



**NELSON GEOTECHNICAL  
ASSOCIATES. INC.**

**17311-135<sup>th</sup> Ave. N.E. Suite A-500  
Woodinville, WA 98072  
(425) 486-1669  
[www.nelsongeotech.com](http://www.nelsongeotech.com)**

June 17, 2024

Mr. David Sheldon  
VIA Email: [dsheldonffs@gmail.com](mailto:dsheldonffs@gmail.com)

Geotechnical Engineering Evaluation  
**Sheldon 66<sup>th</sup> Avenue SE Residence Development**  
**2247 – 66<sup>th</sup> Avenue SE**  
**Mercer Island, Washington**  
NGA File No. 1517424

Dear Mr. Sheldon:

We are pleased to submit the attached report titled **“Geotechnical Engineering Evaluation – Sheldon 66<sup>th</sup> Avenue SE Residence Development – 2247 - 66<sup>th</sup> Avenue SE – Mercer Island, Washington.”** This report summarizes our observations of the existing surface and subsurface conditions within the property and provides general recommendations for the proposed site development. Our services were completed in general accordance with the proposal signed by you and emailed to us on April 24, 2024.

The site is currently occupied by a single-family residence with a daylight basement within the central portion of the property. The ground surface within the site is generally level to gently sloping down from the east to the west. We understand that the proposed development will likely include removal of the existing residence and construction of a new single-family residence within the approximate same area as the existing residence.

We monitored the excavation of seven trackhoe excavated test pits and four hand auger explorations extending to depths in the range of 5.0 to 8.5 feet below the existing ground surface. Our explorations indicated that a majority of the proposed development area was underlain by a significant amount of unsuitable undocumented fill with competent native glacial soils at depth.

It is our opinion from a geotechnical standpoint, that the planned development is feasible provided that our recommendations are incorporated into the design and construction of this project. In our opinion, the undocumented fill soils that underlie a majority of the proposed the proposed development area are not suitable to provide adequate support for foundation and slab loads utilizing conventional shallow foundations, without experiencing significant settlement and distress to the structures. We therefore recommend that the proposed residence structure be supported on a deep foundation system consisting of 4-inch driven pin piles in order to advance the structure loads through the loose upper fill soils down to more competent native bearing deposits interpreted to underlie the site at depth. We also recommend that any proposed slab-on-grade within the residence be supported on pin piles and be designed as a structural slab.

Specific stormwater plans were also not available at the time this report was prepared. However, we understand that stormwater is likely to be directed into on-site infiltration systems, if feasible. We collected samples and attempted to perform onsite infiltration testing to determine the infiltration rate based on the Department of Ecology's 2019 Stormwater Management Manual for Western Washington (2019 SWMMWW), utilized by the City of Mercer Island. Based on our explorations, we concluded that the site soils were not feasible for stormwater infiltration.

In the attached report, we have included recommendations for general site grading, foundation and slab support, retaining walls and drainage. We recommend that Nelson Geotechnical Associates (NGA) be retained to review the geotechnical aspects of the project plans prior to construction. We also recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the construction differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications.

It has been a pleasure to provide service to you on this project. Please contact us if you have any questions regarding this report or require further information.

Sincerely,

**NELSON GEOTECHNICAL ASSOCIATES, INC.**



Khaled M. Shawish, PE  
**Principal Engineer**

## TABLE OF CONTENTS

<b>INTRODUCTION .....</b>	<b>1</b>
<b>SCOPE .....</b>	<b>1</b>
<b>SITE CONDITIONS .....</b>	<b>2</b>
Surface Conditions .....	2
Subsurface Conditions.....	2
Hydrogeologic Conditions .....	3
<b>SENSITIVE AREA EVALUATION .....</b>	<b>4</b>
Seismic Hazard .....	4
Erosion Hazard .....	4
<b>CONCLUSIONS AND RECOMMENDATIONS .....</b>	<b>5</b>
General.....	5
Erosion Control Measures.....	6
Site Preparation and Grading.....	6
Temporary and Permanent Slopes.....	7
Foundations.....	8
Retaining Walls.....	9
Structural Fill .....	10
Structural Slabs.....	11
Pavement Subgrade and Other Exterior Hard Surfaces.....	11
Utilities .....	12
Site Drainage .....	12
<b>CONSTRUCTION MONITORING .....</b>	<b>13</b>
<b>USE OF THIS REPORT .....</b>	<b>13</b>

### LIST OF FIGURES

- Figure 1 – Vicinity Map
- Figure 2 – Schematic Site Plan
- Figure 3 – Soil Classification Chart
- Figures 4 and 5 – Exploration Logs

Geotechnical Engineering Evaluation  
Sheldon 66<sup>th</sup> Avenue SE Residence Development  
2247 – 66<sup>th</sup> Avenue SE  
Mercer Island, Washington

## INTRODUCTION

This report presents the results of our geotechnical engineering investigation and evaluation of the planned Sheldon 66<sup>th</sup> Avenue SE Residence Development project on **Mercer Island, Washington**. The project site is located at the address of **2247 – 66<sup>th</sup> Avenue SE**, as shown on the Vicinity Map in Figure 1. The purpose of this study is to explore and characterize the site's surface and subsurface conditions and to provide geotechnical recommendations for the planned site development.

The site is currently occupied by a single-family residence with a daylight basement within the central portion of the property. The ground surface within the site is generally level to gently sloping down from the east to the west. We understand that the proposed development will likely include removal of the existing residence and construction of a new single-family residence within the approximate same area as the existing residence. The existing site layout is shown on the Schematic Site Plan in Figure 2.

