GEOTECHNICAL ENGINEERING REPORT
PROPOSED SINGLE-FAMILY RESIDENCE
9191 SE 64th Street
Mercer Island, Washington

PROJECT NO. 25-036.200
AUGUST 27, 2025

Image Credit: Citizen Design

Prepared for: CITIZEN DESIGN

PanGEO INCORPORATED

Geotechnical & Earthquake
Engineering Consultants

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August 27, 2025
File No. 25-036.200

Citizen Design
Attn: Mr. Isaac Greenetz
3800 Woodland Park Avenue #300
Seattle, WA 98103

Subject: **Geotechnical Engineering Report**
Proposed Single-Family Residence
9191 SE 64th Street, Mercer Island, Washington

Dear Isaac,

Please find attached our geotechnical engineering report for the proposed single-family residence at the above address in Mercer Island, Washington. This report documents the subsurface conditions at the site and presents our geotechnical engineering recommendations for the proposed project.

PanGEO previously prepared a geotechnical report for three lots, including the subject lot, dated April 16, 2019. We subsequently prepared supplemental addendums to address the previously proposed developments on each specific lot. The attached report is intended to supersede our original report for the three lots, and all previous addendums, and should be used for the design of the currently proposed project.

Surface and Subsurface Conditions - Topographically, the site is comprised of a nominally west to east running ridgeline with steep slopes on the south, and moderate to steep slopes on the north. The crest of the ridge descends from roughly 210 feet in elevation on the west to about 185 feet near the east property line. The currently proposed house footprint straddles the ridgeline near the center of the property. Soil conditions at the site were evaluated based on a total of five test borings. In summary, the footprint of the house is generally underlain by competent soils consisting of very stiff to hard clayey silt over medium dense to dense silty sand. Groundwater was not encountered within the depths of our explorations.

Foundation Recommendations - Based on the currently proposed design, the proposed house foundations are expected to bear on competent soils. As such, conventional footings will be appropriate to support the structure. However, steep slopes are located in close proximity to the foundations on both the north and especially on the south side of the house. To maintain adequate stability of the house foundations, particular during the design seismic event, we recommend that a row of stabilizing soldier piles be incorporated into the design along the south foundation wall, and the northern footings bear on a 4-foot-deep block of lean-mix concrete, to effectively increase the embedment depth of the footing.

Critical Area Considerations – Provided that the recommendations presented in this report are incorporated into the project plans and construction of the project, in our opinion the proposed project is feasible from the geotechnical standpoint, and will not adversely affect the mapped critical areas at the site.

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

Sincerely,

Stephen H. Evans
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Encl.: Geotechnical Engineering Report

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GEOTECHNICAL ENGINEERING REPORT
PROPOSED SINGLE-FAMILY RESIDENCE
9191 SE 64TH STREET
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 single-family residence (SFR) at 9191 SE 64th Street (Parcel 302405-9151) on Mercer Island, Washington. This study was performed in general accordance with our mutually agreed scope of services outlined in our proposal for the current study dated January 24, 2025, which was subsequently authorized on January 29, 2025. Our scope of services included reviewing readily available geologic and geotechnical data, including our previous studies on this site, compiling our previous engineering analyses and recommendations, performing additional engineering analyses, and preparing this geotechnical engineering report for the currently proposed project. All previous reports and memos provided for this property are superseded by this report.

2.0 SITE AND PROJECT DESCRIPTION

The project site consists of an irregularly shaped, undeveloped parcel located at 9191 SE 64th Street, on the east side of Mercer Island, Washington (see Figure 1, *Vicinity Map*). The current property includes an original parcel identified by the parcel number 302405-9001 (address 9191 SE 64th Street, per City of Mercer Island), a 25,125 square-foot parcel. As the original property line ran down the center of the ridgeline (topography discussed below), the portion of the property at 6423 East Mercer Way south of the original lot, down to East Mercer Way, was added to the present site (see Figure 2, *Site and Exploration Plan*) to yield the current 47,398 square-foot property.

The western property line contains a topographic saddle or upper bench area, near the top of the property, around elevation 201 feet (see Figure 2). From here a ridgeline with moderately steep slopes reaches down to the southeast toward the existing house at 6423 East Mercer Way. From a relatively sharp crest below the upper bench, the ridge crest broadens out, especially below elevation 198 feet (see Plate 1, following page). An access driveway or dirt road has been graded up the spine of the ridge to the upper bench area, and the upper part of the ridge appears to have been undercut by past grading work. This has created areas of vertical and near vertical slopes and road cuts where the access road has been excavated through the crest of the ridge (see Plate 2, following page). The ridge area is covered with scattered conifer and deciduous trees, while the lower, broad ridge area was mainly grassy.

North of the ridgeline, between the house site and the steep slope rising the SE 64th Street, there is an open, incised drainage swale. Moderate to steep slopes descending into this swale form the north flank of the ridgeline (see Figure 2).

Plate 1 – General conditions of the property, looking downslope to the east from the approximate location of the currently proposed house, where the ridge crest broadens. (6/18/2025)

The property is mapped by the City of Mercer Island within several geological hazard areas, including an erosion hazard area, a potential landslide hazard area, and seismic hazard area. As such, the development will need to consider these hazards, which are addressed in *Section 5.0* of this report.

Plate 2 – "Road" cut, looking uphill to the west along the ridge crest. Note vertical slope in shadow on left. (6/18/2025)

Plate 3 –Schematic View from the East, dated 5/23/25, by Citizen Design.

Current plans call for developing the house footprint on the central portion of the ridgeline discussed above (see Figure 2). We understand that the house will be multi-level, with the garage level at approximately elevation 194 feet, the main level on the north portion of the house at elevation 199 feet, and the main living area on the south section of the house at elevation 201 feet. All elevations are assumed to be NAVD88. The preliminary plans call for a complex, multilevel excavation, with cuts up to 20 feet in some locations. However, since the cuts are removing the ridge crest, resulting open cuts are generally less than 8 to 10 feet.

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.

3.0 SUBSURFACE EXPLORATIONS

PanGEO completed five test borings at the subject site. Three of the borings (PG-4-19, PG-5-19 and PG-8-19) were completed during our previous exploration program on March 7, 2019 and March 21, 2019. Two additional borings (PG-1-25 and PG-2-25) were drilled on the revised house footprint on July 1, 2025. The 2019 borings were advanced to between 14 and 41½ feet below the existing ground surface using an EC-95 track mounted drill owned and operated by Boretec, Inc. The 2025 borings were advanced to depths of 41½ and 36½ feet below ground surface, respectively. They were drilled using a track-mounted Acker Recon drill rig owned and operated by Geologic Drill Partners of Fall City, Washington. The approximate boring locations are shown on the attached Figure 2.

Soil samples were obtained from the borings at 2½-foot and 5-foot depth intervals in general accordance with Standard Penetration Test (SPT) sampling methods (ASTM test method D-1586) in which the samples were obtained using a 2-inch outside diameter split-spoon sampler. The sampler was driven 18-inches into the soil using a 140-pound weight freely falling a distance of 30 inches. The 2019 samples were obtained with aa hammer that was advanced using a rope and cathead method, while the 2025 samples were obtained using a higher efficiency auto-trip hammer. 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.

A geologist from PanGEO was present on a full-time basis to observe the drilling, assist in sampling, and to describe and document the soil samples obtained from the borings. The soils were logged in general accordance with the system summarized on *Figure A-1, Terms and Symbols for Boring and Test Pit Logs*. Summary boring logs are included as Figures A-2 to A-6 in Appendix A. The stratigraphic contacts indicated on the boring logs represent the approximate depth to the boundaries between soils units. Actual transitions between soil units may be more gradual or occur at different elevations. The descriptions of groundwater conditions and depth are likewise approximate.

4.0 SUBSURFACE CONDITIONS

4.1 Site Geology

According to *The Geologic Map of Mercer Island (Troost and Wisher,2006)*, the subject parcel is underlain almost entirely by Lawton Clay (Qvlc) material, with possibly some pre-Olympia non-glacial deposits (Qpon) toward the base of the site. The mapping suggests the site surface is mantled with mass-wasting deposits. Our borings along the ridgeline indicates that the house site is underlain predominantly by sand deposits, with relatively minor interbeds of silt and clayey silt above the house site, which is inconsistent with the mapped geology. Moreover, the clayey silt and sandy silt beds occur at a topographic level above where they would be expected to be found. In our opinion, the project area is underlain by pre-Olympia strata, both fine grained (Qponf) and coarse-grained (Qponc).

- **Mass-wastage Deposits (Qmw) –** Mass-wastage deposits consist of surficial deposits transported downslope in mass by gravity (landslides, colluvial soil movement, and other gravitational processes). Mass-wastage deposits typically consist of intermixed, very loose to medium dense, coarse-grained deposits and soft to stiff fine-grained deposits with voiding. This geologic unit typically exhibits moderate to high compressibility and low to moderate strength characteristics due to the highly variable composition and the nature in which this unit was deposited. We did not observe significant amounts of this material along the ridgeline at the proposed house location, and only logged about four feet of this unit in PG-8-19.

- **Pre-Olympia Non-Glacial Deposits (Qponf & Qponc)** – This geologic unit (non-differentiated) is described by Troost and Wisher as generally consisting of very dense and hard, sand, gravel, silt, clay and organics of non-glacial origin. The unit may contain tephra beds, paleosols, and iron oxidized layers. These pre-Olympia deposits typically exhibit low compressibility and high strength characteristics in an undisturbed state. As stated above, on this site, in our opinion we have beds of fine-grained Pre-Olympia non-glacial material (Qponf), which is described as laminated to massive silt and clay, as well as coarse-grained deposits (Qponc), described as sand and gravel, clean to silty.

4.2 Soil Conditions

The test borings advanced at the project site generally encountered soils inconsistent with the mapped geologic stratigraphy, as described above, and we did not encounter significant mass-wasting deposits. The thin disturbed surficial materials we found at the site of the proposed house were interpreted to be fill, as clear grading activities had occurred on the site.

The interpreted subsurface conditions are depicted in Figures 3, 4 and 5 – *Generalized Subsurface Profiles A-A', B-B' and C-C',* respectively, and brief descriptions of the generalized soil conditions encountered at the locations of the test borings advanced at the site are presented below. Please refer to the summary boring logs in *Appendix A* for more details. A layer of colluvium (mass wasting deposit) was encountered in PG-8-19, but as this boring was not located near the proposed house footprint, the soil unit is not included in the descriptions below.

Fill – Fill was encountered as thin layers of medium dense, yellow brown, silty sand in both 2025 borings. The unit was not found in the 2019 borings PG-4-19 or PG-5-19, likely because both were located in a road cut area. The unit was roughly less than 2 feet thick, and was characterized by mixed texture and organics.

Pre-Olympia Non-Glacial Fine-Grained Deposits (Qponf) – This unit consisted of sandy silt to silty lean clay, very stiff to hard, varying in color from yellow brown to brown gray. The unit was encountered near the top of the ridge, where it levels off into a shoulder. The unit was found in PG-1-25, PG-4-19 and PG-5-19, and becomes thicker up the slope. The contact zone between the fine-grained strata and the lower sand zone tends to be a zone of interbedded material. Though the material is sticky to the hand, Atterberg Testing shows the bed in PG-1-25 to be non-plastic. The bed is 6½ feet thick in PG-1-25, and up to 12 feet thick in PG-4-19.

Pre-Olympia Non-Glacial Coarse-Grained Deposits (Qponc) – This soil unit was encountered at depth in all borings along the ridgeline. The unit consisted of silty sand to sand with silt, fine to medium, and medium dense to very dense. Number 200 mesh separation tests indicated the fines varied from a low of 9.6% to a high of 16.4%. There was scattered gravel in some beds, and the unit varied from laminated to massive and homogeneous.

Our subsurface descriptions are based on the conditions encountered and observed at the time of our exploration. Soil conditions between exploration locations may vary from those encountered. The nature and extent of variations between our exploratory locations may not become evident until construction. If variations do appear, PanGEO should be requested to reevaluate the recommendations in this report and to modify or verify them in writing prior to proceeding with earthwork and construction.

Selected Sample Photos: Plates 4 through 6 below depict select soil samples obtained from our recent test borings. For reference purposes, the split-soon samplers pictured below have an outside diameter of 2 inches.

Plate 4 – Pre-Olympia, Non-glacial Fine Grained: Hard, sandy SILT (Qponf) | PG-1-25, S-4 @ 7½ – 9 feet.

Plate 5 –Pre-Olympia, Non-glacial Coarse Grained: Very dense fine SAND with silt (Qponc)| PG-1-25, S-9 @ 25-26½ feet.

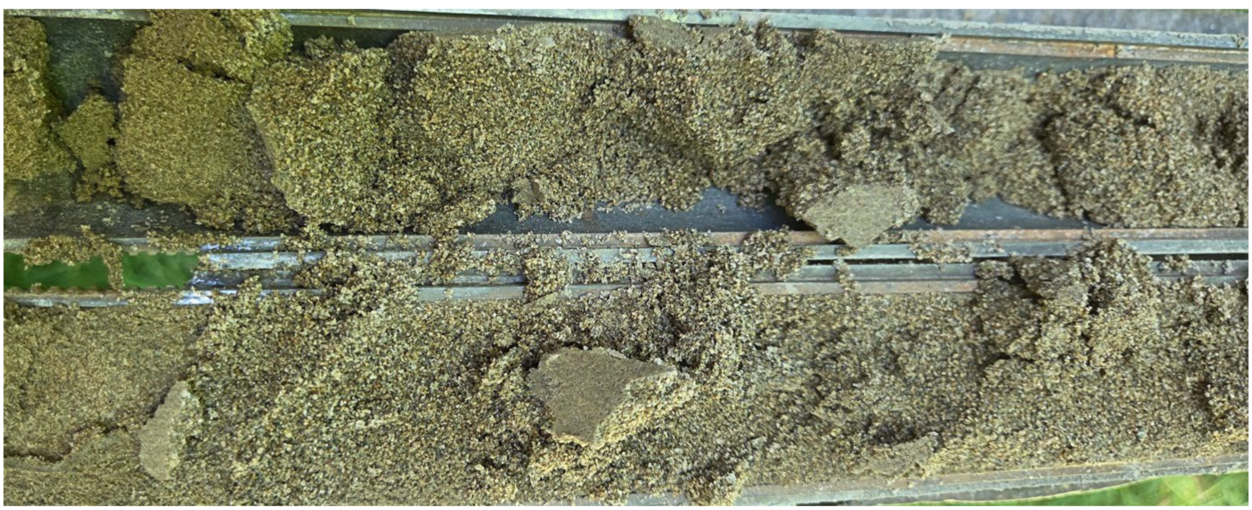


Plate 6 – Pre-Olympia, Non-glacial Coarse Grained: Medium Dense to Very dense, SAND, with silt | PG-2-25, S-4 @ 7½-9 feet.

4.3 GROUNDWATER CONDITIONS

Groundwater was not encountered in any of our test borings. Please note that there will be fluctuations in seepage and groundwater levels, depending on the season, amount of rainfall, surface water runoff, local subsurface conditions and other factors. Generally, the groundwater levels are higher and seepage rates are greater in the wetter winter months (typically October through May).

5.0 GEOLOGIC HAZARDS EVALUATION

As part of our study, we conducted an assessment of potential geologic hazards within the subject site as defined in Mercer Island City Code Chapter 19.07.160, Geologically Hazardous Areas. Mercer Island City Code identifies three different types of Geologic Hazards: Erosion Hazards, Potential Landslide Hazards, and Seismic Hazards. The City's criteria for the various hazard areas and our assessment of the hazard areas with respect to the planned improvements are provided in the following sections of this report.

5.1 Erosion Hazards

The site is mapped as a potential erosion hazard area in accordance with the City of Mercer Island's Geologic Hazards Map. Based on the Web Soil Survey data, the mapped site soils (Kitsap Silt Loam KpD) have an Erosion Factor K of 0.37 to sheet and rill erosion. Factor K values range between 0.02 and 0.69, with the higher number indicating higher vulnerability. As such, we interpret the site soils to have a moderate susceptibility to erosion.

Conclusions: In our opinion, the erosion hazards at the site can be effectively mitigated with best management practices 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 a silt fence at the construction perimeter, placing quarry spalls or hay bales at the disturbed and high traffic areas, covering stockpiled soil or cut slopes with plastic sheets, constructing a temporary drainage pond, if needed, to control surface runoff and trap sediment, and by maintaining a stabilized construction entrance.

Permanent erosion control measures should be applied to the disturbed areas of the site as soon as feasible. These measures may include, but not limited to, planting and mulching. The use of permanent erosion control mats may also be considered in conjunction with planting/mulching to protect the soils from erosion.

5.2 Potential Landslide Hazards

The subject site is mapped within a potential landslide hazard area according to the City of Mercer Island's Geologic Hazards Map.

