GEOTECHNICAL REPORT
PROPOSED SAUNA
5245 FOREST AVENUE SE
MERCER ISLAND, WASHINGTON

Project No. 25-130
May 2025

Prepared for:

Mika Yamamoto & Robert LaRose

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May 8, 2025
File No. 25-130

Mika Yamamoto & Robert LaRose
5245 Forest Avenue SE
Mercer Island, WA 98040

Subject: **Geotechnical Report Addendum #1**
2-inch Pin Pile Recommendations
Proposed Sauna
5245 Forest Avenue Southeast, Mercer Island, WA

Dear Mika & Robert,

As requested, PanGEO prepared this letter to provide our additional recommendations for the pin pile foundations for the above project. Based on the current design plans, we understand the proposed project will also include a canopy, which will be supported by several columns. Based on the site soil conditions and the canopy design, it is our opinion that it is more appropriate to use pin piles to support these columns. Alternatively, the proposed sauna may also be supported by pin piles in-lieu of the mat foundation/structural slabs as recommended in our geotechnical report dated May 2, 2025.

Based on the site access and soil conditions, it is our opinion that 2-inch diameter driven pin piles are considered most feasible to support the sauna and the canopy. Two-inch diameter pin piles should consist of schedule-80 galvanized steel pipes. The piles should be driven to refusal, which is defined as less than one inch of penetration during one minute of continuous driving for consecutive 3 inches, with either a 90-lb jackhammer or a 140-lb pneumatic hammer. Piles driven to refusal are considered adequate for supporting an axial compression load of 3 tons per pile. We estimate that settlement is anticipated to be less than ½ inch under anticipated loading conditions for the pile supported footings.

The numbers of 2” pin piles needed and pile layout should be determined by your structural engineer. Piles shall be driven in nominal sections and connected with compression fitted sleeve couplers. We discourage welding of pipe joints as we have frequently observed welds broken during driving. For planning purposes, we estimate that pile length may be about 20 feet below the proposed new footing level. However, it should be noted that pile embedment depths will vary across the site.

We trust that the information outlined in this letter meets your needs at this time. Please call if you have any questions.

Sincerely,

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

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GEOTECHNICAL REPORT
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5245 FOREST AVENUE SOUTHEAST
MERCER ISLAND, WASHINGTON

1.0 INTRODUCTION

This report presents the results of a geotechnical engineering study that was undertaken to support the design of the proposed sauna project in Mercer Island, Washington. Our study was performed in general accordance with our mutually agreed-upon scope of work as outlined in our proposal dated March 26, 2025, and approved by you on March 28, 2025. Our service scope included reviewing readily available geologic and geotechnical data in the site vicinity, conducting a site reconnaissance, advancing one test boring, and developing the geotechnical design recommendations presented in this report.

2.0 PROJECT AND SITE DESCRIPTION

The project site is an approximately 0.41-acre lot located at 5245 Forest Avenue Southeast in Mercer Island, Washington (See Figure 1 – Vicinity Map). The subject property is approximately trapezoidal shaped, and borders existing single-family residences to the north, east, and south, and Lake Washington to the west (see Figure 2 – Site and Exploration Plan). The site is currently occupied by a 1½-story single-family house with an attached garage. The landscaped areas are vegetated with lawns, landscaping trees, and shrubs. Plate 1 on the following page shows an aerial view of the site. Plate 2 on the following page shows a ground level view of the site conditions at the time of this study.

Based on review of the GIS maps, the existing site grade generally slopes down from the east to the west with an average gradient of about 15 percent and a total vertical elevation relief of about 25 feet across the length of the site.

Based on the information provided to us, we understand that the proposed project consists of constructing a detached sauna on the west side of the existing house (see Figure 2). Detailed design information is not available at this time. However, we envision the proposed sauna is an one-story at-grade structure. We anticipate that temporary excavations for the new foundation construction will likely be on the order of 3 feet deep.