## SCOPE

The purpose of this study is to explore and characterize the site surface and subsurface conditions and provide general recommendations for site development. Specifically, our scope of services includes the following:

1. Review available soil and geologic maps of the area.
2. Explore the subsurface soil and groundwater conditions in the basement and in the vicinity of proposed new foundation areas on the site with trackhoe excavated test pits and hand tool explorations where possible. Trackhoe was provided by NGA.
3. Provide measurements of the thickness of the basement wall, projection of the footing, and depth of the footing, where possible.
4. Provide long-term design infiltration rates based on on-site Small Pilot Infiltration Testing (PIT) per the 2019 SWMMWW, if feasible.
5. Map the conditions on the site slopes and evaluate current slope stability conditions.
6. Perform laboratory grain-size sieve analysis on soil samples, as necessary.
7. Investigate existing foundation condition and subgrade soils.
8. Provide recommendations for earthwork and foundation support.
9. Provide recommendations for temporary and permanent slopes.

10. Provide recommendations for subsurface utilities and pavement subgrade preparation.
11. Provide our opinion on stormwater infiltration feasibility.
12. Provide general recommendations for site drainage and erosion control.
13. Document the results of our findings, conclusions, and recommendations in a written geotechnical report.

## SITE CONDITIONS

### Surface Conditions

The subject site consists of a roughly rectangular-shaped parcel covering approximately 0.36 acres. The site is currently occupied by a single-family residence with a daylight basement within the central portion of the property. The ground surface within the site is generally level to gently sloping down from the east to the west. Vegetation within the site consists of grass-covered yard areas, landscaping plants and young to mature trees. The site is bordered to the north and south by existing residential properties, to the east by 66<sup>th</sup> Avenue SE and to the west by a public trail and West Mercer Way. We did not observe surface water throughout the site during our field work on April 29, 2024 and May 15, 2024.

### Subsurface Conditions

**Geology:** The geologic units for this area are mapped on the [Geologic Map of Mercer Island, Washington](#) by Kathy G. Troost and Aaron P. Wisher, (University of Washington, 2006). The project site is mapped as Quaternary Vashon till ( $Q_{vt}$ ). Vashon till is typically a mixture of relatively equal parts of silt, sand, and gravel, deposited during the last glaciation period approximately 12,000 to 15,000 years ago. Our explorations generally encountered surficial undocumented fill soils underlain in some areas by sandy silt with varying amounts of gravel consistent with the description of the Vashon Till at depth throughout the site.

**Explorations:** The subsurface conditions within the site were explored on April 29, 2024 and May 15, 2024 by monitoring the seven trackhoe excavated test pits and four hand auger explorations to depths ranging from 5.0 to 8.5 feet below the existing ground surface. The approximate locations of our explorations are shown on the Schematic Site Plan in Figure 2. A geologist from NGA was present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the different soil types, and maintained logs of the explorations. The soils were visually classified in general accordance with the Unified Soil Classification System, presented in Figure 3. The logs of our explorations are attached to this report and are presented as Figures 4 and 5. We present a brief summary of the subsurface conditions in the following paragraphs. For a detailed description of the subsurface conditions, the exploration logs should be reviewed.

At the surface of all of our test pit explorations performed around the exterior areas of the existing residence footprint, we encountered approximately 1.5 to 8.5 feet of very loose/soft to loose/soft dark brown silty fine to medium sand and sandy silt with varying amounts of organics, debris and gravel that we interpreted as undocumented fill soils. Below the undocumented fill soils in Test Pits 2 through 4, we encountered very stiff to hard gray sandy silt with gravel that we interpreted as native glacial till soils. **Test Pits 1, and 5 through 7** were terminated within the undocumented fill soils at depths in the range of 5.5 to 8.5 feet below the existing ground surface. **Test Pits 2 through 4** were terminated within the native glacial till soils at depths in the range of 5.0 to 6.5 feet below the existing ground surface.

**Hand Augers 1 and 2** were performed within the interior basement area of the residence while **Hand Augers 3 and 4** were performed along the eastern side of the existing residence area. **Hand Augers 1 and 2** generally encountered approximately three inches of concrete. Underlying the concrete in **Hand Augers 1 and 2** and the ground surface in **Hand Augers 3 and 4**, we encountered loose to medium dense dark brown to gray fine to coarse sand with varying amounts of silt, gravel and organics that we interpreted as undocumented fill soils. Below the undocumented fill soils in **Hand Auger 1 through 3**, we encountered very stiff to hard, gray sandy silt with varying amounts of gravel that we interpreted as native glacial till soils. **Hand Augers 1 through 3** were terminated within the native glacial till soils at depths in the range of 5.0 to 7.0 feet below the existing ground surface, while **Hand Auger 4** met refusal within the undocumented fill soils at a depth of 6.0 feet below the existing ground surface.

### **Hydrogeologic Conditions**

Slight to heavy groundwater seepage was encountered within most of our explorations at depths ranging from 1.5 to 8.5 feet below the existing ground surface. We interpreted the groundwater seepage to be perched groundwater. Perched water occurs when surface water infiltrates through less dense, more permeable soils and accumulates on top of a relatively low permeability material. Perched water does not represent a regional groundwater "table" within the upper soil horizons. Perched water tends to vary spatially and is dependent upon the amount of rainfall. We would expect the amount of perched groundwater to decrease during drier times of the year and increase during wetter periods.

## SENSITIVE AREA EVALUATION

### Seismic Hazard

We reviewed the 2021 International Building Code (IBC) and the ASCE 7-16 for seismic site classification for this project. Since competent glacial soils were encountered to underlie portions of the site at depth, the site conditions best fit the IBC description for Site Class D.