The City of Mercer Island GIS mapping identifies a few landslide indicators within 500 feet of the subject site. Most are below the subject site. Two landslides are indicated on properties west of the subject site, but no information is available as to the nature of these slides. Several small slides are also mapped on the church property north of the project site, also with no further information The map also shows a landslide scarp along the north side of a drainage swale north of the house site. This scarp is not associated with any mapped slide.

Site Reconnaissance and Observations: We conducted a reconnaissance visit to review the condition of the sloping areas of the site, and areas adjacent to the site, and identify indications of potential historical slope instability.

As described above, the site morphology consists of a descending ridge running southeast from a saddle or bench area along the west property line as shown in Figure 2. The upper portion of the ridge is relatively narrow, but widens below elevation 198 feet (see Plate 1). During our site visits, we did not observe evidence of recent slope instability such as slide scarps or tension cracks within the subject property. In addition, no recent or historical slides have been mapped on or directly adjacent to the subject property. Review of the recent Lidar image of the area shows the site grading work fairly readily, and the road cut to the bench, but shows no features that may suggest slope instability in the subject area.

Conclusions: Based on our reconnaissance and our understanding of subsurface conditions at the site, in our opinion a large, deep-seated type of slope failure is unlikely on the subject property. In our opinion, relatively shallow landslides at the site have the potential to occur due to the steep topography. As such, as described below, we performed a detailed slope stability analysis of the site to determine the risk of landsliding, and to provide recommendations to adqeuatly stabilize the site.

It is our opinion that the proposed improvements are feasible from a geotechnical engineering standpoint, and in our opinion will not adversely affect the overall stability of the site or adjacent properties provided the recommendations outlined herein are followed, and the proposed improvements are properly designed and constructed. Our recommendations include the use of permanent stabilizing piles along the south side of the developed area to provide adequate support for the proposed residence in the static and seismic condition, per the current standard of practice. In addition, we recommend effectively deepening the northern house footings adjacent to the moderately steep slopes along the north side of the proposed house footprint by constructing the footings on a 4-foot-deep concrete bearing pad, to achieve adequate stability.

5.3 Seismic Hazards

Based on our review of the City of Mercer Island's Geologic Hazards Maps, the project site is mapped in a seismic hazard area. The City of Mercer Island Code defines seismic hazard areas as those areas subject to risk of damage as a result of earthquake-induced ground shaking, slope failure, soil liquefaction or surface faulting.

Based on our subsurface explorations, the site is underlain by primarily dense silty sand, and a static groundwater level was not encountered in the test borings. Based on these conditions, in our opinion the liquefaction potential of the soils underlying the site is low, and design considerations related to soil liquefaction are not necessary for this project.

It is also our opinion that the potential for significant deep-seated seismic-induced land sliding is low at the site due to the underlying dense sand. However, relatively shallow slides that could adversely affect the proposed development are possible during the design earthquake. As such, we have recommended measures to mitigate the risk of seismic slope instability impacting the proposed house. Provided the proposed project is designed and constructed in accordance with the recommendations in the report, the developed portion of the site should not be adversely affected during the code-level seismic event.

According to our review of the WA DNR Geologic Information portal, the closest mapped fault is described as a strand of the Seattle Fault, and is located about 1000 meters to the north of the project site. Based on the distance to the fault, in our opinion ground rupture is low at the project site.

6.0 SLOPE STABILITY

Due to the mapped geologic hazards at the site, as well as the steep slopes adjacent to the proposed residence, we performed a slope stability analysis to evaluate the stability of the proposed development. Our analysis was intended to evaluate if stabilizing measures would be needed to meet the current building code requirements.

6.1 Slope Stability Analysis

Our evaluation was based on our understanding of the subsurface conditions as described above, the topographic data derived from the topographic survey by Informed Land Survey, the results of our site reconnaissance, and our understanding of the planned improvements.

The stability of a slope depends on a variety of factors, including the geometry of the slope, the subsurface stratigraphy, material properties of the soils, the location of groundwater, and the effects of surface loads. Based on our understanding of the subsurface conditions at the site, the topography shown on Figure 2, and site features observed during our site reconnaissance, we developed generalized subsurface profiles through the site as shown on Figure 2, and presented in Figures 3, 4 and 5. We selected subsurface profile B-B' as the most critical section for our analyses.

Soil & Groundwater Parameters - Soil parameters utilized in the stability analyses are shown on the attached Figures 6 and 7. Soil parameters were selected based on observed soil types, the results of standard penetration tests performed in the test borings, the results of laboratory testing, published correlations for soil units in the Puget Sound Area, and our experience.

Groundwater was not included in our stability model, as none of the test borings encountered water.

Surcharge Loads – Estimated foundation surcharge loads were included in the model, as noted on Figures 6 and 7. The added mass of the recommended 4-foot-thick concrete bearing pad below the northern footings were also included as a surcharge load.

Analysis Method - We performed our slope stability analysis using the program SLIDE2 (Slide) published by Rocscience Inc. Slide is a two-dimensional limit equilibrium slope stability analysis program. Search routines were used to identify the potential circular and non-circular failure surface having the lowest static factor of safety using the Spencer method of analysis.

The seismic stability was analyzed using a pseudo-static approach, where the effect of earthquake ground shaking is added to the static analysis in the form of an additional horizontal force. The seismic coefficient used in the pseudo-static stability analysis shall correspond to some fraction of the anticipated peak ground acceleration associated with a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years). Based on the current IBC, a seismic coefficient of 0.373g was used for this project, which corresponds to one-half of the expected peak PGA_M of 0.745g.

6.2 STABILITY ANALYSIS RESULTS

The City of Mercer Island Building Code states that, *Alteration of landslide hazard areas and seismic hazard areas and associated buffers may occur if the critical area study documents find that the proposed alteration (a) Will not adversely impact other critical areas; (b) Will not* *adversely impact the subject property or adjacent properties; (c) Will mitigate impacts to the geologically hazardous area consistent with best available science to the maximum extent reasonably possible such that the site is determined to be safe; and (d) Includes the landscaping of all disturbed areas outside of building footprints and installation of hardscape prior to final inspection.* In our opinion, to meet criteria (c) above, the static and seismic factors of safety against global instability of 1.5 and 1.1, respectively, should be achieved, to be consistent with the local standard of practice.

As such, to determine if the proposed development on the slope will have an acceptable factor of safety in accordance with the criteria stated above, we evaluated the stability of the proposed condition and found that the factor of safety against global instability did not meet the requirements of 1.1 for the seismic condition. As such, we recommend that mitigating measures be incorporated into the proposed project to adequately stabilize and protect the developed area of the site in accordance with the current building code.

6.3 Recommended Stabilizing Measures

South Wall Foundation of House: To improve the stability of the site and provide adequate factors of safety against future instability of the developed portion of the site, we recommend that a stabilizing wall be constructed along the south side of the proposed house. In our opinion, a feasible wall type consists of drilled soldier piles (steel beams inserted into concrete shafts) with a minimum diameter of 24-inches, and a minimum spacing of 6 feet on-center. As shown in the attached Figures 6A and 6B, if the stabilizing piles have a minimum embedment of 20 feet below the house foundation, or approximately a tip elevation of 172.5 feet (NAVD88), the developed area will exceed the required factor of safety of 1.5 and 1.1 for the static and seismic condition, respectively. Our analysis assumed that each pile, spaced 6-foot on-center, has an allowable shear capacity of 120 kips. See *Section 7.5 Stabilization Piles* for additional discussion and details. As described below, we recommend that the stabilizing soldier piles be designed for an exposed face of 6 feet below the foundation subgrade elevation to account for erosion and/or future slope movements downslope of the wall, particularly during the code-level seismic event. The piles may be extended up to the existing ground surface to serve as temporary shoring to reduce the amount of earthwork associated with open cut excavations.

North Wall Foundation & North and South Site Walls: Along the north side of the house, our analysis indicated that the house footings need to be embedded four feet below the currently designed bottom of footing elevation. In our opinion, a feasible alternative to deepening the footings is to construct the house footings on a 4-foot block of lean-mix concrete to effectively deepen the footing. Figures 7A and 7B depict the proposed deepened footing along the north side of the house, and the associated adequate factors of safety for the static and seismic condition. We recommend the same 4-foot-deep lean-mix bearing pad be installed below all site retaining walls along the north and south sides of the developed area that are adjacent to the steep slopes.

6.4 Stability Risks and Qualifications

Based on the results of our study, it is our opinion that the proposed building and site improvements as planned will have adequate factors of safety against potential future slope instability and will not have adverse impacts on the subject and surrounding properties, provided the project is properly designed and constructed. However, it should be noted that any development on or near a steep slope or a potential landslide area always involves some level of risk. In addition, future activities on and off the site could also affect the stability of the subject site. This may include but is not limited to the proper maintenance of surface drainage, and adequate protection of the side slopes from erosion.

7.0 GEOTECHNICAL RECOMMENDATIONS

7.1 Seismic Design Considerations

7.1.1 Site Class

We understand that the project will be designed in accordance with the 2021 edition of the International Building Code (IBC), and ASCE 7-16, which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years). For design purposes, Site Class C (very dense soil and soft rock) is considered appropriate for the seismic design of the project.

7.1.2 Liquefaction

Liquefaction is a process that can occur when soil loses its shear strength for short periods of time during a seismic event. Ground shaking of sufficient strength and duration results 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, predominately silt and sand sized, must be loose to medium dense, and be below the groundwater table.

Based on our subsurface explorations, the site is underlain by primarily dense silty sand, and a static groundwater level was not encountered in the test borings. Based on these conditions, in our opinion the liquefaction potential of the soils underlying the site is low, and design considerations related to soil liquefaction are not necessary for this project.

7.2 FOUNDATION RECOMMENDATIONS

Based on the results of our test borings and our understanding of the project design, we anticipate that the building footings will bear on competent native soils. The following sections present our design recommendations for conventional footings.

7.2.1 Conventional Footings

Footings should bear on the undisturbed native medium dense to dense or hard soils, or on properly compacted structural fill placed on the undisturbed competent native soils. Footing locations that encounter unanticipated areas of fills or disturbed, loose soils, should be over-excavated to expose undisturbed medium dense to dense native soil, and backfilled with properly compacted structural fill, or lean-mix concrete, as described below.

7.2.2 Over-excavation & Replacement

Any over-excavation should be backfilled with lean-mix concrete (1½ sack of cement per cubic yard, minimum) or properly compacted structural fill, such as 1¼-inch minus crushed rock, or approved equivalent. If lean-mix is used, the over-excavation should extend horizontally at least one-half foot beyond the edges of the footings. If structural fill is utilized, the fill should extend horizontally out from the edges of the footing a distance equal to one-half of the over-excavation depth. As such, to limit the amount of earthwork, if over-excavations more than about 3 feet are required, we recommend lean-mix be used as backfill.

Required 4-foot Over-Excavation for Stability – As described above in *Section 6.3*, we recommend that the northern house footings, and all other site walls that run along the north and south sides of the house, adjacent to steep slopes, be constructed on a 4-foot-deep block of lean-mix concrete (1½-sack of cement per cubic yard, minimum). The lean-mix should extend a minimum of 6 inches wider than the footing on all sides.

7.2.3 Allowable Bearing Pressure

A maximum allowable soil bearing pressure of 3,000 pounds per square foot may be used to size footings bearing on the undisturbed medium dense to dense native soils, or structural fill or lean mix placed over the native soils. For allowable stress design, the recommended allowable bearing pressure may be increased by one-third for transient loading conditions such as those due to wind and/or seismic forces. For frost protection considerations, footings should be placed at least 18 inches below adjacent finished grade.

7.2.4 Lateral Resistance

Lateral loads acting on footings may be resisted by passive earth pressure developed against the embedded portion of the footings and by frictional resistance developed at the base of the footings.

- An allowable frictional coefficient of 0.4 may be used to evaluate sliding resistance.
- An allowable passive soil resistance may be calculated using an equivalent fluid pressure of 300 pcf, assuming the footings are backfilled with 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 geotechnical factor of safety of 1.5.

7.2.5 Footing Drains

Footing drains should be installed around the perimeter of the building, at or just below the bottom of the footings. Under no circumstances should roof downspout drain lines be connected to the footing drain systems. Roof downspouts must be separately tightlined to appropriate discharge locations, and away from steep slope areas. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems.

7.2.6 Footing Subgrade Preparation

Footing subgrades should be carefully prepared and should not contain loose, soft, or disturbed soils. The adequacy of footing subgrades should be verified by a representative of PanGEO prior to placing forms or rebar. The footing subgrades should be in a dense and unyielding condition prior to pouring concrete.

Please note that the site soils are moderately to highly moisture sensitive and can become disturbed and softened when exposed to moisture and construction traffic. Sandy soils with low fines content are also vulnerable to disturbance by general foot traffic. Protection of the foundation bearing soils should be the responsibility of the contractor.

7.2.7 Foundation Performance

Total and differential settlements are anticipated to be within tolerable limits for footings designed and constructed as discussed above. Footing settlement under static loading conditions is estimated to be about ½-inch, and differential settlement across the structure should be about ½-inch or less. Most settlement will be realized during construction as the dead loads are applied.

7.3 FLOOR SLABS

7.3.1 Concrete Slab-on-grade

A slab-on-grade may be used for the lowest level floors of the proposed building. In general, we anticipate that medium dense or very stiff to hard native soil will be encountered at excavation level. Care should be taken to avoid disturbing the sandy silt or silty sand subgrade. Any areas that become disturbed, or areas that are found to be disturbed by previous grading activities or other circumstance, should be over-excavated and replaced with properly compacted structural fill.

We recommend that construction joints be incorporated into the floor slab to control cracking.

7.3.2 Capillary Break

Floor slabs should be placed over a layer of capillary break material to reduce the potential of moisture passing through the slab. The capillary break material should consist of at least 4 inches of free-draining, clean (less than 3 percent fines) crushed rock compacted to a firm and unyielding condition. The capillary break material should have no more than 10 percent and 5 percent by weight of material passing the U.S. Standard No. 4 and No. 100 sieves, respectively. We also recommend that a 10-mil polyethylene vapor barrier be placed below the slab.

7.4 RETAINING AND BELOW-GRADE WALLS

Free standing retaining walls and below-grade foundation walls should be properly designed to resist the lateral earth pressures exerted by the soils behind the walls. The current design includes basement walls and concrete cantilever walls along the north and south side of the developed area that appear to be up to about 8 feet tall.

Proper drainage provisions should be provided behind the walls to intercept and remove groundwater that may be present behind the wall. Our geotechnical recommendations for the design and construction of the retaining and below-grade walls are presented in the sections below.

7.4.1 Concrete Wall Foundation Support

The footing recommendations outlined in *Section 7.2* of this report are also applicable for the walls. For walls along the north and south sides of the developed area, in close proximity to the steep slopes, see *Section 7.2.1.1* for over-excavation and placement of a lean-mix bearing pad below the wall footings.

7.4.2 Lateral Earth Pressures

Cantilever walls should be designed for an equivalent fluid pressure of 35 pcf for level backfills behind the walls, assuming the walls are free to rotate. If walls are to be restrained at the top from free movement, such as basement walls, equivalent fluid pressures of 50 pcf should be used for level backfills behind the walls. Walls with a maximum 2H:1V backslope should be designed for an active and at rest earth pressure of 50 and 65 pcf, respectively. The recommended lateral pressures assume that the backfill behind the wall consists of free draining and properly compacted fill with adequate drainage provisions to prevent the development of hydrostatic pressure.

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

7.4.3 Wall Surcharge

The retaining and basement walls should be designed to resist surcharge pressures, if present, within the height dimension of the wall. As a minimum, for anticipated cars and delivery vans, the traffic surcharge may be considered as 90 psf of horizontal uniform pressure. Similarly, surcharge loads from construction equipment or soil/material stockpiles should be considered in the retaining and basement wall design during construction. We recommend that Figure 8 be used to calculate the lateral pressure on the face of the wall face resulting from surcharge loading.

7.4.4 Lateral Resistance

Lateral forces from wind or seismic loading and unbalanced lateral earth pressures may be resisted by a combination of passive earth pressures acting against the embedded portions of the foundation, and by friction acting on the base of the footings. Passive resistance values may be determined using an equivalent fluid weight of 300 pounds per cubic foot (pcf). This value includes a safety factor of about 1.5 assuming that properly compacted granular fill will be placed adjacent to the footings and level ground surface. If there is a slope descending below the wall, the passive pressure will be significantly reduced, and PanGEO can provide an acceptable value based on the specific geometry and soil conditions at the wall location. An allowable frictional coefficient of 0.4 may be used to evaluate sliding resistance at the base of a footing. This value includes a geotechnical factor of safety of 1.5.

