

GEOTECHNICAL REPORT

PROPOSED SFR ADDITION 4040 – 97TH AVENUE SOUTHEAST MERCER ISLAND, WASHINGTON

Project No. 24-355
October, 2024



Prepared for:

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*Geotechnical & Earthquake
Engineering Consultants*

October 1, 2024
File No. 24-355

Bob Xia & Meng Miao
4040 – 97th Avenue SE
Mercer Island, WA 98040

**Subject: Geotechnical Report
Proposed SFR Addition
4040 – 97th Avenue Southeast, Mercer Island, WA**

Dear Bob Xia & Meng,

Attached please find our geotechnical report for the proposed addition project at the above referenced site in Mercer Island, Washington. This report documents the subsurface conditions at the site and presents our geotechnical design recommendations for the proposed project.

In general, our borings drilled at the site encountered about 2 to 3 feet of fill overlying about 20 to 25 feet of native, loose to medium dense silty sand/sandy silt (Vashon recessional lacustrine deposits) overlying dense to very dense silt (pre-Olympia fine-grained deposits). Based on soil conditions and our understanding of the project design, in our opinion, conventional shallow footings may be used to support the proposed additions. Temporary unsupported excavations may be sloped as steep as 1H:1V (Horizontal:Vertical). The floor slabs for the proposed additions may be constructed using conventional concrete slab-on-grade floor construction.

We appreciate the opportunity to work on this project. Please call if there are any questions.

Sincerely,



H. Michael Xue, P.E.
Principal Geotechnical Engineer

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**GEOTECHNICAL REPORT
PROPOSED SFR ADDITION
4040 – 97TH AVENUE SOUTHEAST
MERCER ISLAND, WASHINGTON**

1.0 INTRODUCTION

This report presents the results of a geotechnical engineering study that was undertaken to support the design of the proposed addition project in Mercer Island, Washington. Our study was performed in general accordance with our mutually agreed-upon scope of work as outlined in our proposal dated August 12, 2024. Our service scope included reviewing readily available geologic and geotechnical data in the site vicinity, conducting a site reconnaissance, advancing two test borings, and developing the geotechnical design recommendations presented in this report.

2.0 PROJECT AND SITE DESCRIPTION

The project site is an approximately 0.27 acre lot located at 4040 – 97th Avenue Southeast in Mercer Island, Washington (See Figure 1 – Vicinity Map). The subject property is approximately trapezoidal shaped, and borders 97th Avenue Southeast to approximately the west, Southeast 40th Place to approximately the north, and existing single-family residences to approximately the south and east (see Figure 2 – Site and Exploration Plan). The site is currently occupied by a one-story single-family house with an attached garage (see Plates 1-2, on the following page). Based on review of the GIS maps, the existing site grade is generally level.

Based on the information provided to us, we understand that the proposed project consists of a second story addition above the existing house. As part of the project, the existing garage will also be expanded, and a covered porch will be added at the main entry. We anticipate that temporary excavations for the new foundation construction will likely be on the order of 2 to 3 feet deep.

According to the City of Mercer Island GIS maps, the site is mapped with seismic/soil liquefaction geologic hazard, but is not mapped with potential slide and erosion geologic hazards. As such, a geotechnical engineering study will be required as part of the building permit process. The objective of our geotechnical study is to explore subsurface conditions, to evaluate the potential geologic, and to provide geotechnical design recommendations pertinent to the proposed development.

Geotechnical Report

Proposed SFR Addition: 4040 – 97th Avenue SE, Mercer Island, Washington

October 1, 2024



Plate 1: Front view of the existing residence. Looking east from 97th Avenue Southeast.



Plate 2: Rear view of the existing residence. Looking west from the east property line.

The conclusions and recommendations in this report are based on our understanding of the proposed development, which is in turn based on the project information provided. If the above project description is incorrect, or the project information changes, we should be consulted to review the recommendations contained in this study and make modifications, if needed. In any case, PanGEO should be retained to provide a review of the final design to confirm that our geotechnical recommendations have been correctly interpreted and adequately implemented in the construction documents.

3.0 SUBSURFACE EXPLORATIONS

Two test borings (PG-1 and PG-2) were advanced at the site on August 28, 2024, using a track-mounted drill rig owned and operated by Geologic Drill Partners, subcontracted to PanGEO. The test borings PG-1 and PG-2 were drilled to depths of about 36½ feet and 31½ feet below the existing grade, respectively. The approximate boring locations were taped from existing features at the site and are indicated on the attached Figure 2.

The drill rig was equipped with 5-inch outside diameter hollow stem augers. Soil samples were obtained from the borings at 2½- and 5-foot intervals in general accordance with Standard Penetration Test (SPT) sampling methods (ASTM test method D-1586) in which the samples are obtained using a 2-inch outside diameter split-spoon sampler. The sampler was driven into the soil a distance of 18 inches using a 140-pound weight falling a distance of 30 inches. The number of blows required for each 6-inch increment of sampler penetration was recorded. The number of blows required to achieve the last 12 inches of sample penetration is defined as the SPT N-value. The N-value provides an empirical measure of the relative density of cohesionless soil, or the relative consistency of fine-grained soils. The completed borings were backfilled with drill cuttings and bentonite chips.

An engineer from PanGEO was present during the field exploration to observe the drilling, to assist in sampling, and to describe and document the soil samples obtained from the borings. The summary boring logs are included in Appendix A, Figures A-2 and A-3. The soil samples were described using the modified Unified Soil Classification System outlined on Figure A-1 in Appendix A.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

The Geologic Map of Mercer Island, Washington (Troost, et al., 2006) mapped the surficial geologic unit at the subject site as Vashon recessional lacustrine deposits (Map Unit: Qvrl). Vashon recessional outwash (Qvr) and pre-Olympia fine-grained deposits (Qpof) are also mapped in the vicinity.

Vashon recessional outwash (Qvr) generally consists of sediment deposited in front of a glacier as the ice sheet retreated from the margin during the Vashon stade of the Fraser glaciation, and typically consists of loose to dense sand and gravel with some silt lenses.

Vashon recessional lacustrine deposits (Qvrl) are a subunit of the Vashon recessional outwash mapped near the site, and consist of laminated silt and clay layers that have been deposited by slow-flowing meltwater streams. They also have not been glacially overridden and are typically soft to stiff.