**Table 1** below provides seismic design parameters for the site that are in conformance with the 2021 IBC, which specifies a design earthquake having a two percent probability of occurrence in 50 years (return interval of 2,475 years), and the 2014 USGS seismic hazard maps.

**Table 1 – ASCE 7-16 Seismic Design Parameters**

Site Class	Spectral Acceleration at 0.2 sec. (g) $S_s$	Spectral Acceleration at 1.0 sec. (g) $S_1$	Site Coefficients		Design Spectral Response Parameters	
			$F_a$	$F_v$	$S_{DS}$	$S_{D1}$
D	1.39	0.484	1.00	Null	0.927	Null

The spectral response accelerations were obtained from the USGS Earthquake Hazards Program Interpolated Probabilistic Ground Motion website (2014 data) for the project latitude and longitude.

Hazards associated with seismic activity include liquefaction potential and amplification of ground motion. Liquefaction is caused by a rise in pore pressures in a loose, fine sand deposit beneath the groundwater table. It is our opinion that the medium dense or better glacial deposits interpreted to underlie the site and nearby vicinity have a low potential for liquefaction or amplification of ground motion.

### Erosion Hazard

The criteria used for determination of the erosion hazard for affected areas include soil type, slope gradient, vegetation cover, and groundwater conditions. The erosion sensitivity is related to vegetative cover and the specific surface soil types, which are related to the underlying geologic soil units. The Natural Resources Conservation Service (NRCS) lists the site as Kitsap silt loam, 2 to 8 percent slopes rating the erosion hazard of the soils as slight. Based on our observations and the material encountered, we would interpret this site as having a low erosion hazard where the surficial soils are exposed. It is our opinion that the erosion hazard for site soils should be low in areas where the site is not disturbed.

## CONCLUSIONS AND RECOMMENDATIONS

### General

It is our opinion that the planned development within the property is feasible from a geotechnical standpoint. Our explorations indicate that a majority of the proposed residence area is underlain by significant amounts of unsuitable undocumented fill soils with competent native glacial deposits at depth. In our opinion, the undocumented fill soils that underlie the proposed residence area are not suitable to provide adequate support for foundation and slab loads utilizing conventional foundations without experiencing significant settlement and distress to the structures. Based on our explorations, we recommend that the proposed residence be supported on a deep foundation system consisting of 4-inch driven pin piles in order to advance the structure loads through the undocumented fill to the more competent native glacial bearing deposits at depth. We recommend that the piles penetrate a minimum of five feet into the competent native glacial soils and also meet the refusal criterion presented in this report.

We recommend any proposed slab-on-grade within the residence be designed as structural slabs, and be supported on the deep foundation system. Other hard surfaces, such as paved areas, patios or walkways that are supported on the existing soil have some risk of future settlement, cracking, and the need for maintenance. To reduce this risk, we recommend over-excavating a minimum of 12 inches of the upper soil from these areas and replacing this material with compacted crushed rock structural fill. The subgrade should be compacted to a firm condition prior to placing the crushed rock. This recommendation is only for exterior hard surfaces to be supported on grade and does not apply for any interior slabs.

We attempted to conduct a small-scale PIT within the property per the Department of Ecology's 2019 Stormwater Management Manual for Western Washington (2019 SWMMWW), utilized by the City of Mercer Island. However, we were unable to adequately perform the small-PIT due to the perched groundwater flowing into our test pits located within the lower western portion of the property and the overall depth of the undocumented fill soils encountered within our explorations within this area. Due to the shallow perched groundwater conditions found throughout the site along with the undocumented fill soils encountered in our explorations, it is our opinion that stormwater infiltration within the site is not feasible. We recommend that the stormwater generated from the proposed development be directed to on-site detention systems and ultimately directed towards an approved point of discharge, likely found within the neighboring roadways.

The soils encountered on this site are considered moisture-sensitive and will disturb when wet. We recommend that construction take place during the drier summer months, if possible. If construction is to take place during wet weather, the soils may disturb, and additional expenses and delays may be expected due to the wet conditions. Additional expenses could include the need for placing erosion control and temporary drainage measures to protect the slopes, the need for placing a blanket of rock spalls on exposed subgrades, and construction traffic areas prior to placing structural fill, and the need for importing all-weather material for structural fill.

### **Erosion Control Measures**

The erosion hazard for the on-site soils is considered to be low, but the actual hazard will be dependent on how the site is graded and how water is allowed to concentrate. Best Management Practices (BMPs) should be used to control erosion. Areas disturbed during construction should be protected from erosion. Erosion control measures may include diverting surface water away from the stripped or disturbed areas. Silt fences and/or straw bales should be erected to prevent muddy water from leaving the site or flowing over the slopes. Stockpiles should be covered with plastic sheeting during wet weather and stockpiled material should not be placed near site slopes. Disturbed areas should be planted as soon as practical, and the vegetation should be maintained until it is established. The erosion potential for areas not stripped of vegetation should be low.

### **Site Preparation and Grading**

Plans for site grading should be developed such that cuts and fills are kept to a minimum, if possible. Site preparation should consist of excavating the residence footprint down to planned elevations. Site preparation should also consist of overexcavating subgrades for future hard surfaces such as exterior walkways, patios, or pavement by a minimum of 12 inches and the resulting overexcavation backfilled with crushed rock or granular pit-run soils compacted to structural fill specifications. The stripped material should be removed from the site. If the exposed soils, after overexcavating the minimum 12 inches, are deemed loose, they should be compacted to a non-yielding condition. Areas observed to pump or weave during compaction should be additionally overexcavated and replaced with rock spalls. If significant surface water flow is encountered during construction, this flow should be diverted around areas to be developed and the exposed subgrade maintained in a semi-dry condition. In wet conditions, the exposed subgrade should not be compacted, as compaction of a wet subgrade may result in further disturbance of the soils. A layer of crushed rock may be placed over the prepared areas to protect them from further disturbance.