7.4.5 Wall Drainage

Provisions for permanent control of subsurface water should be incorporated into the design and construction of the below-grade walls. As a minimum, 4-inch diameter perforated drainpipes should be installed behind and at the base of the wall footings, embedded in 12 to 18 inches of crushed rock or washed gravel. The gravel should be wrapped in a geotextile filter fabric to prevent the migration of fines into the drain system. The drainpipe should be graded to direct water to a suitable outlet, and away from any steep slopes.

Under no circumstances should roof downspout drain lines be connected to the perforated footing/wall drain systems for basement walls. Roof downspouts must be separately tightlined to appropriate discharge locations. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems.

7.4.6 Wall Backfill

In our opinion, the on-site excavated soils are not suitable for use as wall backfill. We recommend that wall backfill should consist of free draining granular structural fill as defined in *Section 8.3* of this report.

Wall backfill 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 (Modified Proctor). Within 5 feet of the wall, the backfill should be compacted with hand-operated equipment to at least 90 percent of the maximum dry density.

7.4.7 Damp-proofing/Waterproofing

We recommend the designers consider utilizing a waterproofing material, such as prefabricated clay mats, or other measures, on the exterior of all below grade foundation walls to reduce the potential for moisture intrusion into the below-grade portion of the homes. We recommend that a waterproofing or building envelope specialty consultant be retained to provide details regarding waterproofing measures, as waterproofing is beyond the scope of our work.

7.5 Soldier Pile Stabilizing Wall

To adequately stabilize the developed portion of the site, as described above, we recommend the installation of soldier pile stabilizing piles along the south, downslope side of the house.

Minimum Pile Size and Spacing - To evaluate the minimum depth of embedment needed to provide adequate stabilization of the developed area, we performed slope stability analyses using limit-equilibrium methods for both static and seismic loading conditions. Based on the results of our analyses, the soldier piles along the south (downslope) side of the developed area should have a minimum hole diameter of 24 inches, a center-to-center spacing of 6 feet or less, and a minimum embedment below the bottom of the house foundation of 20 feet, which is equivalent to a minimum tip elevation of +172.2 feet, or deeper as determined by structural analysis. The piles should have a minimum shear capacity of 120 kips.

As described above, we recommend that the stabilizing soldier piles be designed for an exposed face of 6 feet to account for erosion and/or future slope movements downslope of the wall, particularly during the code-level seismic event.

Design Earth Pressures - The recommended earth pressures depicted on Figure 9 should be used for design of the stabilizing piles, which will function as a cantilevered wall after a potential slide.

Above the bottom of excavation, the recommended active earth pressure should be applied over the full width of the pile spacing. Below the bottom of excavation, the passive resistance should be applied over two times the pile diameter, and the active pressure applied over one single pile diameter.

Because the soldier pile wall is permanent, we recommended a seismic pressure of 9H (psf) be included in the pile design, where H is the exposed design height of the wall in feet.

The footing surcharge pressure behind the piles should be included in the analysis of the piles in the cantilevered condition. Figure 8 may be used to calculate the footing surcharge pressure.

***Vertical Capacity* –** Soldier piles may be designed using an allowable skin friction value of 1.0 ksf for the portion of the pile below the bottom of the potential exposed height of the pile, and an allowable end bearing value of 40 ksf.

***Corrosion Protection* –** Since the soldier pile wall will be utilized as a permanent stabilizing wall, all potentially exposed portions of the steel beams should be galvanized or coated with corrosion protection. The corrosion protection should extend at least 2 feet below the potentially exposed portion of the wall, which is equal to 2 feet more than the 6-foot design height of the wall. Alternatively, the steel section should be over-sized to account for corrosion.

Lagging – In our opinion lagging the wall below the elevation of the house foundation is not required. If a slide were to occur in the future, we anticipate soil arching between the piles spaced at 6 feet on-center will prevent significant soil loss between the piles. If this occurred, lagging would be added and backfilled to repair the wall. However, if the wall is utilized for temporary shoring, lagging will be needed above the bottom of the excavation.

Lagging design recommendations for the anticipated conditions are presented on Figure 9. Lagging, if included in the design, may consist of materials such as timber boards, cast-in-place concrete, precast concrete panels, or steel sheets. For the permanent condition, if timber lagging is utilized, treated timber should be specified, and the saw cut ends of the lagging should be treated on-site prior to lagging installation. It should be noted that even treated timber lagging will eventually deteriorate, and would need to be replaced. The lifespan on treated timber lagging may range from 15 to 25 years. The advantage of concrete or steel lagging is that they would be permanent.

7.6 Permanent Cut and Fill Slopes

Based on the anticipated soil that will be exposed at the site, we recommend permanent cut and fill slopes, if any, be constructed no steeper than 2H:1V (Horizontal:Vertical). Any proposed permanent slopes with a relief of more than 8 feet should be evaluated by PanGEO on a case-by-case basis.

Cut slopes should be observed by PanGEO during excavation to verify that conditions are as anticipated. Supplementary recommendations can then be developed, if needed, to improve stability. Fill slopes must consist of properly placed and compacted structural fill, with careful compaction out to the slope face. Proper compaction may require the need to over-build the slope and then cut it back to the desired final condition. All fill must be placed on horizontal benches, and adequately keyed into the native soil. If fill slopes are proposed, PanGEO will need to assist the design team by providing specific recommendations for the fill slope proposed.

Permanently exposed slopes should be treated with permanent erosion control measures as soon as possible to improve stability of the surficial layer of soil.

7.7 Permanent Drainage

Permanent control of surface water and roof runoff should be incorporated in the final grading design. In addition to these sources, irrigation and rainwater infiltrating into landscape and planter areas adjacent to paved areas or building walls should also be controlled. All collected runoff should be directed into conduits that carry the water away from the pavement, structure, and steep slopes, and into appropriate outlets. Adequate surface gradients should be incorporated into the grading design such that surface runoff is directed away from structures and steep slope.

Under no circumstances should collected surface water or downspout drains be allowed to discharge onto open slopes or behind walls. Furthermore, it is important to note that roof downspouts should be tightlined to a suitable outlet, and not discharged into the wall or perimeter footing drain system.

7.8 Permanent Erosion Control Considerations

Permanent erosion control measures such as covering exposed ground surfaces with topsoil or mulch, and installing landscaping, should be performed as soon as possible after construction to limit the time the exposed surfaces are susceptible to erosion.

8.0 CONSTRUCTION CONSIDERATIONS

8.1 SITE PREPARATION

Site preparation for the proposed project includes clearing, grubbing, and excavations to the design subgrade. All stripped surface materials should be properly disposed of off-site.

Following site 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 be over-excavated and replaced with compacted structural fill.

8.2 MATERIAL REUSE

The soils at the site are moisture sensitive and will become disturbed / soft when exposed to inclement weather conditions. In our opinion, the on-site soils are not suitable to be reused as structural fill. In the context of this report, structural fill is defined as compacted fill placed under footings, pavements, concrete stairs, landings, and slabs, or other load-bearing areas. Material for use as structural fill is described in the following section.

The on-site soil may potentially be used as general fill in the non-structural and landscaping areas. If use of the on-site soil is planned, the excavated soil should be stockpiled and protected with plastic sheeting to prevent softening from rainfall in the wet season.

8.3 STRUCTURAL FILL PLACEMENT AND COMPACTION

For planning purposes, structural fill should consist of imported, well-graded, granular material such as Seattle Type 17 Mineral Aggregate (*COS Standards and Specifications, 2023, Section 9-03.14*), WSDOT Gravel Borrow (*WSDOT Standards and Specifications, 2025, Section 9-03.14(1)*), or an approved equivalent.

Structural fill should be moisture conditioned near its optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and systematically compacted to a dense and relatively unyielding condition. The adequacy of the compaction should be verified by PanGEO. If density tests are performed, the test results should indicate at least 95 percent of the maximum dry density, as determined using test method ASTM D1557 (modified proctor). For utility backfill or backfill within 5 feet of retaining walls, the backfill should be compacted to at least 90 percent of the maximum dry density.

The procedure to achieve proper density of a compacted fill depends on the size and type of compacting equipment, the number of passes, thickness of the lifts being compacted, and certain soil properties. We recommend that structural fill supporting foundations be compacted with jumping jack compactors at a minimum. If the excavation to be backfilled is constricted and limits the use of heavy equipment, smaller equipment can be used, but the lift thickness will need to be reduced to achieve the required relative compaction. PanGEO can provide additional recommendations regarding structural fill and compaction during construction.

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

8.4 TEMPORARY EXCAVATIONS

8.4.1 Temporary Open Cuts

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. All temporary excavations deeper than a total of 4 feet should be sloped or shored. Temporary excavations less than 4 feet along the property lines should also be sloped or shored.

For planning purposes, we recommend that temporary excavations be sloped no steeper than 1H:1V (Horizontal:Vertical). If temporary excavations are not in the fill, but in the dense native soil, steeper excavations may be feasible, based on PanGEO's field observations and the configuration of the excavations.

The temporary excavations and cut slopes should be re-evaluated in the field during construction based on actual observed soil conditions. If groundwater seepage is encountered, the temporary slope will likely need to be cut to shallower angles to maintain stability, or require shoring. During wet weather, runoff water should be prevented from entering excavations and the exposed slopes should be covered with plastic sheets.

8.4.2 Temporary Shoring

Based on currently available plans, temporary shoring is not presently planned for. However, the stabilizing soldier pile wall may be extended up to the existing ground surface to serve as a temporary shoring wall. Future plans, especially for facilities such as stormwater retention facilities, may require temporary shoring in the form of trench boxes or similar systems.

8.4.3 Groundwater Impacts

Groundwater was not encountered in the borings, and we do not anticipate groundwater to impact construction on this site. However, thin water-bearing lenses could be encountered, especially if construction proceeds during wet winter months. We anticipate such impacts should be relatively minimal, but contractors should be prepared to control any groundwater as needed with sumps and pumps.

8.4.4 Surcharge Avoidance

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.

8.5 TEMPORARY EROSION AND DRAINAGE CONSIDERATIONS

We recommend that the exposed temporary slopes be covered with plastic sheeting.

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 prevent water from entering excavations or to prevent turbid runoff from leaving the 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, especially on steep slope sides, 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 an appropriate / approve discharge point or outlet.

While we do not anticipate groundwater impacts, we recommend that the contractor should be prepared to provide temporary groundwater control methods, especially if excavation is conducted in the wet season. If present, we anticipate that the groundwater can likely be controlled with sumps and pumps.

8.6 Soldier Pile Installation Considerations

The drilling of soldier piles is anticipated to encounter several feet of fill over hard silt and clay, which is underlain by medium dense to dense fine to medium sand with some silt. It is important to note that caving of the surficial soils is possible, especially if zones of seepage are encountered. The contractor should be prepared to temporarily case the holes to maintain stability during drilling. Caving in the underlying clean sand is also possible.

We recommend that the following should be incorporated into the project plans and specifications:

- The geotechnical engineer shall verify the suitability of all soldier pile holes before concrete placement;
- Tremie methods shall be used for concrete placement in all holes having 6 or more inches of accumulated water if perched ground water or heavy precipitation is encountered during construction.
- All soldier pile holes drilled shall be filled with lean concrete mix or structural concrete on the same day.
- If soldier piles are designed as a permanent foundation system, any soft/disturbed soils encountered at the bottom of the hole during drilling will need to be removed using a cleanout bucket prior to placing the steel beam and concrete.
- Caving in fill, or wet sand/silty sand layers could occur during drilling. As a result, the drilling contractor should be prepared to stabilize the holes by using temporary casings, hydrostatic pressures (i.e., flooding the hole), or drilling fluids.

8.7 Wet Earthwork Recommendations

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

- All surfaces of the foundation subgrade should be protected against inclement weather. It is the contractor's responsibility to protect the footing subgrade from disturbance. One option is to place a 2- to 3-inch-thick layer of lean-mix concrete or 3 to 4 inches of clean crushed rock on the footing 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.

- 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.

9.0 ADDITIONAL SERVICES

We anticipate the City of Mercer Island will require a plan review and geotechnical special inspections to confirm that our recommendations are properly incorporated into the design and construction of the proposed project. Specifically, we anticipate that the following construction support services may be needed:

- Review final project plans and specifications;
- Verify implementation of erosion control measures;
- Observe the stability of open cut slopes;
- Monitor soldier pile installations;
- Verify footing subgrades;
- Confirm the adequacy of the compaction of structural backfill;
- Observe installation of subsurface drainage provisions, and;
- Other consultation as may be required during construction.

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 Citizen Design 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 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.

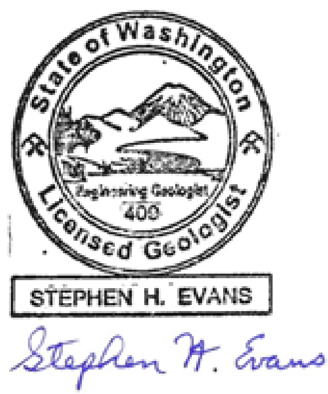
It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.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

Within the limitation of scope, schedule and budget, PanGEO engages in the practice of geotechnical engineering and endeavors to perform its services in accordance with generally accepted professional principles and practices at the time the Report or its contents were prepared. No warranty, express or implied, is made.

We appreciate the opportunity to be of service to you on this project. Please feel free to contact our office with any questions you have regarding our study, this report, or any geotechnical engineering related project issues.

Sincerely,

PanGEO, Inc.



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11.0 REFERENCES

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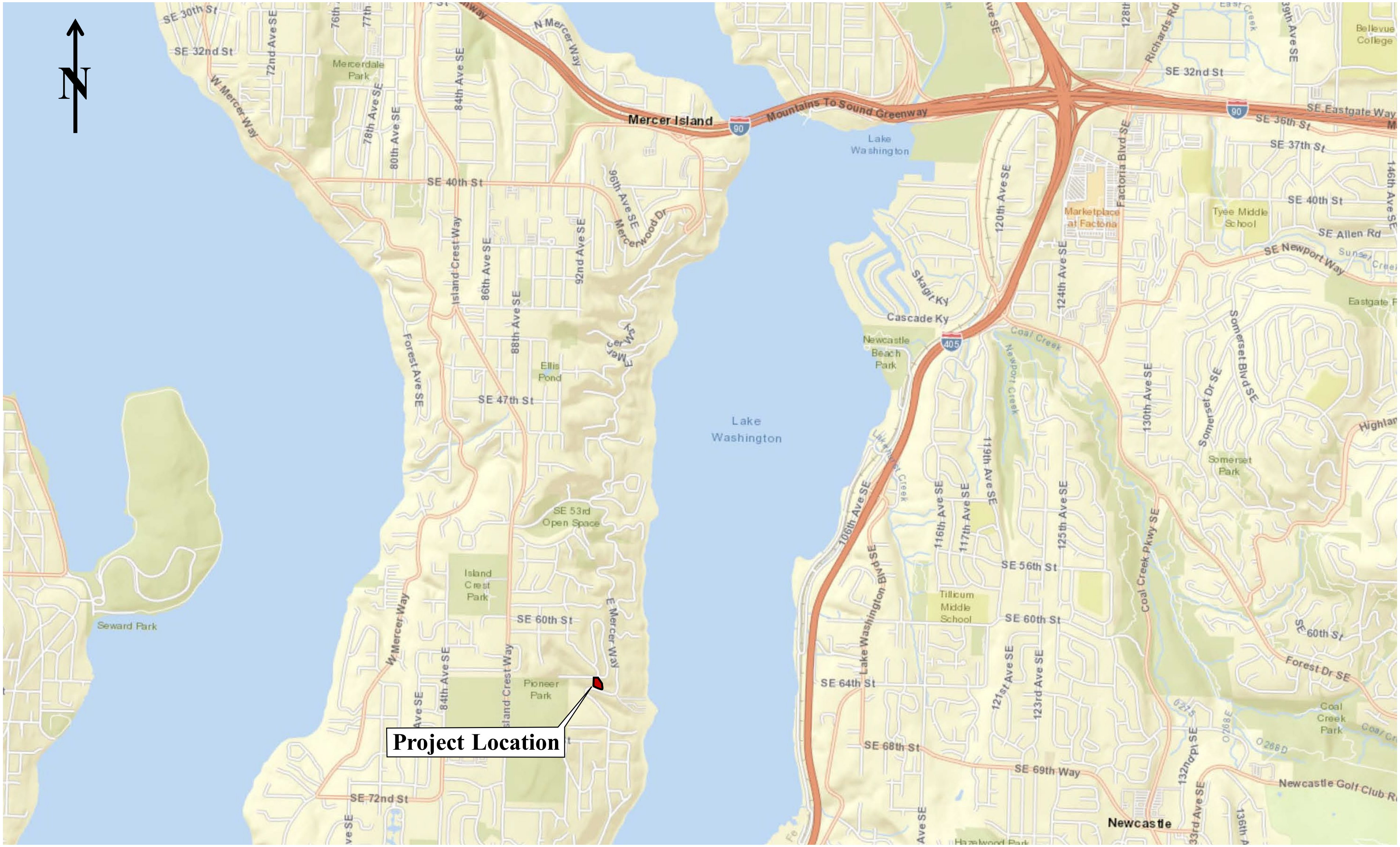