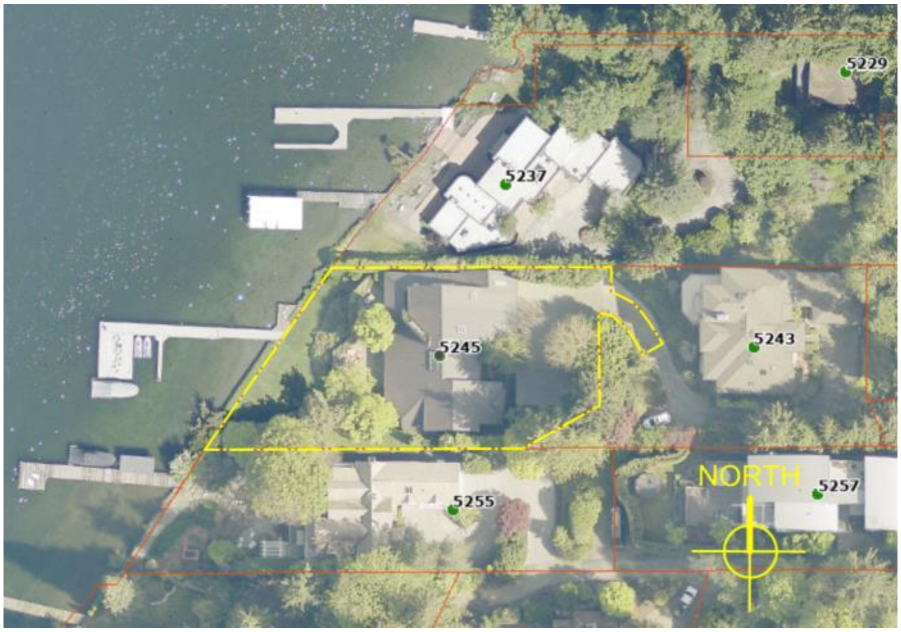

***Plate 1:** Aerial view of the site.*

North is at the top of the image.

The site is outlined in a yellow dashed line.

Image Credit: King County iMap

***Plate 2:** Rear view of the existing residence. Looking southeast from the west property line in the approximate area of the proposed sauna.*

According to the City of Mercer Island GIS maps, the site is mapped with potential slide, seismic, and erosion geologic hazards. As such, a geotechnical engineering study will be required as part of the building permit process. The objective of our geotechnical study is to explore subsurface conditions, to evaluate the potential geologic hazards, and to provide geotechnical design recommendations pertinent to the proposed project.

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

3.0 SUBSURFACE EXPLORATION

One test boring (PG-1) was advanced at the approximate location shown in Figure 2. The boring was drilled at the site on April 4, 2025, using a portable Acker drill rig owned and operated by CN Drilling, Inc., subcontracted to PanGEO. The test boring PG-1 was drilled to a depth of about 19 feet below the existing grade.

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

A geologist from PanGEO was present during the field exploration to observe the drilling, to assist in sampling, and to describe and document the soil samples obtained from the boring. The soils were logged in general accordance with the system summarized on Figure A-1, Terms and Symbols for Boring and Test Pit Logs. The summary test boring log is included as Figure A-2 in Appendix A.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

Based on our review of the *Geologic Map of Mercer Island, Washington* (Troost and Wisher, 2006), most of the sites are mapped as Pre-Olympia Glacial Diamict (Geologic Map Unit Qpogd) with Lake Deposits (Geologic Map Unit Ql) mapped along the west side of the property. Pre-Olympia Fine-Grained Deposits are mapped east of the site (Geologic Map Unit Qpogf). The principal characteristics of these soil units are described below:

- **Pre-Olympia Glacial Diamict (Qpogd):** This unit is described as very dense and hard fine-grained till-like material with less gravel than standard till deposits. Localized-iron-oxide cemented layers and sandy partings and lenses are common.
- **Lake Deposits (Ql):** This unit predominantly consists of very soft to medium stiff or very loose to medium dense horizontally bedded silt and clay derived from lake-bottom sediments exposed by the lowering of Lake Washington in 1916. Local sand layers and peat may also be present. Locally gradational with Recessional Lacustrine, Alluvium, and Peat.
- **Pre-Olympia Fine-Grained Deposits (Qpogf):** The fine-grained glacial deposits are described as hard, silt and clay with some laminated to massive interbedded sand and are observed to have localized iron-oxide cemented layers and sand partings.

4.2 SOIL CONDITIONS

Our test boring (PG-1) generally encountered a thin surficial layer of loose topsoil and fill overlying medium dense native silty sand (lake deposits) underlain by very stiff to hard clay (pre-Olympia fine-grained glacial deposits). The following is a generalized description of the soils encountered in the boring. For a detailed description of the subsurface conditions encountered at our exploration location, please refer to the boring log provided in Appendix A.