The site soils are considered moisture sensitive and will disturb easily when wet. We recommend that earthwork construction take place during periods of extended dry weather and suspended during periods of precipitation if possible. If work is to take place during periods of wet weather, care should be taken during site preparation not to disturb the site soils. This can be accomplished by utilizing large excavators equipped with smooth buckets and wide tracks to complete earthwork and diverting surface and groundwater flow away from the prepared subgrades. Also, construction traffic should not be allowed on the exposed subgrade. A blanket of rock spalls should be used in construction access areas if wet conditions are prevalent. The thickness of this rock spall layer should be based on subgrade performance at the time of construction. For planning purposes, we recommend a minimum one-foot-thick layer of rock spalls.

### **Temporary and Permanent Slopes**

Temporary cut slope stability is a function of many factors, including the type and consistency of soils, depth of the cut, surcharge loads adjacent to the excavation, length of time a cut remains open, and the presence of surface or groundwater. It is exceedingly difficult under these variable conditions to estimate a stable, temporary, cut slope angle. Therefore, it should be the responsibility of the contractor to maintain safe slope configurations at all times as indicated in OSHA guidelines for cut slopes.

The following information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Nelson Geotechnical Associates, Inc. assumes responsibility for job site safety. Job site safety is the sole responsibility of the project contractor.

For planning purposes, we recommend that temporary cuts in the on-site material be no steeper than 1.5 units horizontal to 1.0 unit vertical (1.5H:1V). If significant groundwater is encountered in the excavations, we would expect that significantly flatter inclinations would be necessary. We should be retained to specifically review the proposed geometry for any significant cuts planned on this site. We recommend that cut slopes be protected from erosion. Erosion control measures may include covering cut slopes with plastic sheeting and diverting surface water runoff away from the top of cut slopes. We do not recommend vertical slopes for cuts deeper than four feet if worker access is necessary. We recommend that cut slope heights and inclinations conform to appropriate OSHA/WISHA regulations.

Permanent cut and fill slopes should be no steeper than 2H:1V. However, flatter inclinations may be required in areas where loose soils are encountered. Permanent slopes should be vegetated, and the vegetative cover maintained until established.

## Foundations

We recommend that the proposed structure, including all slab-on-grade, be supported on a deep foundation system to transfer structure loads through the upper undocumented fill and down into the underlying competent native bearing materials at depth. In our opinion, the most feasible deep foundation support systems will consist of 4-inch diameter pin piles driven to refusal. A structural engineer should design the new foundation supports and determine the location of the supports based on the recommendations provided in this report.

For 4-inch driven steel pipe piles, we recommend that they be driven using a tractor-mounted hydraulic hammer, with an energy rating of at least 1,100 foot-lb. For this pile and hammer size, we recommend a design capacity of ten tons for each pile driven to refusal. The refusal criterion for this pile and hammer size is defined as less than one-inch of movement during 15 seconds of continuous driving at a rate of 550 blows per minute or higher. We recommend using galvanized schedule 40 pipe for the 4-inch pin piles. Maintaining these recommendations for minimum hammer size and refusal criteria is essential for obtaining a successful outcome. Our explorations encountered loose undocumented fills within the planned development area. If large objects or debris are present within the fill, there is a possibility that this material may obstruct some piles at shallow depths. There should be contingencies in the budget and design for additional/relocated piles that may be obstructed by possible debris in the fill.

Final pile depths should be expected to vary and will depend on nature and depth to competent soils. Our explorations performed as a part of this evaluation encountered competent native bearing deposits at relatively shallow depths; however, some of the explorations within the southern portion of the property were terminated within the undocumented fill soils at depths of up to 8.5 feet below the existing ground surface. We recommend that the piles extend a minimum of five feet into the competent native bearing deposits, in addition to meeting the refusal criterion. Due to the varying nature of the soils encountered within the explorations, we recommend that one or more “test” piles be installed to verify design parameters and estimate an approximate depth of the piles that will be needed for budgeting purposes. Additional deeper drilled borings could also be performed to attempt to verify the depth to the competent native bearing soils underlying the site.

The piles should be spaced a minimum of three feet apart to avoid a grouping effect on the piles. Due to the relatively small slenderness ratio of pin piles, maintaining pin pile confinement and lateral support is essential in preventing pile buckling. Pin piles should be suitably embedded into the reinforced concrete. The structural engineer should design the connections of the piles to the foundations.

Vertically driven pin piles do not provide meaningful lateral capacity. Due to the rigid pile support, friction between the foundation and subgrade soil should not be considered as resisting lateral pressures on this structure. We recommend that all lateral loads be resisted on battered pin piles and/or passive resistance on the below-grade portions of the foundations and grade beams. The upper foot of soil should be neglected when calculating the passive resistance. We recommend using an equivalent fluid density of 150 pcf for calculating the passive resistance. NGA should be retained to review final plans and to monitor installation of the pin piles during construction.