Map not to Scale
Base Map from
Dept of Natural
Resources Geological
Information Portal

PanGEO INCORPORATED

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

VICINITY MAP

Project No.	Figure No.
25-036.200	1

LEGEND:

Approximate Boring Locations

PanGEO, Inc, March 2019, (PG-4-19) and July 2025 (PG-1-25)

Subsurface Profiles (see Figures 3 to 5)

Notes:

1. Topographic Survey by Informed Land Survey.
2. Assumed Vertical Datum NAVD 88.

Approximate Scale 1" = 30'

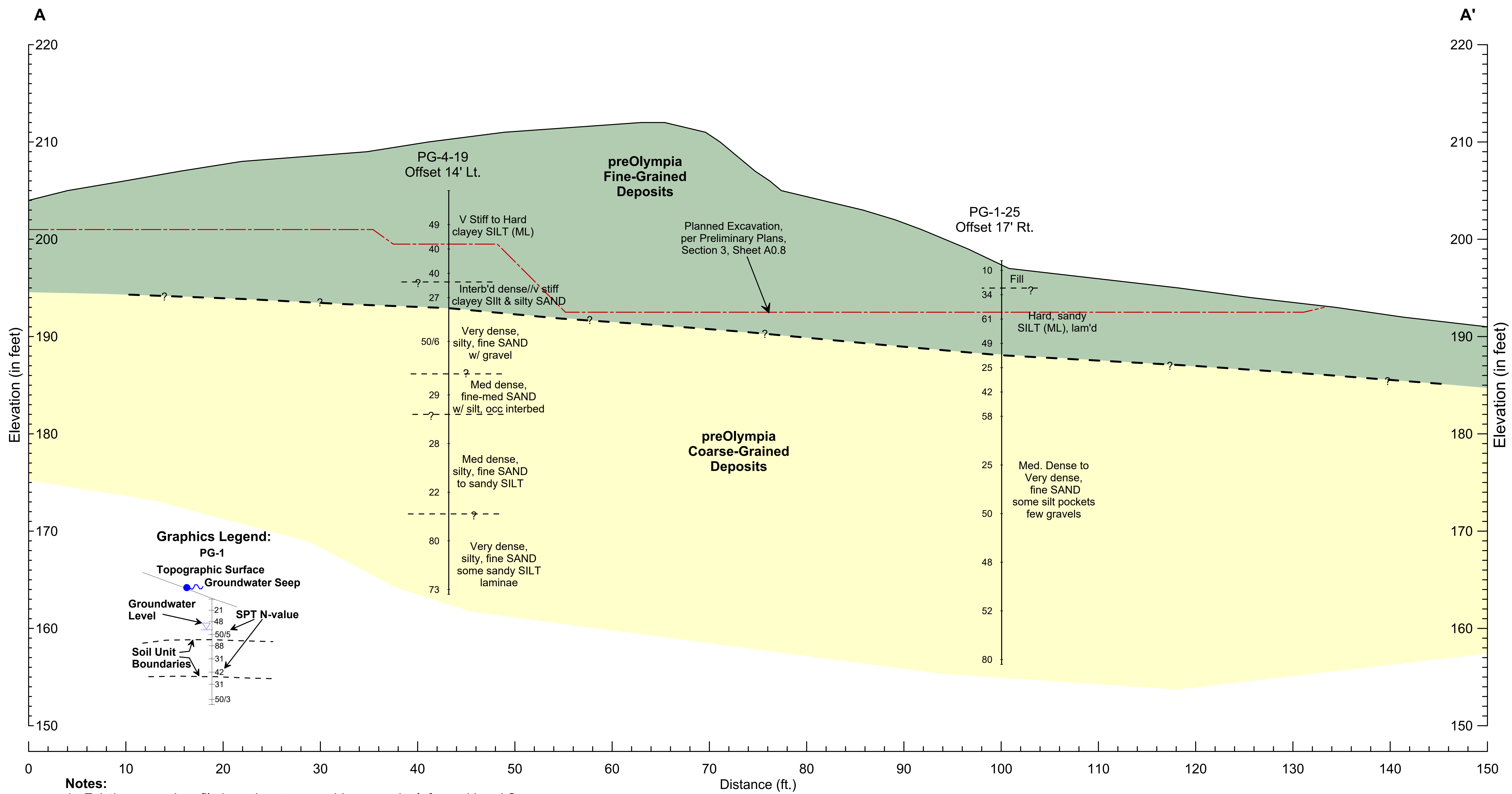
PanGEO INCORPORATED

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

SITE AND EXPLORATION PLAN

Project No.	Figure No.
25-036.200	2

25-036 Site Plan.ppt 8/27/2025(10:12 AM) SHE



Notes:

1. Existing ground profile based on topographic survey by Informed Land Survey.
2. Transitions between soil units and in between explorations are best estimates and may vary from the actual soil conditions.
3. See report text for detailed descriptions of subsurface conditions across site.
4. See Appendix A for detailed exploration logs.
5. See Figure 2 for Site Plan with approximate profile location.
6. Planned Cut Elevations from Sheets A0.7 and A0.8, MI 6429 Lot A Schematic 25.0523.pdf design drawing.
7. Vertical Datum assumed to be NAVD88.

PanGEO INCORPORATED

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

GENERALIZED SUBSURFACE PROFILE - SECTION A-A'

Project No.	Figure No.
25-036.200	3

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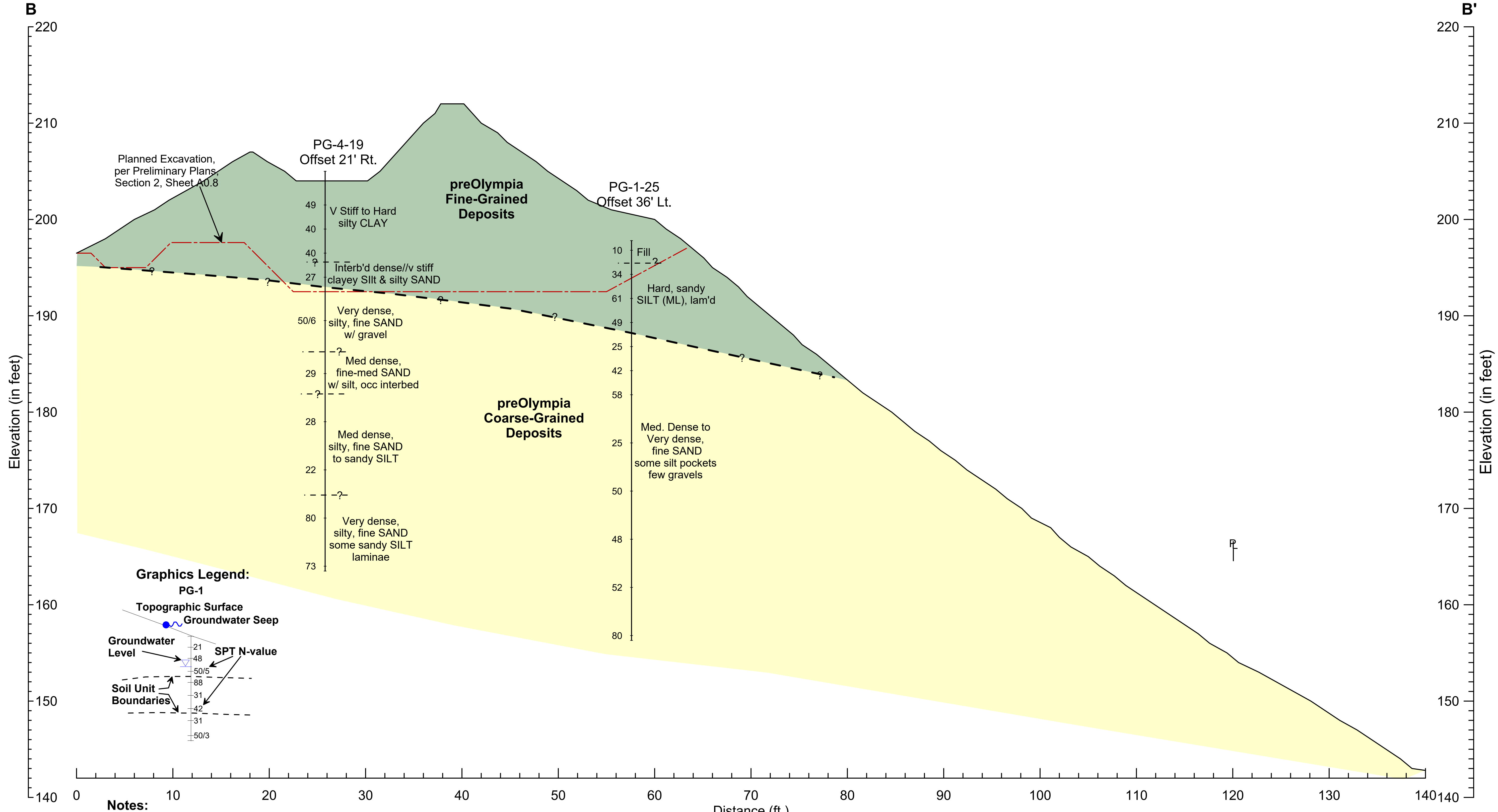

Notes:

1. Existing ground profile based on topographic survey by Informed Land Survey.
2. Transitions between soil units and in between explorations are best estimates and may vary from the actual soil conditions.
3. See report text for detailed descriptions of subsurface conditions across site.
4. See Appendix A for detailed exploration logs.
5. See Figure 2 for Site Plan with approximate profile location.
6. Planned Cut Elevations from Sheets A0.7 and A0.8, MI 6429 Lot A Schematic 25.0523.pdf design drawing.
7. Vertical Datum assumed to be NAVD88.

PanGEO INCORPORATED	Proposed Single Family Residence 9191 SE 64th Street Mercer Island, Washington	GENERALIZED SUBSURFACE PROFILE SECTION B-B'
		Project No. 25-036.200 / Figure No. 4

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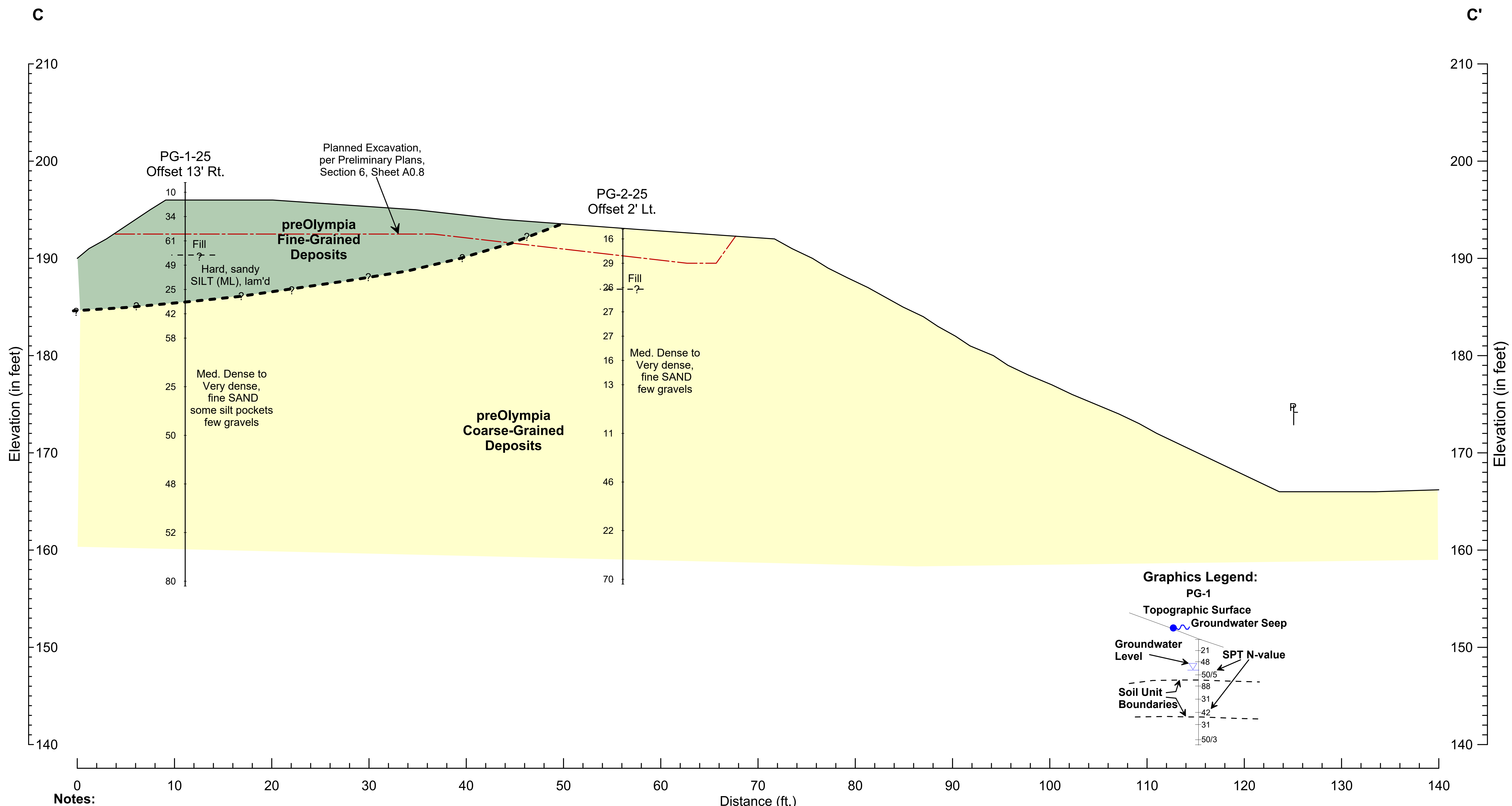
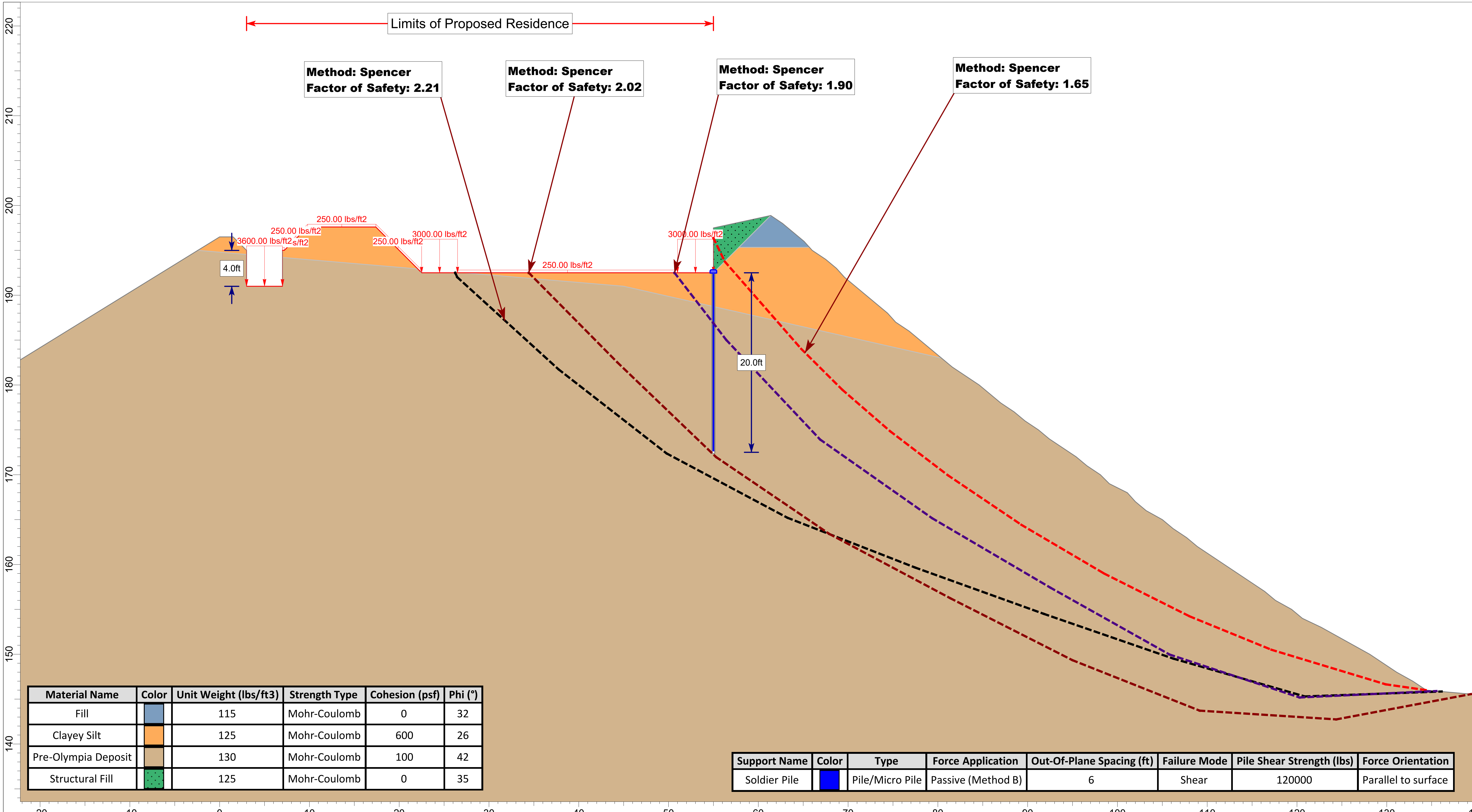


Notes:
1. Existing ground profile based on topographic survey by Informed Land Survey.
2. Transitions between soil units and in between explorations are best estimates and may vary from the actual soil conditions.
3. See report text for detailed descriptions of subsurface conditions across site.
4. See Appendix A for detailed exploration logs.
5. See Figure 2 for Site Plan with approximate profile location.
6. Planned Cut Elevations from Sheets A0.7 and A0.8, MI 6429 Lot A Schematic 25.0523.pdf design drawing.
7. Vertical Datum assumed to be NAVD88.