Topsoil: Boring PG-1 was completed in a landscape area and encountered about 1½ feet of topsoil consisting of a loose, organic-rich silty sand with numerous roots and rootlets.

Fill: Below the topsoil, PG-1 encountered a loose, silty sand with gravel with minor iron-oxidation staining and a disturbed appearance. The fill extended to about 4½ feet deep.

Lake Deposits (Ql): Below the fill, PG-1 encountered a medium dense, silty sand with trace gravel. This unit appeared generally consistent with the lake deposits mapped on site.

Pre-Olympia Fine-Grained Glacial Deposits (Qpogf): Below the lake deposits, PG-1 encountered a very stiff to hard clay. This unit appeared consistent with the pre-Olympia fine-grained glacial deposits mapped in the site vicinity.

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

4.3 Groundwater Conditions

Groundwater was observed between about 6 to 15 feet below existing grade at the time of exploration (4/4/25). It should be noted that groundwater elevations and seepage rates may vary depending on the season, local subsurface conditions, and other factors. Groundwater levels and seepage rates are normally highest during the winter and early spring (typically October through May).

5.0 GEOLOGIC HAZARDS ASSESSMENT

5.1 Landslide Hazards and Steep Slopes

Based on review of the Mercer Island GIS map, the entire site is mapped as a potential slide area. On April 4, 2025, we conducted a reconnaissance of the site and site slopes. Based on our reconnaissance, the site does not contain indications of recent or historical slope movements, such as scarps, sloughs, tension cracks, uneven ground surfaces, jackstrawed trees, breaks in vegetation, water features and convergent landforms. Additionally, we observed that the adjacent properties are covered with bushes and trees. The trunks of the mature trees are observed to be straight.

We also reviewed a LiDAR image of the site and its vicinity, and the landslide inventory map from the Washington Department of Natural Resources (DNR). To the best of our knowledge, there are no reported past known slides at the site. According to the Mercer Island GIS maps, modern to ancient previous landslides are mapped on adjacent properties to the east and southeast, but no documentation is available, nor are they documented on the DNR landslide map or distinguishable on LiDAR.

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

5.2 Erosion Hazards

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

5.3 Seismic Hazards

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

5.3.1 Liquefaction Potential

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

Based on our subsurface exploration, groundwater was encountered at about 6 to 9 feet in the loose to medium dense silty sand, which could be prone to soil liquefaction. From about 9 to 15 feet deep, our borings encountered a very stiff clay, which will not have liquefaction potential due to the cohesion of clay.

We performed an analysis to evaluate the liquefaction potential of the site soils. The analyses were conducted using the computer liquefaction assessment software program LiqSV and the method proposed by Boulanger & Idriss (2014). An earthquake with a magnitude of 7.50 and a PGA_M of 0.594g was used in our analysis, consistent with Site Class D conditions as per the 2021 IBC and ASCE 7-16. The results of our analysis indicate that liquefaction potential for soil between 6 to 9 feet is considered low due to limited thickness and relatively high SPT values. As such, it is our opinion that design considerations associated with soil liquefaction are not needed for this project.

5.3.2 Faults

Where fault lines are present below structures, faulting can potentially displace the structures. Based on our review of the USGS Interactive Fault Map, the closest Class A seismic source to the project is the Seattle fault zone, with one fault line running approximately through the center of the subject site with a reported certainty of “good.” The Seattle fault zone consists of east-west-trending subparallel thrust faults. According to the USGS Quaternary Fault Database (Fault No. 570), this fault has been active within the last approximately 1,100 years (Johnson et al., 2016). Plate 3 on the following page shows the approximate location of the mapped fault line relative to the subject site.

Earthquake-induced surface displacement cannot be ruled out if a strong earthquake occurred along the Seattle Fault Zone, due to the close proximity of an active fault to the site. Most buildings in the area are not designed for this condition. However, this type of event is considered very rare, with a recurrence period of thousands of years. The last known surface rupture in the Seattle Fault Zone occurred about one thousand years ago. Specifically, a M6.7 earthquake on the northernmost strand of the Seattle Fault Zone might be what caused surface displacement of about 2 meters (6.5 feet) mapped just west of Lake Sammamish in southeast Bellevue, near Southeast 38th Street. The causative fault rupture extends for about 23 km (14 miles), from Harbor Island to just east of Lake Sammamish. The most recent and largest known earthquake within the Seattle Fault Zone occurred about 1050 to 1020 years ago, with a magnitude greater than M7.