### **Retaining Walls**

Specific grading plans for this project were not available at the time this report was prepared but retaining walls may be incorporated into the project plans. In general, the lateral pressure acting on subsurface retaining walls is dependent on the nature and density of the soil behind the wall, the amount of lateral wall movement which can occur as backfill is placed, wall drainage conditions, and the inclination of the backfill. For walls that are free to yield at the top at least one thousandth of the height of the wall (active condition), soil pressures will be less than if movement is limited by such factors as wall stiffness or bracing (at-rest condition). We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces, be designed using a triangular earth pressure distribution equivalent to that exerted by a fluid with a density of 40 pcf for yielding (active condition) walls, and 60 pcf for non-yielding (at-rest condition) walls. A seismic design loading of 8H in psf should also be included in the wall design where "H" is the total height of the wall.

These recommended lateral earth pressures are for a drained granular backfill and are based on the assumption of a horizontal ground surface behind the wall for a distance of at least the height of the wall, and do not account for surcharge loads. Additional lateral earth pressures should be considered for surcharge loads acting adjacent to the walls and within a distance equal to the height of the wall. This would include the effects of surcharges such as traffic loads, floor slab loads, slopes, or other surface loads. We could consult with the structural engineer regarding additional loads on retaining walls during final design, if needed.

The lateral pressures on walls may be resisted by passive resistance acting on the below-grade portion of the foundation. Recommendations for passive resistance to lateral loads are presented in the **Foundations** subsection of this report. Retaining walls should be supported on pin piles, as described in the **Foundations** subsection of this report.

All wall backfill should be well-compacted as outlined in the **Structural Fill** subsection of this report. Care should be taken to prevent the buildup of excess lateral soil pressures due to over-compaction of the wall backfill. This can be accomplished by placing wall backfill in 8-inch loose lifts and compacting the backfill with small, hand-operated compactors within a distance behind the wall equal to at least half the height of the wall. The thickness of the loose lifts should be reduced to accommodate the lower compactive energy of the hand-operated equipment. The recommended level of compaction should still be maintained.

Permanent drainage systems should be installed for retaining walls. Recommendations for these systems are found in the **Subsurface Drainage** subsection of this report. We recommend that we be retained to evaluate the proposed wall drain backfill material and observe installation of the drainage systems.

### **Structural Fill**

**General:** Fill placed beneath foundations, pavement, or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional or soils technician. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the **Site Preparation and Grading** subsection prior to beginning fill placement. Sloping areas to receive fill should be benched using a minimum 8-foot-wide horizontal benches keyed into competent soils.

**Materials:** Structural fill should consist of a good quality, granular soil, free of organics and other deleterious material, and be well graded to a maximum size of about three inches. All-weather fill should contain no more than five-percent fines (soil finer than U.S. No. 200 sieve, based on that fraction passing the U.S. 3/4-inch sieve). The on-site soils are not suitable for use as structural fill. We should be retained to evaluate all proposed structural fill material prior to placement.

**Fill Placement:** Following subgrade preparation, placement of structural fill may proceed. All filling should be accomplished in uniform lifts up to eight inches thick. Each lift should be spread evenly and be thoroughly compacted prior to placement of subsequent lifts. All structural fill underlying building areas and pavement subgrade should be compacted to a minimum of 95 percent of its maximum dry density. Maximum dry density, in this report, refers to that density as determined by the ASTM D-1557 Compaction Test procedure. The moisture content of the soils to be compacted should be within about two percent of optimum so that a readily compactable condition exists. It may be necessary to overexcavate and remove wet soils in cases where drying to a compactable condition is not feasible. All compaction should

be accomplished by equipment of a type and size sufficient to attain the desired degree of compaction and should be tested.

### **Structural Slabs**

As mentioned earlier, we recommend that any proposed slabs-on-grade within the residence be designed as structural slabs and fully supported on pin piles. We recommend that slabs be underlain by at least six inches of free-draining gravel with less than three percent by weight passing the Sieve #200 for use as a capillary break. A suitable vapor barrier, such as heavy plastic sheeting (6-mil, minimum), should be placed over the capillary break material. An additional 2-inch-thick moist sand layer may be used to cover the vapor barrier. This sand layer may be used to protect the vapor barrier membrane and to aid in curing the concrete; however, this sand layer is optional and is intended to protect the vapor barrier membrane during construction. Other slabs and hard surfaces that may be supported on the existing soils should be underlain by a minimum of 12-inches of crushed rock in addition to the capillary break and vapor barrier.

### **Pavement Subgrade and Other Exterior Hard Surfaces**

Pavement and walkway subgrade preparation should be completed as recommended in the **Site Preparation and Grading** and **Structural Fill** subsections of this report. If removal of all of the undocumented fill soils is not planned for this site and some of the undocumented fill is to remain within the exterior hard surface areas, we recommend partial removal of the undocumented fill from the subgrade and replacement with granular structural fill or crushed rock, assuming some potential settlement and cracking of these surfaces can be tolerated. At a minimum, we recommend that the upper one-foot of the existing undocumented fill soils be removed, and the resulting subgrade covered with a woven geotextile fabric consisting of Mirafi 500X or equivalent and granular structural fill or crushed rock placed up to the subgrade.

If possible, the subgrades should be proof-rolled with a heavy, rubber-tired piece of equipment, to identify soft or yielding areas that may require repair prior to placing any structural fill and prior to placing the pavement base course. We should be retained to observe the proof-rolling and to recommend repairs prior to placement of the asphalt or hard surfaces. The hard surface section should be thickened and reinforced with rebar where applicable to further reduce the effects of settlement due to the loose/soft undocumented fill soils, but potential long-term cracking should still be expected.

## Utilities

We recommend that underground utilities be bedded with a minimum six inches of pea gravel prior to backfilling the trench with on-site or imported material. Trenches within settlement sensitive areas should be compacted to 95 percent of the modified proctor as described in the **Structural Fill** subsection of this report. Trench backfill should be compacted to a minimum of 95 percent of the modified proctor maximum dry density. Trenches located in non-structural areas and five feet below roadway subgrade should be compacted to a minimum 90 percent of the maximum dry density. The trench backfill compaction should be tested.