PanGEO INCORPORATED	Proposed Single Family Residence 9191 SE 64th Street Mercer Island, Washington	GENERALIZED SUBSURFACE PROFILE SECTION C-C'	
		Project No. 25-036.200	Figure No. 5

25-036 Stick Log and Profile Data.xls 8/28/25 (8:16:36) SHE



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill		115	Mohr-Coulomb	0	32
Clayey Silt		125	Mohr-Coulomb	600	26
Pre-Olympia Deposit		130	Mohr-Coulomb	100	42
Structural Fill		125	Mohr-Coulomb	0	35

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
Soldier Pile		Pile/Micro Pile	Passive (Method B)	6	Shear	120000	Parallel to surface

PanGEO INCORPORATED

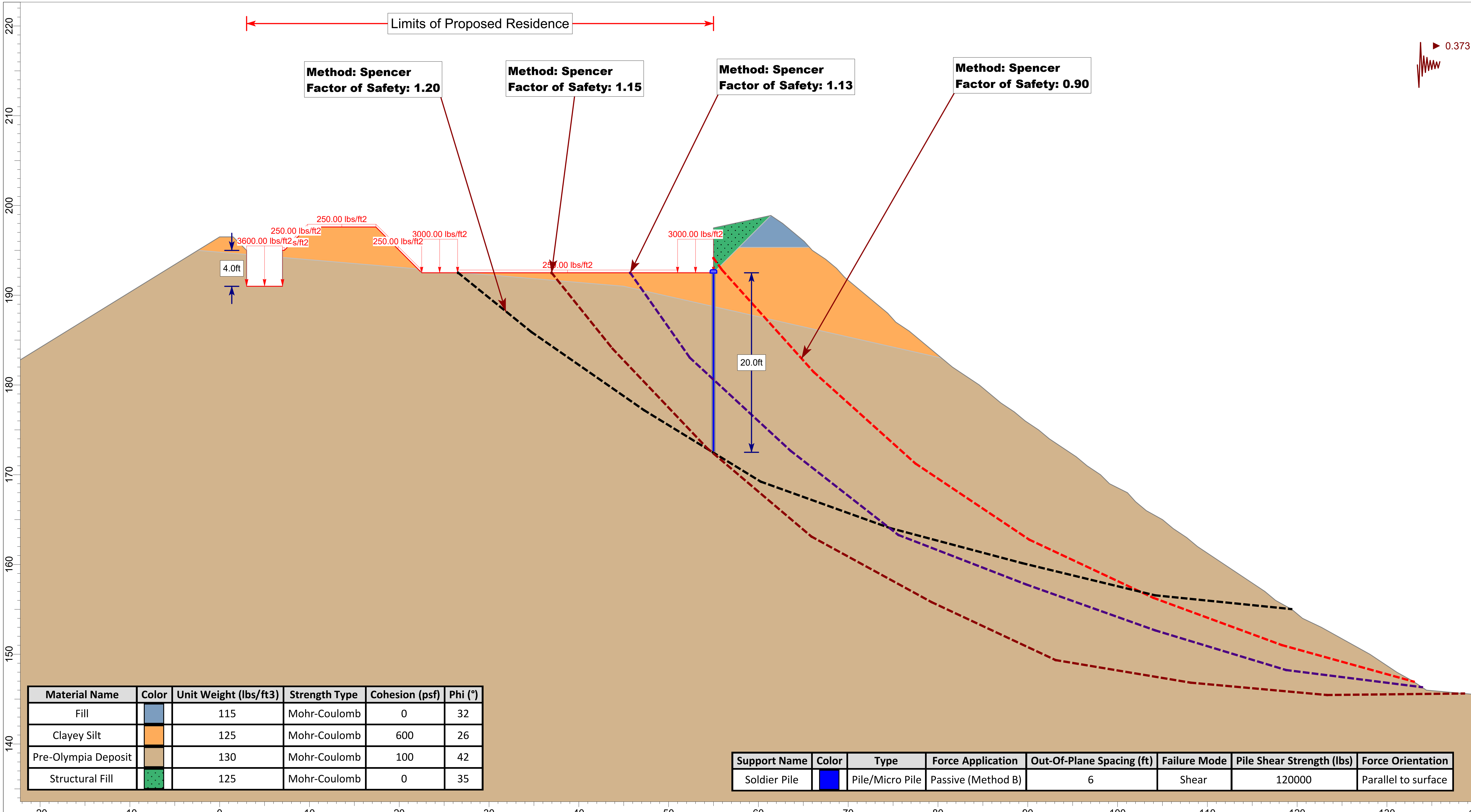
SLIDEINTERPRET 9.036

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

Static Slope Stability Analysis (right)

Section B-B'

Scale:	Project No.	Figure No.
1:120	25-036.200	6A



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill		115	Mohr-Coulomb	0	32
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Pre-Olympia Deposit		130	Mohr-Coulomb	100	42
Structural Fill		125	Mohr-Coulomb	0	35

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
Soldier Pile		Pile/Micro Pile	Passive (Method B)	6	Shear	120000	Parallel to surface

PanGEO INCORPORATED

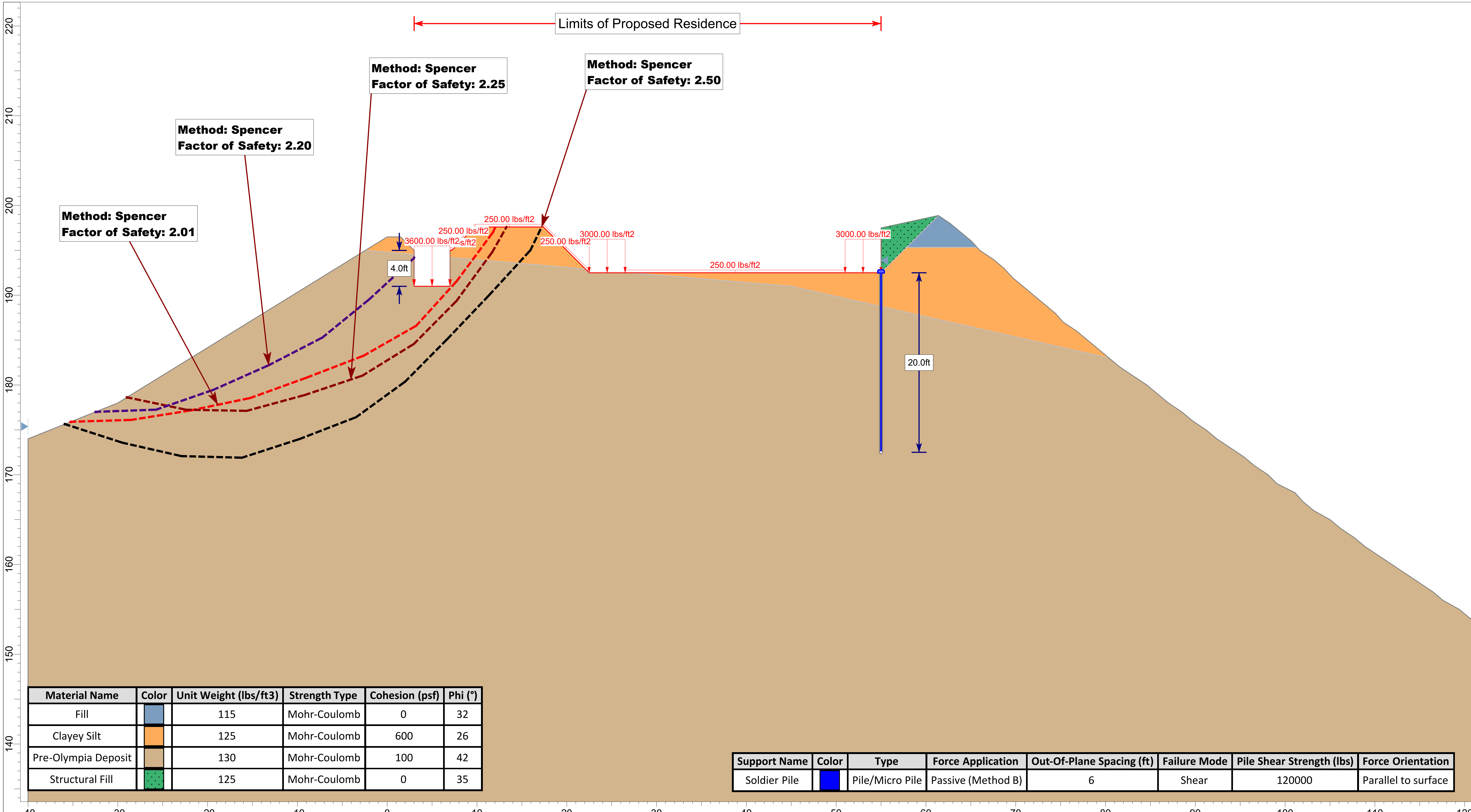
SLIDEINTERPRET 9.036

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

Pseudo Static Slope Stability Analysis (right)

Section B-B'

Scale:	Project No.	Figure No.
1:120	25-036.200	6B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill		115	Mohr-Coulomb	0	32
Clayey Silt		125	Mohr-Coulomb	600	26
Pre-Olympia Deposit		130	Mohr-Coulomb	100	42
Structural Fill		125	Mohr-Coulomb	0	35

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
Soldier Pile		Pile/Micro Pile	Passive (Method B)	6	Shear	120000	Parallel to surface

PanGEO INCORPORATED

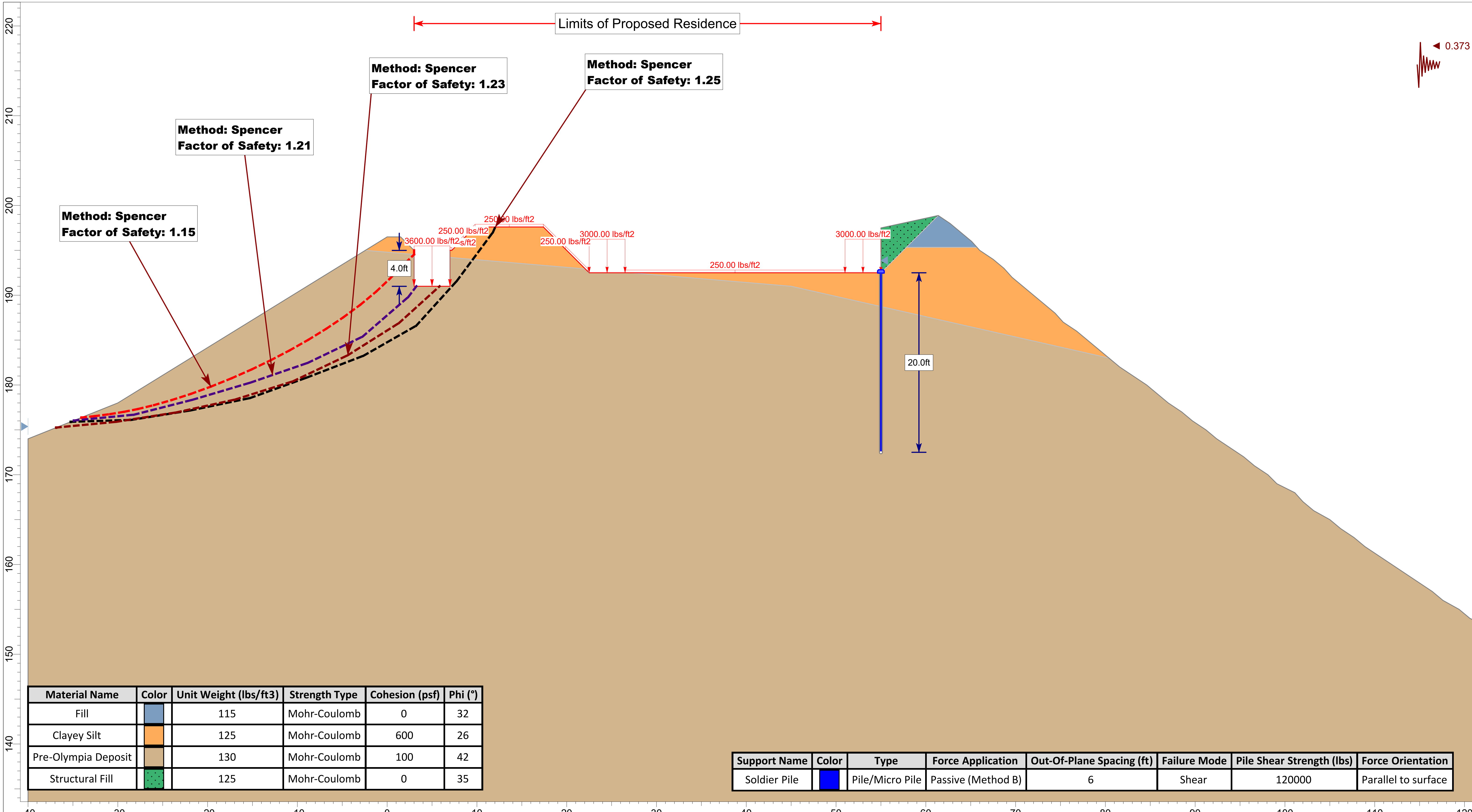
SLIDEINTERPRET 9.036

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

Static Slope Stability Analysis (left)

Section B-B'

Scale:	Project No.	Figure No.
1:120	25-036.200	7A



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Fill		115	Mohr-Coulomb	0	32
Clayey Silt		125	Mohr-Coulomb	600	26
Pre-Olympia Deposit		130	Mohr-Coulomb	100	42
Structural Fill		125	Mohr-Coulomb	0	35

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
Soldier Pile		Pile/Micro Pile	Passive (Method B)	6	Shear	120000	Parallel to surface

