacing of 3 pile diameter or larger a group reduction factor (η) of 1.0 should be used. If the piles must be more closely spaced, group reduction factors can be provided.

Lateral Driven Pile Design Parameters

Based on our liquefaction analysis, lateral loading on the dock piles is anticipated to be high. Design for lateral resistance can be performed using LPILE to model and evaluate the response of plumb piles subjected to lateral loading. Soil parameters for use in LPILE analyses are provided in **Table 3** and **Table 4**. These soil parameters may be used with LPILE for lateral structural analysis and design of the pile caps. Parameters are provided for static and post liquefaction conditions.

Liquefiable soil is anticipated to be present at the site and liquefaction induced settlement is anticipated. Based on our review of the 70 percent draft set of plans, grading for the park is anticipated to be minimal and the site is anticipated to remain relatively flat. Therefore, the risk of liquefaction induced lateral spreading is anticipated to be low at this site.

Table 3: LPILE Parameters for Static Conditions based on HWA-3-24

Soil Layer	Soil Type (p-y model)	Top of Layer (ft)*	Bottom of Layer (ft)	Effective Unit Wt, γ′ (pcf)	Friction Angle (deg)	Undrained Cohesion, C (psf)	p-y Modulus Static, k (pci)	Strain Factor, ε_{50} (dim)
Fill	Sand (Reese)	0.0		110	30	--	90	--
			2.0	110	30	--	90	--
Fill (Below Groundwater)	Sand (Reese)	2.0		50	30	--	60	--
			3.0	50	30	--	60	--
Younger Alluvium (Below Groundwater)	Sand (Reese)	3.0		60	32	--	60	--
			15.0	60	32	--	60	--
Older Alluvium (Below Groundwater)	Sand (Reese)	15.0		60	36	--	60	--
			60.0	60	36	--	60	--
Pre-Fraser (Below Groundwater)	Stiff Clay w/ Free Water (Reese)	60.0		80	--	2000	1000	0.005
			70.0	80	--	2000	1000	0.005
Pre-Fraser (Below Groundwater)	Sand (Reese)	70.0		80	40	--	225	--
			71.0	80	40	--	225	--

Table 4: LPILE Parameters for Liquefied Conditions based on HWA-3-24

Soil Layer	Soil Type (p-y model)	Top of Layer (ft)*	Bottom of Layer (ft)	Effective Unit Wt, γ′ (pcf)	Friction Angle (deg)	Undrained Cohesion, C (psf)	p-y Modulus Static, k (pci)	Strain Factor, ε_{50} (dim)
Fill	Sand (Reese)	0.0		110	30	--	60	--
			2.0	110	30	--	60	--
Fill (Below Groundwater)	Liquefied Sand (Rollins)	2.0		50	--	--	20	--
			3.0	50	--	--	20	--
Younger Alluvium (Below Groundwater)	Liquefied Sand (Rollins)	3.0		60	--	--	20	--
			25.0	60	--	--	20	--
Older Alluvium (Below Groundwater)	Sand (Reese)	25.0		60	36	--	60	--
			35.0	60	36	--	60	--
Older Alluvium (Below Groundwater)	Liquefied Sand (Rollins)	35.0		60	--	--	20	--
			40.0	60	--	--	20	--
Older Alluvium (Below Groundwater)	Sand (Reese)	40.0		60	36	--	60	--
			50.0	60	36	--	60	--
Older Alluvium (Below Groundwater)	Liquefied Sand (Rollins)	50.0		60	--	--	20	--
			60.0	60	--	--	20	--
Pre-Fraser (Below Groundwater)	Stiff Clay w/ Free Water (Reese)	60.0		80	--	2000	1000	0.005
			70.0	80	--	2000	1000	0.005
Pre-Fraser (Below Groundwater)	Sand (Reese)	70.0		80	40	--	225	--
			71.0	80	40	--	225	--

The p-y curves generated by the lateral parameters provided must be modified by the applicable p multipliers to account for the group reduction effects. The p multipliers for pile spacing of 2 and 3 pile diameters are provided in **Table 5** and **Table 6**.

Table 5:
P-Multipliers for Center-to-Center Spacing of 2.0 Pile Diameters

Row	P-Multiplier
1	0.45
2	0.33
3 or more	0.25

Table 6:
P-Multipliers for Center-to-Center Spacing of 3.0 Pile Diameters

Row	P-Multiplier
1	0.80
2	0.40
3 or more	0.30

P-multipliers will vary for other pile spacing and can be provided upon request. The same p-multiplier factor should be applied parallel and perpendicular to the group pile alignment. If the piles are closely spaced, less than 3 pile diameters, HWA should be contacted to provide specific recommendations regarding pile spacing and group effects.

Driven Pile Construction Recommendations

All pile installation operations should be observed by a representative of the geotechnical engineer, or a qualified earthworks inspector, to verify that the pile design criteria and intent are satisfied.

We estimate that the termination depths for piles will be encountered on the order of 50 to 60 feet below the ground surface based on HWA-3-24 and offshore testing data from Metropolitan Engineers (Metro, 1964). HWA did not perform offshore drilling to evaluate subsurface conditions and delays associated with ordering additional pile length can be costly. Based on the level of uncertainty in the available data we recommend that at least 10 additional feet of pile be assumed in the contract documents to account for potential variations in the stratigraphy of the subsurface.

Our understanding is that use of a vibratory hammer, also known as vibro-piling or vibro-driving, to advance piles is the preferred method of installation for the piles. We anticipate that this method will be sufficient for advancing piles through the fill and alluvial soils and will also have the added benefit of densifying the soils around the piles. However, the Pre-Fraser deposits are glacially overridden and are very dense, and a vibratory hammer is unlikely to be able to advance the piles to a sufficient embedment depth. Soil plugs frequently form within open ended piles during installation and the soil plug may need to be periodically removed during driving. The soil within the pile can likely be pumped out, or augured out, from within the piles. This will lower the overburden pressure on the soils at the base of the pile, which should generate uplift pressures to loosen the native soils and assist with advancing the piles. If the soil plug is removed, the pile will need to be backfilled with concrete to achieve the full design capacity.

Driven piles can be impacted by the presence of cobbles, boulders, previous pier foundations, or other obstructions. Pile driving may be obstructed by these buried obstructions and crumple or deflect and continue to be driven in an unintended direction. The contractor should monitor pile driving for these conditions, piles that have been driven more than 10 feet beyond the anticipated tip elevation may have been damaged or deflected, and they should be evaluated by the structural and geotechnical engineer. To the extent that any of these conditions may exist at this site, provisions should be made in the contract documents to deal with potential obstructions during pile driving.

Driven Pile Verification Testing

The capacity of piles that are driven at the site should be verified based on dynamic pile driving methods, such as the Wave Equation Analysis Program (WEAP). The WEAP evaluation should be performed by the geotechnical engineer after the pile lengths, pile driving hammer, cushion, and pile cap block have been selected by the contractor. WEAP should be performed for each size of pile used for the project, if applicable, and for any modifications to the pile driving equipment or procedures, if they have a bearing on the results.

We recommend a minimum of two production piles be equipped with high-strain dynamic testing equipment with a Pile Driving Analyzer (PDA). CAPWAP analyses of the dynamic testing data should be performed on data obtained from the driving of all test piles. Piles should be tested immediately after driving and again at least 24 hours after driving; re-strikes and additional testing may be necessary to achieve design ultimate capacities. We recommend that the contractor submit a pile testing program for review prior to the start of work.

4.3.4 Temporary Support Piles

We understand that small diameter pin piles may be used to supplement or support the existing structures while they are being retrofitted. The design team may assume allowable axial capacities of up to 4 kips for 2-inch diameter pin piles and up to 10 kips for 3-inch pin piles. Pin piles should be driven until refusal within the Pre-Faser deposits, which we anticipate will be on the order of 30 to 45 feet below the surface. HWA does not recommend pin piles be used to provide permanent foundation support as they will not provide sufficient lateral resistance in a liquefaction event.

4.3.5 Diamond Piers

We understand that the design team is considering the use of Diamond Pier foundations for the proposed viewing platforms at the site. We anticipate that the viewing platforms will be wooden or composite decks with short railings and possibly small bench seating areas. Diamond Pier foundations use a precast concrete head to lock in four galvanized steel pins to transfer loading from the structure to a larger area of soil compared to a traditional precast spread footing of similar size.

Diamond piers are unlikely to provide sufficient foundation support to preserve these structures in the event of a seismic event, however, for these lightly loaded deck structures they should be suitable to preserve life safety provided the surface of the platform area is less than 4 feet above the surrounding ground and the platforms have no overhead features, such as roofs or pergolas. HWA recommends that the existing ground be recompacted with a heavy vibratory roller prior to installing the Diamond Piers. Ground improvement discussed for the shallow mat foundations could also be implemented to strengthen the surficial soils prior to installing the Diamond Piers.

4.3.6 Utility Connections

Utilities will need to tolerate settlement of the structures. Flexible above grade utilities connected to structures should be evaluated to assess if they can accommodate the anticipated rapid settlement induced by liquefaction at the site. Below grade utilities will need to tolerate potential differential settlement along the utility alignment, as well as at the connections to the structures at the site. HWA recommends that the design team plan for the use of flexible piping, flexible connections, or automatic shutoffs as appropriate.

4.4 STORMWATER INFILTRATION

4.4.1 Feasibility

The near surface soil conditions at the site have a very high fines content, which is not conducive to infiltration. Groundwater was also observed at shallow depths ranging from approximately 2 to 6½ feet below the ground surface between September and October. Based on historical trends, these values likely represent deeper groundwater levels and it is anticipated that the groundwater level at the site will rise to a shallower seasonal high over the winter and through the spring season.

Section 5.2 of the 2021 King County, Washington Surface Water Design Manual provides guidance for various types of infiltration facilities such as ponds, tanks, vaults, or trenches. These facilities generally require 3 feet of separation between the groundwater table and the base of the facility, which is unlikely based on the current groundwater readings. Additionally, a groundwater mounding analysis is generally required for infiltration facilities that have less than 15 feet of separation.

Our understanding is that the design team is also considering the use of permeable pavements for the project. Section C.2.7 of the King County, Washington Surface Water Design Manual states that permeable pavement only requires 1 foot of separation from the bottom of the base course for the pavement section. However, field testing to evaluate infiltration rates would be required to verify feasibility and based on the grain size data for the near surface soils, HWA does not anticipate that the infiltration rate for the soils will meet or exceed the minimum required rate of 3.0 inches per hour.

It is our experience that permeable pavements in the region typically become clogged and stop infiltrating within only a few years after construction, even with continuous maintenance. The pores of permeable pavements are often clogged with moss that grows over time or detritus such as trash, leaves, pine straw, or other "road grime." Furthermore, the use of permeable pavement for a pollution generating surface such as a parking lot represents an increased risk of contamination to Lake Washington.

4.5 PAVEMENT DESIGN

4.5.1 Pavement Subgrade

Subgrade preparation for pavement, sidewalks, ramps, curbs and other improvements founded at grade should begin with the removal of all existing pavement, topsoil, deleterious material, 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 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 soil should be evaluated by the geotechnical engineer using a T-handled probe.

4.5.2 New Hot Mix Asphalt (HMA) Pavement Design

The proposed project will include automobile parking and driveway pavements consisting of Hot Mix Asphalt (HMA) surfacing. Anticipated traffic loading was not provided to HWA, we have assumed HMA pavement sections could be exposed to typical automobile traffic and occasional heavy truck traffic but will not be exposed to bus and/or transit loop traffic.

We recommend that the asphaltic layers consist of HMA Class ½-inch, and base course consist of CSBC meeting the requirements specified in Section 9-03.9(3) of the WSDOT *Standard Specifications* (WSDOT, 2024). The upper 2 inches of the CSBC layer could be replaced with CSTC if desired.

Standard Duty HMA Pavement – Automobile Parking Areas and Areas Subject to Occasional Heavy Truck Traffic

- 6 inches (minimum) HMA Class ½ inch.
- 6 inches (minimum) of CSBC.
- Subgrade consisting of existing site soils prepared as described in **Section 4.5.1.**

4.5.3 HMA Design Considerations

The following design considerations should be noted and implemented:

- The longitudinal joints in the HMA wearing course should coincide with a line lane or an edge line.
- When pavement reconstruction is called for in conjunction with the HMA overlay, construction of the wearing course for both the HMA overlay and reconstruction areas should be placed as the final stage of the paving operation.

- The HMA will likely require a functional overlay after about 17 years because of non-structural associated distress caused by environmental factors such as degradation of the asphalt surface.

4.5.4 HMA Binder Selection

The selection of the optimum asphalt binder type for the prevailing climate is critical to ensure long-term pavement performance. Use of the wrong binder can result in low temperature cracking or permanent deformation at high temperatures.

Based on the climate in Lake Forest Park, we recommend Superpave Performance Grade binder PG 58H-22 be used for new HMA.

4.5.5 Placement of HMA

Placement of HMA should be in accordance with Section 5-04 of the *WSDOT Standard Specifications* (WSDOT, 2024). Particular attention should be paid to the following:

- HMA should not be placed until the engineer has evaluated and approved the surface following grinding. In some areas, deeper grinding may be required due to distresses observed in the layer after initial grinding.

- HMA should not be placed on any frozen or wet surface.

- HMA should not be placed when precipitation is anticipated before the pavement can be compacted, or before any other weather conditions that could prevent proper handling and compaction of HMA.

- HMA should not be placed when the average surface temperatures are less than 45° F.

- HMA temperature behind the paver should be in excess of 240° F. Compaction should be completed before the mix temperature drops below 180° F. Comprehensive temperature records should be kept during the HMA placement.

- Sufficient tack coat must be applied uniformly and allowed to break and set before placing HMA above an existing HMA layer in order to create a strong bond between layers. The surface of the pavement should be thoroughly cleaned prior to tack coat application. Improper tack coat application can cause unbonded layers and will lead to premature pavement distress/failure.

- For cold joints, tack coat should be applied to the edge to be joined, and the paver screed should be set to overlap the first mat by 1 to 2 inches.

4.5.6 Drainage

For HMA pavements, it is essential to the satisfactory performance of the roadway that good drainage is provided to prevent water ponding on or alongside, or accumulating beneath, the pavement. Water ponding can cause saturation of the pavement and subgrade layers and lead to premature failure. The surface of the pavement should be sloped to convey water from the pavement to appropriate drainage facilities.

4.6 EARTHWORK

Excavation of the on-site soils can generally be completed using conventional earthmoving equipment such as bulldozers, scrapers, and excavators. We did not encounter cemented soils or bedrock. The soils are generally alluvial and glacial deposits, it is possible that coarse deposits ranging from cobbles to boulders may be encountered.

4.6.1 Temporary Excavation Slopes

Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. The near surface groundwater conditions present an elevated risk for trenching and other excavations at this site. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed near the top of any excavation. Excavations anticipated to extend more than a few feet below the ground surface should not be performed until appropriate safety equipment, such as temporary shoring, is on site and readily available for use.

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. Design of temporary shoring and maintenance of safe working conditions, including temporary excavation stability and/or dewatering, is the sole responsibility of the contractor.

Based on the information collected from our explorations, existing soils are generally classified as Type C soils per WAC 296-155 and may be sloped as shallow as 1½H:1V in dry conditions. Groundwater is likely to be encountered at shallow depths and groundwater seepage should be anticipated in excavations extending beyond shallow depths. Unshored excavations within these conditions will likely require shoring such as trench boxes or flatter side slopes of at least 4H:1V.

4.6.2 Dewatering

Groundwater should be anticipated in excavations at the site. Due to the proximity of Lake Washington, achieving a fully dewatered condition within excavations is likely to be extremely challenging, if not impossible. Seepage within shallow excavations extending to shallow depths above or slightly below the groundwater table could potentially be managed with sumps and high volume pumps; however, the contractor should be prepared to manage the anticipated volume of water from these methods.

We recommend the use of steel sheet piles wherever possible to minimize dewatering requirements as well as to reduce the potential for damage to existing structures and utilities for excavations anticipated to extend beyond shallow depths below the ground surface. Excavations anticipated to extend beyond shallow depths below the groundwater table will likely require dewatering systems. The design and implementation of any dewatering system should be the responsibility of the contractor.

4.6.3 Structural Fill

Material placed below structures or parking lots should be considered structural fill. Structural should be imported as the on-site soils have high fines and moisture contents which will make them difficult to work with and compact in all seasons. The on-site soils may be used for non-structural backfill such as in landscaping areas.

Structural fill should consist of clean, free-draining, granular soils free from organic matter or other deleterious materials. Structural fill should have a maximum particle dimension less than 4 inches and should contain less than 5 percent fines (portion passing the U. S. Standard No. 200 sieve), as specified for “Gravel Borrow” in Section 9-03.14(1) of the WSDOT Standard Specifications (WSDOT, 2024). The fine-grained portion of structural fill soils should be non-plastic. Structural fill may also consist of CSBC as specified in Section 9-03.9(3) of the WSDOT Standard Specifications.

Controlled Density Fill (CDF), also known as CLSM or flowable fill, as specified in section 2-09.3(1)E of the WSDOT Standard Specifications (WSDOT, 2024) may be placed below foundations as structural fill. CDF should be designed to have a minimum 28-day compressive strength of 100 psi and be readily flowable at the time of placement. Samples of the CDF should be collected during placement and tested following ASTM D4832. The Contractor should provide a CDF mix design to the design team for review prior to placing any CDF.

4.6.4 Backfill and Compaction

Granular soil placed as structural fill soils should be moisture conditioned, placed in loose horizontal lifts less than 8 inches thick, and compacted to the requirements specified in Section 2-03.3(14)C, Method C, of the WSDOT Standard Specifications and be compacted to 95 percent of their theoretical maximum dry density as determined by test method ASTM D 1557 (Modified

Proctor) for soils below structural elements such as foundations. Subgrade compaction in pavement areas should conform to the requirements of Section 2 06.3(1) of the WSDOT Standard Specifications.

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 to achieve the required relative compaction. During placement of the initial lifts, the backfill material should not be bulldozed into the excavation or dropped directly on the utility. Heavy vibratory equipment should not be permitted to operate directly over utilities until a minimum of 2 feet of backfill has been placed over the utility and compacted.

Typically, 4-inch-thick loose lifts or less is appropriate for smaller equipment (e.g., plate compactors, jumping jacks, etc.) and larger equipment (e.g., large vibratory drum roller, large hoe packs, etc.) may be able to compact up to 12-inch-thick loose lifts of structural fill, depending on the equipment. Generally, loosely compacted soils result from poor construction technique and/or improper 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. The contractor is responsible for implementing compaction methods that consistently produce adequate compaction levels.

Proper preparation, placement, and compaction of the native soils and structural fill is extremely important to limit future settlement of the ground surface around structures and along trenches. Observation and testing of backfill by a representative of the Geotechnical Engineer is recommended to help the contractor achieve proper backfill preparation and uniform moisture conditioning, loose lift thickness control, and application of appropriate compaction effort.

4.6.5 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.

- For wet weather conditions, the allowable fines content of the structural fill should be reduced to no more than 5 percent by weight of the portion of the fill material 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.

- Bales of straw and/or geotextile silt fences should be strategically located to control erosion and the movement of soil.

- Temporary slopes and material stockpiles should be protected from the elements by covering them with plastic sheeting or similar means. Sheeting sections should overlap by at least 12 inches and be tightly secured with sandbags, tires, staking, or other means to prevent wind from exposing the soil under the sheeting.

5.0 CONDITIONS AND LIMITATIONS

We have prepared this Geotechnical Report for Facet and the City of Lake Forest Park for use in design for this project. The interpretations presented in this report should not be construed as our warranty of subsurface conditions at the site. Experience has shown that soil and groundwater conditions can vary significantly over small distances and with time. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study of this scope and nature.

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.

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

William R. Rosso, P.E.
Geotechnical Engineer

Steven R. Wright, P.E.
Geotechnical Engineer, Vice President

6.0 REFERENCES

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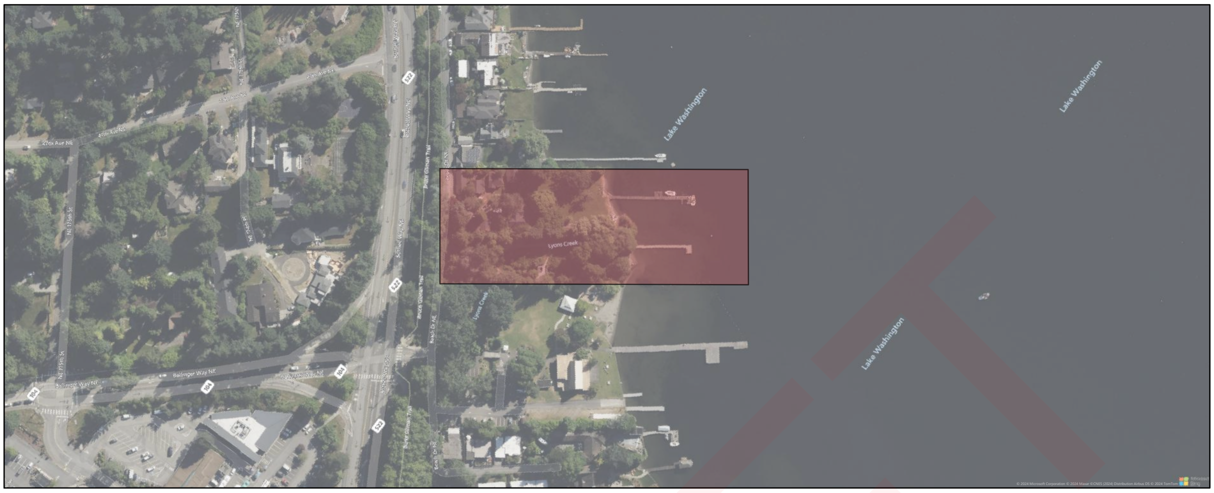
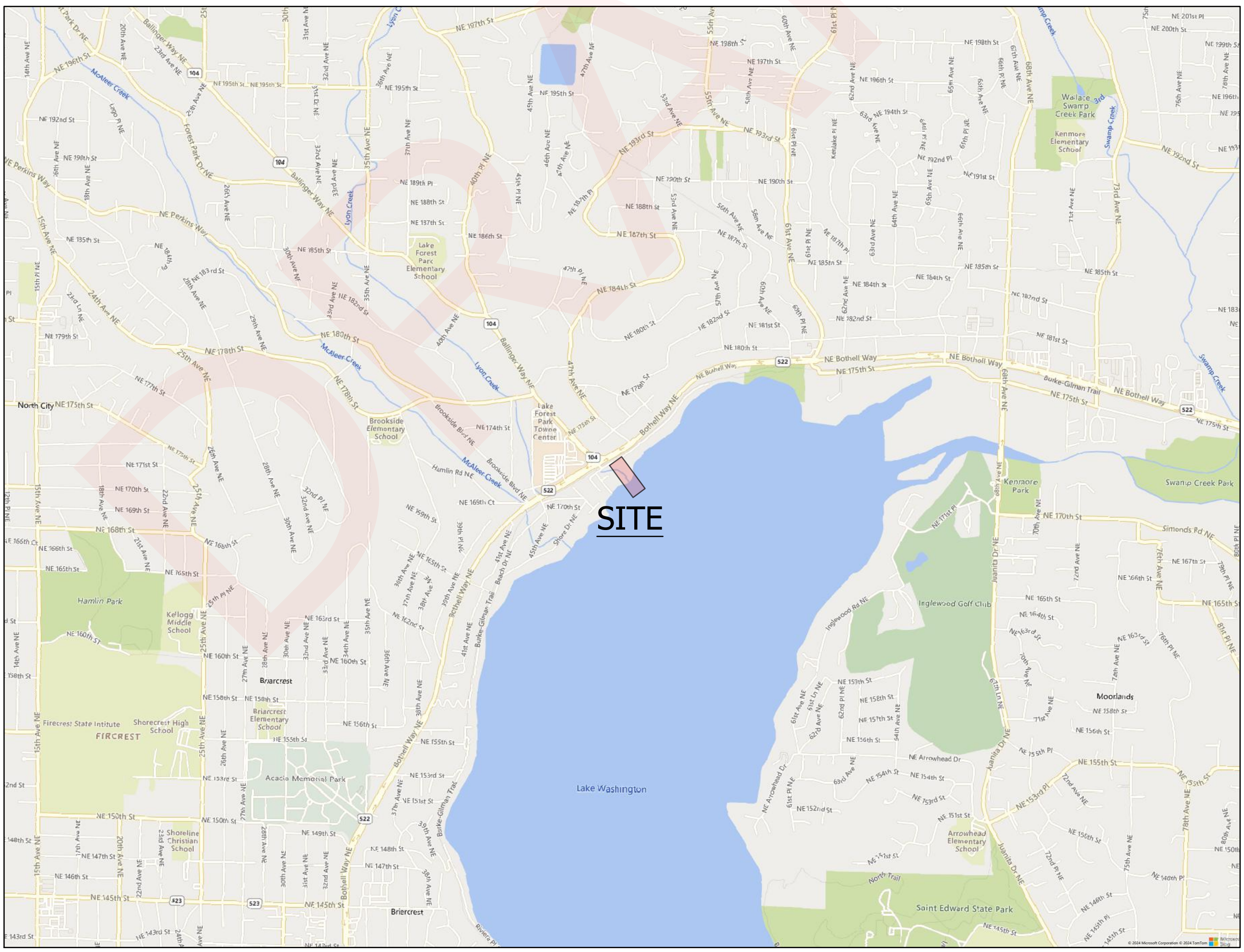