## Site Drainage

**Stormwater Infiltration:** We attempted to conduct a small-scale PIT within the property per the Department of Ecology's 2019 SWMMWW, utilized by the City of Mercer Island. However, we were unable to adequately perform the small-PIT due to the perched groundwater flowing into our test pits located within the lower western portion of the property and the overall depth of the undocumented fill soils encountered within our explorations within this area. Due to the shallow perched groundwater conditions found throughout the site along with the undocumented fill soils encountered in our explorations, it is our opinion that stormwater infiltration within the site is not feasible. We recommend that the stormwater generated from the proposed development be directed to on-site detention systems and ultimately directed towards an approved point of discharge, likely found within the neighboring roadways.

**Surface Drainage:** Final site grades should allow for drainage away from the planned residence area. We suggest that the finished ground be sloped at a minimum downward gradient of three percent for a distance of at least 10 feet away from the structures. Runoff generated on this site should be collected and routed into a permanent discharge system. This should include all downspouts and runoff generated on all hard surfaces and yards areas. Under no circumstances should water be allowed to flow uncontrolled over the site. Water should not be allowed to collect in any area where footings or slabs are to be constructed.

**Subsurface Drainage:** If groundwater is encountered during construction, we recommend that the contractor slope the bottom of the excavation and collect the water into ditches and small sump pits where the water can be pumped out of the excavation and routed into a suitable outlet. We recommend that the residence down spouts and footing drains be tightlined to an approved discharge location. We recommend the use of footing drains around structures. Footing drains should be installed at least one foot below planned finished floor elevation. The drains should consist of a minimum 4-inch-diameter, rigid, slotted or perforated, PVC pipe surrounded by free-draining material wrapped in a filter fabric. We recommend that the free-draining material consist of an 18-inch-wide zone of clean (less than three-percent fines), granular material placed along the back of walls. Washed rock is an acceptable drain material, or drainage composite may be used instead. The free-draining material should extend up the wall to one foot below the finished surface. The top foot of soil should consist of low permeability soil placed over plastic sheeting or building paper to minimize the migration of surface water or silt into the footing drain. Footing drains should discharge into tightlines leading to an approved collection and discharge point with convenient cleanouts to prolong the useful life of the drains. Roof drains should not be connected to wall or footing drains.

### **CONSTRUCTION MONITORING**

We recommend that we be retained to provide construction monitoring services to evaluate conditions encountered in the field with respect to anticipated conditions, to provide recommendations for design changes should the conditions differ from anticipated, and to evaluate whether construction activities comply with contract plans and specifications.

### **USE OF THIS REPORT**

NGA has prepared this report for **Mr. David Sheldon**, and his agents, for use in the planning and design of the development of this site only. The scope of our work does not include services related to construction safety precautions and our recommendations are not intended to direct the contractors' methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. There are possible variations in subsurface conditions between the explorations and also with time. Our report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions. A contingency for unanticipated conditions should be included in the budget and schedule. We recommend that we be retained to review the project plans after they have been developed to determine that recommendations in the report were incorporated into project plans.

We recommend that NGA be retained to review final plans prior to construction. We also recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications. We should be contacted a minimum of one week prior to construction activities and could attend pre-construction meetings if requested.

Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this report was prepared. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

O-O-O

It has been a pleasure to provide service to you on this project. If you have any questions or require further information, please call.