PanGEO INCORPORATED

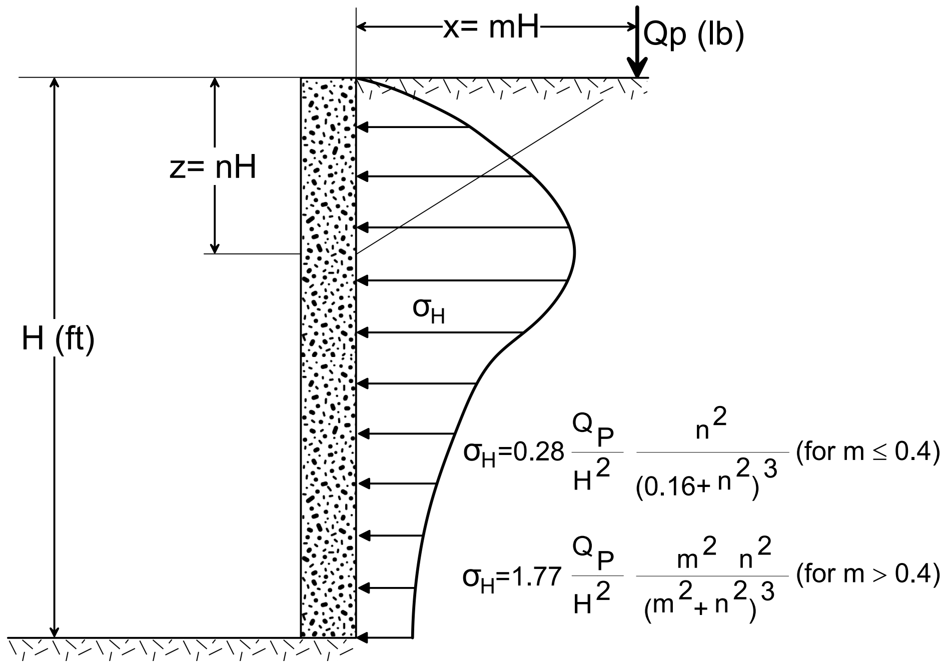
SLIDEINTERPRET 9.036

Proposed Single Family Residence
9191 SE 64th Street
Mercer Island, Washington

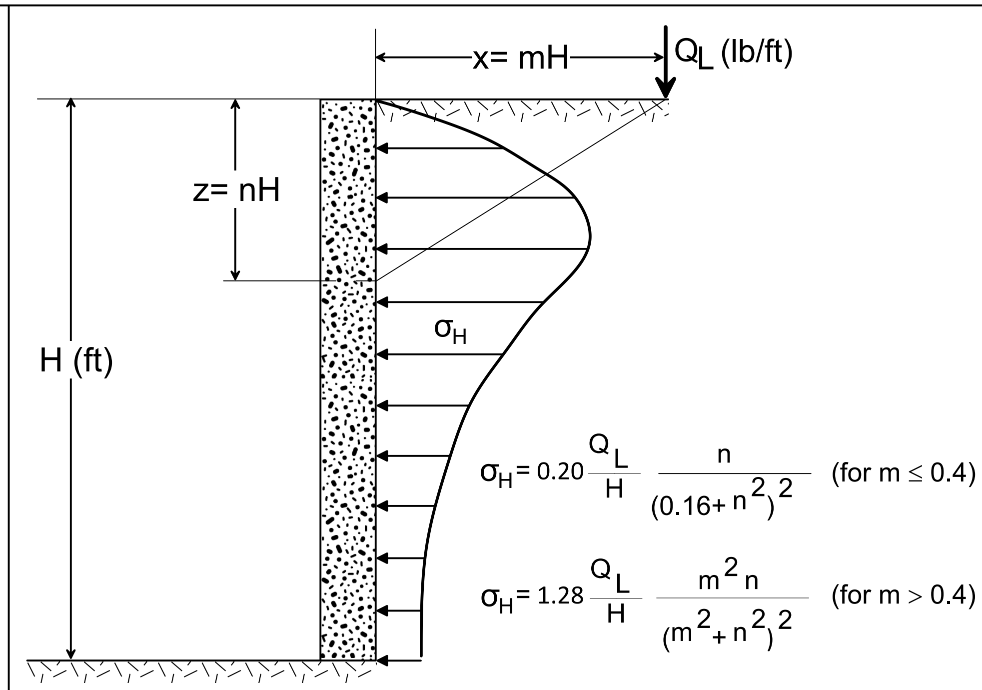
Pseudo Static Slope Stability Analysis (left)

Section B-B'

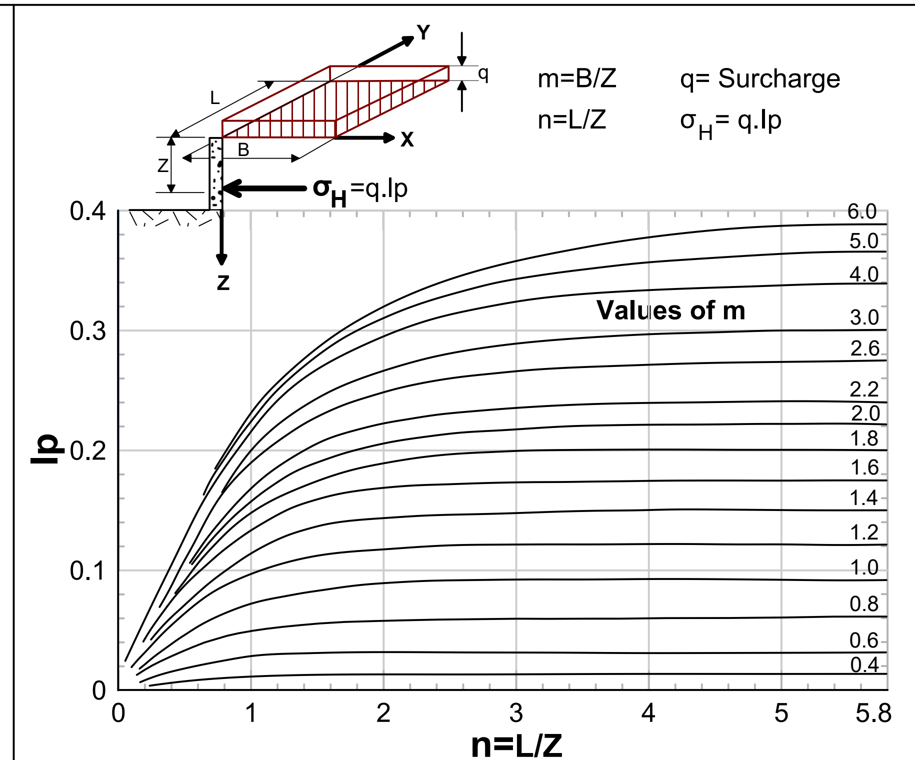
Scale:	Project No.	Figure No.
1:120	25-036.200	7B



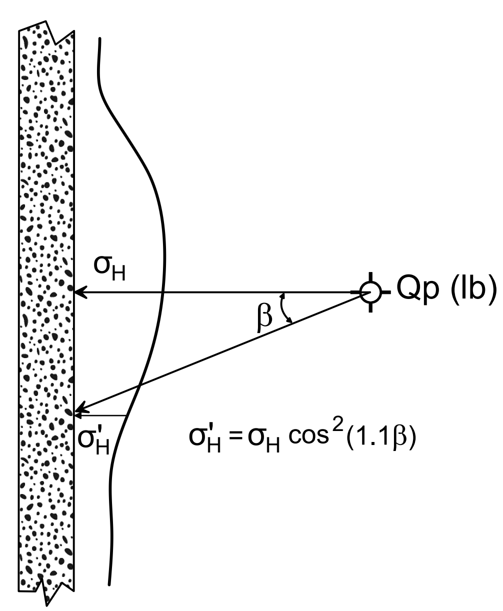
A-1) Lateral Pressure Due to Point Load- Elevation View



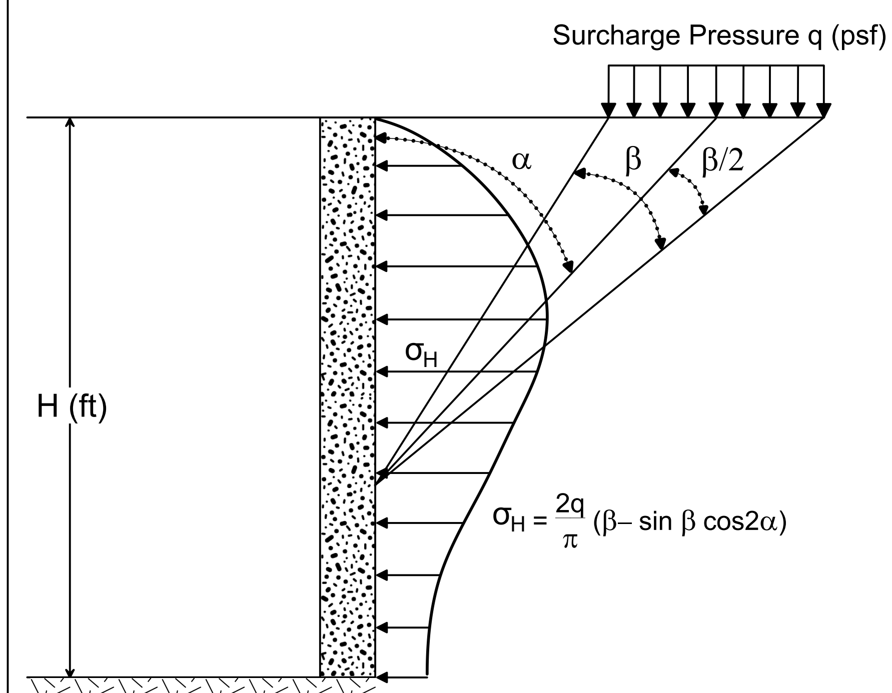
B) Lateral Pressure Due to Line Load-Parallel to the Wall



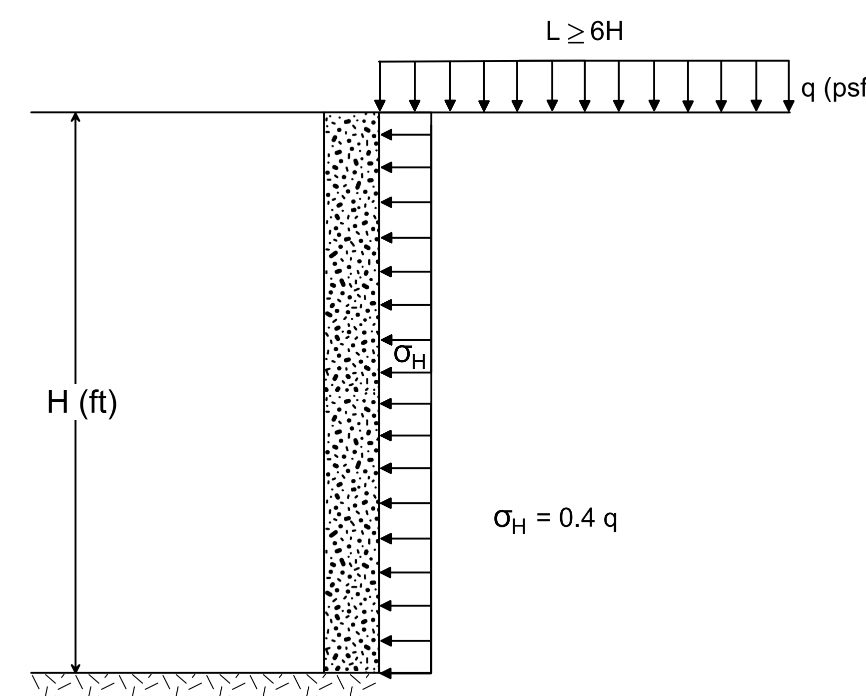
D) Lateral Pressure Due to Adjacent Footing



A-2) Lateral Pressure Due to Point Load- Plan View



C) Lateral Pressure Due to Strip Load-Perpendicular to the Wall



E) Lateral Pressure Due to Uniform Surcharge.
(For L≤6H Use Chart D Above)

* σ_H in psf.

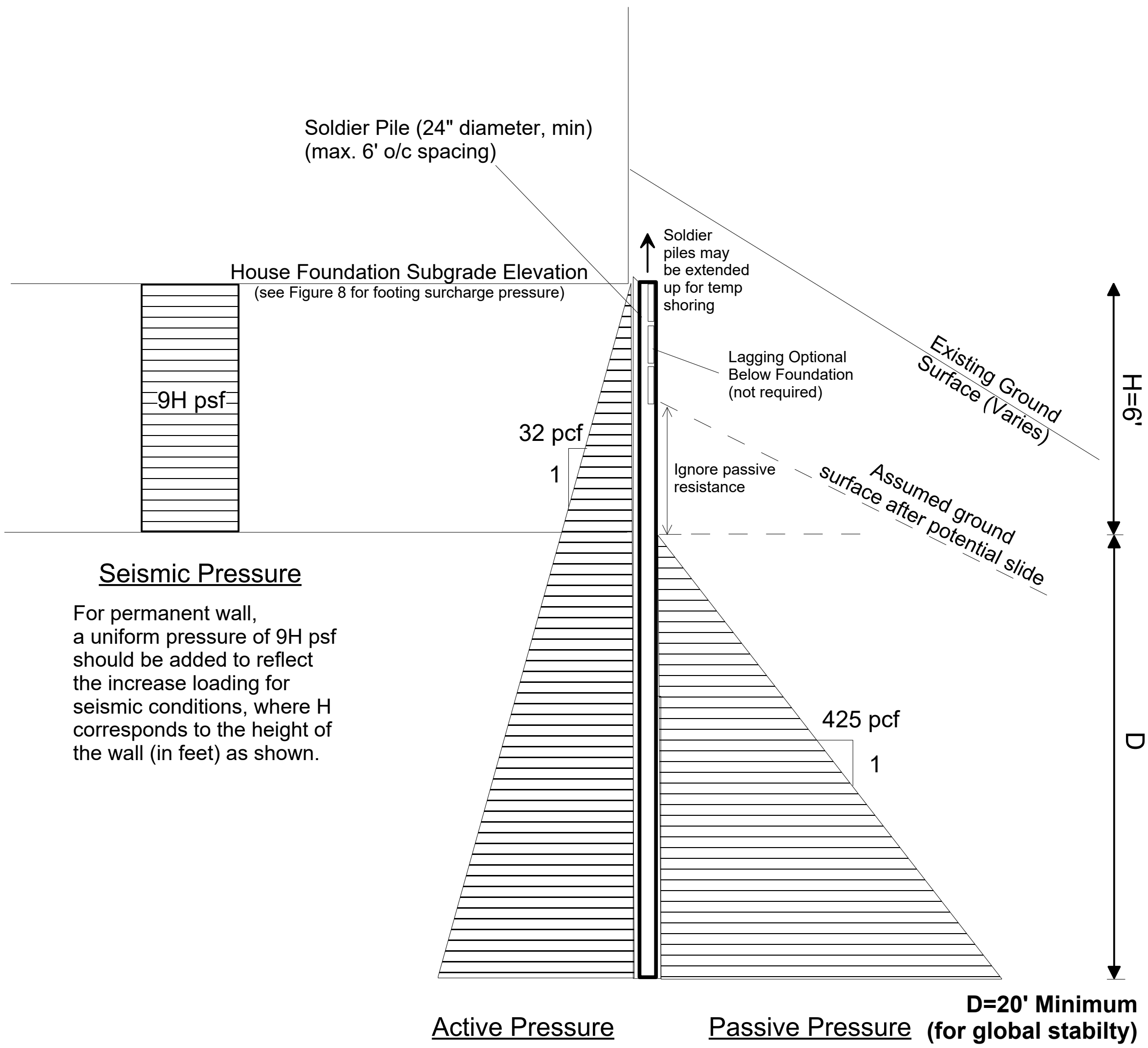
PanGEO INCORPORATED

Proposed Single-Family Residence
9191 SE 64th Street
Mercer Island, Washington

SURCHARGE LOADING ON WALLS

Project No.	Figure No.
25-036.200	8

19-062.300 Surcharge Loading for Walls 8/27/25 (3:33:46)



Notes:
1. Embedment (D) should be determined by summation of moments at the bottom of the soldier piles, or minimum tip elevation, as shown.
2. A factor of safety of 1.5 has been applied to the recommended passive earth pressure values. No factor of safety has been applied to the recommended active earth pressure values.
3. Active and seismic pressures should be applied over the full width of the pile spacing above the the bottom of excavation. The active pressure should be applied over one pile diameter below the bottom of excavation.
4. Passive pressure should be applied to two times the diameter of the soldier piles.
5. Use 50% of the lateral earth pressure for lagging design if used for temporary shoring.
6. For permanent wall, piles should be treated for corosion protection, or oversized accordingly.
7. Refer to report text for additional discussions.

Fig 8 EP diagram.grf 8/27/25 (7:46:21) JCR

PanGEO INCORPORATED

Proposed Single-Family Residence
9191 SE 64th Street
Mercer Island, Washington

DESIGN LATERAL PRESSURES
SOUTH STABILIZING SOLDIER PILE WALL

Project No.	25-036.200	Figure No.	9

APPENDIX A

SUMMARY BORING LOGS

9191 SE 64th Street, Mercer Island, WA | PanGEO, Inc.

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
		GP	Poorly-graded GRAVEL
	GRAVEL (>12% fines)	GM	Silty GRAVEL
		GC	Clayey 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)	SW	Well-graded SAND
		SP	Poorly-graded SAND
	SAND (>12% fines)	SM	Silty SAND
		SC	Clayey SAND
Silt and Clay 50%or more passing #200 sieve	Liquid Limit < 50	ML	SILT
		CL	Lean CLAY
		OL	Organic SILT or CLAY
	Liquid Limit > 50	MH	Elastic SILT
		CH	Fat CLAY
		OH	Organic SILT or CLAY
Highly Organic Soils		PT	PEAT

Notes:

1. 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.