SITE MAP

0 200' 400' 600' 800'
SCALE: 1" = 400'

N



VICINITY MAP

0 1500' 3000' 4500' 6000'
SCALE: 1" = 3000'

N

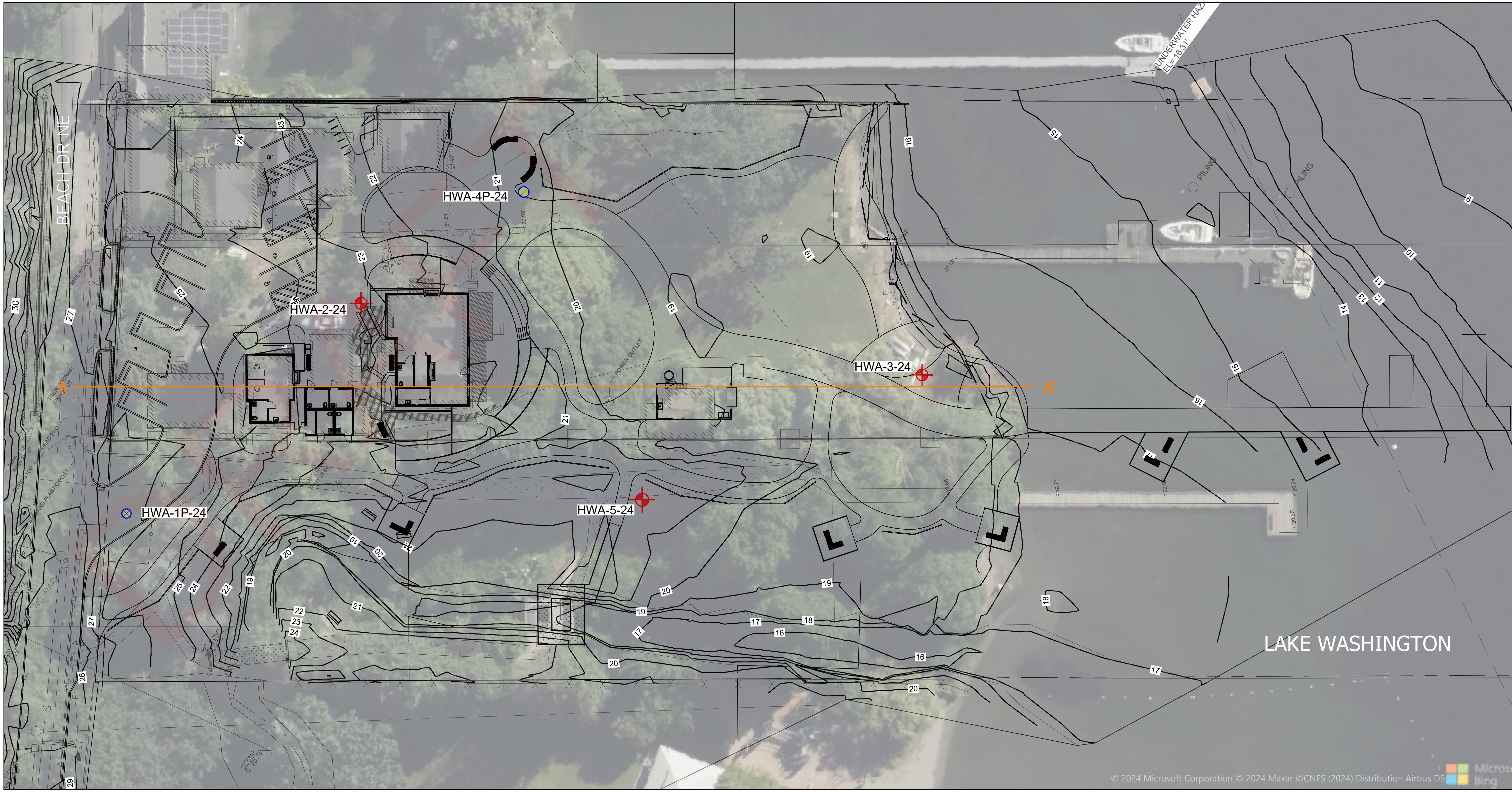
HWA GEOSCIENCES INC.
DBE/MWBE

SITE AND VICINITY MAP

LAKEFRONT IMPROVEMENTS PHASE 2
17337, 17345, AND 17347 BEACH DR NE
LAKE FOREST PARK, WASHINGTON

FIGURE NO.: 1
DRAWN BY: CF
CHECK BY: WRR
PROJECT # 2024-069-21

C:\USERS\CFRY\DESKTOP\2024-069-21 LFP LAKEFRONT PARK (PHASE 2)\2024-069-21 LFP LAKEFRONT PARK (PHASE 2).DWG <1> Plotted: 7/18/2024 4:38 PM



LAKEFRONT PARK
Scale: 1" = 40'-0"

A ———— A' GEOLOGIC CROSS SECTION

EXPLORATION LEGEND

HWA-2-24 BOREHOLE DESIGNATION AND APPROXIMATE LOCATION (HWA, 2024)

HWA-1P-24 MONITORING WELL DESIGNATION AND APPROXIMATE LOCATION (HWA, 2024)

0 20 40 60 80
SCALE: 1" = 40'

AERIAL IMAGERY REFERENCE IS APPROXIMATE AND MAY APPEAR OFFSET FROM SURVEYED DATA AND BASEMAPS.

BASE MAP PROVIDED BY: BING AND FACET NW 4.11.2024

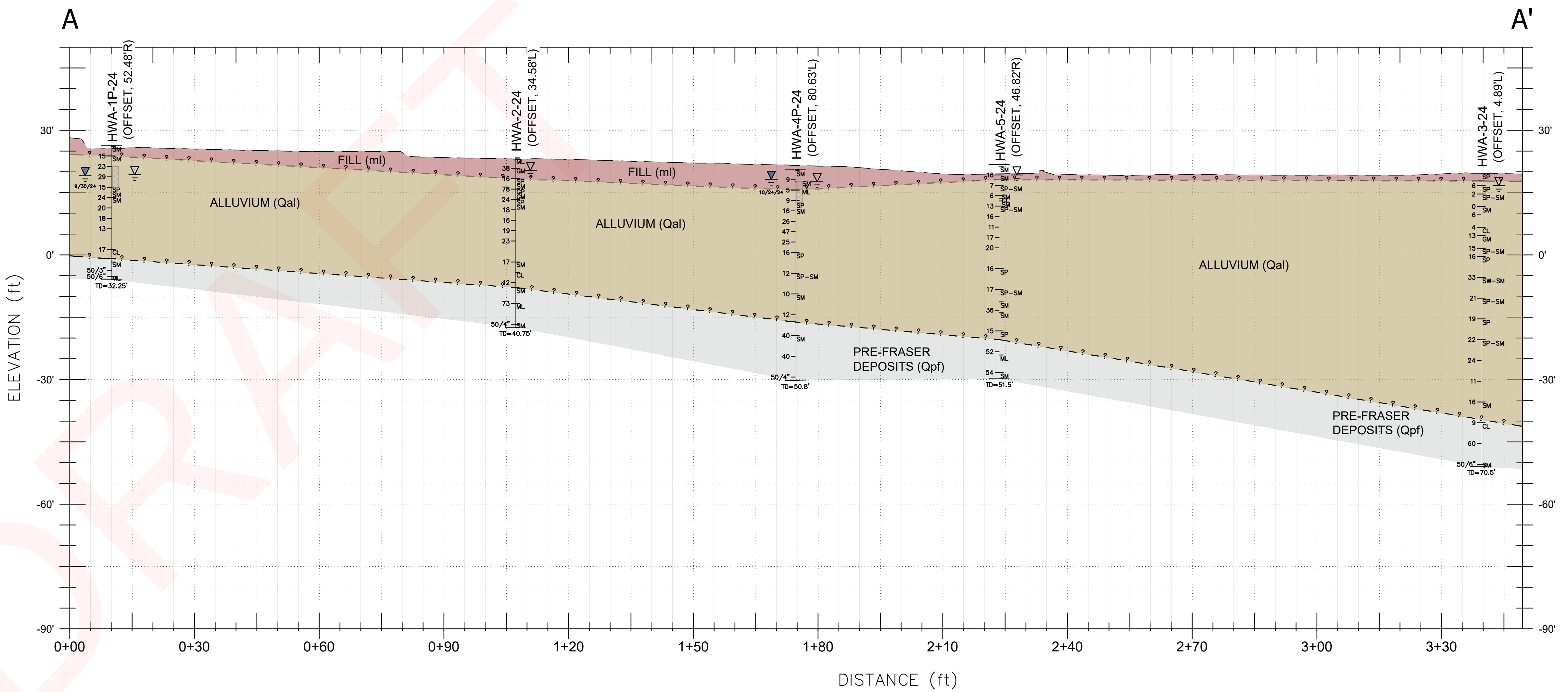
HWA GEOSCIENCES INC. DBE/MWBE

LAKE FOREST PARK
LAKEFRONT IMPROVEMENTS PHASE 2
LAKE FOREST PARK, WASHINGTON

SITE AND EXPLORATION PLAN

DRAWN BY:	FIGURE NO.:
CF	2
CHECK BY:	PROJECT NO.:
WRR	2024-069-21

C:\USERS\CFRY\DESKTOP\2024-069-21 LFP LAKEFRONT PARK (PHASE 2)\2024-069-21 LFP LAKEFRONT PARK (PHASE 2).DWG <2> Plotted: 10/21/2024 1:41 PM



BORE LEGEND

- HWA-1P-24 — EXPLORATION DESIGNATION
- BLOW COUNT "N-VALUE "
- USGS SOIL CLASSIFICATION
- WATER LEVEL DURING DRILLING
- WATER LEVEL IN WELL AND DATE
- SCREEN
- INFERRED GEOLOGIC CONTACT
- TD=46.5' — BOTTOM OF EXPLORATION

SOILS LEGEND

- FILL (ml)
- ALLUVIUM (Qal)
- PRE-FRASER DEPOSITS (Qpf)
- - ? - INFERRED GEOLOGIC CONTACT

NOTES: - ? — ? - DENOTES THAT THE SUBSURFACE CONDITIONS SHOWN ARE BASED ON WIDELY SPACED BORINGS AND SHOULD BE CONSIDERED APPROXIMATE. FURTHERMORE, THE CONTACT LINES SHOWN BETWEEN UNITS ARE INTERPRETIVE IN NATURE AND MAY VARY LATERALLY OR VERTICALLY OVER RELATIVELY SHORT DISTANCES ON SITE.

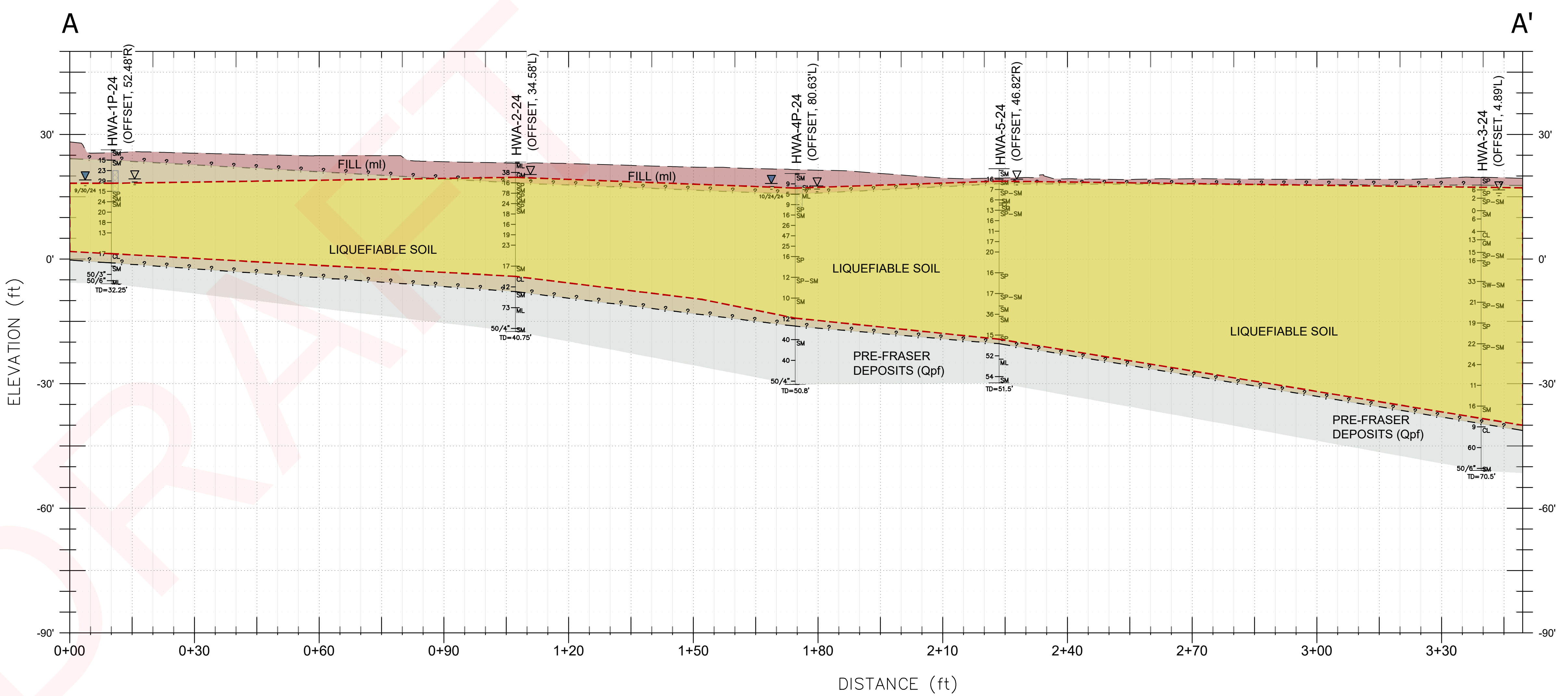
THIS IMAGE WAS DEVELOPED IN COLOR. BLACK AND WHITE REPRODUCTION OF THIS COLOR FIGURE MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

0 15 30 45 60

HORIZ. / VERT. SCALE: 1" = 30'

HWA GEOSCIENCES INC. DBE/MWBE	LAKE FOREST PARK LAKEFRONT IMPROVEMENTS PHASE 2 LAKE FOREST PARK, WASHINGTON	GEOLOGIC CROSS SECTION A-A'	DRAWN BY: CF	FIGURE NO.: 3A
			CHECK BY: WRR	PROJECT NO.: 2024-069-21

C:\USERS\CFRY\DESKTOP\2024-069-21 LFP LAKEFRONT PARK (PHASE 2)\2024-069-21 LFP LAKEFRONT PARK (PHASE 2).DWG <3A> Plotted: 11/8/2024 11:33 AM



BORE LEGEND

- HWA-1P-24 — EXPLORATION DESIGNATION
- BLOW COUNT "N-VALUE "
- USGS SOIL CLASSIFICATION
- WATER LEVEL DURING DRILLING
- WATER LEVEL IN WELL AND DATE
- SCREEN
- INFERRED GEOLOGIC CONTACT
- TD=46.5' BOTTOM OF EXPLORATION

SOILS LEGEND

- FILL (ml)
- ALLUVIUM (Qal)
- PRE-FRASER DEPOSITS (Qpf)
- INFERRED GEOLOGIC CONTACT
- LIQUEFIABLE SOIL

NOTES: - ? - ? - DENOTES THAT THE SUBSURFACE CONDITIONS SHOWN ARE BASED ON WIDELY SPACED BORINGS AND SHOULD BE CONSIDERED APPROXIMATE. FURTHERMORE, THE CONTACT LINES SHOWN BETWEEN UNITS ARE INTERPRETIVE IN NATURE AND MAY VARY LATERALLY OR VERTICALLY OVER RELATIVELY SHORT DISTANCES ON SITE.

AREAS IDENTIFIED ON THIS FIGURE AS LIQUEFIABLE SOIL IS BASED ON INFORMATION AND ANALYSIS DESCRIBED WITHIN THE ASSOCIATED GEOTECHNICAL REPORT.

THIS IMAGE WAS DEVELOPED IN COLOR. BLACK AND WHITE REPRODUCTION OF THIS COLOR FIGURE MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

0 15 30 45 60

HORIZ. / VERT. SCALE: 1" = 30'

HWA GEOSCIENCES INC. DBE/MWBE

LAKE FOREST PARK
LAKEFRONT IMPROVEMENTS PHASE 2
LAKE FOREST PARK, WASHINGTON

LIQUEFACTION POTENTIAL ALONG GEOLOGIC CROSS SECTION A-A'

DRAWN BY:	FIGURE NO.:
CF	3B
CHECK BY:	PROJECT NO.:
WRR	2024-069-21

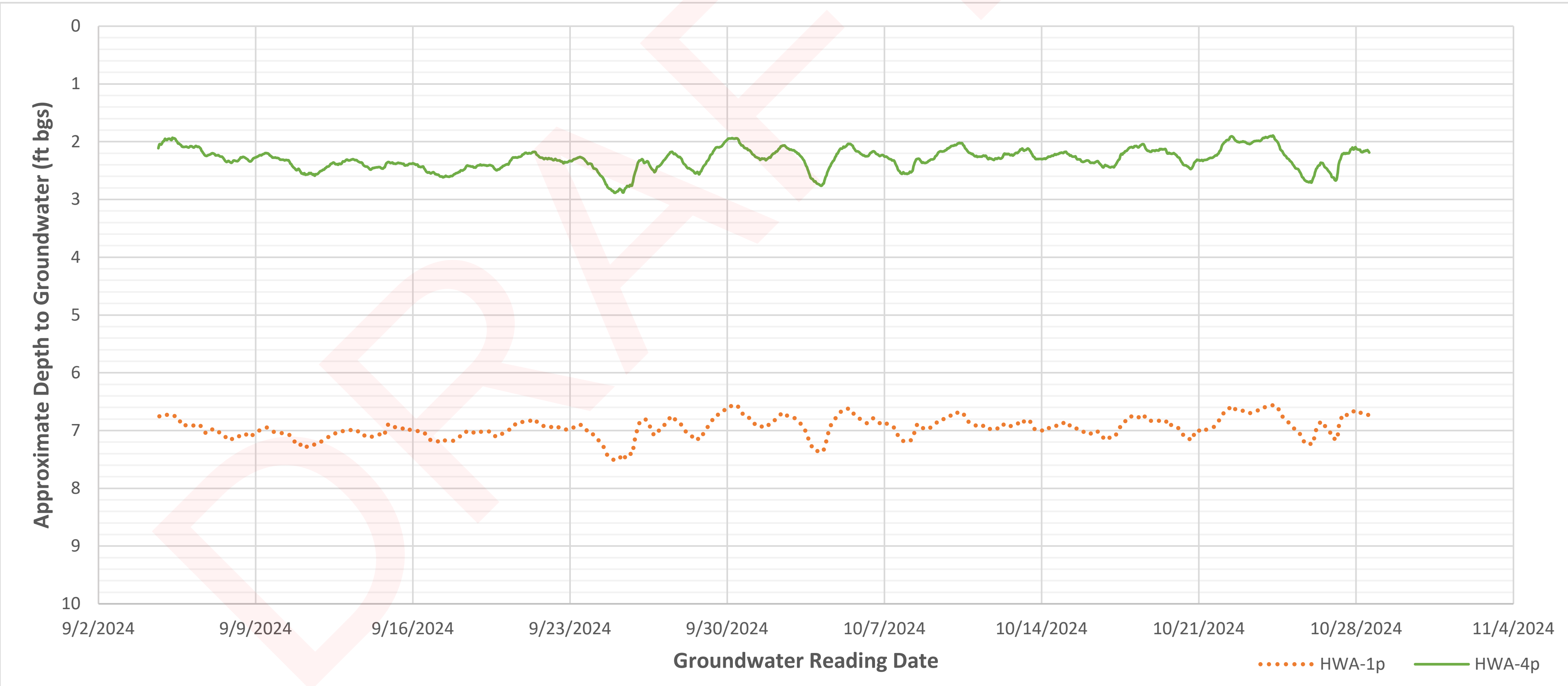
C:\USERS\CFRY\DESKTOP\2024-069-21 LFP LAKEFRONT PARK (PHASE 2)\2024-069-21 LFP LAKEFRONT PARK (PHASE 2).DWG <3B> Plotted: 11/8/2024 11:33 AM

Date	October 29, 2024
Job No.	2024-069-21
Project	Lake Forest Park Lakefront Improvements Phase 2 Lake Forest Park, Washington

Figure - 4
Groundwater Monitoring Data

HWA GeoSciences Inc. DBE/MWBE

	Boring	Ground Elevation (ft)	Shallowest Water Depth (ft bgs)	Deepest Water Depth (ft bgs)	First Reading	Last Reading	Latitude	Longitude	Datum	Collector
	HWA-1p	26.5	6.6	7.5	9/4/2024	10/28/2024	47.75359	-122.27531	WGS84	W. Rosso
	HWA-4p	20.5	1.9	2.9	9/4/2024	10/28/2024	47.75344	-122.27447	WGS84	W. Rosso



Notes: *Ground surface elevations are estimated from topographic data provided by Facet*

APPENDIX A

FIELD EXPLORATION

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

ASTM 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

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)

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation in general accordance with ASTM D 2487 and ASTM D 2488. 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.