Pre-Olympia fine-grained deposits (Qpof) typically consist of very dense and hard, interbedded sand, silt, and clay of indeterminate age and origin (deposited prior to the Olympia non-glacial interval).

4.2 SOIL CONDITIONS

Our borings generally encountered a thin surficial layer of loose fill overlying loose to medium dense native silty sand and sandy silt (recessional lacustrine deposits) underlain by very stiff to hard clay (pre-Olympia fine-grained deposits). The following is a generalized description of the soils encountered in the borings. For a detailed description of the subsurface conditions encountered at each exploration location, please refer to the boring logs provided in Appendix A.

UNIT 1: Fill – Loose to medium dense silty sand with varying amounts of organics and gravel were encountered from the surface to about 2 to 3 feet deep in the borings. We interpret this soil unit as undocumented fill based on the loose condition, disturbed texture, and presence of organics.

UNIT 2: Vashon recessional lacustrine deposits (Qvrl) – Below Unit 1, both borings encountered loose to medium dense, silty sand to sandy silt to between 23 feet to 28 feet below the existing ground surface. We interpret this soil unit as the Vashon recessional lacustrine deposits mapped at the site.

UNIT 3: Pre-Olympia fine-grained deposits (Qpof) – Below Unit 2, the borings encountered very stiff to hard clay to the maximum drilling depths which was interpreted as mapped pre-Olympia fine-grained deposits.

The stratigraphic contacts indicated on the boring logs represent the approximate depth to boundaries between soil units. Actual transitions between soil units may be more gradual or occur at different elevations. The descriptions of groundwater conditions and depths are likewise approximate.

4.3 GROUNDWATER CONDITIONS

No groundwater was observed within the drilling depth during drilling. Scattered, thin layers of very moist soils were observed in the relatively sandier layers between about 4 and 28 feet depth. It should be noted that groundwater elevations and seepage rates may vary depending on the season, local subsurface conditions, and other factors. Groundwater levels and seepage rates are normally highest during the winter and early spring (typically October through May).

5.0 GEOLOGY HAZARDS ASSESSMENT

5.1 LANDSLIDE HAZARDS AND STEEP SLOPES

Based on review of the Mercer Island GIS map, no landslide hazard areas are mapped within the project site. This is consistent with our site observations, as discussed below.

On August 28, 2024, we conducted a reconnaissance of the site and site slopes. As previously discussed, the site topography is practically flat. Based on our reconnaissance, the site does not contain indications of recent or historical slope movements, such as scarps, sloughs, tension cracks, uneven ground surfaces, jackstrawed trees, breaks in vegetation, water features and convergent landforms. Additionally, we observed that the adjacent properties are covered with bushes and trees. The trunks of the mature trees are observed to be straight.

Our test borings did not encounter permeable soils overlying impermeable soils that may intersect the ground surface. We also did not observe any springs at the site. The site is not located near any stream or lake that could incise or undercut the base of the slope.

We also reviewed a LiDAR image of the site and its vicinity, and the landslide inventory map from the Washington Department of Natural Resources (DNR). To the best of our knowledge, there are no reported past known slides at the site.

In summary, based on subsurface conditions encountered in the test borings, the relatively gentle topography of the site, and our field observations, it is our opinion that the site appears to be globally stable in its present condition, and the landslide susceptibility at the site is considered negligible. It is also our opinion that the proposed development as currently planned will not decrease the site stability or adversely impact the subject site and surrounding properties, provided that the proposed project is properly designed and constructed. It is our further opinion that building setback distance due to potential landslide hazard is not needed for the proposed project.

5.2 EROSION HAZARDS

The site is not mapped within potential erosion hazard area according to the City of Mercer Island's Geologic Hazards Map. Based on the results of our borings, the sandy site soils at the site are anticipated to exhibit moderate erosion potential. The current addition project will have limited ground disturbance for the proposed construction. In our opinion, the potential erosion hazards at the site can be effectively mitigated with the best management practice during construction and with properly designed and implemented landscaping for permanent erosion control. During construction, the temporary erosion hazard can be effectively managed with an appropriate erosion and sediment control plan, including but not limited to installing silt fence at the construction perimeter, limiting removal of vegetation to the construction area, placing rocks or hay bales at the disturbed/traffic areas and on the downhill side of the project, covering stockpile soil or cut slopes with plastic sheets, constructing a temporary drainage pond to control surface runoff and sediment trap if needed, placing rocks at the construction entrance, etc. Permanent erosion control measures should include establishing vegetation, landscape plants, and hardscape established at the end of project.

5.3 SEISMIC HAZARDS

Based on review of the City of Mercer Island Parcel Map, the site is mapped within a seismic/soil liquefaction hazard area.

Liquefaction is a process that can occur when soils lose shear strength for short periods of time during a seismic event. Ground shaking of sufficient strength and duration can result in the loss of grain-to-grain contact and an increase in pore water pressure, causing the soil to behave as a fluid. Soils with a potential for liquefaction are typically cohesionless, with a predominately silt and sand grain size, must be loose, and be below the groundwater table.

Based on our subsurface explorations, the site is mainly underlain by medium dense silty sand to sandy silt at shallow depths. The borings PG-1 and PG-2 only encountered thin layers of very moist soils, and the borings did not encounter unconfined groundwater. Based on this and results of our analyses, it is our opinion that the liquefaction potential of the site soils is considered low, and design considerations related to soil liquefaction are not necessary for this project.

6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

6.1 SEISMIC SITE CLASS

We anticipate that the seismic design of the structures will be accomplished using the 2018/2021 edition of the International Building Code (IBC), which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years). Based on the results of our subsurface explorations, a Site Class D (stiff Soil) would be appropriate for the project.

6.2 FOUNDATIONS

Based on the subsurface conditions encountered, it is our opinion that conventional shallow footings may be used to support the SFR and additions.

6.2.1 Allowable Bearing Pressures

New Footings - In our opinion, where new foundations will be needed, the proposed additions may be supported on conventional footings bearing on at least one foot of structural fill placed on the recompacted native soils. The structural fill should extend at least six inches beyond the footing edges. The native soils should be re-compacted to a dense condition prior to placement of structural fill. If native soils cannot be compacted to a dense condition, they should be over-excavated and replaced with structural fill.