In summary, because the proposed development is limited to the construction of a sauna, in our opinion, the chances of significant foundation settlement of the lightly loaded structure with a small footprint are considered negligible, and mitigation measures related to the faulting are not needed.

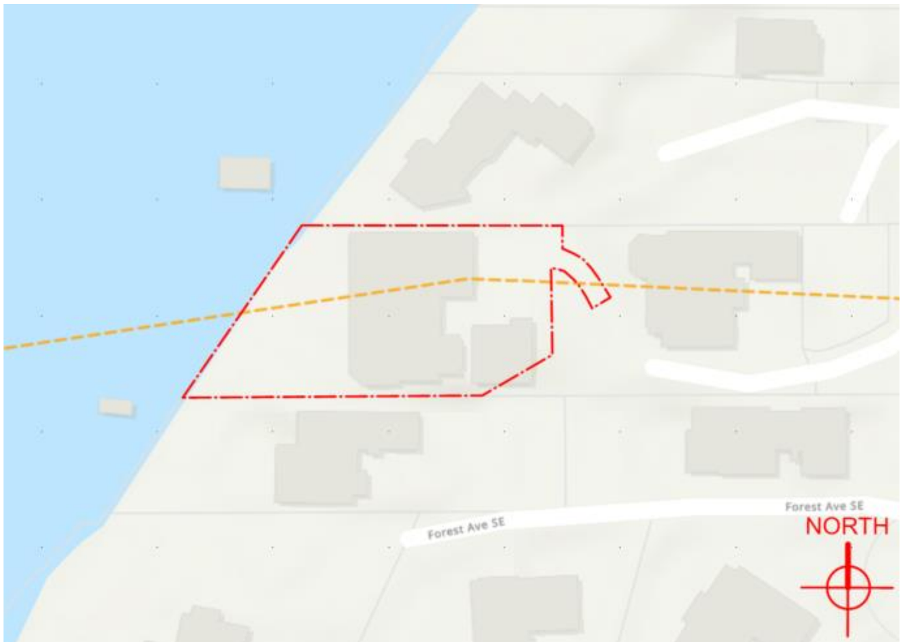

Plate 3: *Aerial view of the site with the Seattle fault line shown as an orange dashed line running approximately through the center of the site.*

North is at the top of the image.

The site is outlined in a red dashed line.

Image Credit: USGS Interactive Fault Map

6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

6.1 Seismic Site Class

The seismic design should be performed using the 2021 edition of the International Building Code (IBC), which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years). Based on the site soil conditions, it is our opinion that Site Class D (stiff soil) should be used.

6.2 Foundations

Based on the subsurface conditions at the site, our understanding of the current design, and the results of our engineering analysis, it is our opinion that a mat foundations/structural slab with thickened edges with improved foundation subgrade are the most appropriate foundation system to support the proposed structure. Our foundation design recommendations are presented in the sections below.

6.2.1 Mat Foundation/Structural Slab with Thickened Edges

The mat foundation/structural slab should bear on a minimum of 12 inches of structural backfill. The native subgrade soil should be compacted to a firm and unyielding condition prior to placement of structural fill. Any soft/loose and pumping native subgrade soil detected during compaction should be removed and replaced with structural fill. The structural fill should extend horizontally a minimum of 6 inches beyond the edge of the foundations.

The mat foundation/ structural slab should be thickened to a minimum depth of 18 inches below the adjacent finish grade around the perimeter of the mat. The thickened edges of the structural slabs should have a minimum width of 18 inches.

For design of the mat foundation/structural slab with thickened edges bearing on the prepared subgrade as discussed above, a modulus of subgrade reaction, k_s, of 60 pounds per cubic inch (pci) may be used. With the mat foundation/structural slab foundation, we anticipate the average bearing pressure to be less than 1,000 psf.

6.2.2 Foundation Performance

Provided the mat slab subgrade is prepared as described above, the total mat foundation/structural slab settlement is estimated to be approximately 1 to 1½ inch with differential settlement on the order of ½ inch during the static loading condition. Most of the anticipated settlement should occur during construction as dead loads are applied.