2. 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		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

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 Spilt Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

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

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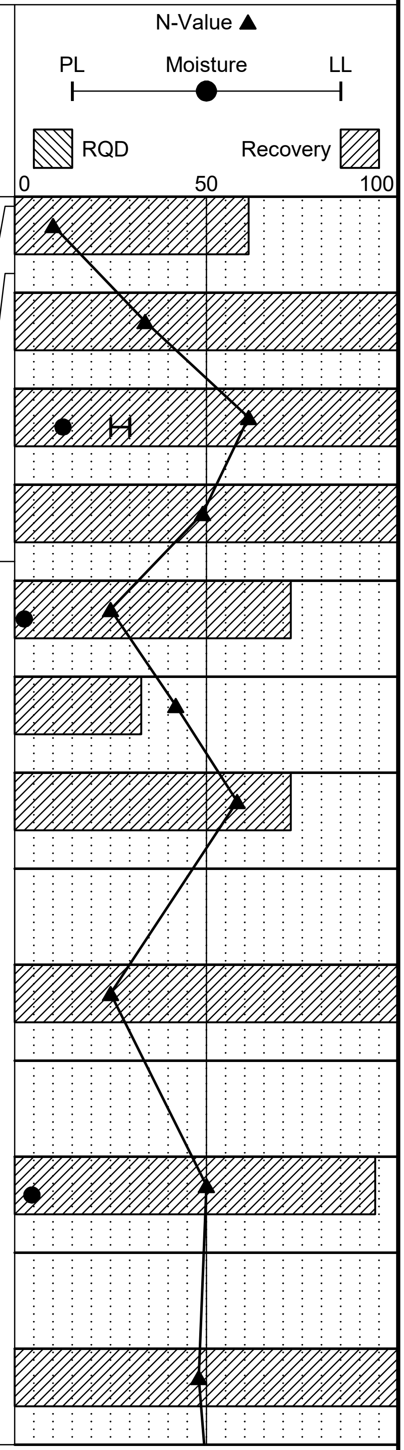
Phone: 206.262.0370

Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	Proposed Single-Family Residence	Surface Elevation:	197.8ft
Job Number:	25-036.200	Top of Casing Elev.:	N/A
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54521, Easting: -122.2134	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0	S-1		4 6 4			**[Topsoil]** Approximately 3 inches of topsoil overlain by forest litter.
2.5	S-2		7 15 19			**[Fill]** Medium dense, yellow-brown, silty SAND, organics (rootlets and wood fragments); moist.
5.0	S-3		9 25 36			**[Pre-Olympia Nonglacial Fine-grained Deposit - Qponf]** Hard, yellow-brown, sandy SILT (ML), laminated to thinly bedded, non-plastic fines, weathered appearance; moist.
7.5	S-4		8 21 28			
10.0	S-5		6 13 12	GS		**[Pre-Olympia Nonglacial Coarse-grained Deposits - Qponc]** Medium dense to very dense, brown, SAND silty to with silt, some silt pockets, few subangular to subrounded fine gravel, scattered iron oxide staining; moist.
12.5	S-6		23 23 19			#200 mesh passing - 16.4%.
15.0	S-7		20 40 18			-- gravel no longer present in samples.
17.5						
20.0	S-8		8 11 14			Homogeneous below 20 feet, massive, faint Fe staining.
22.5						
25.0	S-9		14 24 26	GS		#200 mesh passing - 9.6%.
27.5						
30.0	S-10		10 20 28			
32.5						



Completion Depth:	41.5ft
Date Borehole Started:	7/1/25
Date Borehole Completed:	7/1/25
Logged By:	T. Howitz
Drilling Company:	Geologic Drill Partners, Inc.

Remarks: Borings drilled using tracked drill rig. Standard Penetration Test (SPT) sampler driven with a 140 lb. safety hammer w/ 30" drop. Hammer operated by hydraulic mechanism. Samples were collected using a 2-inch OD split-spoon. Coordinates and elevation are approximate and based on their relative location to known site features. This surface elevation is estimated from the topographic survey provided by Informed Land Survey dated May 23, 2025.

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LOG OF TEST BORING PG-1-25

Figure A-2

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Single-Family Residence	Surface Elevation:	197.8ft
Job Number:	25-036.200	Top of Casing Elev.:	N/A
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54521, Easting: -122.2134	Sampling Method:	SPT

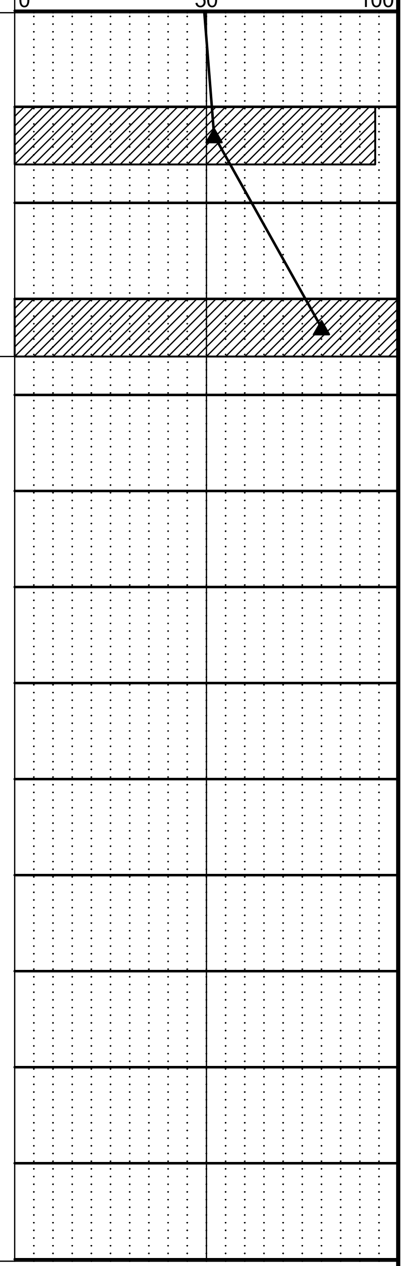
Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
32.5						**[Pre-Olympia Nonglacial Coarse-grained Deposits - Qponc]** Medium dense to very dense, brown, SAND silty to with silt, some silt pockets, few subangular to subrounded fine gravel, scattered iron oxide staining; moist. *(Continued)*
35.0	S-11	X	15 22 30			-- silt content increases, silty laminae.
37.5						
40.0	S-12	X	28 40 40			-- becomes yellow-brown and slight increase in grain size.
						Boring terminated approximately 41.5 feet below ground surface. No obvious signs of groundwater were observed at the time of drilling.
42.5						
45.0						
47.5						
50.0						
52.5						
55.0						
57.5						
60.0						
62.5						
65.0						

N-Value ▲

PL — Moisture — LL

RQD — Recovery

0 — 50 — 100



Completion Depth:	41.5ft
Date Borehole Started:	7/1/25
Date Borehole Completed:	7/1/25
Logged By:	T. Howitz
Drilling Company:	Geologic Drill Partners, Inc.

Remarks: Borings drilled using tracked drill rig. Standard Penetration Test (SPT) sampler driven with a 140 lb. safety hammer w/ 30" drop. Hammer operated by hydraulic mechanism. Samples were collected using a 2-inch OD split-spoon. Coordinates and elevation are approximate and based on their relative location to known site features. This surface elevation is estimated from the topographic survey provided by Informed Land Survey dated May 23, 2025.

PanGEO INCORPORATED

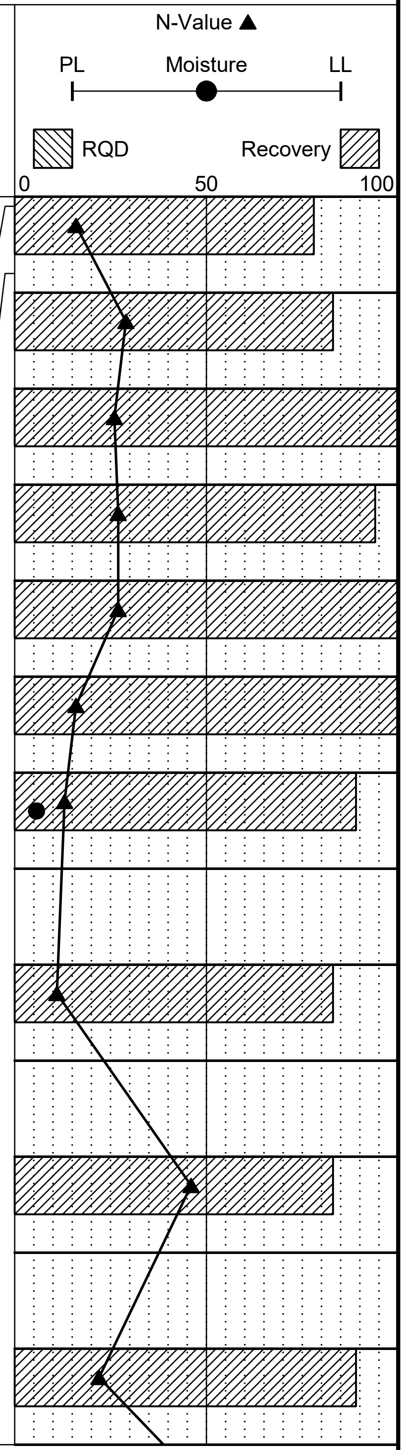
LOG OF TEST BORING PG-1-25

Figure A-2

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Single-Family Residence	Surface Elevation:	192.8ft
Job Number:	25-036.200	Top of Casing Elev.:	N/A
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54527, Easting: -122.21325	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0	S-1		2 5 11			**[Topsoil]** Approximately 3 inches of topsoil overlain by forest litter.
2.5	S-2		8 13 16			**[Fill]** Medium dense, yellow-brown, silty SAND, organics (rootlets and wood fragments); moist.
5.0	S-3		11 14 12			**[Pre-Olympia Nonglacial Coarse-grained Deposits - Qponc]** Medium dense to very dense, brown, fine silty SAND, few subangular to subrounded fine gravel, homogeneous, scattered iron oxide staining; moist.
7.5	S-4		8 13 14			-- gravel no longer present in samples.
10.0	S-5		9 13 14			
12.5	S-6		8 8 8			
15.0	S-7		7 6 7	GS		#200 mesh passing - 11.4%.
17.5						
20.0	S-8		5 6 5			
22.5						
25.0	S-9		11 22 24			
27.5						
30.0	S-10		9 11 11			Laminated with silty laminae.
32.5						



Completion Depth:	36.5ft
Date Borehole Started:	7/1/25
Date Borehole Completed:	7/1/25
Logged By:	T. Howitz
Drilling Company:	Geologic Drill Partners, Inc.

Remarks: Borings drilled using tracked drill rig. Standard Penetration Test (SPT) sampler driven with a 140 lb. safety hammer w/ 30" drop. Hammer operated by hydraulic mechanism. Samples were collected using a 2-inch OD split-spoon. Coordinates and elevation are approximate and based on their relative location to known site features. This surface elevation is estimated from the topographic survey provided by Informed Land Survey dated May 23, 2025.

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LOG OF TEST BORING PG-2-25

Figure A-3

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Single-Family Residence	Surface Elevation:	192.8ft
Job Number:	25-036.200	Top of Casing Elev.:	N/A
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54527, Easting: -122.21325	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION	N-Value ▲ / PL – Moisture – LL / RQD / Recovery (0 – 50 – 100)
32.5						**[Pre-Olympia Nonglacial Coarse-grained Deposits - Qponc]** Medium dense to very dense, brown, fine silty SAND, few subangular to subrounded fine gravel, homogeneous, scattered iron oxide staining; moist. *(Continued)*	
35.0	S-11		25 30 40			-- slight increase in grain size, fine to medium silty sand, massive.	
						Boring terminated approximately 36.5 feet below ground surface. No obvious signs of groundwater were observed at the time of drilling.	
37.5							
40.0							
42.5							
45.0							
47.5							
50.0							
52.5							
55.0							
57.5							
60.0							
62.5							
65.0							

Completion Depth:	36.5ft
Date Borehole Started:	7/1/25
Date Borehole Completed:	7/1/25
Logged By:	T. Howitz
Drilling Company:	Geologic Drill Partners, Inc.

Remarks: Borings drilled using tracked drill rig. Standard Penetration Test (SPT) sampler driven with a 140 lb. safety hammer w/ 30" drop. Hammer operated by hydraulic mechanism. Samples were collected using a 2-inch OD split-spoon. Coordinates and elevation are approximate and based on their relative location to known site features. This surface elevation is estimated from the topographic survey provided by Informed Land Survey dated May 23, 2025.

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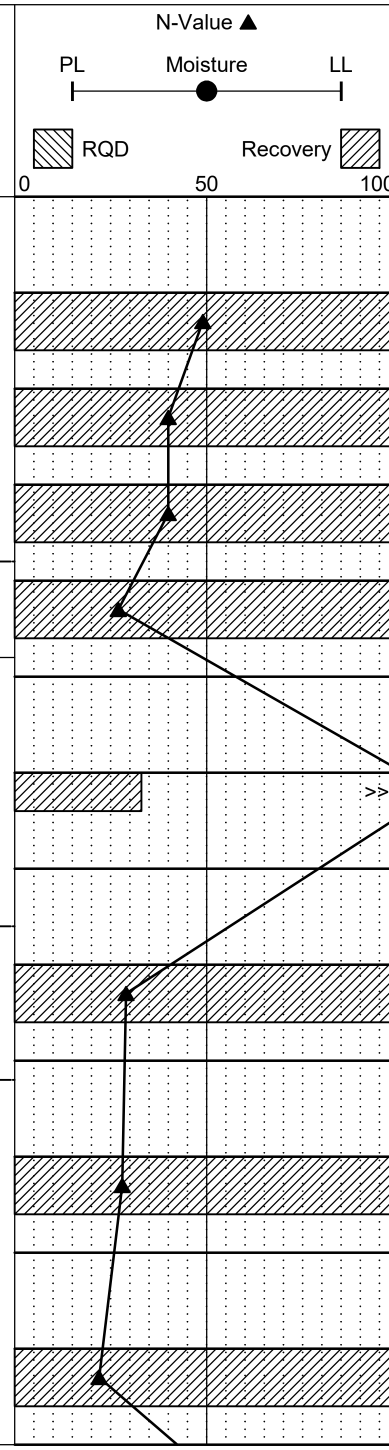
LOG OF TEST BORING PG-2-25

Figure A-3

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Lot Development	Surface Elevation:	205.2ft
Job Number:	25-036.200	Top of Casing Elev.:	
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						Hard, brown gray, silty, lean CLAY: slightly moist, low plastic, homogeneous, laminated, occasional slightly rusty laminae, dip ~ 10°. **(Pre-Olympia Non-glacial Fine-grained Deposit - Qponf)**.
2.5	S-1		10 21 28			
5.0	S-2		10 19 21			Low plastic, slow dilatancy, light brown laminae and partings, splits easily on bedded, dips to ~ 20°.
7.5	S-3		14 17 23			Laminated, dips to 25°, planar fracture cutting across bedding at 60°, occasional fine organic grains and non-plastic silt laminae.
10.0	S-4		6 13 14			Medium dense or very stiff, brown gray, interbedded clayey SILT and silty, fine SAND:slightly moist, slightly to low plastic and non-plastic, moderately sharp contacts, dips to 20°.
12.5						Dense, brown gray, silty, fine SAND with gravel: slightly moist, gravel subrounded, blocky and tabular, non-plastic fines, homogeneous, gravelly beds especially, massive. **(Pre-Olympia Non-glacial Coarse-grained Deposit - Qponc)**.
15.0	S-5		16 50/6			
17.5						
20.0	S-6		10 13 16			Medium dense, brown, fine to medium SAND with silt: slightly moist, non-plastic fines, homogeneous, laminated with occasional clayey silt interbed, dips to 10°.
22.5						Medium dense, brown gray, silty, fine SAND: slightly moist, non-plastic fines, grading to sandy silt in some layers, homogeneous, indistinctly laminated with dips to 5°.
25.0	S-7		12 14 14			
27.5						
30.0	S-8		9 10 12			Sub-horizontal laminae, slightly rusty laminae.
32.5						



Completion Depth:	41.5ft
Date Borehole Started:	3/7/19
Date Borehole Completed:	3/7/19
Logged By:	S. Evans
Drilling Company:	Boretec, Inc

Remarks: No groundwater encountered during drilling.