We recommend that a maximum allowable bearing pressure of 2,000 pounds per square feet (psf) be used for sizing the new footings bearing on minimum one foot compacted structural fill placed on the competent native soil. The recommended allowable bearing pressures are for dead plus live loads. For allowable stress design, the recommended bearing pressure may be increased by one-third for transient loads, such as wind or seismic forces. Continuous and individual spread footings should have minimum widths of 18 and 24 inches, respectively.

Exterior foundation elements should be placed at a minimum depth of 18 inches below final exterior grade. Interior spread foundations should be placed at a minimum depth of 12 inches below grade.

Existing Footings – Since the existing foundation subgrade soil had been consolidated under the existing structural loads, we recommend a maximum allowable soil bearing pressure of 2,500 pounds per square foot (psf) be used to evaluate the existing footings' adequacy for the second story addition.

Lateral Resistance - Lateral loads on the structures may be resisted by passive earth pressure developed against the embedded portion of the foundation system and by frictional resistance between the bottom of the foundation and the supporting subgrade soils.

For the existing footings, a frictional coefficient of 0.35 may be used to evaluate sliding resistance developed between the concrete and the subgrade soil.

Passive soil resistance may be calculated using an equivalent fluid weight of 250 pcf, assuming foundations are backfilled with properly compacted structural fill, and level ground surface. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected. The above values include a factor of safety of 1.5.

6.2.2 Foundation Settlement

Settlements of footings designed and constructed as described above should have a total settlement on the order of 1 to 1¼ inch, and differential settlement on the order of ½ inch. Most of the anticipated settlement should occur during construction as dead loads are applied.

6.2.3 Lateral Resistance

Lateral loads on the structure may be resisted by passive earth pressure developed against the embedded portion of the foundation system and by frictional resistance between the bottom of the foundation and the supporting subgrade soils. For the new footings bearing on minimum one foot compacted structural fill, a frictional coefficient of 0.35 may be used to evaluate sliding resistance at the bottom of footings. Passive soil resistance may be calculated using an equivalent fluid weight of 250 pcf, assuming properly compacted structural fill will be placed against the footings. The above values include a factor of safety of 1.5. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected.

6.2.4 Footing Subgrade Preparation

All footing subgrades should be carefully prepared. Loose or softened soil exposed at the construction subgrade elevation should be removed prior to pouring concrete. The adequacy of footing subgrade should be verified by a representative of PanGEO, prior to placing forms or rebar.

6.3 CONCRETE SLAB-ON-GRADE

Conventional slab on grade construction may be used for the project. We recommend that floor slabs be supported on the recompacted native soil or structural fill placed on recompacted native soil. If loose or soft soils are encountered at the slab subgrade elevation that cannot be adequately compacted, the loose or soft soil should be over-excavated to competent native and replaced with compacted structural fill, such as WSDOT Gravel Borrow or approved equivalent.

Interior slab-on-grade floors should be underlain by a capillary break consisting of at least of 4 inches of pea gravel or compacted ¾-inch, clean crushed rock (less than 3 percent fines). The capillary break material should meet the gradational requirements provided in Table 1, below.

Table 1 – Capillary Break Gradation

Sieve Size	Percent Passing
¾-inch	100
No. 4	0 – 10
No. 100	0 – 5
No. 200	0 – 3

The capillary break should be placed on subgrade soils that have been compacted to a dense and unyielding condition.

A 10-mil polyethylene vapor barrier should also be placed directly below the slab. Construction joints should be incorporated into the floor slab to control cracking.

6.4 FOUNDATION WALL AND RETAINING WALL DESIGN PARAMETERS

Concrete retaining walls should be properly designed to resist the lateral earth pressures exerted by the soils behind the wall. Proper drainage provisions should also be provided behind the walls to intercept and remove groundwater and seepage that may be present behind the wall. Our geotechnical recommendations for the design and construction of the retaining and basement walls are presented below.

6.4.1 Lateral Earth Pressures

Cantilever walls should be designed for an equivalent fluid pressure of 35 pcf for a level backfill condition behind the walls assuming the walls are free to rotate. If the walls are restrained at the top from free movement, such as basement walls with a floor diaphragm, an equivalent fluid pressure of 50 pcf should be used for a level backfill condition behind the walls.

Permanent walls should be designed for an additional uniform lateral pressure of 9H psf for seismic loading, where H corresponds to the buried depth of the wall.

The recommended lateral pressures assume the backfill behind the walls consists of a free draining and properly compacted fill with adequate drainage provisions.

6.4.2 Surcharge

Surcharge loads, where present, should also be included in the design of retaining walls. We recommend a lateral load coefficient of 0.35 be used to compute the lateral pressure on the wall face resulting from surcharge loads located within a horizontal distance of one-half the wall height.

6.4.3 Wall Drainage

Provisions for wall drainage should consist of a 4-inch diameter perforated drainpipe placed behind and at the base of the wall footings, embedded in 12 to 18 inches of clean crushed rock or pea gravel wrapped with a layer of filter fabric. A minimum 18-inch-wide zone of free draining granular soils (i.e., pea gravel or washed rock) is recommended to be placed adjacent to the wall for the full height of the wall. Alternatively, a composite drainage material, such as Miradrain 6000, may be used in lieu of the clean crushed rock or pea gravel. The drainpipe at the base of the wall should be graded to direct water to a suitable outlet.

6.4.4 Wall Backfill

Based on the field exploration, the on-site soil would not be suitable for wall backfill due to its high fines content. As such, wall backfill should consist of imported, free draining, granular materials, such as WSDOT Gravel Borrow or approved equivalent.

Wall backfill should be properly moisture conditioned, placed in loose, horizontal lifts less than about 12 inches in thickness, and systematically compacted to a dense and relatively unyielding

condition and to at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557. Within 5 feet of the wall, care should be exercised during compaction so that no extra pressure is exerted on the walls and the walls are damaged.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 SITE PREPARATION

Site preparation for the proposed project includes stripping and clearing of surface vegetation and excavations to the design subgrade for the addition. All stripped surface materials should be properly disposed off-site or be “wasted” on site in non-structural landscaping areas.