TEST SYMBOLS

MC	Moisture Content
GS	Grain Size Distribution
%F	Percent Fines
CN	Consolidation
UC	Unconfined Compression
DS	Direct Shear
CD	Consolidated Drained Triaxial
CU	Consolidated Undrained Triaxial
UU	Unconsolidated Undrained Triaxial
OC	Organic Content
pH	pH of Soils
Res	Resistivity
PID	Photoionization Device Reading
AL	Atterberg Limits: PL Plastic Limit, LL Liquid Limit
M	Resilient Modulus
SL	Slake Test

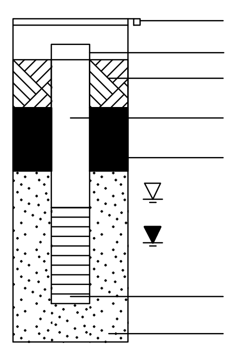
SAMPLE TYPE SYMBOLS

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

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Clean	< 5%
Slightly (Clayey, Silty, Sandy)	5 - 12%
Clayey, Silty, Sandy, Gravelly	12 - 30%
Very (Clayey, Silty, Sandy, Gravelly)	30 - 50%

GROUNDWATER WELL COMPLETIONS



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.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

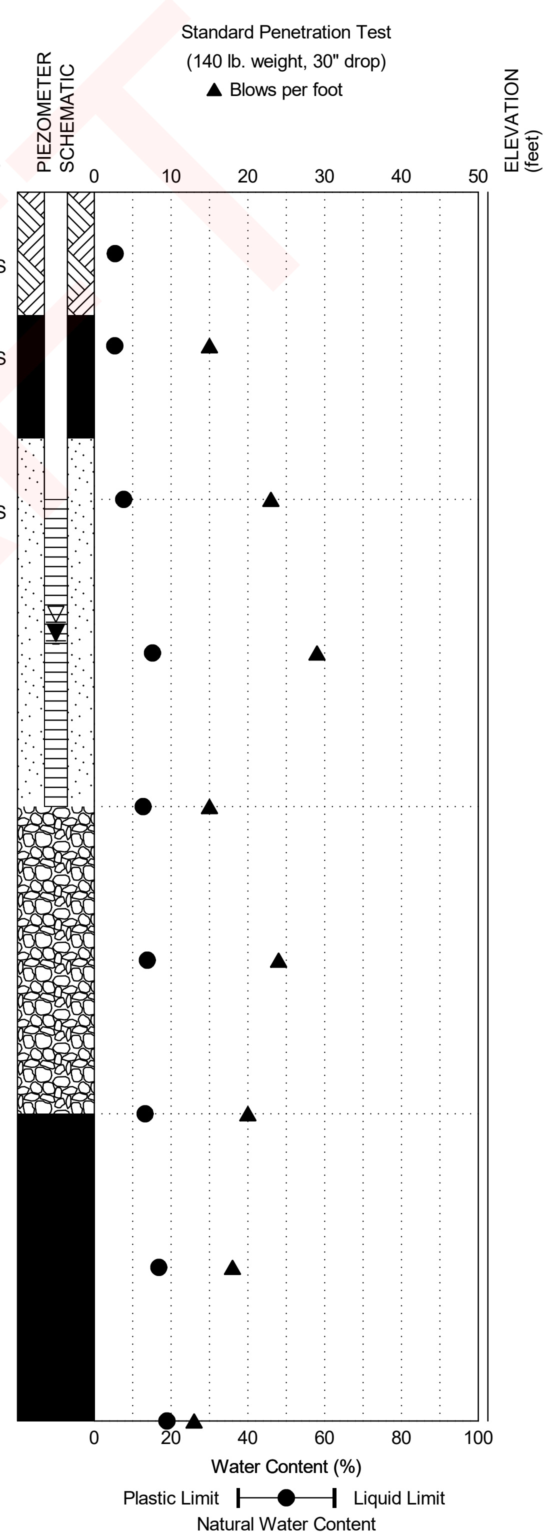
LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

PROJECT NO.: 2024-069 FIGURE: A -1

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD: HSA, Acker Recon Tracked Rig w/ 3¼" ID
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75359, Long: -122.27531; Datum: WGS 84

DATE STARTED: 9/4/2024
DATE COMPLETED: 9/5/2024
LOGGED BY: A. Heinze Fry

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	SM	About 2-inches of asphalt pavement. **(ASPHALT)**			
		Medium dense, light yellowish-brown, very silty SAND, moist. Fine sand. **(FILL)**	S-1		GS
	SM	Medium dense, light brownish-gray, very silty SAND, moist. Fine sand, two ½-inch thick silt lenses observed in sample. Recovery: 15 inches.	S-2	5-6-9	GS
		(ALLUVIUM)			
5		Becomes brown with dark brown mottling, gravel content increases becomes gravelly. Recovery: 12 inches. Auger rattle / gravelly drilling.	S-3	8-13-10	GS
		Moisture content increases, becomes wet.			
		Becomes olive brown. Recovery: 16 inches.	S-4	11-14-15	
		Driller began adding drilling mud to borehole.			
10	SP SM	Medium dense, olive brown, very gravelly, slightly silty, poorly-graded SAND, wet. Fine to medium sand, fine gravel. Recovery: 9 inches.	S-5	1-4-11	
	SM	Medium dense, olive brown, very gravelly, silty SAND, wet. Fine sand, fine gravel. Recovery: 9 inches.	S-6	3-11-13	
15		Gravel content decreases, becomes gravelly. Recovery: 12 inches.	S-7	8-8-12	
		Silt and gravel content decreases. Recovery: 13 inches.	S-8	5-8-10	
20					



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.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

BORING:
HWA-1p-24

PAGE: 1 of 2

PROJECT NO.: 2024-069

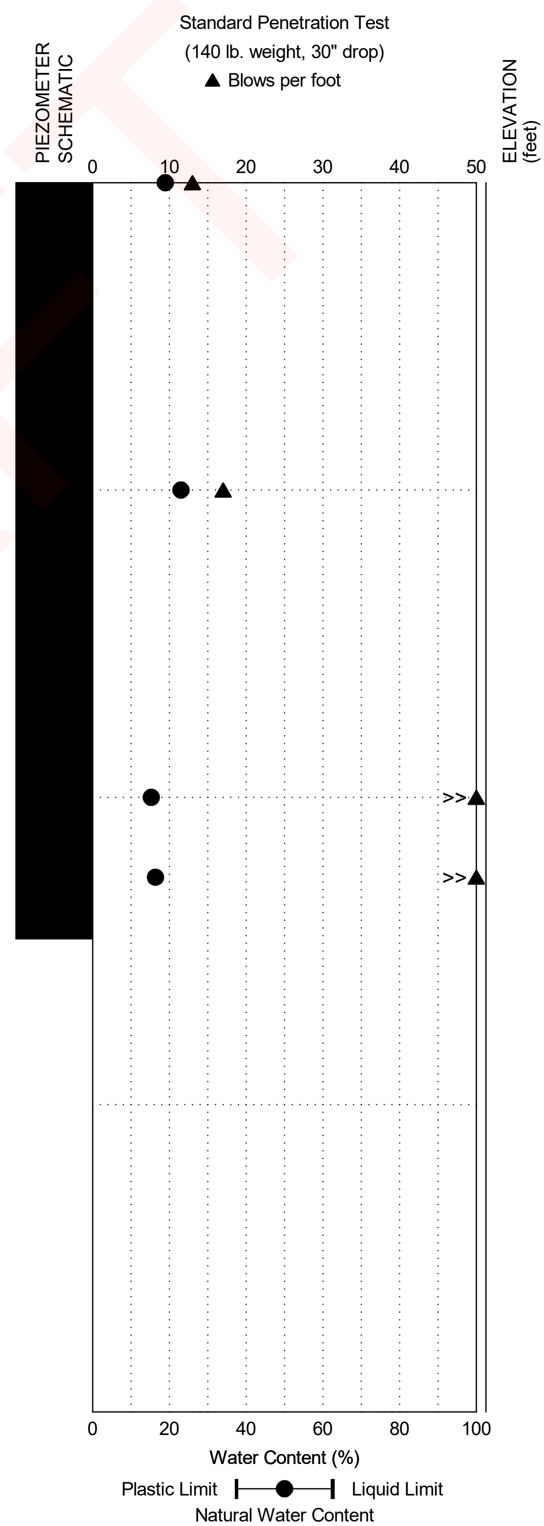
FIGURE: A -2

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD: HSA, Acker Recon Tracked Rig w/ 3¼" ID
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75359, Long: -122.27531; Datum: WGS 84

DATE STARTED: 9/4/2024
DATE COMPLETED: 9/5/2024
LOGGED BY: A. Heinze Fry

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)
20	SM	Medium dense, olive brown, very silty SAND, wet. Fine to medium sand, stratified 2 to 3 inch lenses grading from clean sand to sandy silt. Recovery: 9 inches.	S-9	4-6-7
25	CL	Very stiff, yellowish brown with orange mottling, lean CLAY, moist. 3-inch thick lens of gravelly silty sand at about 26.1 feet. Recovery: 18 inches. Drilling effort increases at about 28 feet, progress slows.	S-10	5-8-9
	SM	Very dense, gray, silty SAND, wet to moist. Fine sand. Recovery: 15 inches. **(PRE-FRASER DEPOSITS)**		
30		Drilling rate slows to about 1½ feet in 45 minutes.	S-11	18-40-50/3"
	ML	Hard, gray, slightly gravelly, very sandy SILT, moist. Fine sand, fine gravel. Recovery: 12 inches.	S-12	21-50/6"

HWA-1p-24 was terminated at about 32¼ feet below ground surface (bgs).
Groundwater was observed at about 7 feet during exploration.
2 inch PVC standpipe piezometer installed in 10 foot well on 9/4/24.
DOE unique well tag #BNZ 186.
Groundwater was observed at 7¼ feet bgs on 9/5/24.



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.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

BORING:
HWA-1p-24

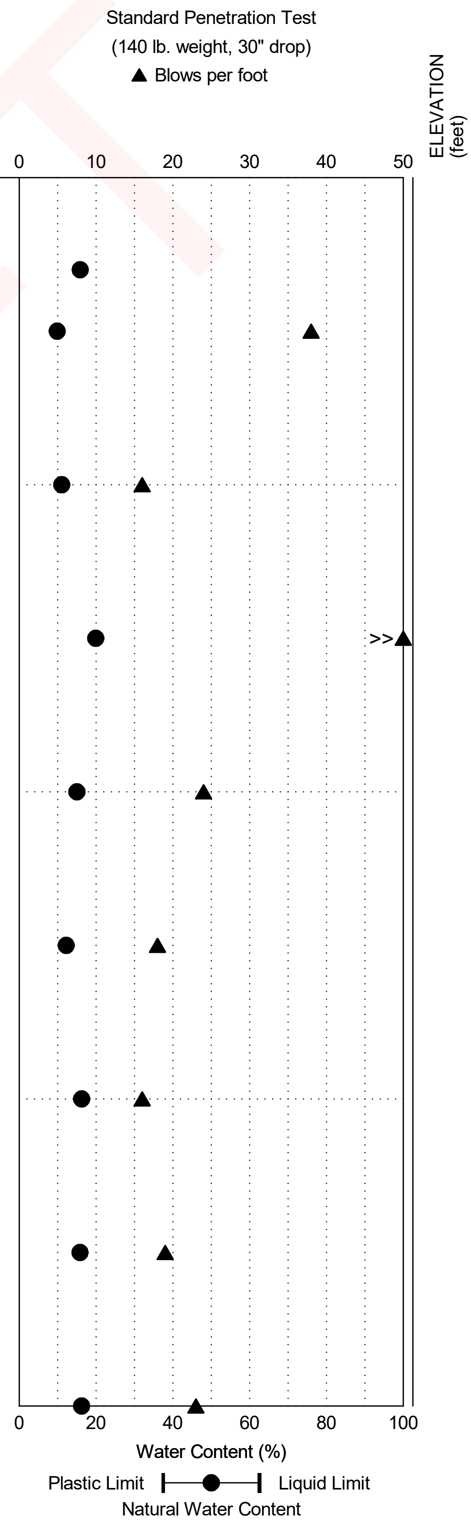
PROJECT NO.: 2024-069 FIGURE: A -2

PZO-DSM 2024-069.GPJ 11/6/24

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD: HSA, Acker Recon Tracked Rig w/ 3¼" ID
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75353, Long: -122.27476; Datum: WGS 84

DATE STARTED: 9/4/2024
DATE COMPLETED: 9/4/2024
LOGGED BY: W. Rosso

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0		About 3-inches of grass and rootmat. **(TOPSOIL)**			
	ML	Medium stiff, brown to olive brown, slightly gravelly, very sandy SILT, moist. Trace organics (roots, rootlets). **(FILL)**	S-1		GS
	GM	Dense, dark olive-brown, very sandy, silty GRAVEL, wet. Coarse gravel in sampler shoe, blow counts may be overstated. Recovery: 2 inches	S-2	14-22-16	GS
5	SP SM	Medium dense, dark olive brown, slightly silty, poorly-graded SAND, wet. Medium to coarse sand, trace fine subrounded gravel. Recovery: 14 inches **(ALLUVIUM)**	S-3	3-8-8	
	GP GM	Drilling mud added to borehole. Very dense, dark olive brown, sandy, slightly silty, poorly-graded GRAVEL, wet. Fine subrounded to rounded gravel, medium to coarse sand. Recovery: 3 inches	S-4	4-28-50	
10	SP SM	Slight hammer bounce, sampler appears to be impacting buried obstruction (possible coarse gravel or cobble), blow counts may be overstated. Medium dense, dark olive brown, slightly silty, poorly-graded SAND, wet. Medium to coarse sand, trace fine subrounded to rounded gravel. Recovery: 10 inches	S-5	5-12-12	%F
		Less than 3 inches of heave/slough observed, gravel content increases, becomes gravelly. Recovery: 15 inches	S-6	3-7-11	
15		Less than 3 inches of heave/slough observed, gravel content decreases, trace fine gravel observed. Recovery: 12 inches	S-7	6-7-9	
		Less than 3 inches of heave/slough observed. Recovery: 16 inches	S-8	4-6-13	%F
20					



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.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

BORING:
HWA-2-24

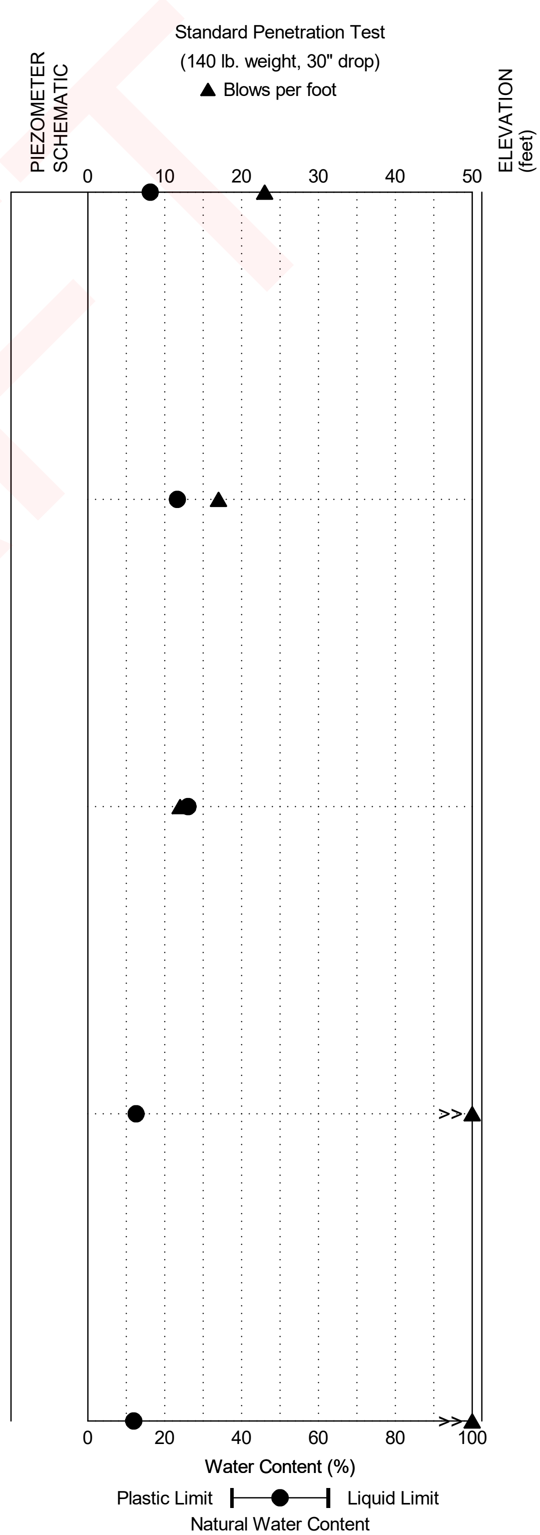
PROJECT NO.: 2024-069 FIGURE: A -3

PZO-DSM 2024-069.GPJ 11/6/24

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD: HSA, Acker Recon Tracked Rig w/ 3¼" ID
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75353, Long: -122.27476; Datum: WGS 84

DATE STARTED: 9/4/2024
DATE COMPLETED: 9/4/2024
LOGGED BY: W. Rosso

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
20	SP SM	Medium dense, dark olive brown, slightly gravelly, slightly silty, poorly graded SAND, wet. Medium to coarse sand, fine subrounded to rounded gravel. Less than 3 inches of heave/slough observed. Recovery: 15 inches	S-9	6-11-12	
25	SM	Medium dense, dark olive brown, silty SAND, wet. Medium to coarse sand, trace fine subrounded to rounded gravel. Becomes light brown with laminated lean clay lenses less than 1/8 inch think in bottom 3 inches of sample. Thickness of the lenses appears to increase with depth. Recovery: 11 inches	S-10	4-6-11	%F
	CL	Medium stiff to stiff, light brown, lean CLAY, wet. Low to medium plasticity, trace fine sand. Gray silty sand observed in tip of sampler. Recovery: 18 inches			
30			S-11	3-6-6	
	SM	Very dense, gray, silty SAND, wet. Fine to medium sand, trace fine subrounded gravel. **(PRE-FRASER DEPOSITS)** Drilling rate of advance slows significantly to approximately 30 minutes per 5 feet from ~33 to 40 feet bgs.			
35	ML	Hard, gray, sandy SILT, moist. Fine to medium sand, trace fine subrounded gravel. Split spoon hot to the touch. Recovery: 15 inches. Cuttings no longer observed being returned to the surface.	S-12	11-31-42	
40					



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.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

BORING:
HWA-2-24

PROJECT NO.: 2024-069 FIGURE: A -3

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD: HSA, Acker Recon Tracked Rig w/ 3¼" ID
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75353, Long: -122.27476; Datum: WGS 84

DATE STARTED: 9/4/2024
DATE COMPLETED: 9/4/2024
LOGGED BY: W. Rosso

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC	Standard Penetration Test (140 lb. weight, 30" drop) ▲ Blows per foot (0 10 20 30 40 50)	ELEVATION (feet)
40		SM	Very dense, gray, silty SAND, wet. Fine to medium sand, trace fine subrounded gravel. Recovery: 8 inches		S-13	34-50/4"				
			HWA-2-24 terminated at approximately 40¾ feet below the ground surface. Boring was backfilled with bentonite chips per Washington DOE requirements and cuttings were spread at the surface. Groundwater was observed at approximately 3 feet bgs during drilling.							
45										
50										
55										
60										

Water Content (%): 0 20 40 60 80 100

Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

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.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

BORING:
HWA-2-24

PROJECT NO.: 2024-069
FIGURE: A -3

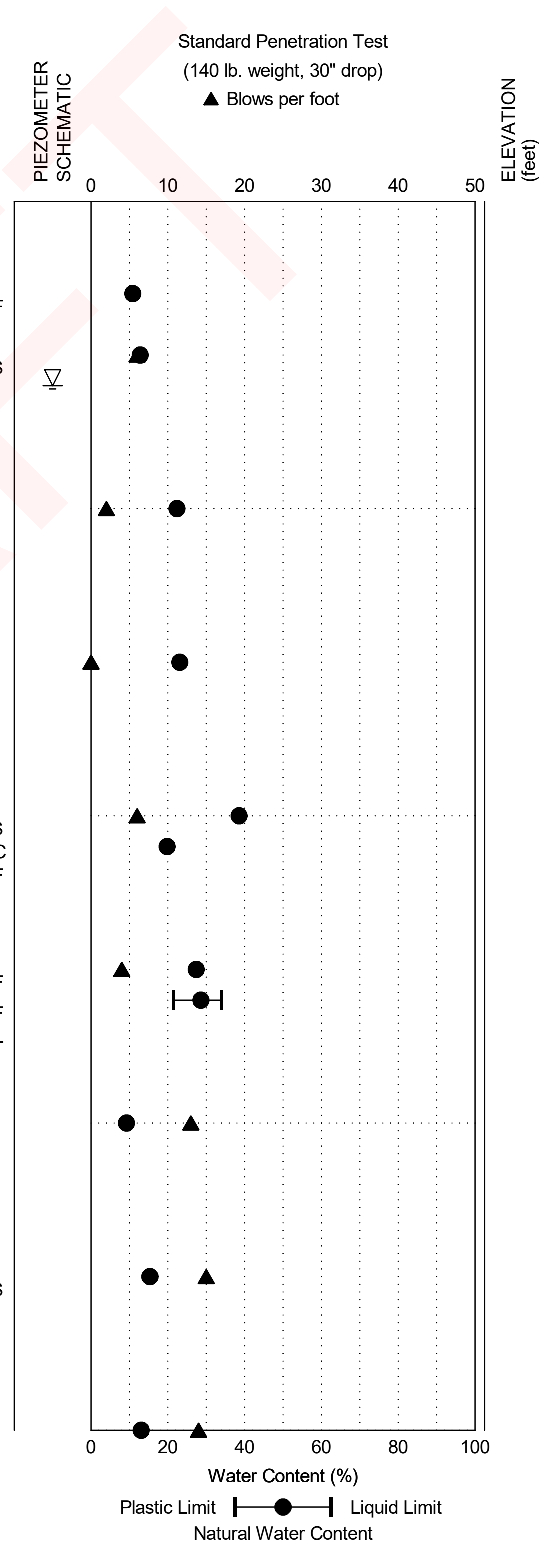
PZO-DSM 2024-069.GPJ 11/6/24

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD:
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75297, Long: -122.27428; Datum: WGS 84

DATE STARTED: 9/3/2024
DATE COMPLETED: 9/3/2024
LOGGED BY: A. Heinze Fry

DRAFT

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	SP	Loose, olive brown, clean, poorly-graded SAND, moist. Fine to medium sand. Boring was advanced next to a shallow sand pile covered in a tarp, additional tarp encountered about 1 foot below surface. **(FILL)**	S-1		%F
		Advanced through another tarp at about 3 feet bgs. Recovery: 10 inches.	S-2a	4-4-2	GS
	SP	Loose, olive-gray, clean poorly-graded SAND, wet. Fine to medium sand, trace fine gravel. **(ALLUVIUM)**	S-2b		
5	SP SM	Very loose, olive-gray, slightly gravelly, slightly silty SAND, wet. Fine to medium sand, fine gravel, trace organics. Recovery: 18 inches. Driller began adding drilling mud to borehole.	S-3	1-1-1	
	SM	Loose, gray, silty SAND, wet. Fine sand. Recovery: 1 inch.	S-4	0-0-0	
10		Becomes brown to olive gray. Recovery: 18 inches. Orange mottling observed, silt content increases, becomes very silty.	S-5a S-5b	3-3-3	GS OC %F
	ML	Medium stiff, light olive-brown, very sandy SILT, wet. Fine sand. Recovery: 18 inches.	S-6a	2-2-2	%F
	CL	Medium stiff, light yellowish-brown with orange mottling, sandy, lean CLAY, moist. 2-inch thick lens of fine to medium sand at bottom of sampler.	S-6b		%F AL
15	GM	Medium dense, olive brown, silty GRAVEL, wet. Fine gravel, fine to coarse sand, coarse gravel in shoe of sampler. Recovery: 9 inches.	S-7	4-5-8	
	SP SM	Medium dense, dark grayish-brown, gravelly, slightly silty, poorly graded SAND, wet. Medium to coarse sand, fine gravel. Recovery: 14 inches.	S-8	3-6-9	GS
20					



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.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

BORING:
HWA-3-24

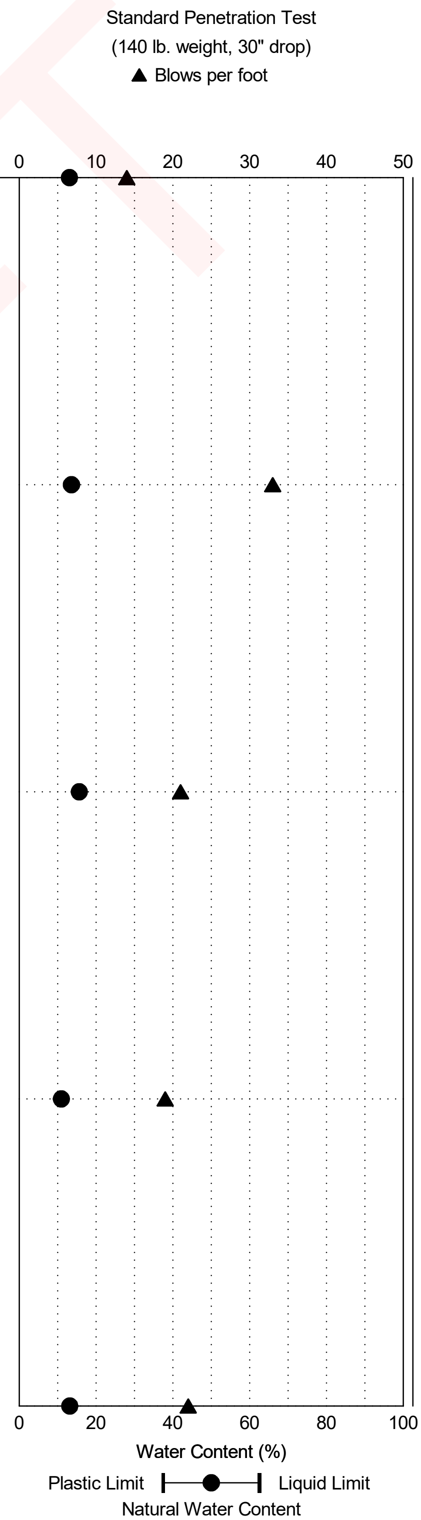
PROJECT NO.: 2024-069 FIGURE: A -4

PZO-DSM 2024-069.GPJ 11/6/24

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD:
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75297, Long: -122.27428; Datum: WGS 84