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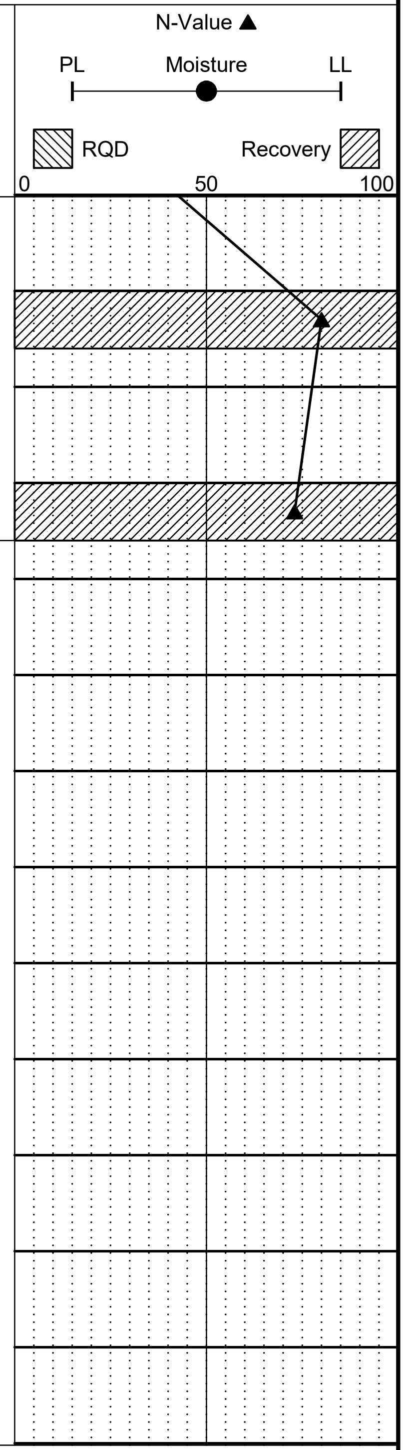
LOG OF TEST BORING PG-4-19

Figure A-4

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Lot Development	Surface Elevation:	205.2ft
Job Number:	25-036.200	Top of Casing Elev.:	
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
32.5						Medium dense, brown gray, silty, fine SAND: slightly moist, non-plastic fines, grading to sandy silt in some layers, homogeneous, indistinctly laminated with dips to 5°. *(Continued)*
35.0	S-9		19 37 43			Becoming very dense, rare rusty pocket.
37.5						
40.0	S-10		19 34 39			Indistinctly laminated to massive.
						Bottom of Boring.
42.5						
45.0						
47.5						
50.0						
52.5						
55.0						
57.5						
60.0						
62.5						
65.0						



Completion Depth:	41.5ft
Date Borehole Started:	3/7/19
Date Borehole Completed:	3/7/19
Logged By:	S. Evans
Drilling Company:	Boretec, Inc

Remarks: No groundwater encountered during drilling.

PanGEO INCORPORATED

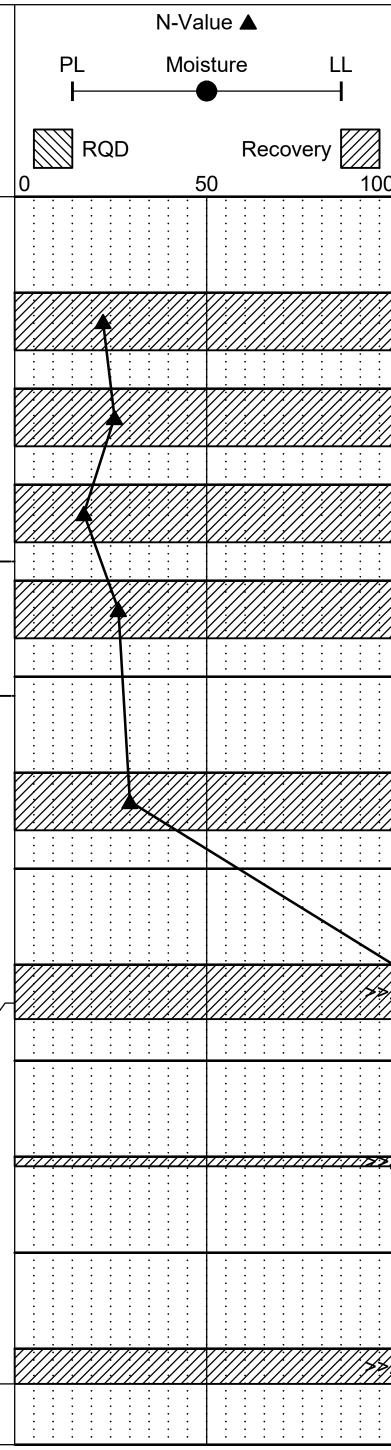
LOG OF TEST BORING PG-4-19

Figure A-4

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Lot Development	Surface Elevation:	201.5ft
Job Number:	25-036.200	Top of Casing Elev.:	
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						Very stiff, brown gray, silty, lean CLAY: moist, low plastic, homogenous, laminated with occasional rusty laminae, dips to 5°. **(Pre-Olympia Non-glacial Fine-grained Deposit - Qponf)**.
2.5	S-1		5 10 13			
5.0	S-2		7 12 14			Occasional organic bits, rusty laminae, dips 5 to 7°.
7.5	S-3		7 8 10			Occasional non-plastic silt bed, one hard, waxy gray clay bed, occasional rip-up clast, rusty veins.
10.0	S-4		10 13 14			Medium dense, brown gray, clayey SILT: slightly moist, slightly plastic, homogeneous, laminated with rusty partings and pockets, occasional organic bits, dips to 5°.
12.5						Dense or hard, brown gray, interbedded, silty, fine SAND and silty, lean CLAY: slightly moist, non-plastic and low plastic beds, occasional rusty zones, fine bedded (4 to 6 inches), indistinctly laminated.
15.0	S-5		8 14 16			
17.5						
20.0	S-6		14 43 50/5			Grading to clayey Silt, slightly to low plastic, massive, occasional rusty vein.
						Very dense, brown gray, fine to coarse SAND; slightly moist, trace to some silt, massive, weathered gravel at upper contact. **(pre-Olympia Non-glacial Coarse-grained Deposit - Qponc)**.
22.5						
25.0	S-7		50/3			Grading to fine to medium SAND.
27.5						
30.0	S-8		35 50/5			Homogeneous, indistinctly laminated to massive.
						Bottom of Boring.
32.5						



Completion Depth:	30.9ft	Remarks: No groundwater encountered during drilling.
Date Borehole Started:	3/7/19	
Date Borehole Completed:	3/7/19	
Logged By:	S. Evans	
Drilling Company:	Boretec, Inc	

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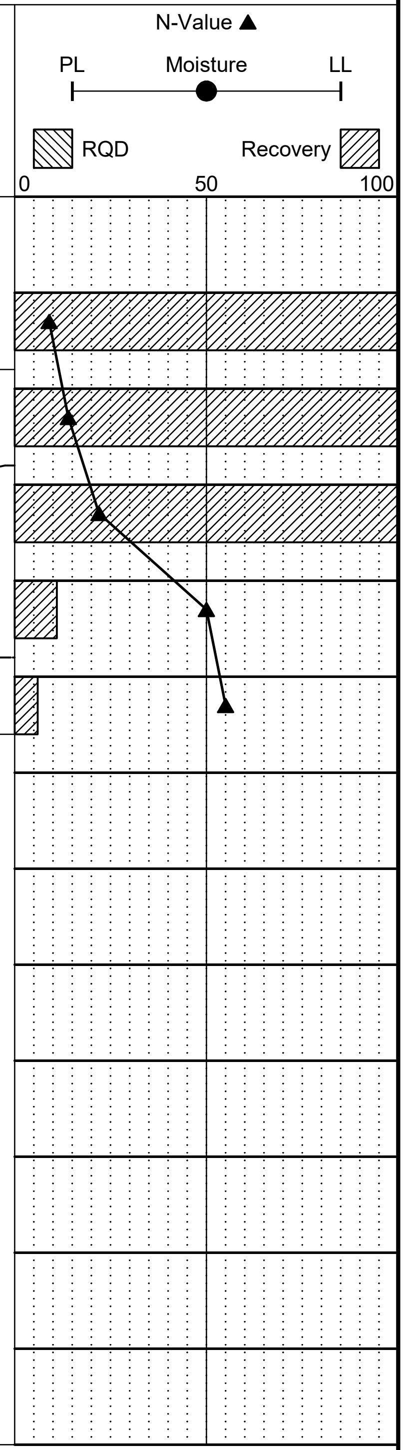
LOG OF TEST BORING PG-5-19

Figure A-5

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Proposed Lot Development	Surface Elevation:	194.8ft
Job Number:	25-036.200	Top of Casing Elev.:	
Location:	9191 SE 64th Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						Loose / Stiff, brown, clayey SILT to silty CLAY: wet, slightly to low plastic layers, some layers with rapid dilatancy, faint rusty mottles, occasional gravel, massive. **(Colluvium / Mass Wasting Deposit)**.
2.5	S-1		2 3 6			
5.0	S-2		4 6 8			Stiff, brown, silty, lean CLAY: very moist to wet, low plastic, homogeneous, faint reddish stains, laminated, occasional fine gravel, possible organic clast. **(pre-Olympia Non-glacial Fine-grained Deposit)**.
7.5	S-3		7 8 14			Medium dense to very dense, brown gray, clayey SILT with fine sand: very moist, slightly plastic, homogeneous, occasional rusty bands, massive to indistinctly laminated.
10.0	S-4		12 20 30			Becoming moist, very dense.
12.5	S-5		31 28 27			Hard / Very dense, brown gray, clayey SIL to silty, lean CLAY: moist, some fine sand, low to slightly plastic, homogeneous, occasional fine gravel, massive.
						Bottom of Boring.
15.0						
17.5						
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						



Completion Depth:	14.0ft
Date Borehole Started:	3/21/19
Date Borehole Completed:	3/21/19
Logged By:	S. Evans
Drilling Company:	Boretec, Inc

Remarks: Groundwater level estimated based on wetness of soil sample and water on the sampling rods.

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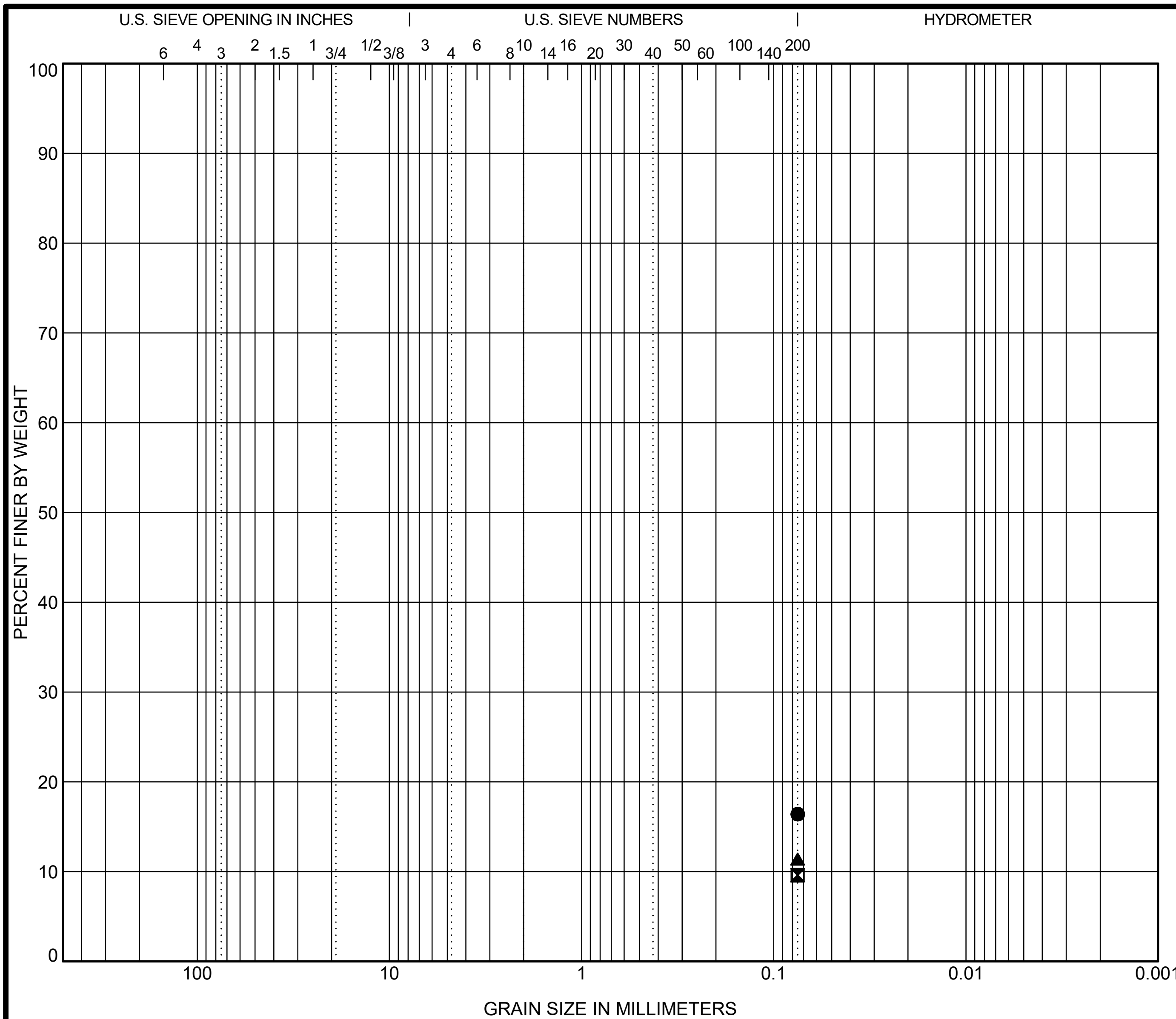
LOG OF TEST BORING PG-8-19

Figure A-6

The stratification lines represent approximate boundaries. The transition may be gradual.

APPENDIX B

LABORATORY TEST RESULTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**PG-1-25**	**@ 11.0 ft.**	**SILTY SAND**					
⊠	**PG-1-25**	**@ 26.0 ft.**	**SAND, SOME SILT**					
▲	**PG-2-25**	**@ 16.0 ft.**	**SAND, SOME SILT**					

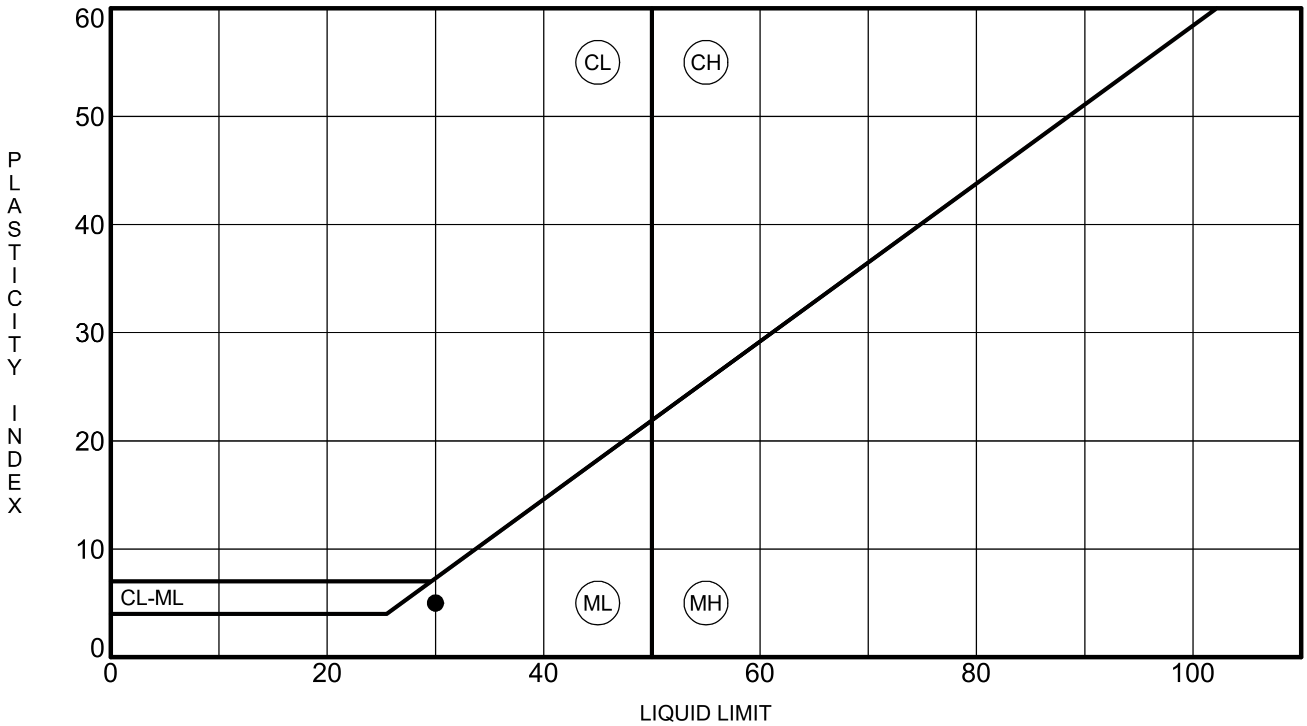
	Specimen Identification		D90	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**PG-1-25**	**11.0**					**0.0**	**0.0**	**16.4**	
⊠	**PG-1-25**	**26.0**					**0.0**	**0.0**	**9.6**	
▲	**PG-2-25**	**16.0**					**0.0**	**0.0**	**11.4**	

GRAIN SIZE DISTRIBUTION

PanGEO INCORPORATED
Phone: 206.262.0370

Project: Proposed Single-Family Residence
Job Number: 25-036.200
Location: 9191 SE 64th Street, Mercer Island, WA

Figure B-1



	Specimen Identification		M	LL	PL	PI	Fines	Classification
●	**PG-1-25**	**6.0**	**13**	**30**	**25**	**5**		**SANDY SILT (ML)**

PanGEO
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Phone: 206.262.0370

ATTERBERG LIMITS

Project: Proposed Single-Family Residence
Job Number: 25-036.200
Location: 9191 SE 64th Street, Mercer Island, WA

Figure B-2