Following site clearing and excavations, the adequacy of the subgrade where structural fill, foundations, slabs, or pavements are to be placed should be verified by a representative of PanGEO. The subgrade soil in the improvement areas, if recompacted and still yielding, should also be over-excavated and replaced with compacted structural fill or CDF/lean-mix concrete.

7.2 TEMPORARY EXCAVATION

Based on our understanding of the project, we anticipate that temporary excavations on the order of about 2 to 3 feet will be needed for the new addition foundation construction. As such, it is our opinion that unsupported slope cut excavations are feasible at the site. Based on the soil conditions at the site, for planning purposes, it is our opinion that temporary excavations may be sloped as steep as 1H:1V.

All temporary excavations should be performed in accordance with Part N of WAC (Washington Administrative Code) 296-155. The contractor is responsible for maintaining safe excavation slopes and/or shoring. In general, temporary excavations deeper than a total of 4 feet should be sloped or shored. However, excavations less than 4 feet deep, if located along or near property lines, will also need to be sloped or supported if sufficient space is not available to lay back the excavations without encroaching into neighboring properties.

The temporary excavations and cut slopes should be re-evaluated in the field during construction based on actual observed soil conditions and may need to be flattened in the wet seasons and should be covered with plastic sheets. The cut slopes should be covered with plastic sheets in the raining season. We also recommend that heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a distance equal to 1/3 the slope height from the top of any excavation.

7.3 MATERIAL REUSE

In the context of this report, structural fill is defined as compacted fill placed under footings, concrete stairs and landings, and slabs, or other load-bearing areas. The contractor should be aware that the site soils contain high fines content and are poorly graded, and may be difficult to compact to the requirements of structural fill. As a result, for planning purposes, we do not recommend the on-site soils be re-used as structural backfill for the project. Structural fill should consist of a well-graded granular material, such as WSDOT Gravel Borrow or CSBC, or approved equivalent.

7.4 STRUCTURAL FILL PLACEMENT AND COMPACTION

Structural fill should be moisture conditioned to within about 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and systematically compacted to a dense and relatively unyielding condition and to at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557.

Depending on the type of compaction equipment used and depending on the type of fill material, it may be necessary to decrease the thickness of each lift in order to achieve adequate compaction. PanGEO can provide additional recommendations regarding structural fill and compaction during construction.

7.5 EROSION AND DRAINAGE CONSIDERATIONS

Surface runoff can be controlled during construction by careful grading practices. Typically, this includes the construction of shallow, upgrade perimeter ditches or low earthen berms in conjunction with silt fences to collect runoff and prevent water from entering excavations or to prevent runoff from the construction area from leaving the immediate work site. Temporary erosion control may require the use of hay bales on the downhill side of the project to prevent water from leaving the site and potential storm water detention to trap sand and silt before the water is discharged to a suitable outlet. All collected water should be directed under control to a positive and permanent discharge system.

Permanent control of surface water should be incorporated in the final grading design. Adequate surface gradients and drainage systems should be incorporated into the design such that surface runoff is directed away from structures. Potential problems associated with erosion may also be reduced by establishing vegetation within disturbed areas immediately following grading operations.

7.6 WET EARTHWORK RECOMMENDATIONS

It is our opinion that construction of the project can be accomplished during the wet season. However, performing earthwork activities during wet season is anticipated to be more costly than during dry weather conditions. Based on the anticipated soil conditions and topography in the proposed construction area, it is our opinion that potential for erosion at the site can be adequately mitigated by employing sediment control best management practices (BMPs). Additional information and details of the BMPs discussed in this section can be found in the Washington State Department of Ecology's *Stormwater Management Manual for Western Washington, Volume II* (<http://www.ecy.wa.gov/programs/wq/stormwater/manual.html>). Sediment control BMPs should be installed/constructed and functional prior to land disturbing activities.

General recommendations relative to earthwork performed in wet weather or in wet conditions are presented below:

- All footing surfaces should be protected against inclement weather unless the footings can be poured immediately after the subgrade is exposed. It is the contractor's responsibility to protect the footing subgrade from disturbance. If needed, one option is to place 2 to 3 inches of lean-mix concrete or 4 to 6 inches of crushed surfacing base course (CSBC) on the exposed foundation subgrade as soon as the subgrade is exposed.
- Earthwork should be performed in small areas to minimize subgrade exposure to wet weather. Excavation or the removal of unsuitable soil should be followed promptly by the placement and compaction of clean structural fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance.
- Where practical, maintain vegetation buffers around cleared areas (BMP C101).
- During wet weather, the allowable fines content of the structural fill should be reduced to no more than 5 percent by weight based on the portion passing ¾-inch sieve. The fines should be non-plastic.
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water.

- Geotextile silt fences should be strategically located to control erosion and the movement of soil. Erosion control measures should be installed along all the property boundaries.
- Excavation slopes and soils stockpiled on site should also be covered with plastic sheets.

8.0 STATEMENT OF RISK

We understand that the portion of the site is mapped as geologic hazard areas, specifically as potential liquefaction hazard area. Per Mercer Island City Code Section 19.07.060.D.2, development within geologic hazard areas and critical slopes may occur if the geotechnical engineer provides a statement of risk with supporting documentation indicating that one of the following conditions can be met:

- a. The geologic hazard area will be modified, or the development has been designed so that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe; or
- b. An evaluation of site specific subsurface conditions demonstrates that the proposed development is not located in a geologic hazard area; or
- c. Development practices are proposed for the alteration that would render the development as safe as if it were not located in a geologic hazard area; or
- d. The alteration is so minor as not to pose a threat to the public health, safety, and welfare.

It is our opinion that the proposed development meets the criteria (a), (b), (c) and (d), above.

9.0 ADDITIONAL SERVICES

To confirm that our recommendations are properly incorporated into the design and construction of the proposed addition, PanGEO should be retained to conduct a review of the final project plans and specifications, and to monitor the construction of geotechnical elements. Modifications to our recommendations presented in this report may be necessary, based on the actual conditions encountered during construction.