DATE STARTED: 9/3/2024
DATE COMPLETED: 9/3/2024
LOGGED BY: A. Heinze Fry

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC	ELEVATION (feet)
20	SP	Medium dense, dark grayish-brown, slightly gravelly, clean, poorly-graded SAND, wet. Fine to medium sand, gravel content grades to gravelly with depth, coarse angular gravel near the bottom of the sampler. Recovery: 16 inches.	S-9	4-7-9	%F		
25	SW SM	Medium dense, dark grayish-brown, gravelly, slightly silty, well-graded SAND, wet. Fractured coarse gravel in the sampler. Blow counts may be overstated. Recovery: 11 inches. About 1 to 1.5 feet of heave.	S-10	9-20-13	GS		
30	SP SM	Medium dense, dark grayish-brown, gravelly, slightly silty, poorly-graded SAND, wet. Trace organics. Recovery: 18 inches. About 1 foot of heave.	S-11	7-8-13			
35	SP	Medium dense, dark grayish-brown, gravelly, clean, poorly-graded SAND, wet. Fine to medium sand, fine gravel. Recovery: 18 inches. About 1 foot of heave.	S-12	11-10-9	GS		
40							



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HWA GeoSciences Inc.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

BORING:
HWA-3-24

PROJECT NO.: 2024-069

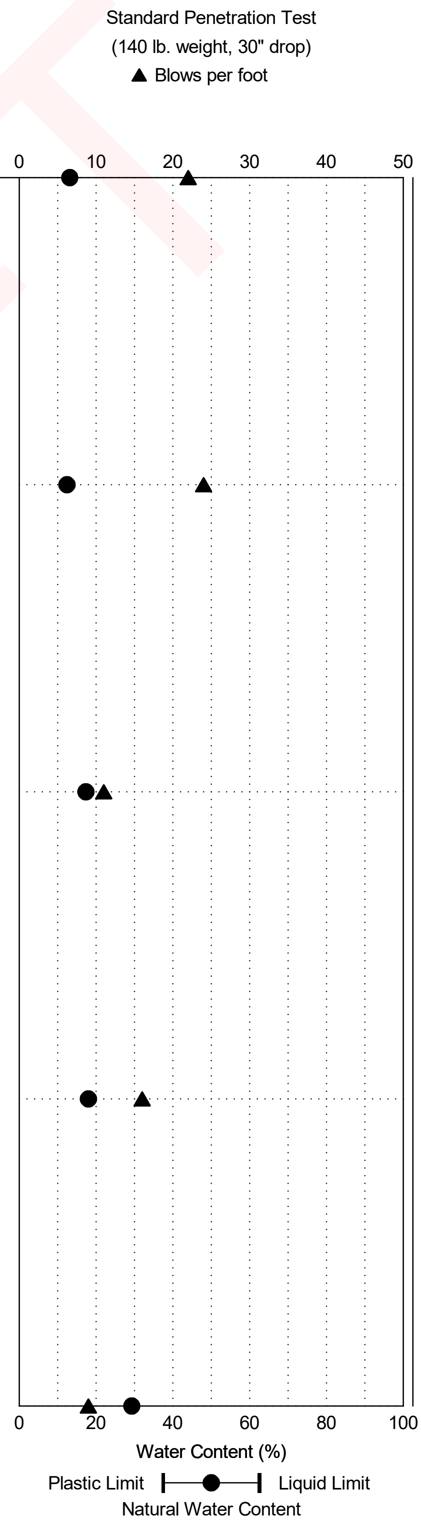
FIGURE: A -4

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD:
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75297, Long: -122.27428; Datum: WGS 84

DATE STARTED: 9/3/2024
DATE COMPLETED: 9/3/2024
LOGGED BY: A. Heinze Fry

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
40	SP SM	Medium dense, olive brown, gravelly, slightly silty, poorly-graded SAND, wet. Fine to medium sand, fine gravel. Recovery: 18 inches.	S-13	8-9-13	
45		About 1 foot of heave. Recovery: 18 inches.	S-14	25-14-10	
50		Decreased heave, less than 3 inches observed. Trace fine gravel. Recovery: 16 inches.	S-15	5-4-7	
		About 1½ feet of heave.			
55	SM	Medium dense, dark gray, slightly gravelly, silty SAND, wet. Fine to medium sand, fine gravel. Recovery: 9 inches.	S-16	1-6-10	%F
60		About 1½ feet of heave.			

SYMBOL | SAMPLE TYPE | PIEZOMETER SCHEMATIC | ELEVATION (feet)



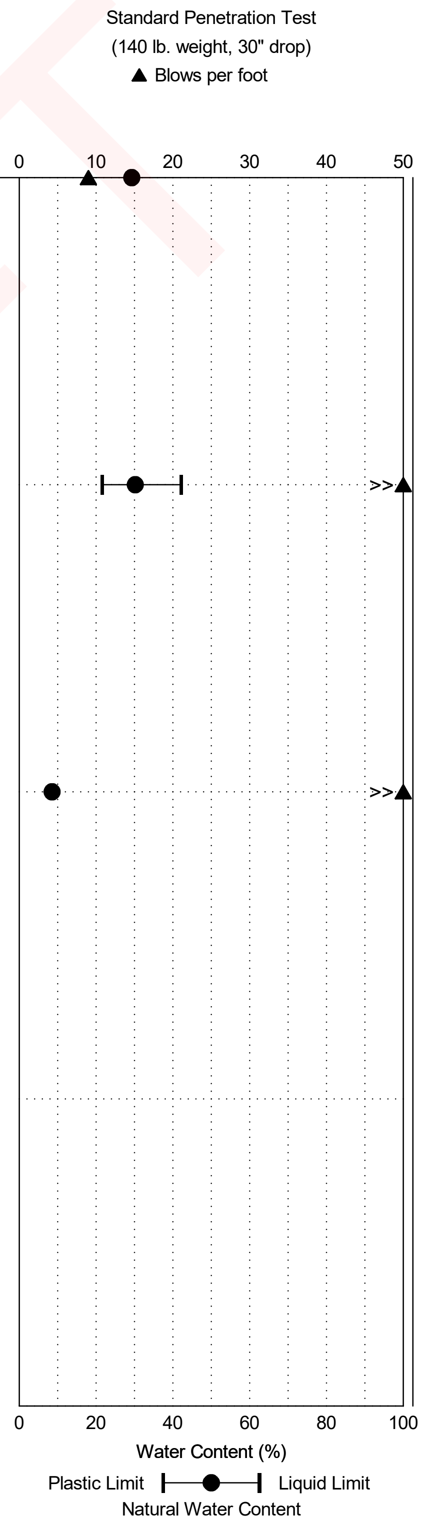
NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD:
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75297, Long: -122.27428; Datum: WGS 84

DATE STARTED: 9/3/2024
DATE COMPLETED: 9/3/2024
LOGGED BY: A. Heinze Fry

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
60	CL	Stiff to hard, gray, slightly sandy lean CLAY, moist. Recovery: 18 inches. **(PRE-FRASER DEPOSITS)** Drilling effort increases at about 62 feet, progress slows, rig chatter / somewhat gravelly drilling.	S-17	3-4-5	
65		Becomes hard, trace fine gravel, 1-inch yellow-brown discoloration near the bottom of the sample. Recovery: 18 inches.	S-18	12-20-40	%F AL
70	SM	Very dense, olive gray, very gravelly, silty SAND, moist. Fine to medium sand. Recovery: 5 inches.	S-19	50/6"	GS

HWA-3-24 terminated at about 70½ feet below ground surface (bgs).
Boring was backfilled with bentonite chips per Washington DOE requirements and cuttings were spread at the surface.
Groundwater was observed at approximately 3 feet bgs during drilling.



PIEZOMETER SCHEMATIC

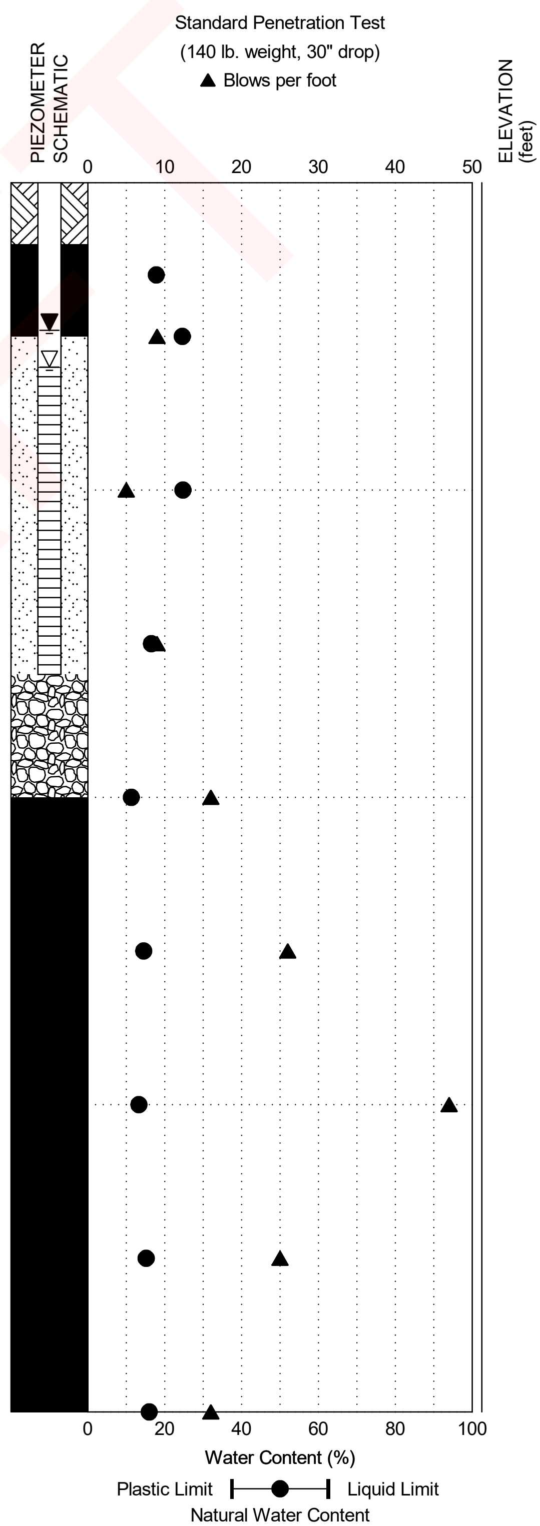
ELEVATION (feet)

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.

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD: HSA, Acker Recon Tracked Rig w/ 3¼" ID
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75344, Long: -122.27447; Datum: WGS 84

DATE STARTED: 9/3/2024
DATE COMPLETED: 9/4/2024
LOGGED BY: W. Rosso

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0		About 3-inches of grass and rootmat. **(TOPSOIL)**			
	SM	Loose, brown to olive brown, silty SAND, moist. Rust colored motteling, trace organics (roots, rootlets). **(FILL)** Recovery: 15 inches	S-1		GS
			S-2	2-4-5	%F
	SM	Loose, dark olive brown, very silty SAND, wet. Fine to medium sand. Drilling mud added to borehole.			
5	ML	Medium stiff, gray, very sandy SILT, wet. Medium to coarse sand, trace fine subrounded gravel. Recovery: 18 inches. **(ALLUVIUM)**	S-3	1-2-3	%F
	SP SM	Loose to dense, olive-gray, gravelly, slightly silty SAND, wet. Medium to coarse sand, fine subrounded to rounded gravel. Recovery: 14 inches	S-4	2-4-5	GS
10		Becomes medium dense. Recovery: 6 inches	S-5	2-7-9	%F
		Coarse subangular gravel observed in the middle of the sample. Recovery: 15 inches	S-6	5-12-14	
15		Gravel content increases, becomes gravelly. Recovery: 10 inches	S-7	3-24-23	
		Gravel content decreases, becomes slightly gravelly. Recovery: 6 inches	S-8	8-12-13	
20					



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.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

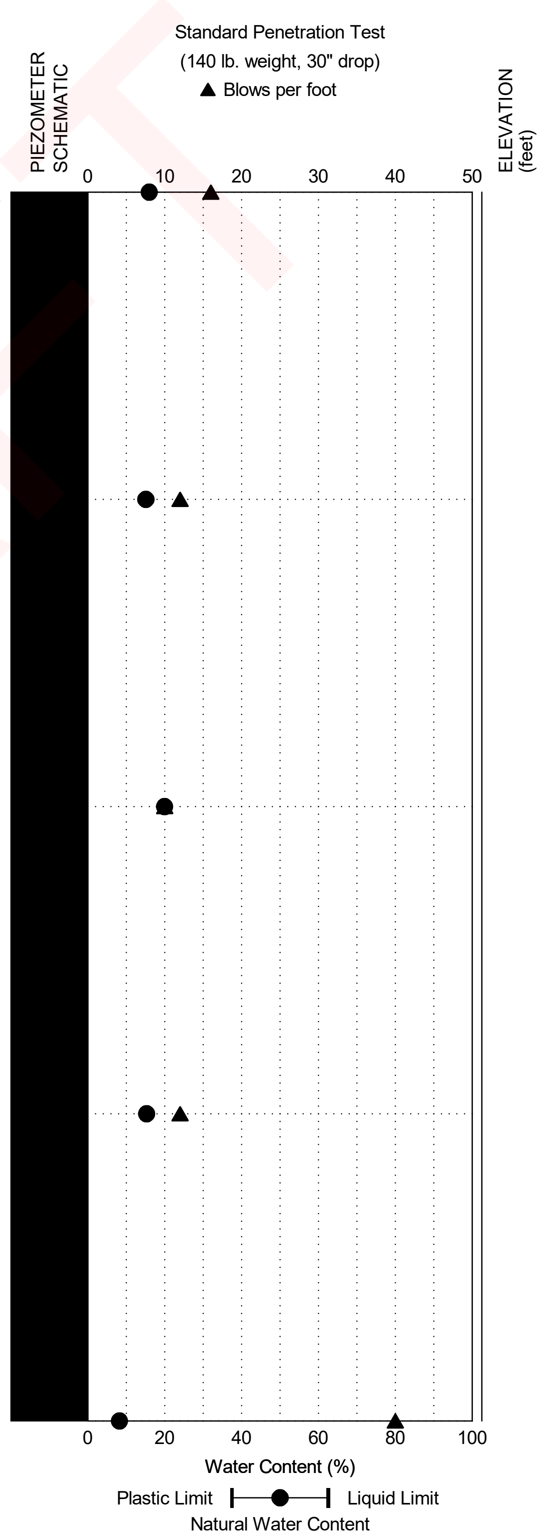
BORING:
HWA-4p-24

PROJECT NO.: 2024-069 FIGURE: A -5

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD: HSA, Acker Recon Tracked Rig w/ 3¼" ID
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75344, Long: -122.27447; Datum: WGS 84

DATE STARTED: 9/3/2024
DATE COMPLETED: 9/4/2024
LOGGED BY: W. Rosso

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
20	SP	Medium dense, olive-grey, clean, poorly-graded SAND, wet. Medium to coarse sand, trace fine subrounded to rounded gravel. Recovery: 10 inches	S-9	1-4-12	%F
25	SP SM	Medium dense, olive-gray, gravelly, slightly silty SAND, wet. Medium to coarse sand, fine subrounded to rounded gravel. 2 inches of olive brown lean clay recovered at the top of the sample. Recovery: 12 inches	S-10	3-6-6	%F
30	SM	Medium dense, olive-gray, silty SAND, wet. Medium to coarse sand, trace fine subrounded to rounded gravel. Recovery: 10 inches.	S-11	2-4-6	
35		Approximately 1 foot of heave in borehole. Recovery: 16 inches	S-12	3-4-8	
40					



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.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

BORING:
HWA-4p-24

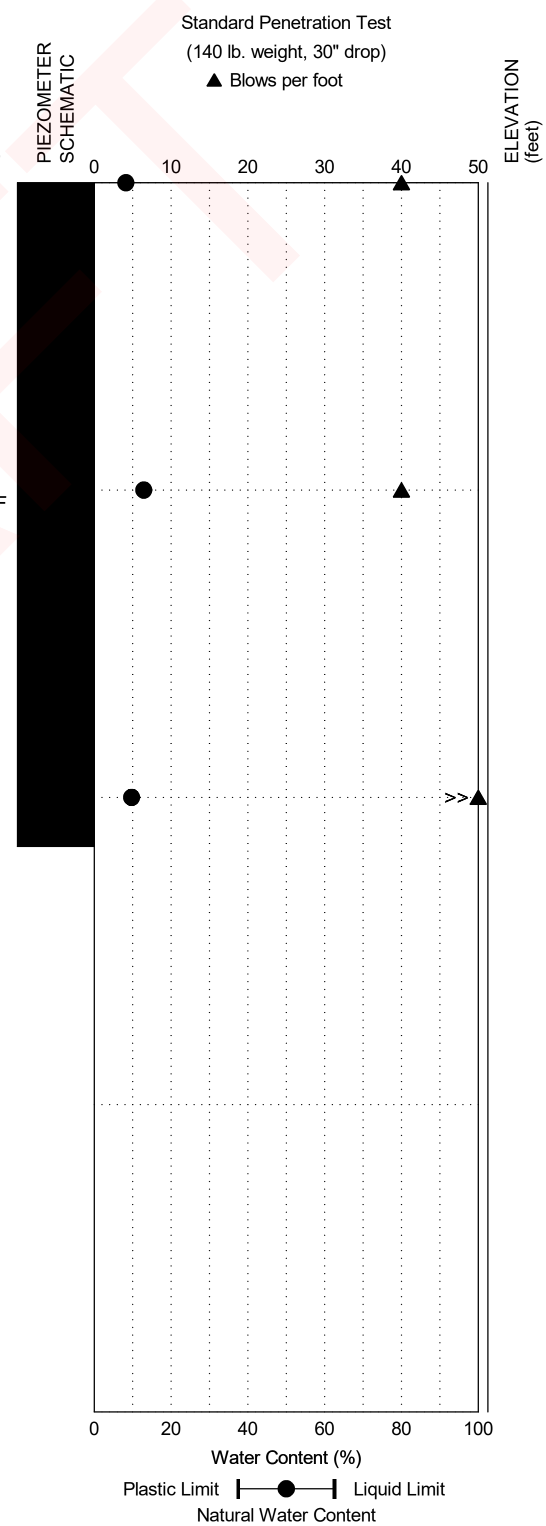
PROJECT NO.: 2024-069
FIGURE: A -5

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD: HSA, Acker Recon Tracked Rig w/ 3¼" ID
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75344, Long: -122.27447; Datum: WGS 84

DATE STARTED: 9/3/2024
DATE COMPLETED: 9/4/2024
LOGGED BY: W. Rosso

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
40		SM	Dense, dark gray, gravelly, silty SAND, wet. Fine to medium sand, fine subrounded gravel. Less than 6 inches of heave observed. Recovery: 12 inches **(PRE-FRASER DEPOSITS)** Drilling rate of advance slows to approximately 25 minutes per 5 feet from ~40 to 45 feet bgs.	☒	S-13	17-24-16	
45			Silt content increases, becomes very silty, gravel content decreases, becomes slightly gravelly. Cuttings no longer observed being returned to the surface. Drilling rate of advance slows to approximately 40 minutes per 5 feet from ~45 to 50 feet bgs.	☒	S-14	3-10-30	%F
50		SM	Dense, gray, very gravelly, silty SAND, wet. Fine to medium sand, fine subrounded gravel. Recovery: 7 inches	☒	S-15	6-50/4"	

HWA-4p-24 was terminated at about 50.8 feet below ground surface (bgs).
Groundwater was observed at about 3 feet during exploration.
2 inch PVC standpipe piezometer installed in 8 foot well on 9/3/24.
DOE unique well tag #BNZ 185.
Groundwater was observed at 2.4 feet bgs on 9/5/24.



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HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

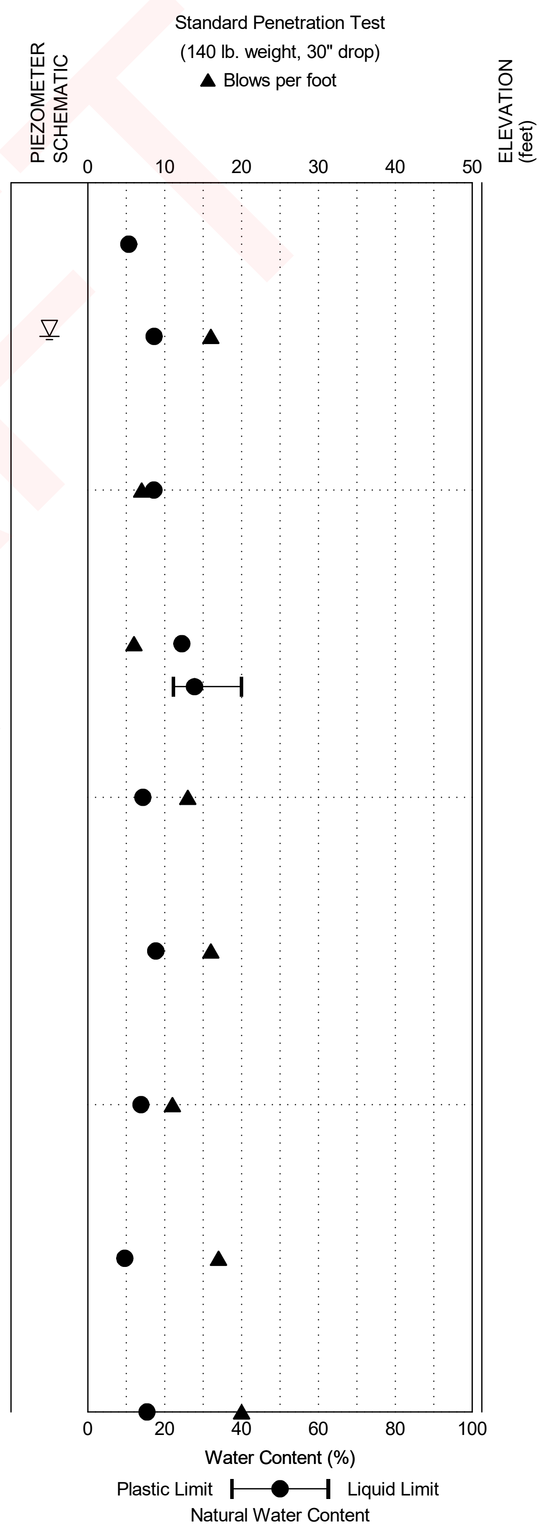
BORING:
HWA-4p-24

PROJECT NO.: 2024-069
FIGURE: A -5

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD:
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75314, Long: -122.27473; Datum: WGS 84

DATE STARTED: 9/5/2024
DATE COMPLETED: 9/5/2024
LOGGED BY: A. Heinze Fry

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0		About 3-inches of grass and rootmat. **(TOPSOIL)**			
	SM	Olive brown, gravelly, silty SAND, moist. Coarse angular gravel layer at about 1 foot bgs, fine gravels to cobbles observed. **(FILL)**	S-1		GS
	SM	Medium dense, gray, slightly silty, poorly-graded SAND, wet. Fine to medium sand, trace fine gravel, trace organics, trace coarse gravel in sampler shoe. Recovery: 12 inches. **(ALLUVIUM)**	S-2	4-5-11	
5	SP SM	Loose, olive-brown, gray, silty SAND, wet. Fine to medium sand, trace fine gravel. Recovery: 2½ inches.	S-3	3-3-4	%F
		Driller began adding drilling mud to borehole.			
	SM	Loose, yellowish olive brown, silty SAND, wet. Fine sand. Recovery: 12 inches.	S-4a	3-2-4	
	CL	Medium stiff, light olive-brown with orange mottling, sandy, lean CLAY, moist. Fine sand. Recovery: 6 inches.	S-4b		%F AL
	SM	Loose, olive-brown, silty SAND, wet. Fine to coarse sand, trace fine gravel.			
10	SP SM	Medium dense, olive brown, slightly gravelly, silty, poorly-graded SAND, wet. Fine to coarse sand, trace coarse gravel. Recovery: 9 inches.	S-5	5-7-6	
		Recovery: 9 inches.	S-6	2-7-9	%F
15		Decreased silt content. Recovery: 9 inches.	S-7	3-5-6	
		Three coarse gravels in sampler. Recovery: 8 inches.	S-8	5-8-9	%F
20					



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HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

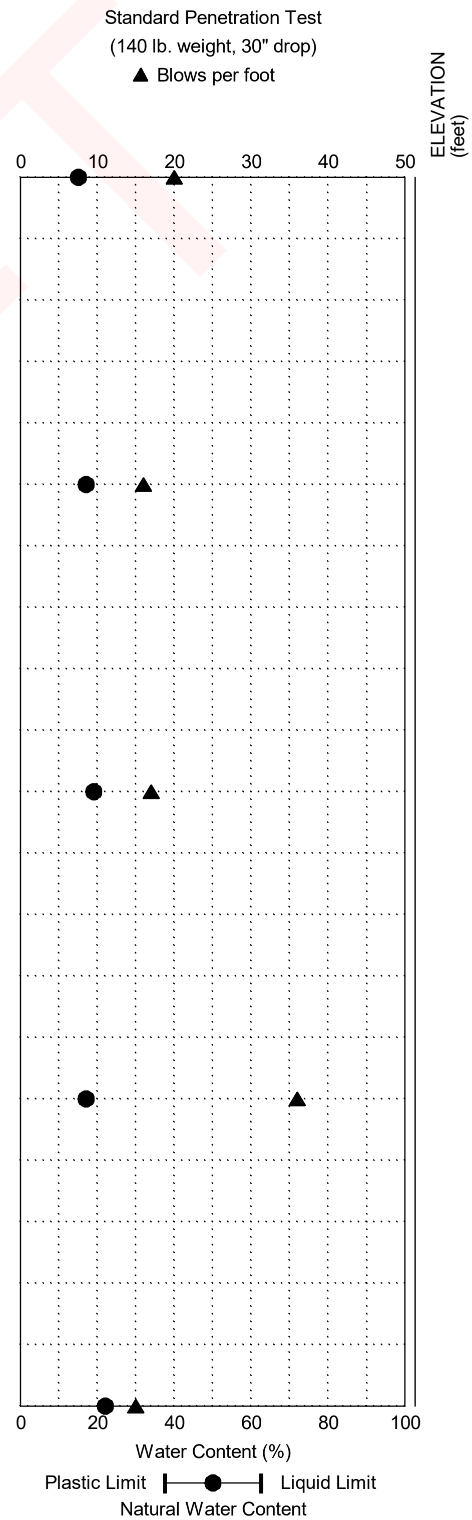
BORING:
HWA-5-24

PROJECT NO.: 2024-069
FIGURE: A -6

DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD:
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75314, Long: -122.27473; Datum: WGS 84

DATE STARTED: 9/5/2024
DATE COMPLETED: 9/5/2024
LOGGED BY: A. Heinze Fry

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
20	SP SM	Medium dense, olive brown, slightly silty, poorly-graded SAND, wet. Fine to medium sand, trace gravel. Recovery: 7 inches.	S-9	6-8-12		
25	SP	Medium dense, olive brown, slightly gravelly, clean, poorly-graded SAND, wet. Fine to medium sand. Recovery: 11 inches.	S-10	3-7-9	%F	
30	SP SM	Medium dense, olive brown, slightly gravelly, slightly silty, poorly-graded SAND, wet. Fine to medium sand. Recovery: 13 inches.	S-11	6-8-9	%F	
		Drilling effort increases at about 33 feet.				
35		Recovery: 10 inches.	S-12a	3-16-20		
	SM	Dense, yellowish olive brown, gravelly, very silty, fine SAND, moist.	S-12b			
40		Tip of sampler warm from drilling.				