Sincerely,

**NELSON GEOTECHNICAL ASSOCIATES, INC.**



LEE S. BELLAH

Lee S. Bellah, LG  
**Senior Geologist**



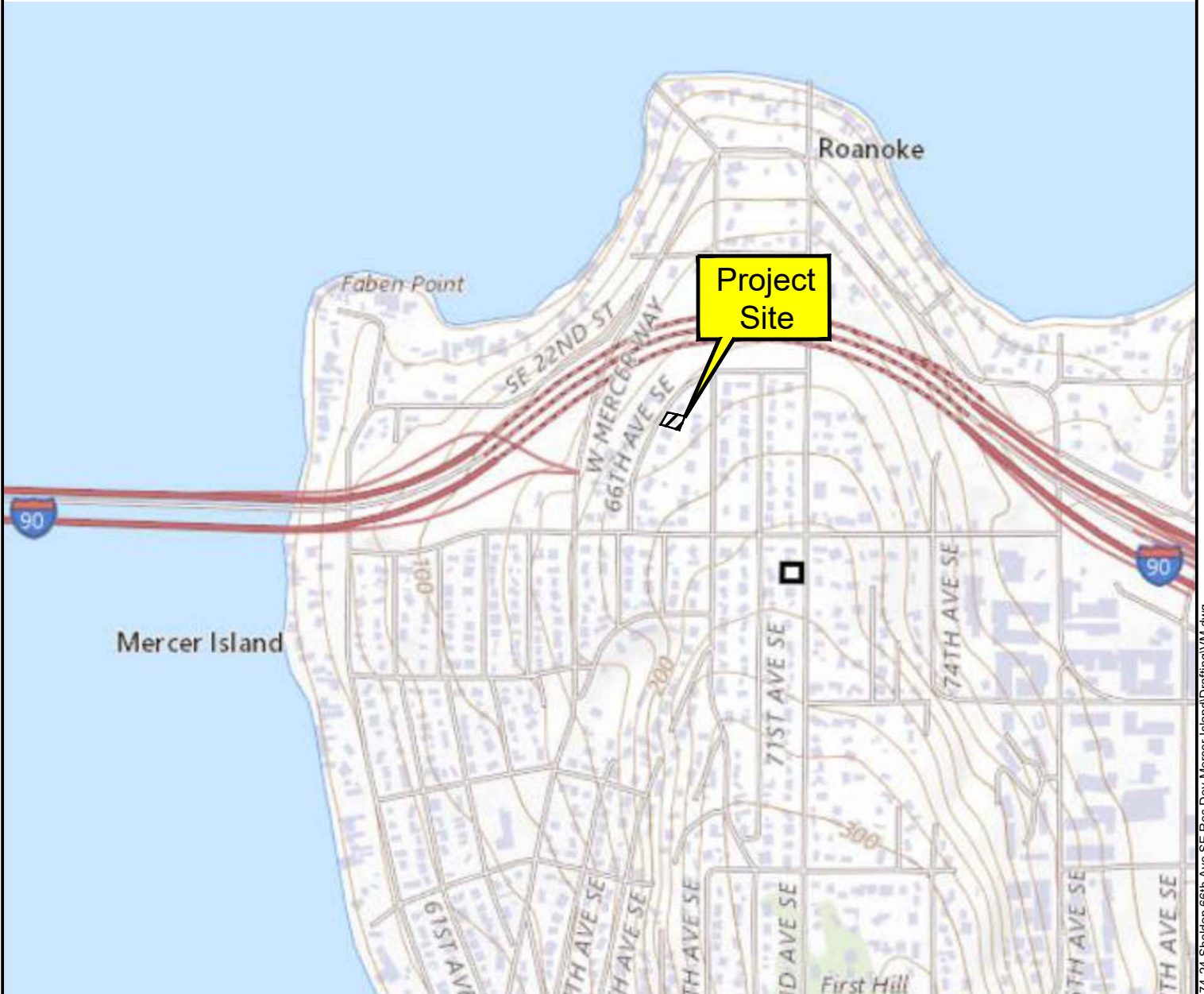
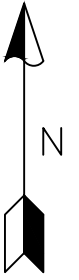
Khaled M. Shawish, PE  
**Principal**

LSB:KMS:dy

Five Figures Attached

# VICINITY MAP

Not to Scale



## Mercer Island, WA

Project Number 1517424	Sheldon 66th Avenue SE Residence Development Vicinity Map	 <b>NELSON GEOTECHNICAL ASSOCIATES, INC</b> Woodinville Office 17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax: 481-2510 Wenatchee Office 105 Palouse St Wenatchee, WA 98801 (509) 665-7696 / Fax: 665-7692	No.	Date	Revision	By	CK
Figure 1			1	6/3/24	Original	AMS	LSB

# Site Plan

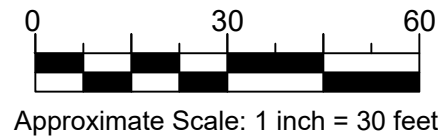


## LEGEND

Property line

TP-1  
Number and approximate location of test pit

HA-1  
Number and approximate location of hand auger



Reference: Site plan based on site observations and aerial photo interpretation.

No.	Date	Revision	By	CK
1	5/20/24	Original	LSB	LSB

**NELSON GEOTECHNICAL ASSOCIATES, INC.**

Woodville Office  
17311 133th Ave NE A-500  
Woodville, WA 98072  
(425) 488-1669 / Fax: 481-2510  
www.nelsongeotech.com

Wenatchee Office  
105 Pine St  
Wenatchee, WA 98801  
(509) 665-7696 / Fax: 665-7692

Sheldon 66th Avenue SE  
Residence Development  
Site Plan

Project Number 1515724	Figure 2
---------------------------	----------

# UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
<b>COARSE - GRAINED SOILS</b>  <small>MORE THAN 50 % RETAINED ON NO. 200 SIEVE</small>	<b>GRAVEL</b>  <small>MORE THAN 50 % OF COARSE FRACTION RETAINED ON NO. 4 SIEVE</small>	CLEAN GRAVEL	GW	WELL-GRADED, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	<b>SAND</b>  <small>MORE THAN 50 % OF COARSE FRACTION PASSES NO. 4 SIEVE</small>	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
<b>FINE - GRAINED SOILS</b>  <small>MORE THAN 50 % PASSES NO. 200 SIEVE</small>	<b>SILT AND CLAY</b>  <small>LIQUID LIMIT LESS THAN 50 %</small>	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	<b>SILT AND CLAY</b>  <small>LIQUID LIMIT 50 % OR MORE</small>	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
<b>HIGHLY ORGANIC SOILS</b>			PT	PEAT

**NOTES:**

- 1) Field classification is based on visual examination of soil in general accordance with ASTM D 2488-93.
- 2) Soil classification using laboratory tests is based on ASTM D 2488-93.
- 3) Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

**SOIL MOISTURE MODIFIERS:**

- Dry - Absence of moisture, dusty, dry to the touch
- Moist - Damp, but no visible water.
- Wet - Visible free water or saturated, usually soil is obtained from below water table

<b>Project Number</b> 1517424	<b>Sheldon 66th Avenue SE Residence Development Soil Classification Chart</b>	 <small>www.nelsongeotech.com</small>	<b>NELSON GEOTECHNICAL ASSOCIATES, INC</b> <small>Woodinville Office 17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax: 481-2510</small>	<small>Wenatchee Office 105 Palouse St Wenatchee, WA 98801 (509) 665-7696 / Fax: 665-7692</small>	<b>No.</b> 1	<b>Date</b> 6/3/24	<b>Revision</b> Original	<b>By</b> AMS	<b>CK</b> LSB
----------------------------------	---	---	---	---	-----------------	-----------------------	-----------------------------	------------------	------------------