10.0 LIMITATIONS

We have prepared this report for use by Bob Xia and Meng Miao and the project design team. Recommendations contained in this report are based on a site reconnaissance, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

Variations in soil conditions may exist between the explorations and the actual conditions underlying the site. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations. Additionally, we should also be notified to review the applicability of our recommendations if there are any changes in the project scope.

The scope of our work does not include services related to construction safety precautions. 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. Additionally, the scope of our work specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances. We are not mold consultants nor are our recommendations to be interpreted as being preventative of mold development. A mold specialist should be consulted for all mold-related issues.

This report has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's

option and risk. Any party other than the client who wishes to use this report shall notify PanGEO of such intended use and for permission to copy this report. Based on the intended use of the report, PanGEO may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release PanGEO from any liability resulting from the use of this report.

We appreciate the opportunity to be of service.

Sincerely,

Bart Weitering

Bart Weitering, G.I.T.
Project Geologist



10/1/2024

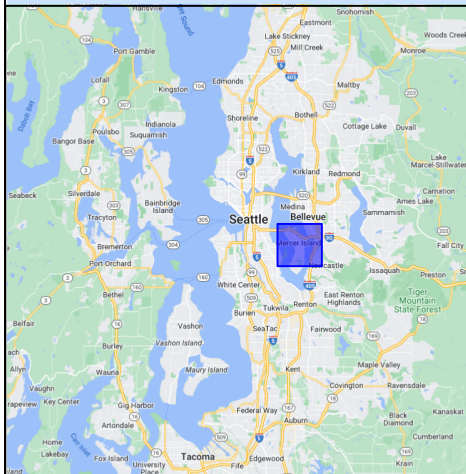
H. Michael Xue, P.E.
Principal Geotechnical Engineer

11.0 REFERENCES

- ASTM D1557-12e1, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))*, ASTM International, West Conshohocken, PA, 2012, www.astm.org
- ASTM D1586-11, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*, ASTM International, West Conshohocken, PA, 2011, www.astm.org.
- International Building Code (IBC), 2018/21, *International Code Council*.
- Troost, K.G., Wisner, A. P., 2006, *Geologic Map of Mercer Island, scale 1:24,000*.
- Washington Administrative Code (WAC), 2019, Chapter 296-155 - *Safety Standards for Construction Work, Part N - Excavation, Trenching, and Shoring*, Olympia, Washington.
- WSDOT, 2024, *Standard Specifications for Road, Bridge and Municipal Construction, M 41-10, Washington State Department of Transportation*.



Project Site



Base Map: SDCI GIS Map



Not to Scale



**Proposed SFR Addition
4040 97th Avenue Southeast
Mercer Island, Washington**

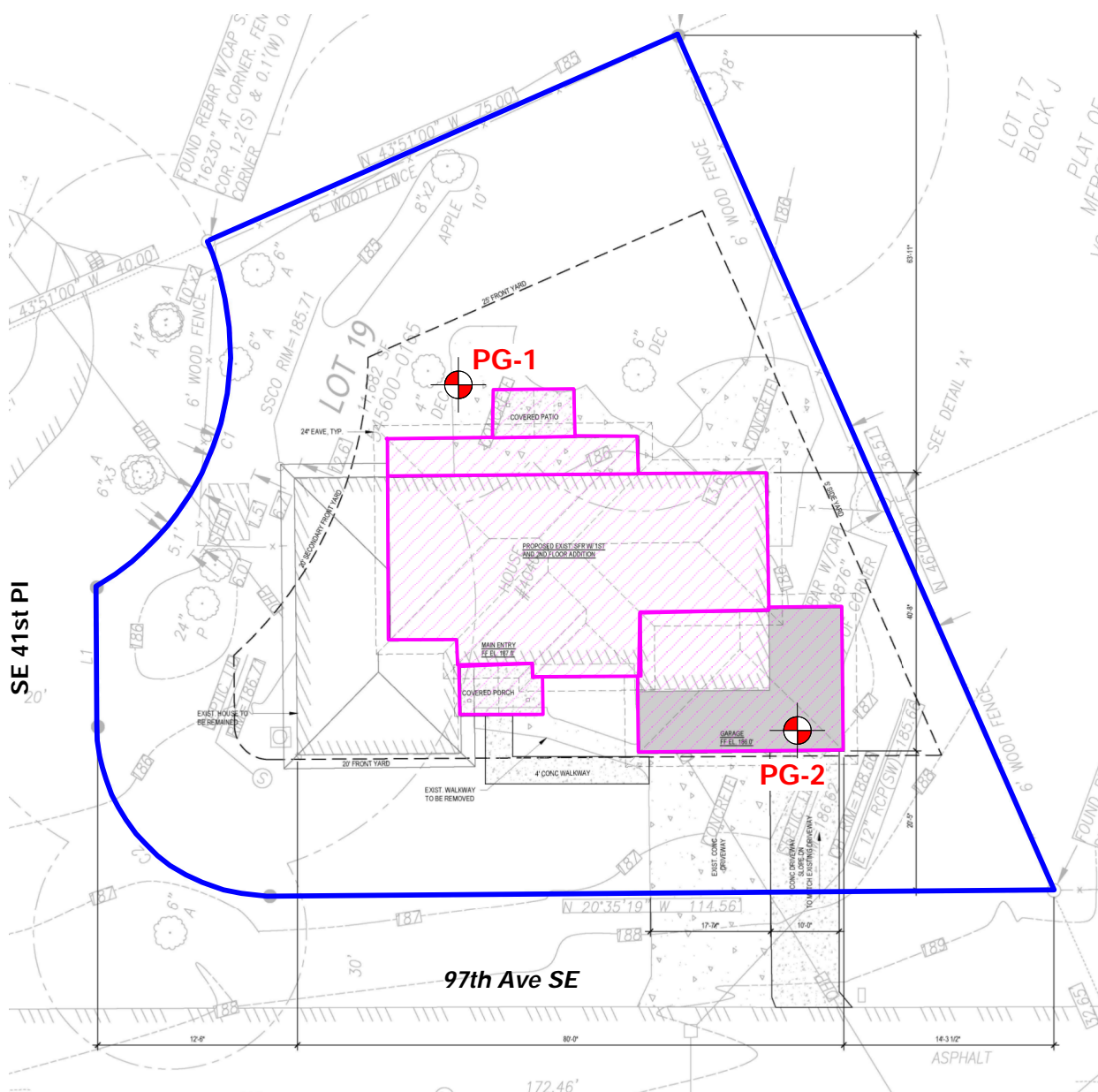
VICINITY MAP

Project No.