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HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

BORING:
HWA-5-24

PROJECT NO.: 2024-069 FIGURE: A -6

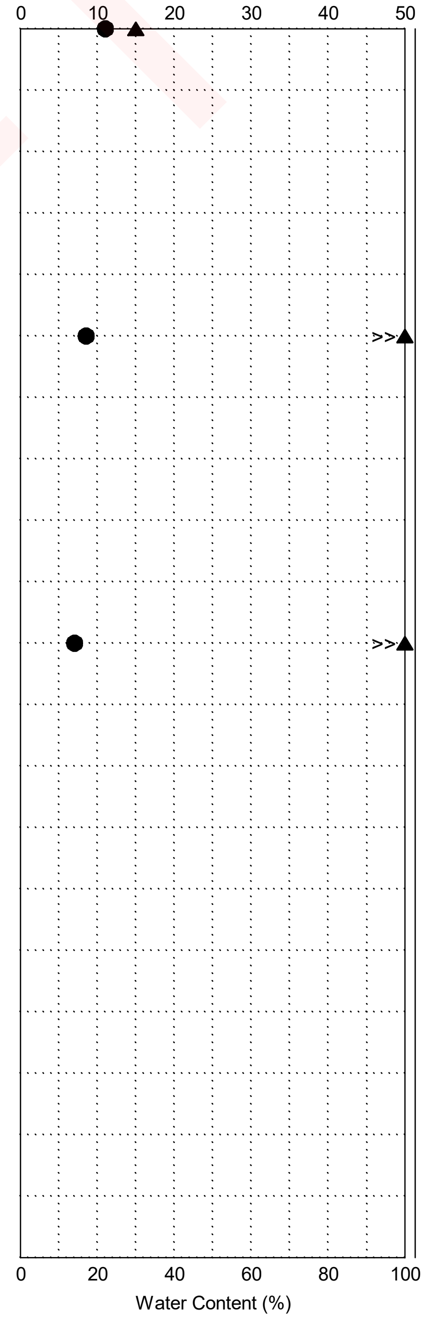
DRILLING COMPANY: Geologic Drill Partners, Inc.
DRILLING METHOD:
SAMPLING METHOD: SPT w/ Autohammer (90% efficiency)
LOCATION: See Figure 2. Lat: 47.75314, Long: -122.27473; Datum: WGS 84

DATE STARTED: 9/5/2024
DATE COMPLETED: 9/5/2024
LOGGED BY: A. Heinze Fry

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
40	SP	Medium dense, olive brown, clean, poorly-graded SAND, wet. Recovery: 17 inches.	S-13	4-7-8	%F	
	SP	Very dense, dark grayish-brown, clean, poorly-graded SAND, wet. Slow drilling starting at about 42 feet. **(PRE-FRASER DEPOSITS)**				
45		Recovery: 18 inches.	S-14a	14-19-33	%F	
	ML	Hard, dark grayish-brown, slightly gravelly, very sandy SILT, moist. Very slow drilling, auger rattle / gravelly drilling.	S-14b		%F	
50		Recovery: 16 inches.	S-15	14-22-32		

HWA-5-24 terminated at about 51½ feet below ground surface (bgs).
Boring was backfilled with bentonite chips per Washington DOE requirements and cuttings were spread at the surface.
Groundwater was observed at about 2½ feet during exploration.

Standard Penetration Test
(140 lb. weight, 30" drop)
▲ Blows per foot



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.

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY PROGRAM

Representative soil samples obtained from our explorations were placed in plastic bags to prevent loss of moisture and transported to our Bothell, Washington, laboratory for further examination and testing. Laboratory tests were conducted on selected soil samples to characterize relevant engineering and index properties of the site soils. Laboratory testing was conducted as described below. A Summary of Material Properties is provided on **Figures B-1** through **B-4**.

MOISTURE CONTENT: The moisture content of selected soil samples was determined in general accordance with ASTM D 2216. The results are summarized on the attached Summary of Material Properties, **Figures B-1** through **B-4**, which also provide information regarding the classification of the samples, as determined using ASTM D 2487, and are shown at the sampled intervals on the appropriate summary logs in **Appendix A**.

PERCENT FINER THAN NO. 200 SIEVE: The percentage of material finer than the No. 200 sieve was determined for select samples in general accordance with ASTM D 1140. The soil was oven dried and washed over a No. 200 sieve to determine the percentage of fines. The results are provided on **Figures B-1** through **B-4**, which also provide information regarding the classification of the sample, as determined using ASTM D 2487.

PARTICLE SIZE ANALYSIS OF SOILS (SIEVE AND HYDROMETER): Selected samples were tested to determine the particle distribution in general accordance with ASTM D 6913 and/or D 7928. The results are summarized on the attached Grain Size Distribution reports, **Figures B-5** through **B-17**, which also provide information regarding the classification of the sample and the moisture content at the time of testing.

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS (ATTERBERG LIMITS): Selected samples were tested using method ASTM D 4318, multi-point method. The results are reported on the attached Liquid Limit, Plastic Limit, and Plasticity Index report, **Figure B-18**, which also provides information regarding the classification of the sample, as determined using ASTM D 2487.

EXPLORATION DESIGNATION	TOP DEPTH (feet)	BOTTOM DEPTH (feet)	MOISTURE CONTENT (%)	ORGANIC CONTENT (%)	SPECIFIC GRAVITY	ATTERBERG LIMITS (%)			% GRAVEL	% SAND	% FINES	ASTM SOIL CLASSIFICATION	SAMPLE DESCRIPTION
						LL	PL	PI					
HWA-1p-24,S-1	1.0	2.0	5.4								46.2	SM	Brown, silty SAND
HWA-1p-24,S-2	2.5	4.0	5.3						0.8	60.0	39.2	SM	Light brownish-gray, silty SAND
HWA-1p-24,S-3	5.0	6.5	7.7						15.3	52.5	32.2	SM	Brown, silty SAND with gravel
HWA-1p-24,S-4	7.5	9.0	15.2									SM	Olive-brown, silty SAND with gravel
HWA-1p-24,S-5	10.0	11.5	12.7									SP-SM	Dark grayish-brown, poorly graded SAND with silt and gravel
HWA-1p-24,S-6	12.5	14.0	13.8									SM	Light olive-brown, silty SAND with gravel
HWA-1p-24,S-7	15.0	16.5	13.2									SM	Olive-brown, silty SAND with gravel
HWA-1p-24,S-8	17.5	19.0	16.8									SM	Dark grayish-brown, silty SAND
HWA-1p-24,S-9	20.0	21.5	18.9									SM	Light olive-brown, silty SAND
HWA-1p-24,S-10	25.0	26.5	23.0									CL	Grayish-brown, lean CLAY
HWA-1p-24,S-11	30.0	31.3	15.3									SM	Dark gray, silty SAND
HWA-1p-24,S-12	31.3	32.3	16.3									ML	Dark gray, sandy SILT
HWA-2-24,S-1	1.5	2.0	15.9						7.8	39.8	52.4	ML	Olive-brown, sandy SILT
HWA-2-24,S-2	2.5	4.0	9.9						45.9	38.6	15.5	GM	Dark olive-brown, silty GRAVEL with sand
HWA-2-24,S-3	5.0	6.5	11.1									SP-SM	Dark grayish-brown, poorly graded SAND with silt
HWA-2-24,S-4	7.5	9.0	19.9									GP-GM	Dark grayish-brown, poorly graded GRAVEL with silt and sand
HWA-2-24,S-5	10.0	11.5	15.0								5.0	SP-SM	Olive-brown, poorly graded SAND with silt
HWA-2-24,S-6	12.5	14.0	12.2									SP-SM	Light olive-brown, poorly graded SAND with silt and gravel
HWA-2-24,S-7	15.0	16.5	16.2									SP-SM	Olive-brown, poorly graded SAND with silt
HWA-2-24,S-8	17.5	19.0	15.8								8.1	SP-SM	Dark grayish-brown, poorly graded SAND with silt

Notes:
1. This table summarizes information presented elsewhere in the report and should be used in conjunction with the report test, other graphs and tables, and the exploration logs.
2. The soil classifications in this table are based on ASTM D2487 and D2488 as applicable.

GeoSciences Inc.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

SUMMARY OF
MATERIAL PROPERTIES

PROJECT NO.: 2024-069

FIGURE: B -1

EXPLORATION DESIGNATION	TOP DEPTH (feet)	BOTTOM DEPTH (feet)	MOISTURE CONTENT (%)	ORGANIC CONTENT (%)	SPECIFIC GRAVITY	ATTERBERG LIMITS (%)			% GRAVEL	% SAND	% FINES	ASTM SOIL CLASSIFICATION	SAMPLE DESCRIPTION
						LL	PL	PI					
HWA-2-24,S-9	20.0	21.5	16.2									SP-SM	Olive-gray, poorly graded SAND with silt
HWA-2-24,S-10	25.0	26.5	23.3						0.3	85.6	14.0	SM	Olive, silty SAND
HWA-2-24,S-11	30.0	31.5	26.1									CL	Olive, lean CLAY
HWA-2-24,S-12	35.0	36.5	12.5									ML	Olive-gray, SILT with sand
HWA-2-24,S-13	40.0	40.8	11.9									SM	Dark gray, silty SAND
HWA-3-24,S-1	1.5	1.7	10.8								0.7	SP	Olive-gray, poorly graded SAND
HWA-3-24,S-2a	2.5	3.0	12.8						3.1	92.6	4.3	SP	Olive-gray, poorly graded SAND
HWA-3-24,S-3	5.0	6.5	22.4									SP-SM	Olive-gray, poorly graded SAND with silt
HWA-3-24,S-4	7.5	9.0	23.1									SM	Very dark grayish-brown, silty SAND
HWA-3-24,S-5a	10.0	10.5	38.5	0.8					4.7	73.3	22.0	SM	Dark grayish-brown, silty SAND with trace organics
HWA-3-24,S-5b	10.5	11.5	19.8								37.8	SM	Grayish-brown, silty SAND
HWA-3-24,S-6a	12.5	13.0	27.4								53.8	ML	Light olive-brown, sandy SILT
HWA-3-24,S-6b	13.0	14.0	28.6			33	21	12			85.1	CL	Light yellowish-brown, lean CLAY
HWA-3-24,S-7	15.0	16.5	9.2									GM	Olive-brown, silty GRAVEL with sand
HWA-3-24,S-8	17.5	19.0	15.3						17.4	77.2	5.3	SP-SM	Dark grayish-brown, poorly graded SAND with silt and gravel
HWA-3-24,S-9	20.0	21.5	13.1								2.8	SP	Dark grayish-brown, poorly graded SAND with gravel
HWA-3-24,S-10	25.0	26.5	13.6						26.3	63.3	10.3	SW-SM	Dark grayish-brown, well-graded SAND with silt and gravel
HWA-3-24,S-11	30.0	31.5	15.6									SP-SM	Dark grayish-brown, poorly graded SAND with silt
HWA-3-24,S-12	35.0	36.5	11.0						28.0	67.3	4.7	SP	Dark grayish-brown, poorly graded SAND with gravel
HWA-3-24,S-13	40.0	41.5	13.1									SP-SM	Dark grayish-brown, poorly graded SAND with silt and gravel

Notes: 1. This table summarizes information presented elsewhere in the report and should be used in conjunction with the report test, other graphs and tables, and the exploration logs.
2. The soil classifications in this table are based on ASTM D2487 and D2488 as applicable.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

SUMMARY OF
MATERIAL PROPERTIES

PROJECT NO.: 2024-069 FIGURE: B -2

EXPLORATION DESIGNATION	TOP DEPTH (feet)	BOTTOM DEPTH (feet)	MOISTURE CONTENT (%)	ORGANIC CONTENT (%)	SPECIFIC GRAVITY	ATTERBERG LIMITS (%)			% GRAVEL	% SAND	% FINES	ASTM SOIL CLASSIFICATION	SAMPLE DESCRIPTION
						LL	PL	PI					
HWA-3-24,S-14	45.0	46.5	12.4									SP-SM	Dark grayish-brown, poorly graded SAND with silt and gravel
HWA-3-24,S-15	50.0	51.5	17.3									SP-SM	Dark grayish-brown, poorly graded SAND with silt
HWA-3-24,S-16	55.0	56.5	18.0								28.9	SM	Dark gray, silty SAND
HWA-3-24,S-17	60.0	61.5	29.3									CL	Dark gray, lean CLAY
HWA-3-24,S-18	65.0	66.5	30.2			42	21	21			87.3	CL	Dark gray, lean CLAY
HWA-3-24,S-19	70.0	70.5	8.5						37.1	47.5	15.4	SM	Dark gray, silty SAND with gravel
HWA-4p-24,S-1	1.5	2.0	17.8						2.9	74.2	23.0	SM	Olive-brown, silty SAND
HWA-4p-24,S-2	2.5	4.0	24.6								34.8	SM	Light olive-brown, silty SAND
HWA-4p-24,S-3	5.0	6.5	24.7								61.1	ML	Light olive-brown, sandy SILT
HWA-4p-24,S-4	7.5	9.0	16.5						17.8	75.9	6.4	SP-SM	Olive-gray, poorly graded SAND with silt and gravel
HWA-4p-24,S-5	10.0	11.5	11.3								5.3	SP-SM	Olive-gray, poorly graded SAND with silt and gravel
HWA-4p-24,S-6	12.5	14.0	14.5									SP-SM	Olive-gray, poorly graded SAND with silt and gravel
HWA-4p-24,S-7	15.0	16.5	13.3									SP-SM	Olive-gray, poorly graded SAND with silt and gravel
HWA-4p-24,S-8	17.5	19.0	15.2									SP-SM	Olive-gray, poorly graded SAND with silt
HWA-4p-24,S-9	20.0	21.5	16.0								4.0	SP	Olive-gray, poorly graded SAND with gravel
HWA-4p-24,S-10	25.0	26.5	15.1								5.7	SP-SM	Olive-gray, poorly graded SAND with silt and gravel
HWA-4p-24,S-11	30.0	31.5	20.0									SM	Olive-gray, silty SAND
HWA-4p-24,S-12	35.0	36.5	15.3									SM	Olive-gray, silty SAND
HWA-4p-24,S-13	40.0	41.5	8.2									SM	Dark gray, silty SAND with gravel
HWA-4p-24,S-14	45.0	46.5	12.9								34.2	SM	Dark gray, silty SAND

Notes: 1. This table summarizes information presented elsewhere in the report and should be used in conjunction with the report test, other graphs and tables, and the exploration logs.
2. The soil classifications in this table are based on ASTM D2487 and D2488 as applicable.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

SUMMARY OF
MATERIAL PROPERTIES

PROJECT NO.: 2024-069 FIGURE: B -3

EXPLORATION DESIGNATION	TOP DEPTH (feet)	BOTTOM DEPTH (feet)	MOISTURE CONTENT (%)	ORGANIC CONTENT (%)	SPECIFIC GRAVITY	ATTERBERG LIMITS (%)			% GRAVEL	% SAND	% FINES	ASTM SOIL CLASSIFICATION	SAMPLE DESCRIPTION
						LL	PL	PI					
HWA-4p-24,S-15	50.0	50.8	9.7									SM	Dark gray, silty SAND with gravel
HWA-5-24,S-1	1.0	2.5	10.6						19.6	61.7	18.8	SM	Dark olive-brown, silty SAND with gravel
HWA-5-24,S-2	2.5	4.0	17.2									SM	Dark gray, silty SAND
HWA-5-24,S-3	5.0	6.5	17.2								7.3	SP-SM	Olive-brown, poorly graded SAND with silt
HWA-5-24,S-4a	7.5	8.2	24.4									SM	Light olive-brown, silty SAND
HWA-5-24,S-4b	8.2	9.0	27.8			40	22	18			71.8	CL	Light olive-brown, lean CLAY with sand
HWA-5-24,S-5	10.0	11.5	14.3									SP-SM	Olive-brown, poorly graded SAND with silt and gravel
HWA-5-24,S-6	12.5	14.0	17.7								7.9	SP-SM	Dark grayish-brown, poorly graded SAND with silt
HWA-5-24,S-7	15.0	16.5	13.8									SP-SM	Very dark grayish-brown, poorly graded SAND with silt
HWA-5-24,S-8	17.5	19.0	9.6								5.2	SP-SM	Olive-brown, poorly graded SAND with silt and gravel
HWA-5-24,S-9	20.0	21.5	15.4									SP-SM	Dark grayish-brown, poorly graded SAND with silt
HWA-5-24,S-10	25.0	26.5	17.4								4.2	SP	Dark grayish-brown, poorly graded SAND
HWA-5-24,S-11	30.0	31.5	18.9								5.1	SP-SM	Dark grayish-brown, poorly graded SAND with silt
HWA-5-24,S-12a	35.0	35.5	17.4									SP-SM	Dark grayish-brown, poorly graded SAND with silt
HWA-5-24,S-13	40.0	41.5	21.8								4.1	SP	Dark grayish-brown, poorly graded SAND
HWA-5-24,S-14a	45.0	45.8	17.0								4.9	SP	Dark grayish-brown, poorly graded SAND
HWA-5-24,S-15	50.0	51.5	13.6									ML	Dark grayish-brown, sandy SILT

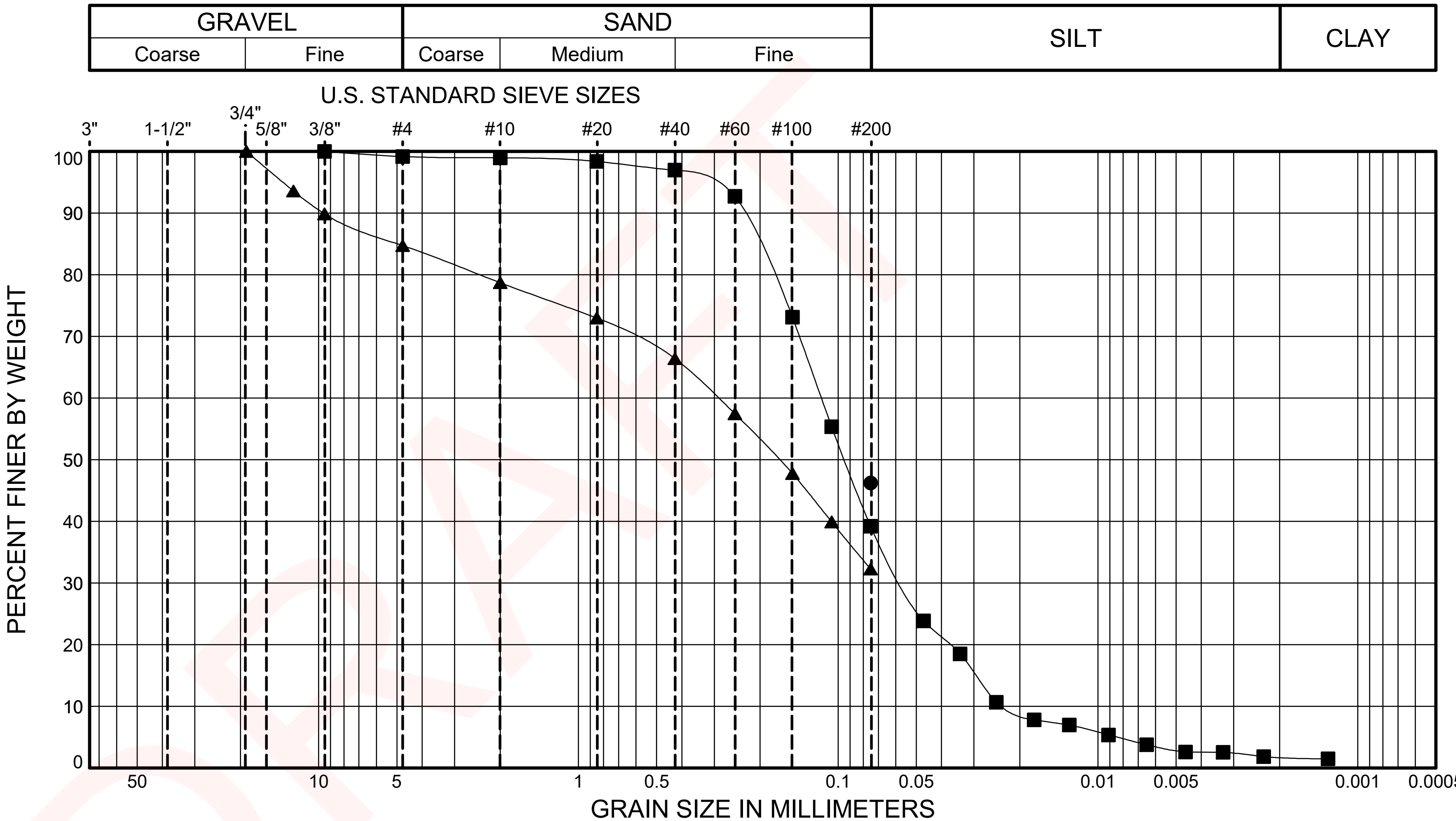
Notes: 1. This table summarizes information presented elsewhere in the report and should be used in conjunction with the report test, other graphs and tables, and the exploration logs.
2. The soil classifications in this table are based on ASTM D2487 and D2488 as applicable.