C:\Users\LeeBellah\OneDrive - NGA\2024 NGA Project\15174-24 Sheldon 66th Ave SE Res Dev Mercer Island\Drafting\SC.dwg

## LOG OF EXPLORATION

DEPTH (FEET)	USCS	SOIL DESCRIPTION
<b>TEST PIT ONE</b>		
0.0 – 8.5		DARK BROWN, SILT WITH FINE SAND, GRAVEL AND ORGANICS (SOFT, MOIST TO WET) ( <b>FILL</b> )  SAMPLES WERE COLLECTED AT 4.0, 6.5 AND 8.0 FEET MODERATE GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 5.0 TO 8.5 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.5 FEET ON 5/15/24
<b>TEST PIT TWO</b>		
0.0 – 1.5		DARK BROWN, SILTY, FINE TO MEDIUM SAND WITH GRAVEL AND ORGANIC DEBRIS (LOOSE, MOIST) ( <b>FILL</b> )
1.5 – 6.0	ML	GRAY, SANDY SILT WITH GRAVEL (HARD TO VERY HARD, MOIST TO WET)  SAMPLE WAS COLLECTED AT 3.5 FEET LIGHT GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 4.0 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 6.0 FEET ON 5/15/24
<b>TEST PIT THREE</b>		
0.0 – 4.0		DARK BROWN, SILTY, FINE TO MEDIUM SAND WITH GRAVEL AND ORGANIC DEBRIS (LOOSE, MOIST TO WET) ( <b>FILL</b> )
4.0 – 6.5	ML	GRAY, SANDY SILT WITH GRAVEL (HARD TO VERY HARD, MOIST TO WET)  SAMPLE WAS COLLECTED AT 5.0 FEET LIGHT GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 3.5 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 6.5 FEET ON 5/15/24
<b>TEST PIT FOUR</b>		
0.0 – 2.0		DARK BROWN, SILTY, FINE TO MEDIUM SAND WITH GRAVEL AND ORGANIC DEBRIS (LOOSE, MOIST) ( <b>FILL</b> )
2.0 – 5.0	ML	GRAY, SANDY SILT WITH GRAVEL (VERY STIFF TO HARD, MOIST)  SAMPLE WAS COLLECTED AT 4.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 5.0 FEET ON 5/15/24
<b>TEST PIT FIVE</b>		
0.0 – 8.0		DARK BROWN, SANDY SILT WITH GRAVEL AND ABUNDANT ORGANICS (VERY SOFT TO SOFT, MOIST TO WET) ( <b>FILL</b> )  SAMPLE WAS COLLECTED AT 5.0 FEET MODERATE GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 4.0 TO 8.0 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.0 FEET ON 5/15/24
<b>TEST PIT SIX</b>		
0.0 – 5.5		DARK BROWN, SANDY SILT WITH GRAVEL AND ABUNDANT ORGANICS (VERY SOFT TO SOFT, MOIST TO WET) ( <b>FILL</b> )  SAMPLES WERE NOT COLLECTED MODERATE GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 4.0 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 5.5 FEET ON 5/15/24

## LOG OF EXPLORATION

DEPTH (FEET)	USCS	SOIL DESCRIPTION
<b>TEST PIT SEVEN</b>		
0.0 – 8.5		DARK BROWN GRAY, SANDY SILT WITH GRAVEL AND ABUNDANT ORGANICS (VERY SOFT TO SOFT, MOIST TO WET) (FILL)  SAMPLES WERE NOT COLLECTED MODERATE GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 3.5 TO 8.5 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.5 FEET ON 5/15/24
<b>HAND AUGER ONE</b>		
0.0 – 0.3		CONCRETE
0.3 – 1.4		GRAY FINE TO COARSE SAND WITH SILT AND GRAVEL (MEDIUM DENSE, MOIST TO WET) (FILL)
1.4 – 5.0	ML	GRAY, SANDY SILT WITH GRAVEL (HARD, MOIST)  SAMPLE WERE NOT COLLECTED LIGHT GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 1.5 FEET HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER WAS COMPLETED AT 5.0 FEET ON 5/15/24
<b>HAND AUGER TWO</b>		
0.0 – 0.3		CONCRETE
0.3 – 1.4		GRAY FINE TO COARSE SAND WITH SILT AND GRAVEL (MEDIUM DENSE, MOIST) (FILL)
1.4 – 5.0	ML	GRAY, SANDY SILT WITH GRAVEL (HARD, MOIST)  SAMPLE WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER WAS COMPLETED AT 5.0 FEET ON 5/15/24
<b>HAND AUGER THREE</b>		
0.0 – 3.0		DARK BROWN, SILTY, FINE TO MEDIUM SAND WITH GRAVEL AND ORGANIC DEBRIS (LOOSE, MOIST) (FILL)
3.0 – 7.0	ML	GRAY BROWN, SANDY SILT WITH GRAVEL (VERY STIFF TO HARD, MOIST)  SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER WAS COMPLETED AT 7.0 FEET ON 5/15/24
<b>HAND AUGER FOUR</b>		
0.0 – 6.0		DARK GRAY BROWN, SANDY SILT WITH GRAVEL AND ABUNDANT ORGANICS (VERY SOFT TO SOFT, MOIST TO WET) (FILL)  SAMPLES WERE NOT COLLECTED MODERATE GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 4.0 TO 6.0 FEET HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER MET REFUSAL AT 6.0 FEET ON 5/15/24