24-355




Figure No.

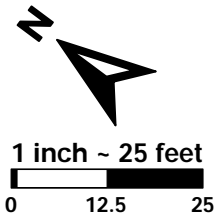
1




Notes: Base map modified from Site Plan by MJZ Design, dated 06/10/2024.

LEGEND

-  Approximate Location of Explorations (PanGEO, 2024)
-  Approximate Property Boundary
-  Approximate Footprint of Proposed Structures



	Proposed SFR Addition 4040 97th Avenue Southeast Mercer Island, Washington	SITE AND EXPLORATION PLAN	
		Project No. 24-355	Figure No. 2

APPENDIX A

SUMMARY TEST BORING LOGS

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)		GW: Well-graded GRAVEL
	GRAVEL (>12% fines)		GP: Poorly-graded GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)		GM: Silty GRAVEL
	SAND (>12% fines)		GC: Clayey GRAVEL
			SW: Well-graded SAND
Silt and Clay 50% or more passing #200 sieve	Liquid Limit < 50		SP: Poorly-graded SAND
			SM: Silty SAND
			SC: Clayey SAND
	Liquid Limit > 50		ML: SILT
			CL: Lean CLAY
			OL: Organic SILT or CLAY
			MH: Elastic SILT
			CH: Fat CLAY
Highly Organic Soils			OH: Organic SILT or CLAY
			PT: PEAT

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

- ATT Atterberg Limit Test
- Comp Compaction Tests
- Con Consolidation
- DD Dry Density
- DS Direct Shear
- %F Fines Content
- GS Grain Size
- Perm Permeability
- PP Pocket Penetrometer
- R R-value
- SG Specific Gravity
- TV Torvane
- TXC Triaxial Compression
- UCC Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals

- 2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
- 3.25-inch OD Split Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

- Notes:**
- Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.
 - The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

Layered: Units of material distinguished by color and/or composition from material units above and below	Fissured: Breaks along defined planes
Laminated: Layers of soil typically 0.05 to 1mm thick, max. 1 cm	Slickensided: Fracture planes that are polished or glossy
Lens: Layer of soil that pinches out laterally	Blocky: Angular soil lumps that resist breakdown
Interlayered: Alternating layers of differing soil material	Disrupted: Soil that is broken and mixed
Pocket: Erratic, discontinuous deposit of limited extent	Scattered: Less than one per foot
Homogeneous: Soil with uniform color and composition throughout	Numerous: More than one per foot
	BCN: Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel	3 to 3/4 inches	Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
		Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Coarse Gravel:	3 to 3/4 inches	Silt	0.074 to 0.002 mm
Fine Gravel:	3/4 inches to #4 sieve	Clay	<0.002 mm

MONITORING WELL

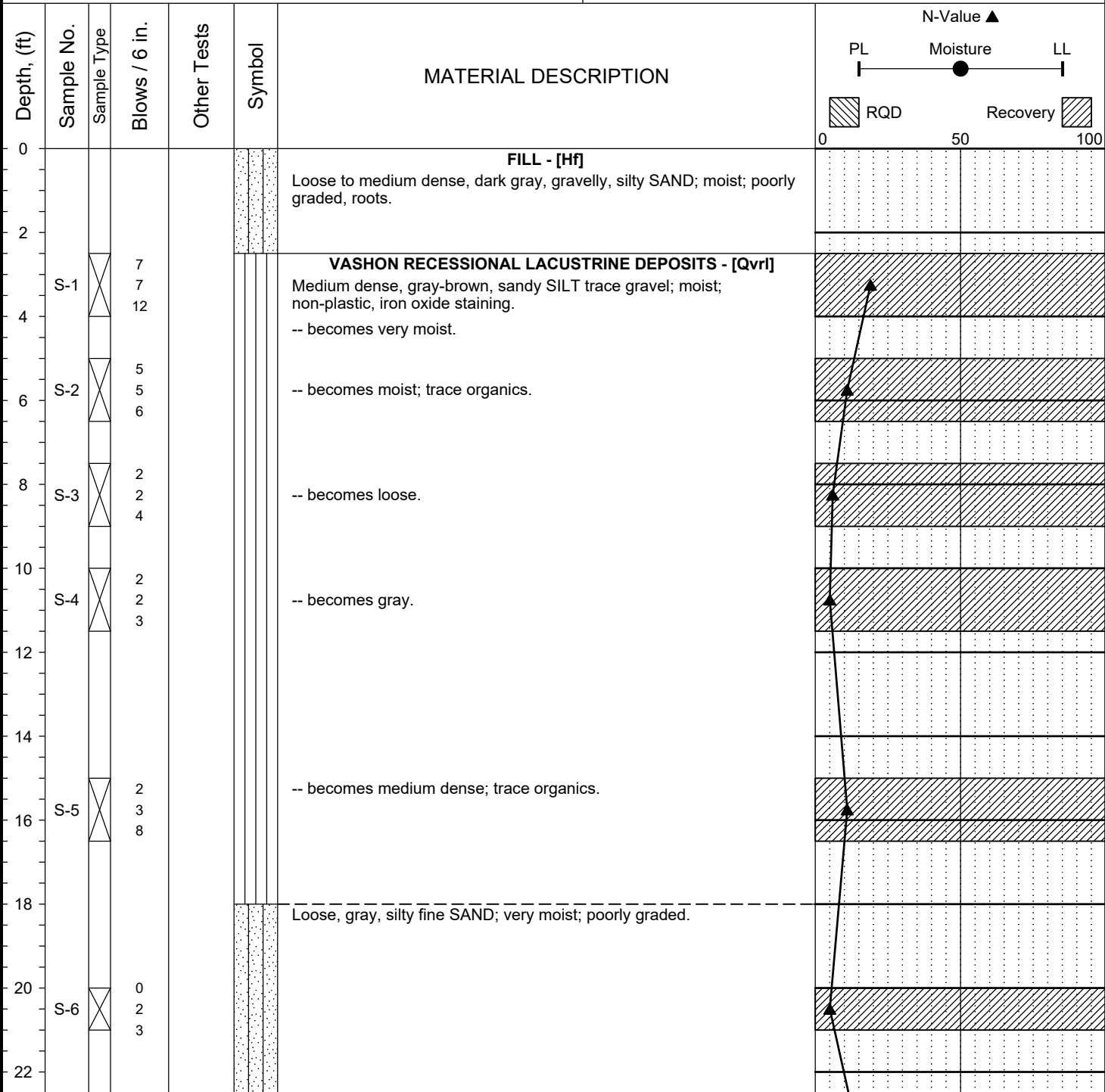
- Groundwater Level at time of drilling (ATD)
- Static Groundwater Level
- Cement / Concrete Seal
- Bentonite grout / seal
- Silica sand backfill
- Slotted tip
- Slough
- Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