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

SUMMARY OF
MATERIAL PROPERTIES

PROJECT NO.: 2024-069 FIGURE: B -4



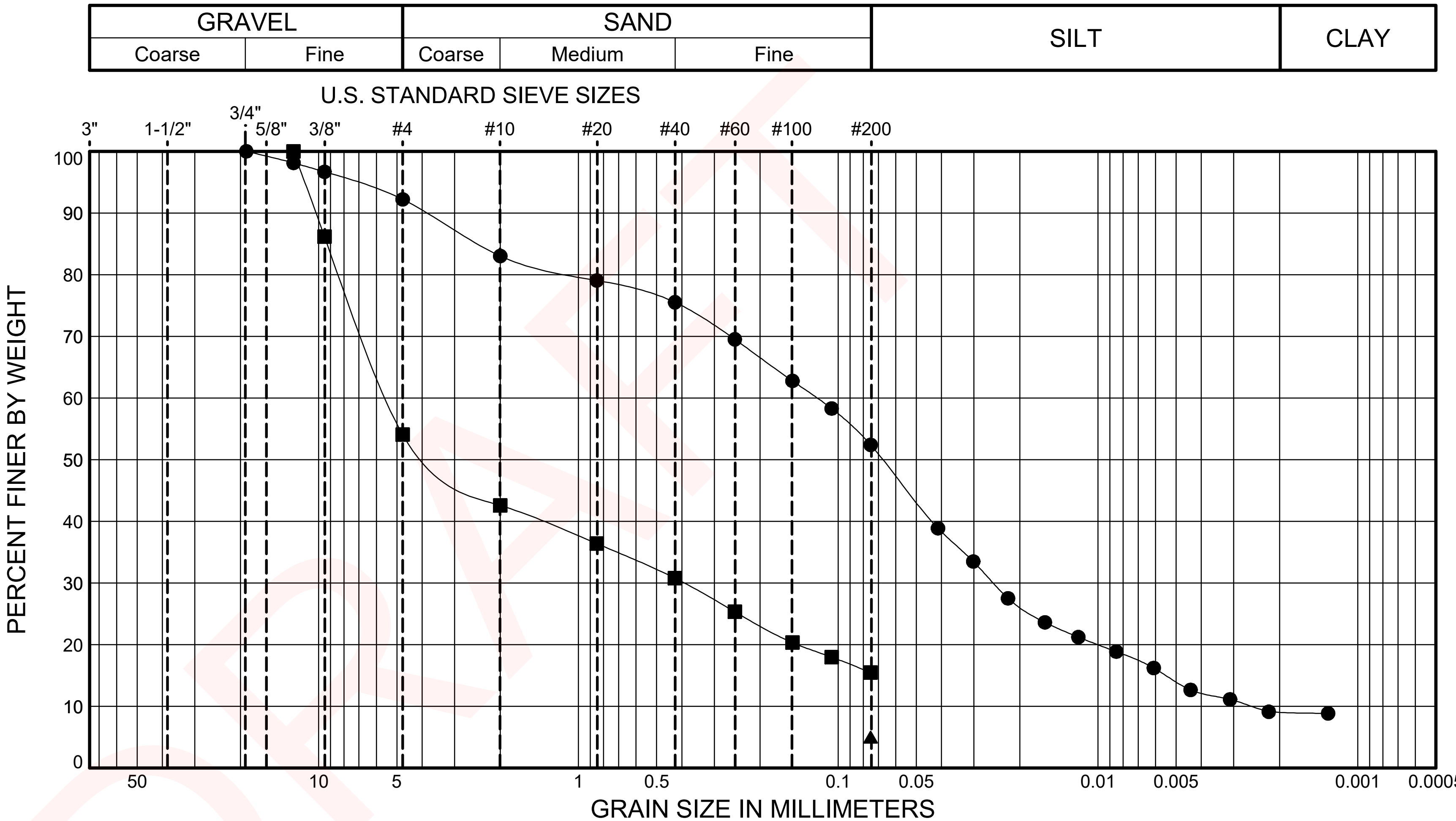
SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-1p-24	S-1	1.0 - 2.0	(SM) Brown, silty SAND	5								46.2
■	HWA-1p-24	S-2	2.5 - 4.0	(SM) Light brownish-gray, silty SAND	5				0.8	60.0	37.4	1.7	
▲	HWA-1p-24	S-3	5.0 - 6.5	(SM) Brown, silty SAND with gravel	8				15.3	52.5			32.2

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -5



SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-2-24	S-1	1.5 - 2.0	(ML) Olive-brown, sandy SILT	16				7.8	39.8	43.3	9.1	
■	HWA-2-24	S-2	2.5 - 4.0	(GM) Dark olive-brown, silty GRAVEL with sand	10				45.9	38.6			15.5
▲	HWA-2-24	S-5	10.0 - 11.5	(SP-SM) Olive-brown, poorly graded SAND with silt	15								5.0

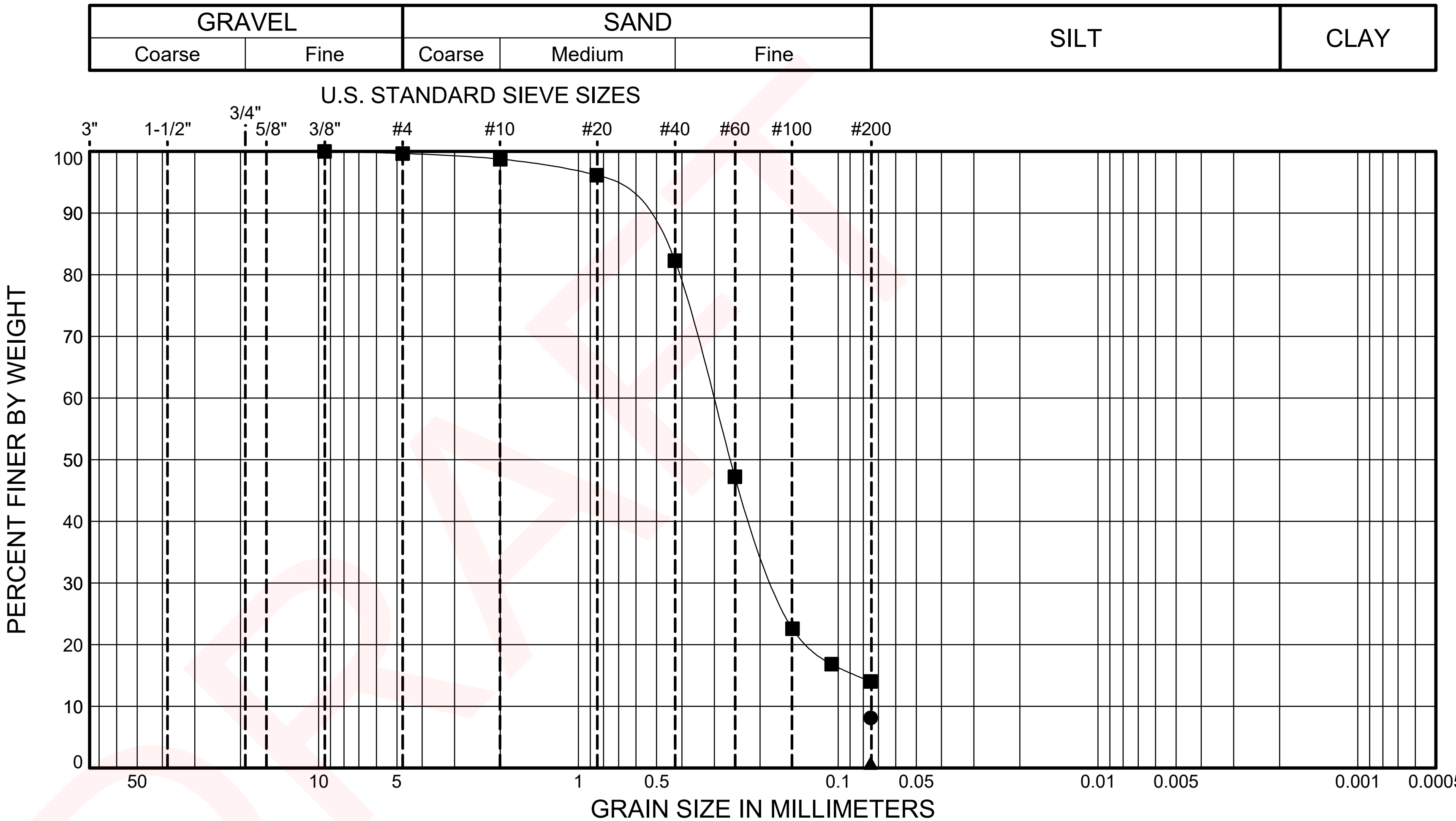
HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069

FIGURE: B -6



SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-2-24	S-8	17.5 - 19.0	(SP-SM) Dark grayish-brown, poorly graded SAND with silt	16								8.1
■	HWA-2-24	S-10	25.0 - 26.5	(SM) Olive, silty SAND	23				0.3	85.6			14.0
▲	HWA-3-24	S-1	1.5 - 1.7	(SP) Olive-gray, poorly graded SAND	11								0.7

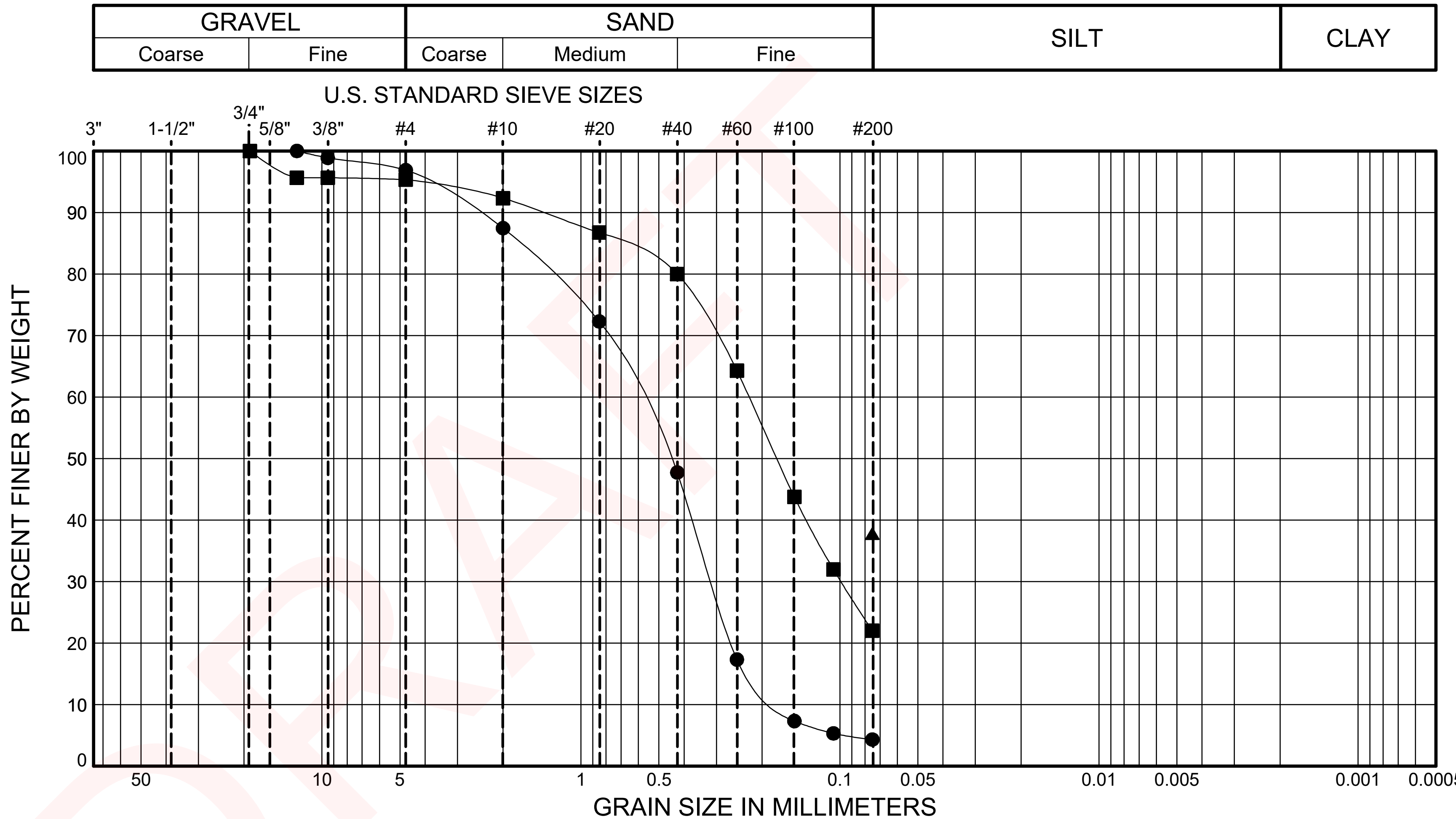
HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -7

HWAGRSZ SILT-CLAY % WITH 6913/7928/1140 2024-069.GPJ 10/25/24



SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-3-24	S-2a	2.5 - 3.0	(SP) Olive-gray, poorly graded SAND	13				3.1	92.6			4.3
■	HWA-3-24	S-5a	10.0 - 10.5	(SM) Dark grayish-brown, silty SAND with trace organics	39				4.7	73.3			22.0
▲	HWA-3-24	S-5b	10.5 - 11.5	(SM) Grayish-brown, silty SAND	20								37.8

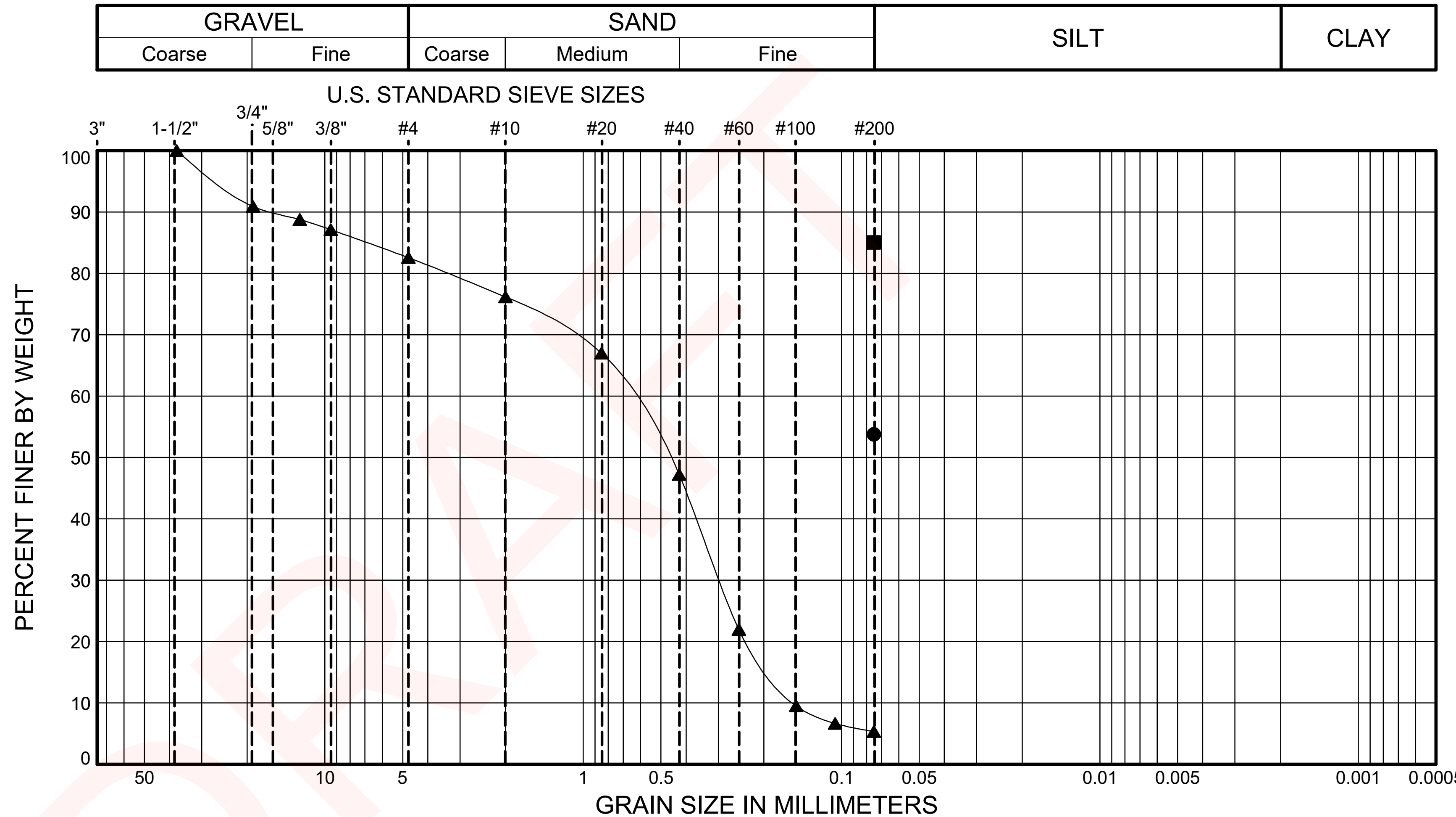
HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -8

HWAGRSZ SILT-CLAY % WITH 6913/7928/1140 2024-069.GPJ 10/25/24



SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-3-24	S-6a	12.5 - 13.0	(ML) Light olive-brown, sandy SILT	27								53.8
■	HWA-3-24	S-6b	13.0 - 14.0	(CL) Light yellowish-brown, lean CLAY	29	33	21	12					85.1
▲	HWA-3-24	S-8	17.5 - 19.0	(SP-SM) Dark grayish-brown, poorly graded SAND with silt and gravel	15				17.4	77.2			5.3

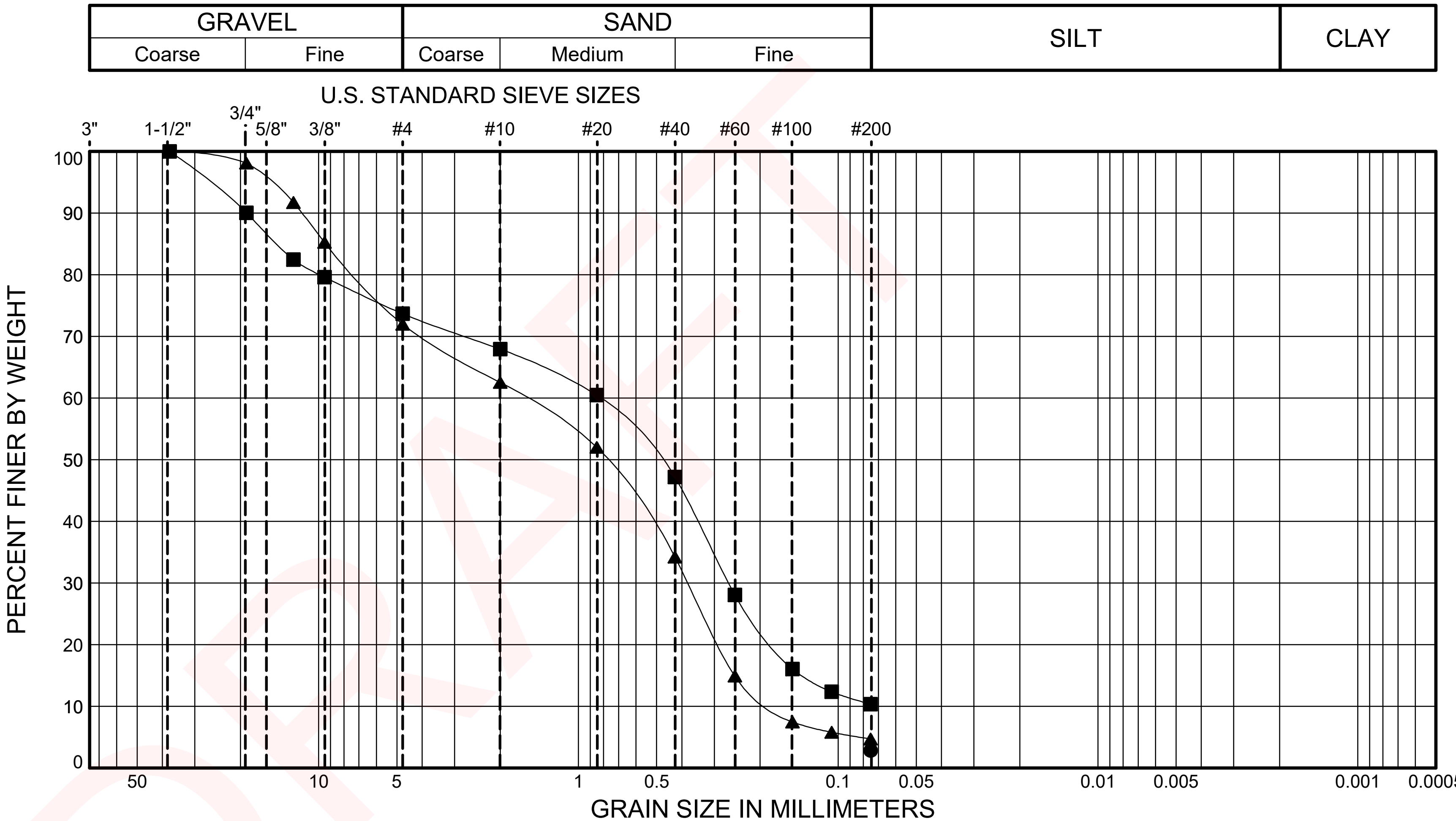
HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -9

HWAGRSZ SILT-CLAY % WITH 6913/7928/1140 2024-069.GPJ 10/25/24



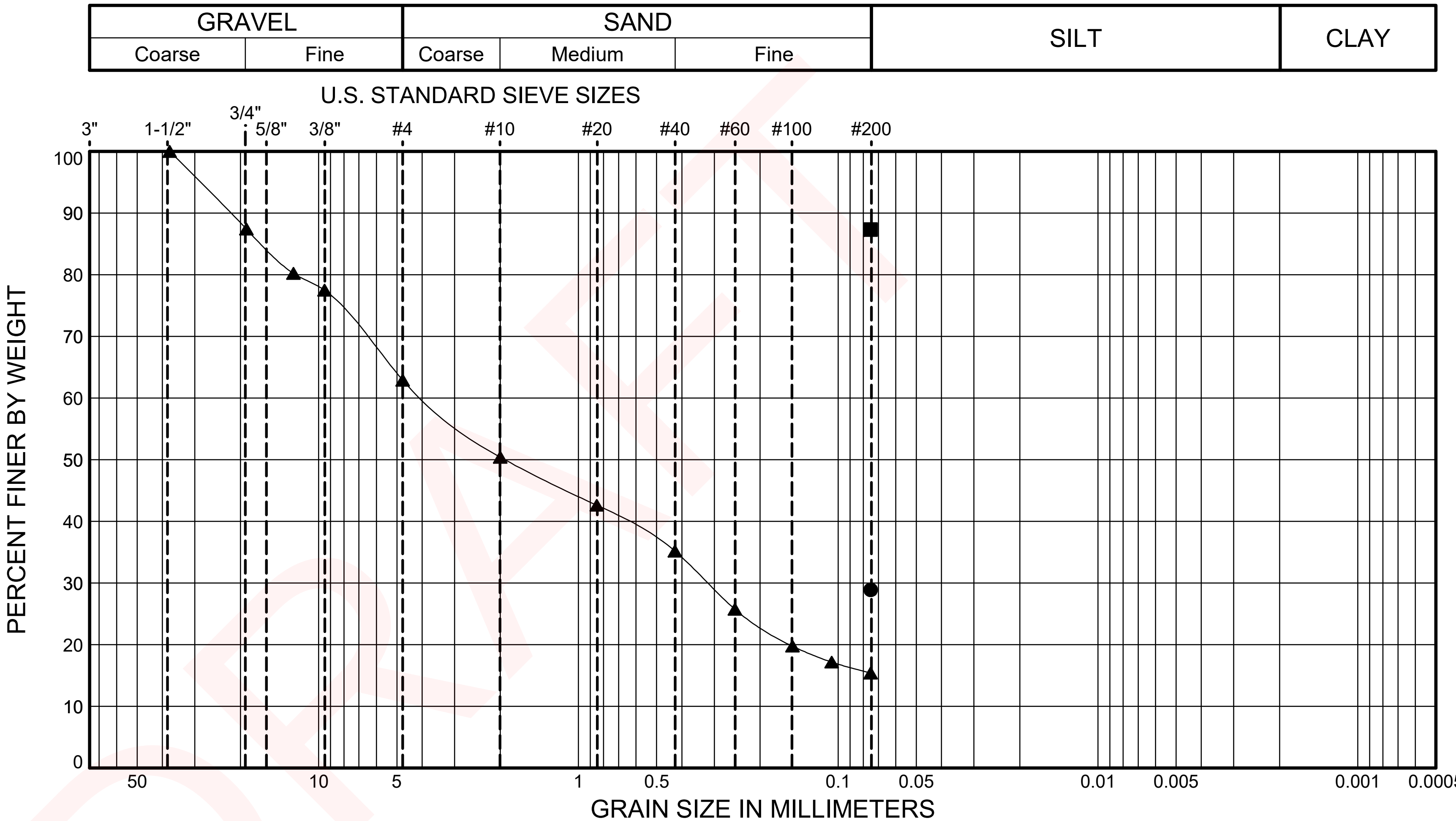
SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-3-24	S-9	20.0 - 21.5	(SP) Dark grayish-brown, poorly graded SAND with gravel	13								2.8
■	HWA-3-24	S-10	25.0 - 26.5	(SW-SM) Dark grayish-brown, well-graded SAND with silt and gravel	14				26.3	63.3			10.3
▲	HWA-3-24	S-12	35.0 - 36.5	(SP) Dark grayish-brown, poorly graded SAND with gravel	11				28.0	67.3			4.7

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -10



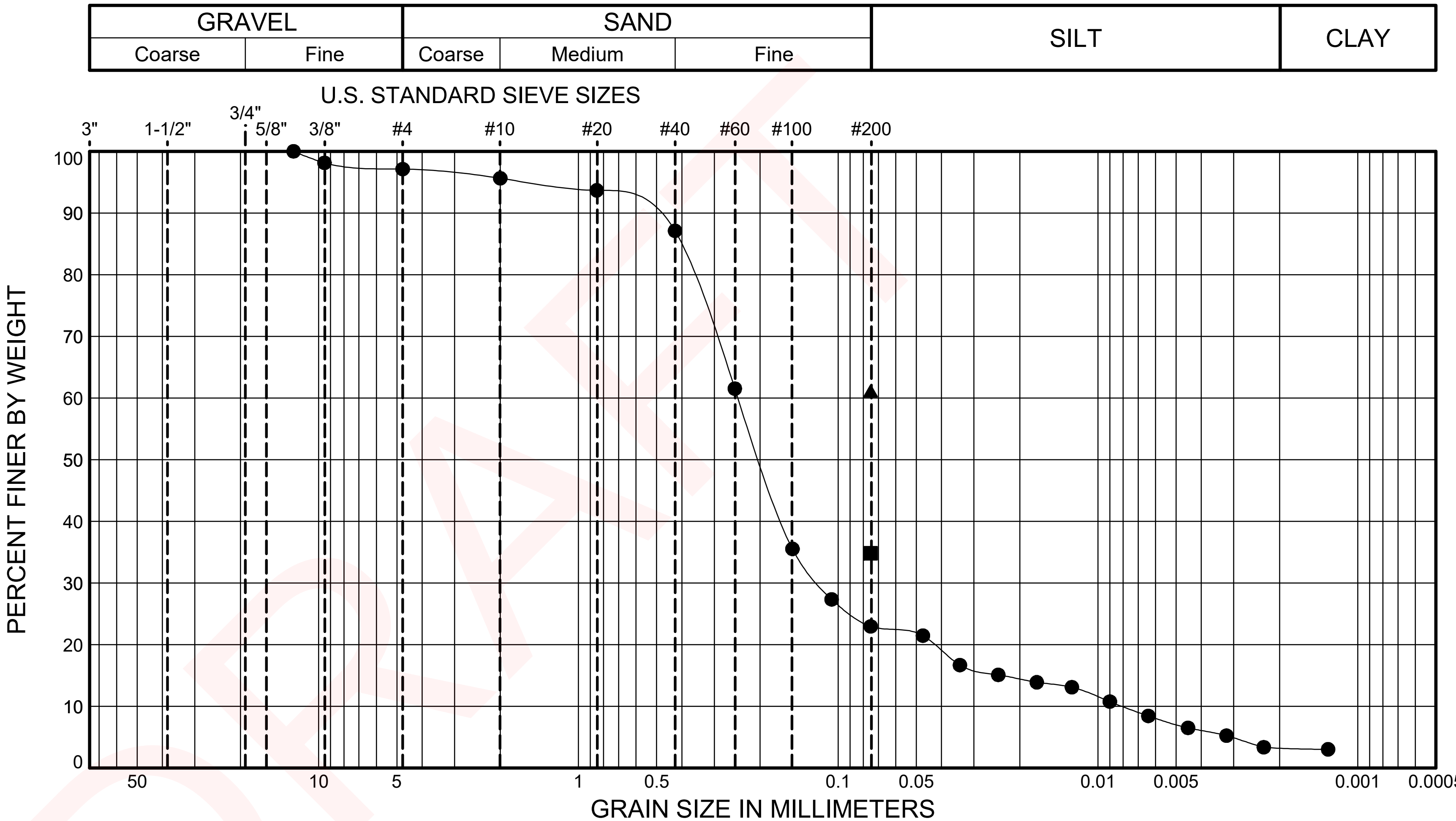
SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-3-24	S-16	55.0 - 56.5	(SM) Dark gray, silty SAND	18								28.9
■	HWA-3-24	S-18	65.0 - 66.5	(CL) Dark gray, lean CLAY	30	42	21	21					87.3
▲	HWA-3-24	S-19	70.0 - 70.5	(SM) Dark gray, silty SAND with gravel	9				37.1	47.5			15.4

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -11



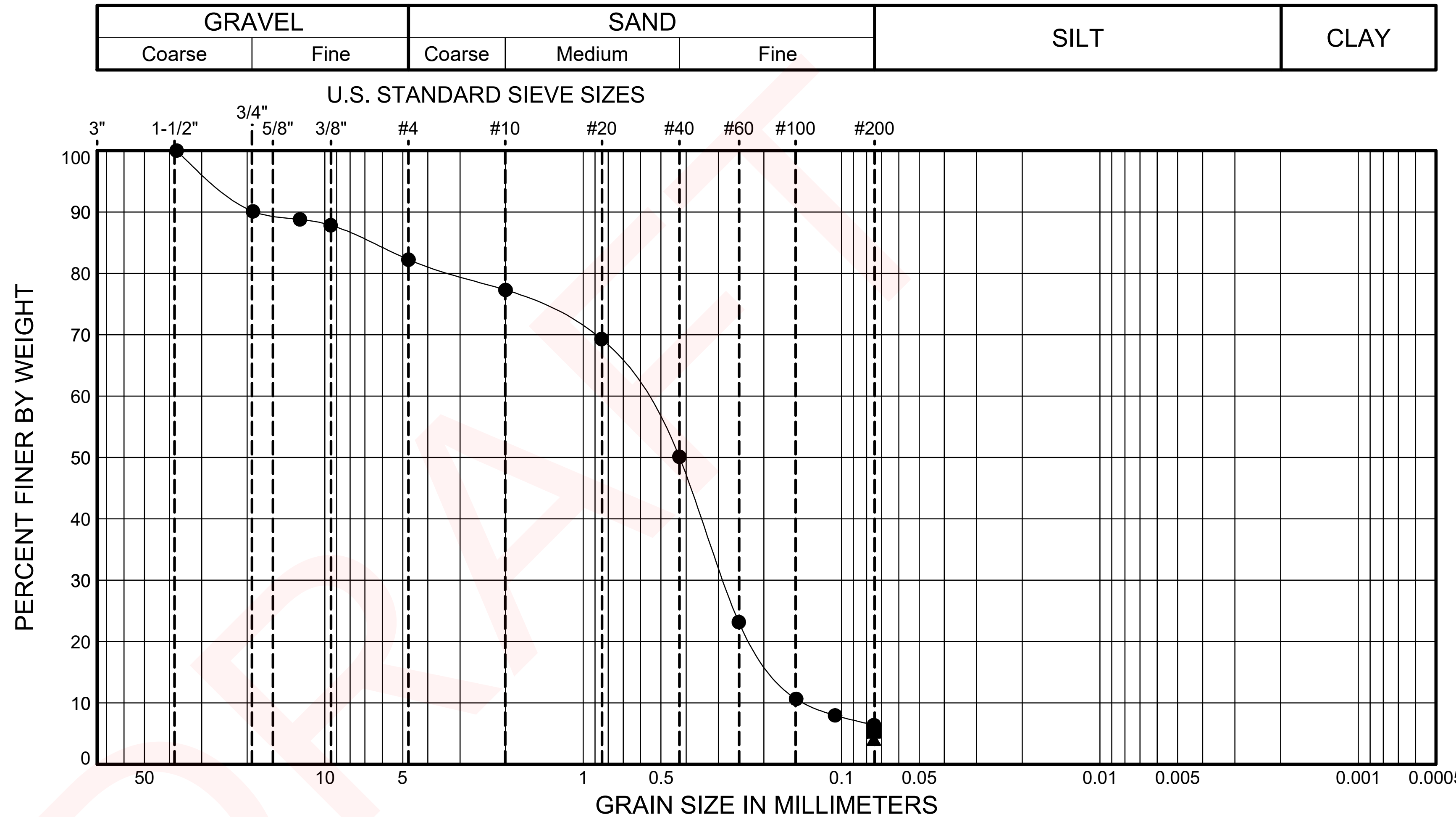
SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-4p-24	S-1	1.5 - 2.0	(SM) Olive-brown, silty SAND	18				2.9	74.2	19.7	3.3	
■	HWA-4p-24	S-2	2.5 - 4.0	(SM) Light olive-brown, silty SAND	25								34.8
▲	HWA-4p-24	S-3	5.0 - 6.5	(ML) Light olive-brown, sandy SILT	25								61.1

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -12



SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-4p-24	S-4	7.5 - 9.0	(SP-SM) Olive-gray, poorly graded SAND with silt and gravel	17				17.8	75.9			6.4
■	HWA-4p-24	S-5	10.0 - 11.5	(SP-SM) Olive-gray, poorly graded SAND with silt and gravel	11								5.3
▲	HWA-4p-24	S-9	20.0 - 21.5	(SP) Olive-gray, poorly graded SAND with gravel	16								4.0

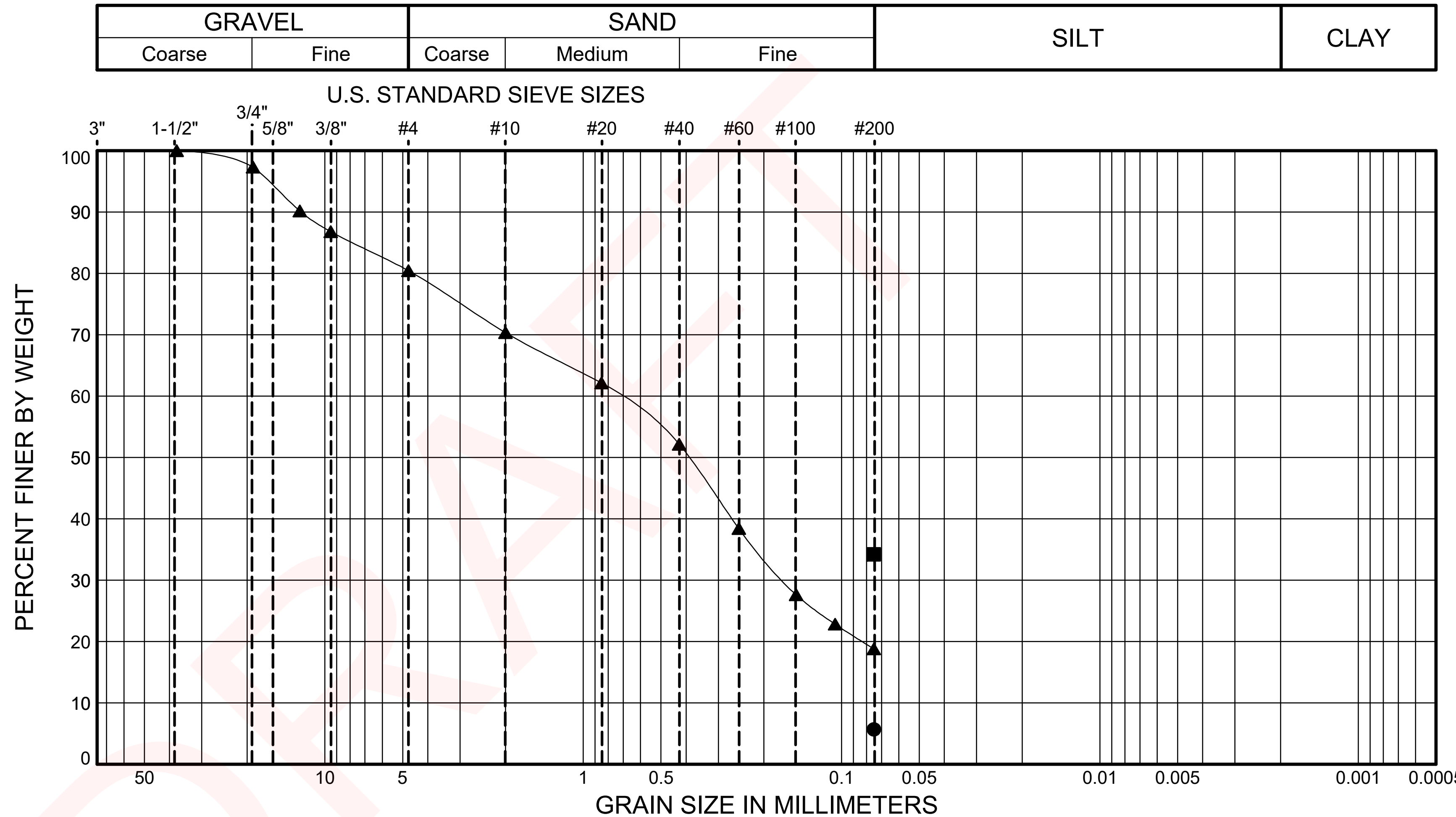
HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -13

HWAGRSZ SILT-CLAY % WITH 6913/7928/1140 2024-069.GPJ 10/25/24



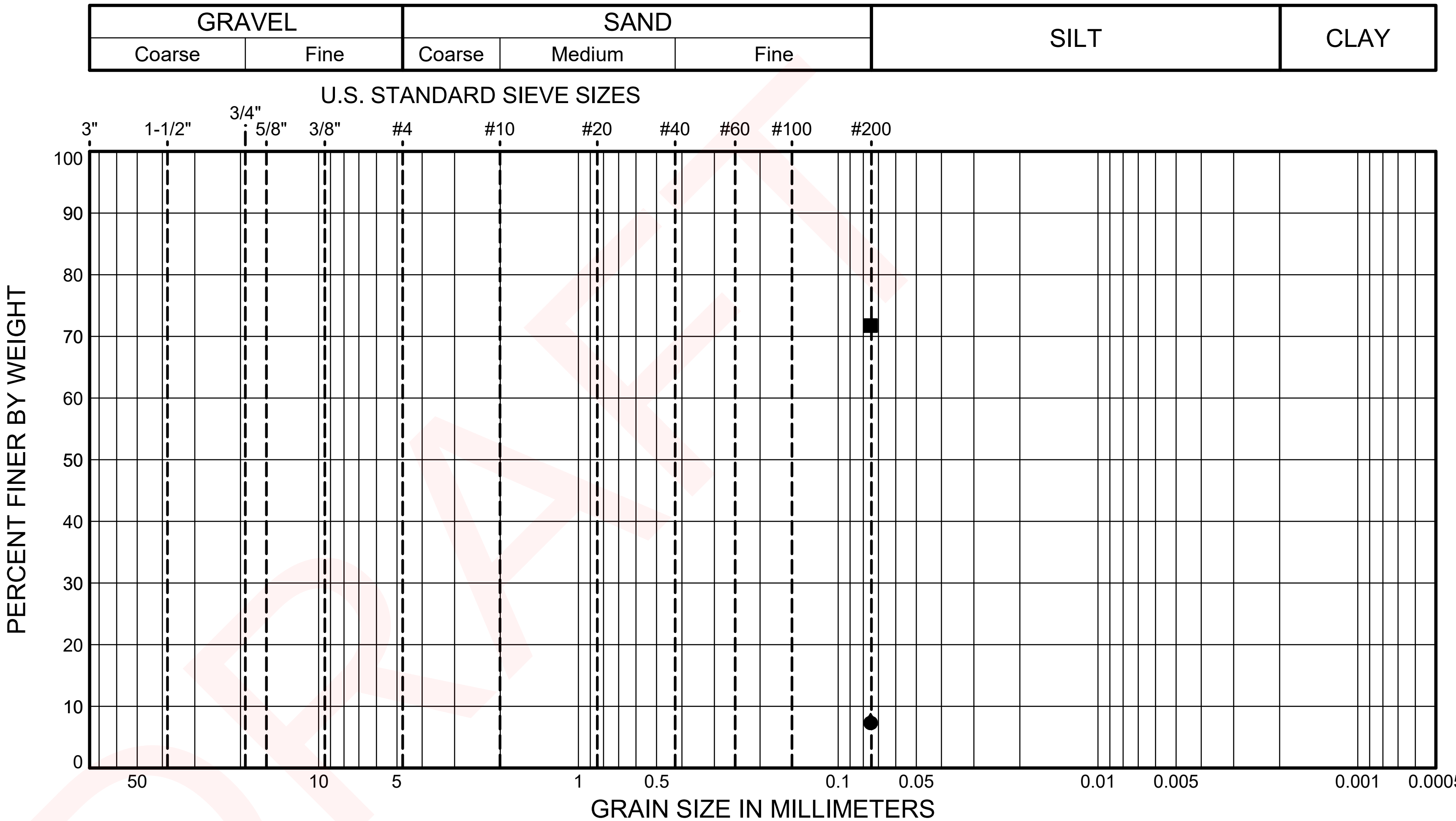
SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-4p-24	S-10	25.0 - 26.5	(SP-SM) Olive-gray, poorly graded SAND with silt and gravel	15								5.7
■	HWA-4p-24	S-14	45.0 - 46.5	(SM) Dark gray, silty SAND	13								34.2
▲	HWA-5-24	S-1	1.0 - 2.5	(SM) Dark olive-brown, silty SAND with gravel	11				19.6	61.7			18.8

GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -14



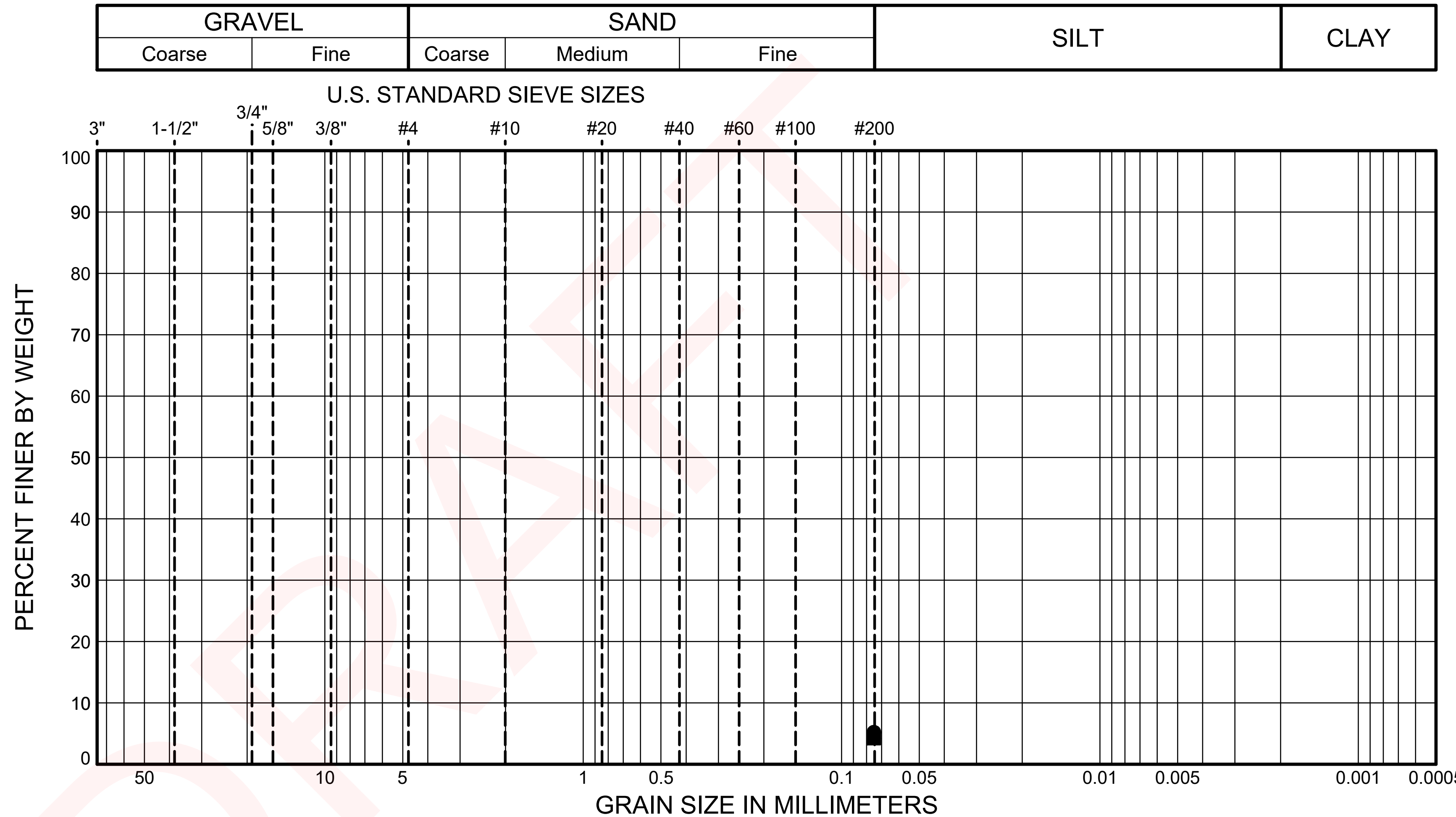
SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-5-24	S-3	5.0 - 6.5	(SP-SM) Olive-brown, poorly graded SAND with silt	17								7.3
■	HWA-5-24	S-4b	8.2 - 9.0	(CL) Light olive-brown, lean CLAY with sand	28	40	22	18					71.8
▲	HWA-5-24	S-6	12.5 - 14.0	(SP-SM) Dark grayish-brown, poorly graded SAND with silt	18								7.9

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -15



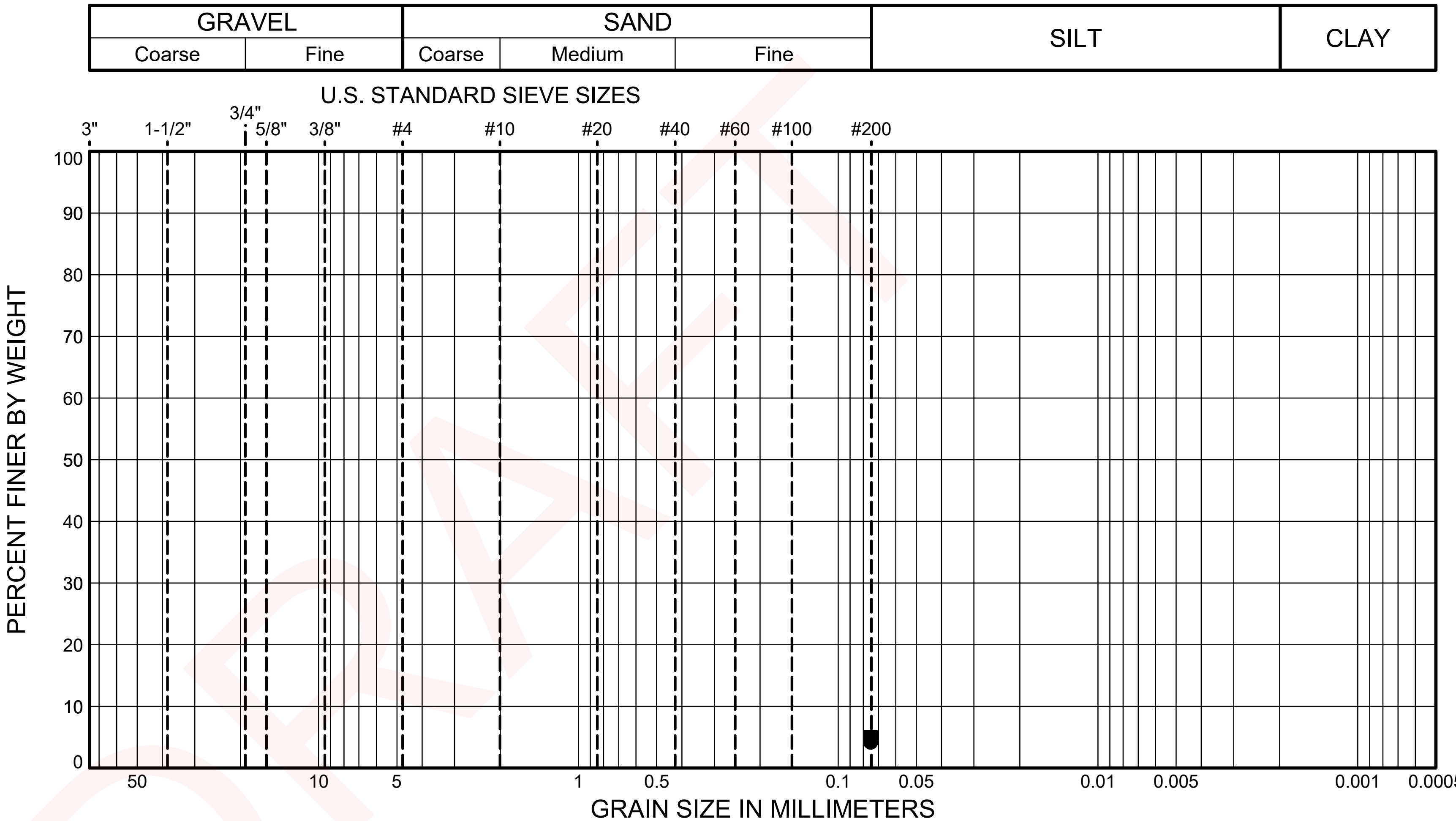
SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-5-24	S-8	17.5 - 19.0	(SP-SM) Olive-brown, poorly graded SAND with silt and gravel	10								5.2
■	HWA-5-24	S-10	25.0 - 26.5	(SP) Dark grayish-brown, poorly graded SAND	17								4.2
▲	HWA-5-24	S-11	30.0 - 31.5	(SP-SM) Dark grayish-brown, poorly graded SAND with silt	19								5.1