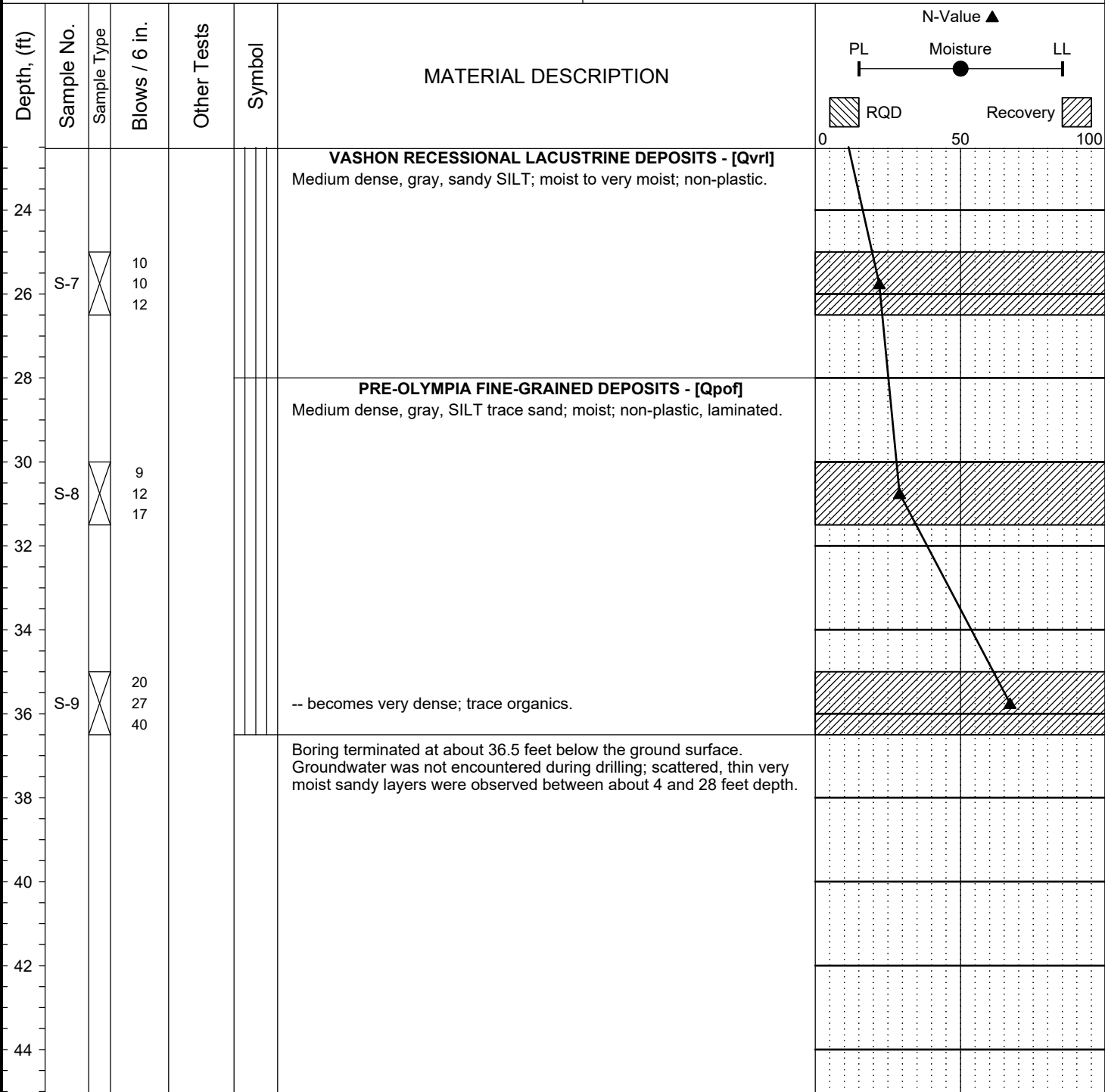
LOG KEY 16-056 LOGS.GPJ PANGEO.GDT 02/22/16

Project:	Proposed SFR Addition	Surface Elevation:	186.0ft
Job Number:	24-355	Top of Casing Elev.:	N/A
Location:	4040 - 97th Ave SE, Mercer Island, Washington	Drilling Method:	HSA
Coordinates:	Northing: 47.57374, Easting: -122.21084	Sampling Method:	SPT