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -16



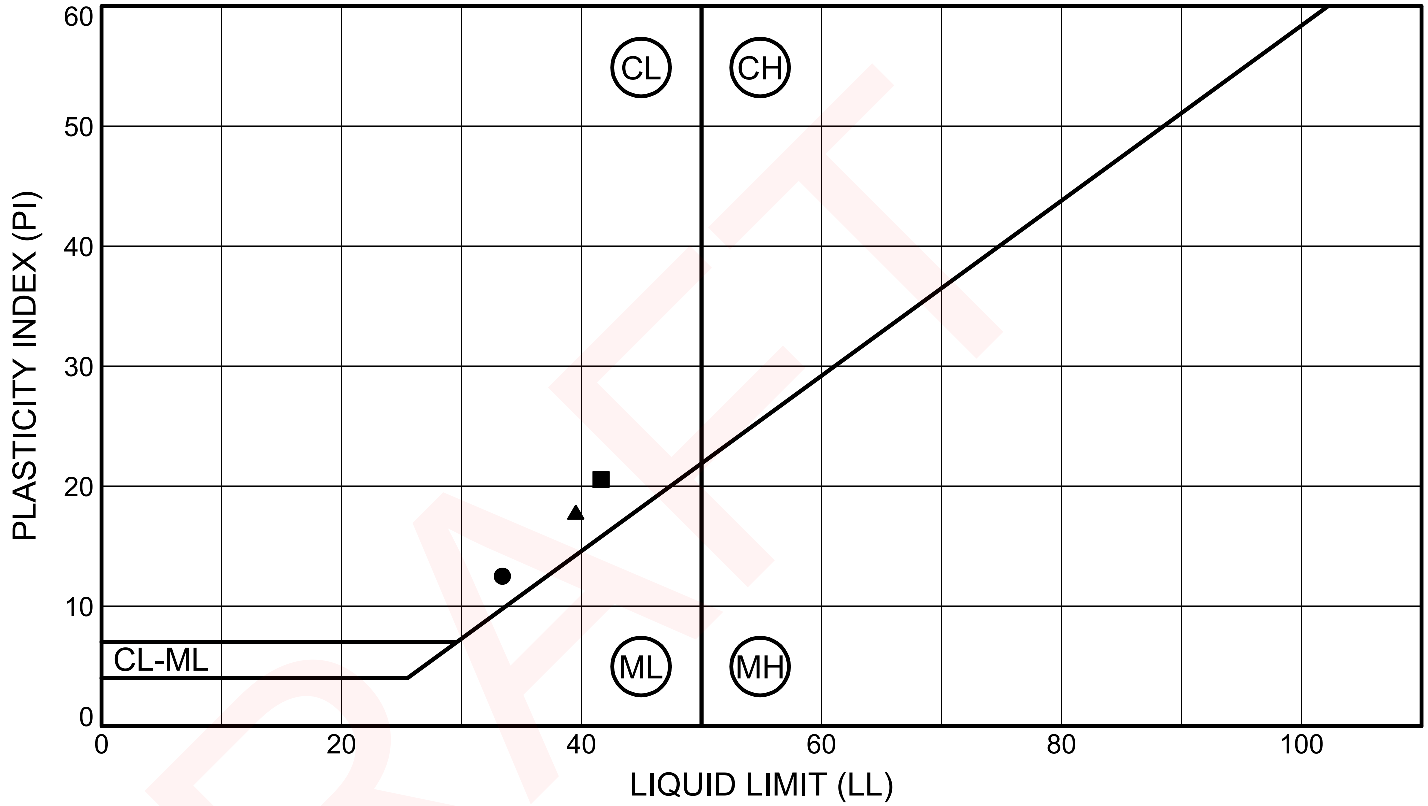
SYMBOL	SAMPLE		DEPTH (ft.)	ASTM SOIL CLASSIFICATION	% MC	LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	Fines %
●	HWA-5-24	S-13	40.0 - 41.5	(SP) Dark grayish-brown, poorly graded SAND	22								4.1
■	HWA-5-24	S-14a	45.0 - 45.8	(SP) Dark grayish-brown, poorly graded SAND	17								4.9

HWA GEOSCIENCES INC.

Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHODS ASTM D6913/D7928/D1140

PROJECT NO.: 2024-069 FIGURE: B -17



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Fines
●	HWA-3-24	S-6b	13.0 - 14.0	(CL) Light yellowish-brown, lean CLAY	29	33	21	12	85.1
■	HWA-3-24	S-18	65.0 - 66.5	(CL) Dark gray, lean CLAY	30	42	21	21	87.3
▲	HWA-5-24	S-4b	8.2 - 9.0	(CL) Light olive-brown, lean CLAY with sand	28	40	22	18	71.8

HWA GEOSCIENCES INC.

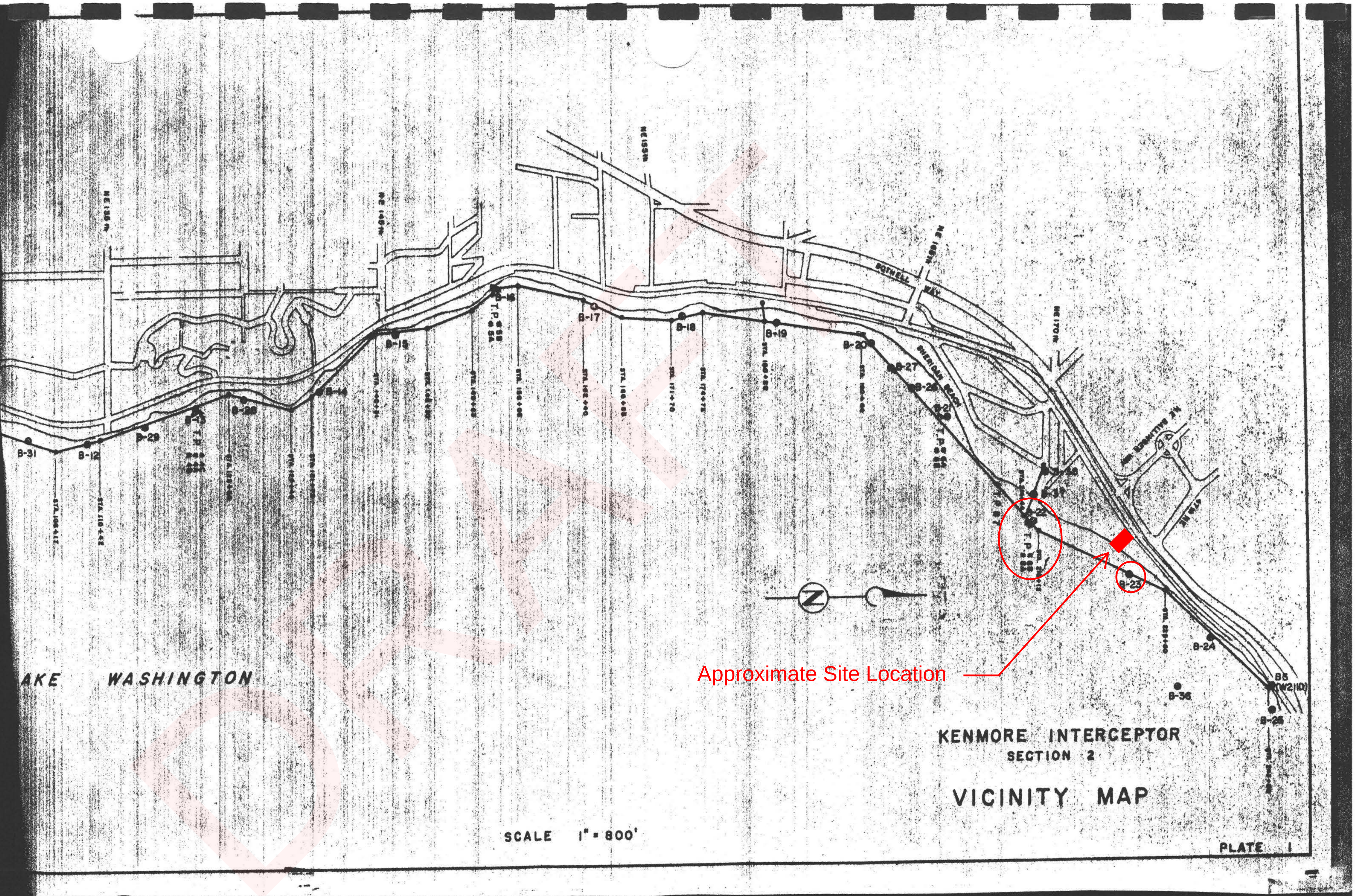
Lake Forest Park
Lakefront Improvements Phase 2
Lake Forest Park, Washington

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS METHOD ASTM D4318

PROJECT NO.: 2024-069 FIGURE: B -18

APPENDIX C

EXISTING INFORMATION



LAKE WASHINGTON
BOTHELL WAY
SHERIDAN BEACH
NE 170 th
B-31
B-12
B-29
B-14
B-15
B-16
B-17
B-18
B-19
B-20
B-27
B-22
B-23
B-24
B-36
B-25
Approximate Site Location
KENMORE INTERCEPTOR
SECTION 2
VICINITY MAP
SCALE 1" = 800'
PLATE 1

Appendix A

FIELD EXPLORATION AND LABORATORY TESTING

Field Exploration

The subsurface conditions along the alignment were explored by drilling 38 test borings at the locations shown on the Vicinity Map, Plate 1. The locations, with reference to either stationing and offset from the sewer center line or Lambert coordinates, are also noted on the top of each boring log.

All the borings were drilled with truck-mounted cable-tool drilling equipment. B1 through B36 were drilled from a barge in Lake Washington. B37 and B38 were drilled onshore. Supervision of the drilling, sampling and logging of the soils encountered was carried out by our geologist. Representative undisturbed samples were taken using a 3.25-inch O.D. split-barrel sampler driven by means of a 500-pound drop weight falling approximately 20 inches. The soils encountered in the exploratory borings are shown graphically on the boring logs on Plates A1 through A38, and the blow counts required to drive the sampler one foot are shown at the respective sample elevation. Also included in this Appendix is the log of boring B5 (W211D), Plate A39, which was drilled onshore for an adjacent project.

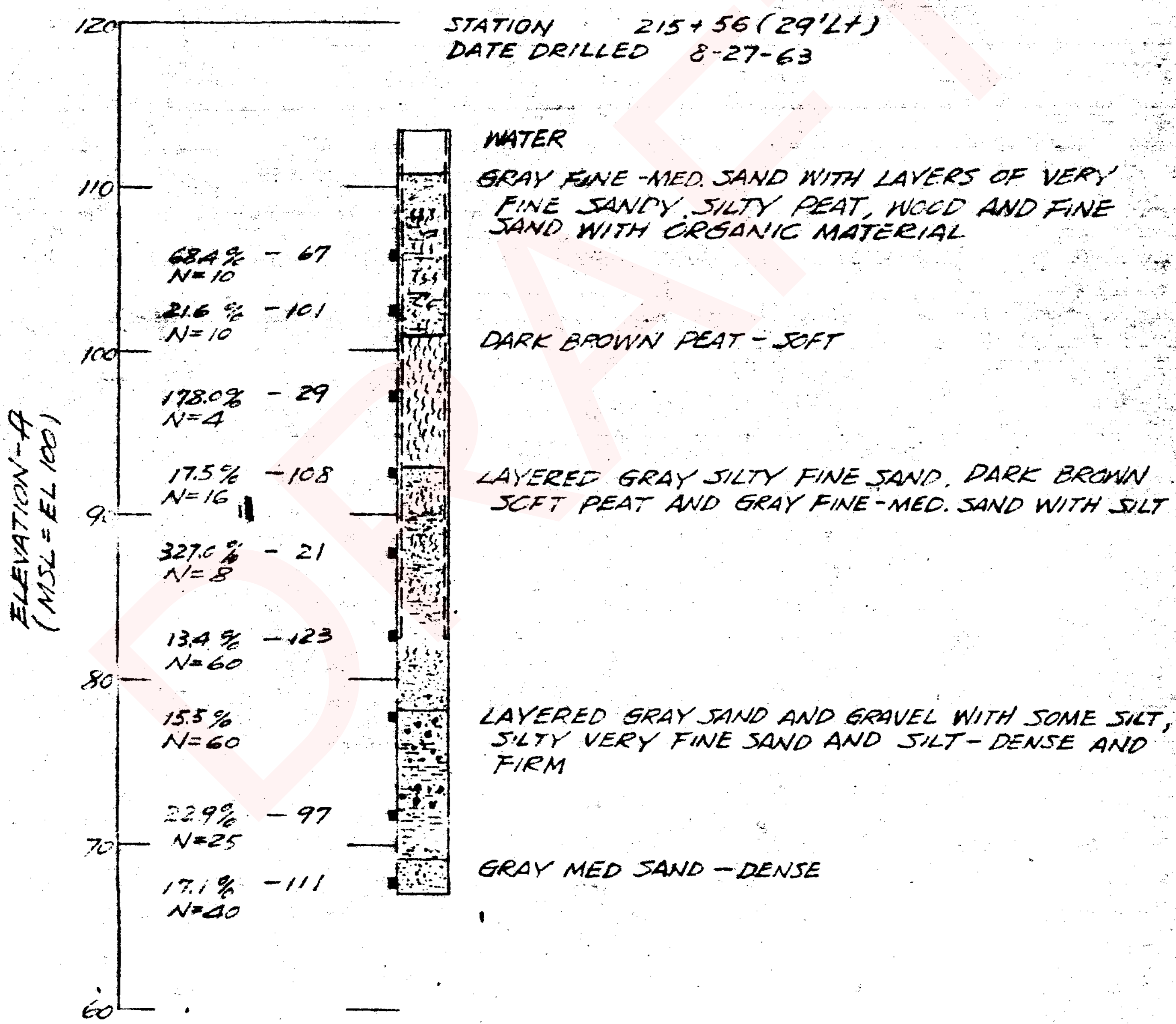
Laboratory Testing

Laboratory testing was limited to determining the natural in-place densities and moisture contents of the representative undisturbed samples. The results of these tests are shown at the left of the respective boring logs.

CALCULATION SHEET

METROPOLITAN ENGINEERS
SEATTLE, WASHINGTON

BORING 22



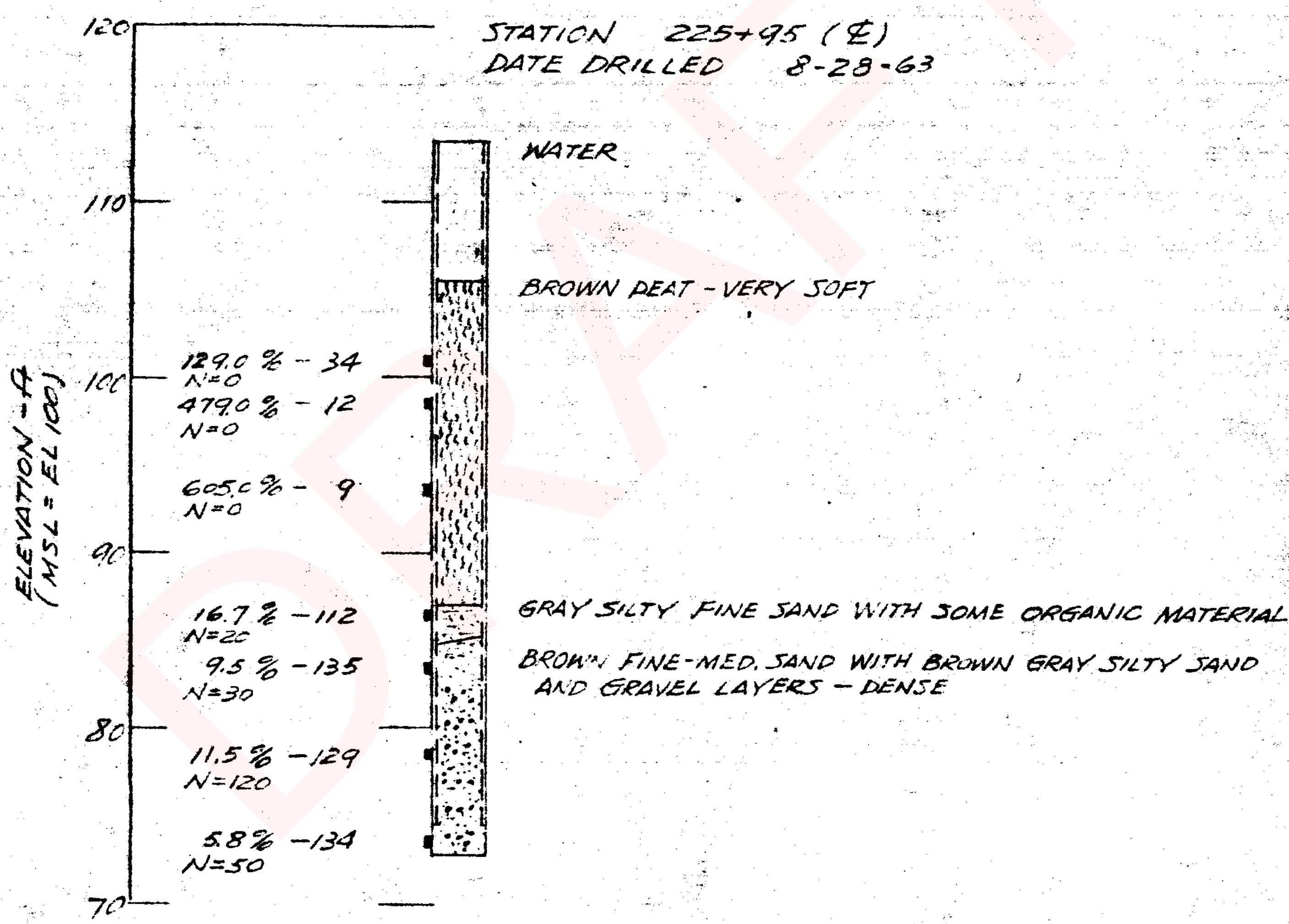
DATE	BY	JOB NO.	TITLE	PLATE
	CHW	W211C	LOG OF BORING	A-22

CALCULATION SHEET

METROPOLITAN ENGINEERS
SEATTLE, WASHINGTON

BORING 23

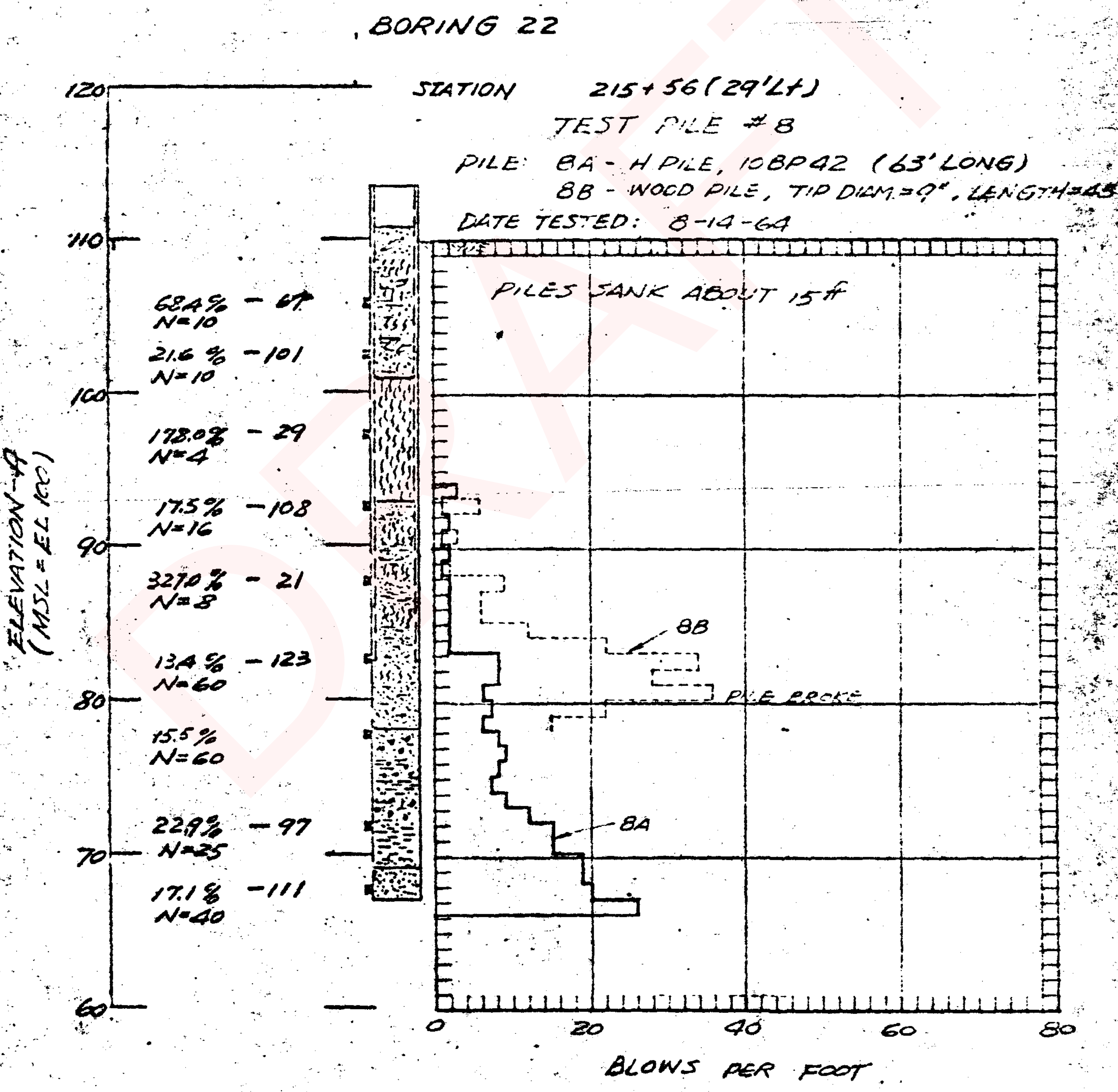
STATION 225+95 (℄)
DATE DRILLED 8-28-63



DATE	BY	JOB NO.	TITLE	
	CHW	W211C	LOG OF BORING	PLATE A-23

CALCULATION SHEET

METROPOLITAN ENGINEERS
SEATTLE, WASHINGTON



NOTES
(1) HAMMER: VULCAN #1, MEASURED STROKE = 2'-9", WEIGHT = 5000 lbs
(2) FINAL CONDITION: H PILE - PULLED WITH JET
WOOD PILE — WHILE BEING DRIVEN TO EL 79, PILE WAS BROKEN @ EL 99; 25' PULLED, 20' LEFT IN PLACE.

DATE	BY	JOB NO.		PLATE
		W2HC	TEST PILE DRIVING RECORD	B-8