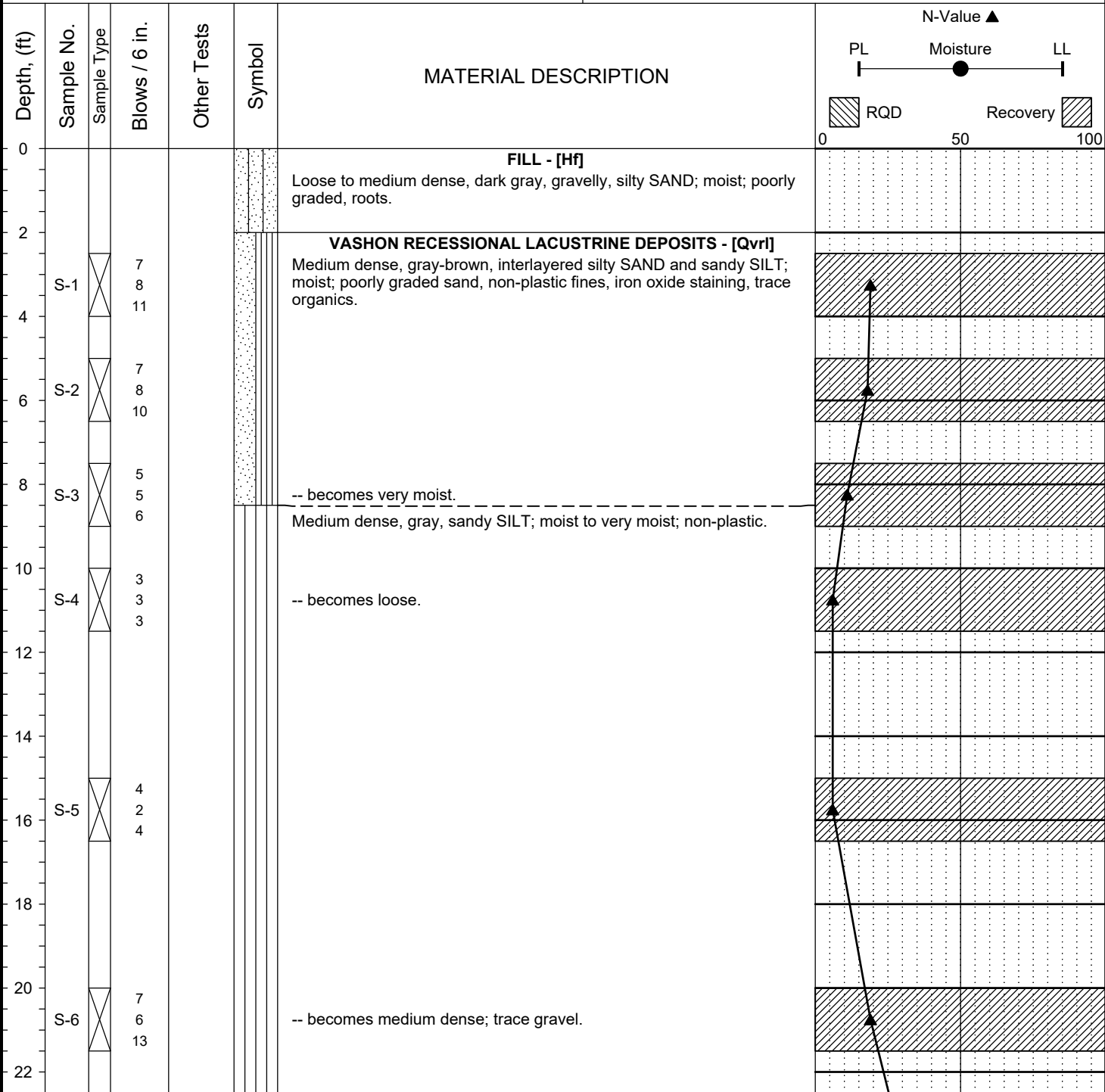
Completion Depth:	36.5ft	Remarks: Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer. Hammer operated with a rope and cathead mechanism. Coordinates and elevation are approximate and based on their relative location to known site features. This information is provided for relative information only and is not a substitution for field survey. Datum: NAVD88
Date Borehole Started:	8/28/24	
Date Borehole Completed:	8/28/24	
Logged By:	H. Wang	
Drilling Company:	Geologic Drill Partners	

Project:	Proposed SFR Addition	Surface Elevation:	186.0ft
Job Number:	24-355	Top of Casing Elev.:	N/A
Location:	4040 - 97th Ave SE, Mercer Island, Washington	Drilling Method:	HSA
Coordinates:	Northing: 47.57374, Easting: -122.21084	Sampling Method:	SPT



Completion Depth:	36.5ft	Remarks: Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer. Hammer operated with a rope and cathead mechanism. Coordinates and elevation are approximate and based on their relative location to known site features. This information is provided for relative information only and is not a substitution for field survey. Datum: NAVD88
Date Borehole Started:	8/28/24	
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Logged By:	H. Wang	
Drilling Company:	Geologic Drill Partners	

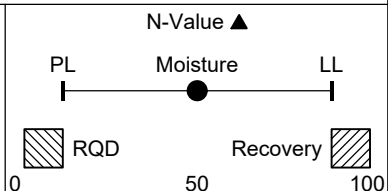
Project:	Proposed SFR Addition	Surface Elevation:	187.0ft
Job Number:	24-355	Top of Casing Elev.:	N/A
Location:	4040 - 97th Ave SE, Mercer Island, Washington	Drilling Method:	HSA
Coordinates:	Northing: 47.5735, Easting: -122.21092	Sampling Method:	SPT



Completion Depth:	31.5ft	Remarks: Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer. Hammer operated with a rope and cathead mechanism. Coordinates and elevation are approximate and based on their relative location to known site features. This information is provided for relative information only and is not a substitution for field survey. Datum: NAVD88
Date Borehole Started:	8/28/24	
Date Borehole Completed:	8/28/24	
Logged By:	H. Wang	
Drilling Company:	Geologic Drill Partners	

Project:	Proposed SFR Addition	Surface Elevation:	187.0ft
Job Number:	24-355	Top of Casing Elev.:	N/A
Location:	4040 - 97th Ave SE, Mercer Island, Washington	Drilling Method:	HSA
Coordinates:	Northing: 47.5735, Easting: -122.21092	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION	N-Value ▲	
							PL	Moisture
24						PRE-OLYMPIA FINE-GRAINED DEPOSITS - [Qpof] Dense, gray, SILT trace sand; moist; non-plastic, trace organics.		
26	S-7		13 16 21					
30	S-8		17 36 44			-- becomes very dense.		
32						Boring terminated at about 31.5 feet below the ground surface. Groundwater was not encountered during drilling; scattered, thin very moist sandy layers were observed between about 8 and 22 feet depth.		
34								
36								
38								
40								
42								
44								



Completion Depth:	31.5ft	Remarks: Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer. Hammer operated with a rope and cathead mechanism. Coordinates and elevation are approximate and based on their relative location to known site features. This information is provided for relative information only and is not a substitution for field survey. Datum: NAVD88
Date Borehole Started:	8/28/24	
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