6.2.3 Lateral Resistance

Lateral loads on the structure may be resisted by passive earth pressure developed against the embedded portion of the foundation system and by frictional resistance between the bottom of the foundation and the supporting subgrade soils. For the new footings bearing on minimum of one foot of compacted structural fill, a frictional coefficient of 0.35 may be used to evaluate sliding resistance at the bottom of footings. Passive soil resistance may be calculated using an equivalent fluid weight of 200 pcf, assuming properly compacted structural fill will be placed against the footings. The above values include a factor of safety of 1.5. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected.

6.3 FOUNDATION AND RETAINING WALL DESIGN PARAMETERS

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

6.3.1 Lateral Earth Pressures

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

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

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

6.3.2 Surcharge

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

6.3.3 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 foundations and by friction acting on the base of the foundations. Passive resistance values may be determined using an equivalent fluid weight of 200 pounds per cubic foot (pcf), assuming a level ground in front of the foundations. This value includes a factor of safety of 1.5, assuming the footing is poured against recompacted native soil or properly compacted structural fill adjacent to the sides of footing. A friction coefficient of 0.35 may be used to determine the frictional resistance at the base of the footings. This coefficient also includes a safety factor of approximately 1.5.

6.3.4 Wall Drainage

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

6.3.5 Wall Backfill

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

Wall backfill should be properly moisture conditioned, placed in loose, horizontal lifts less than about 12 inches in thickness, and systematically compacted to a dense and relatively unyielding condition and to at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557. Within 5 feet of the wall, care should be exercised during compaction so that no extra pressure is exerted on the walls and the walls are damaged.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Site Preparation

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

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

7.2 Temporary Excavation

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

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

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

7.3 Material Reuse

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

7.4 Structural Fill Placement and Compaction

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

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

7.5 EROSION AND DRAINAGE CONSIDERATIONS

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

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

7.6 WET EARTHWORK RECOMMENDATIONS

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

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

- All footing surfaces should be protected against inclement weather unless the footings can be poured immediately after the subgrade is exposed. It is the contractor's responsibility to protect the footing subgrade from disturbance. If needed, one option is to place 2 to 3 inches of lean-mix concrete or 4 to 6 inches of crushed surfacing base course (CSBC) on the exposed foundation subgrade as soon as the subgrade is exposed.

- Earthwork should be performed in small areas to minimize subgrade exposure to wet weather. Excavation or the removal of unsuitable soil should be followed promptly by the placement and compaction of clean structural fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance.
- Where practical, maintain vegetation buffers around cleared areas (BMP C101).
- During wet weather, the allowable fines content of the structural fill should be reduced to no more than 5 percent by weight based on the portion passing ¾-inch sieve. The fines should be non-plastic.
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water.
- Geotextile silt fences should be strategically located to control erosion and the movement of soil. Erosion control measures should be installed along all the property boundaries.
- Excavation slopes and soils stockpiled on site should also be covered with plastic sheets.

8.0 STATEMENT OF RISK

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

a. The geologic hazard area will be modified, or the development has been designed so that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe; or

b. An evaluation of site-specific subsurface conditions demonstrates that the proposed development is not located in a geologic hazard area; or

c. Development practices are proposed for the alteration that would render the development as safe as if it were not located in a geologic hazard area; or

d. The alteration is so minor as not to pose a threat to the public health, safety, and welfare.

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

9.0 ADDITIONAL SERVICES

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

10.0 LIMITATIONS

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

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

The scope of our work does not include services related to construction safety precautions. Our recommendations are not intended to direct the contractors' methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design. Additionally, the scope of our work specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances. We are not mold consultants nor are our recommendations to be interpreted as being preventative of mold development. A mold specialist should be consulted for all mold-related issues.

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

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

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk. Any party other than the client who wishes to use this report shall notify PanGEO of such intended use and for permission to copy this report. Based on the intended use of the report, PanGEO may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release PanGEO from any liability resulting from the use of this report.

We appreciate the opportunity to be of service.

Sincerely,

PanGEO, Inc.

5/2/2025

Mary V. Green, LEG, CEG
Project Engineering Geologist
(MGreen@pangeoinc.com)

Michael H. Xue, P.E.
Principal Geotechnical Engineer
(MXue@pangeoinc.com)

11.0 REFERENCES

ASCE, 2016, *ASCE 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures.*

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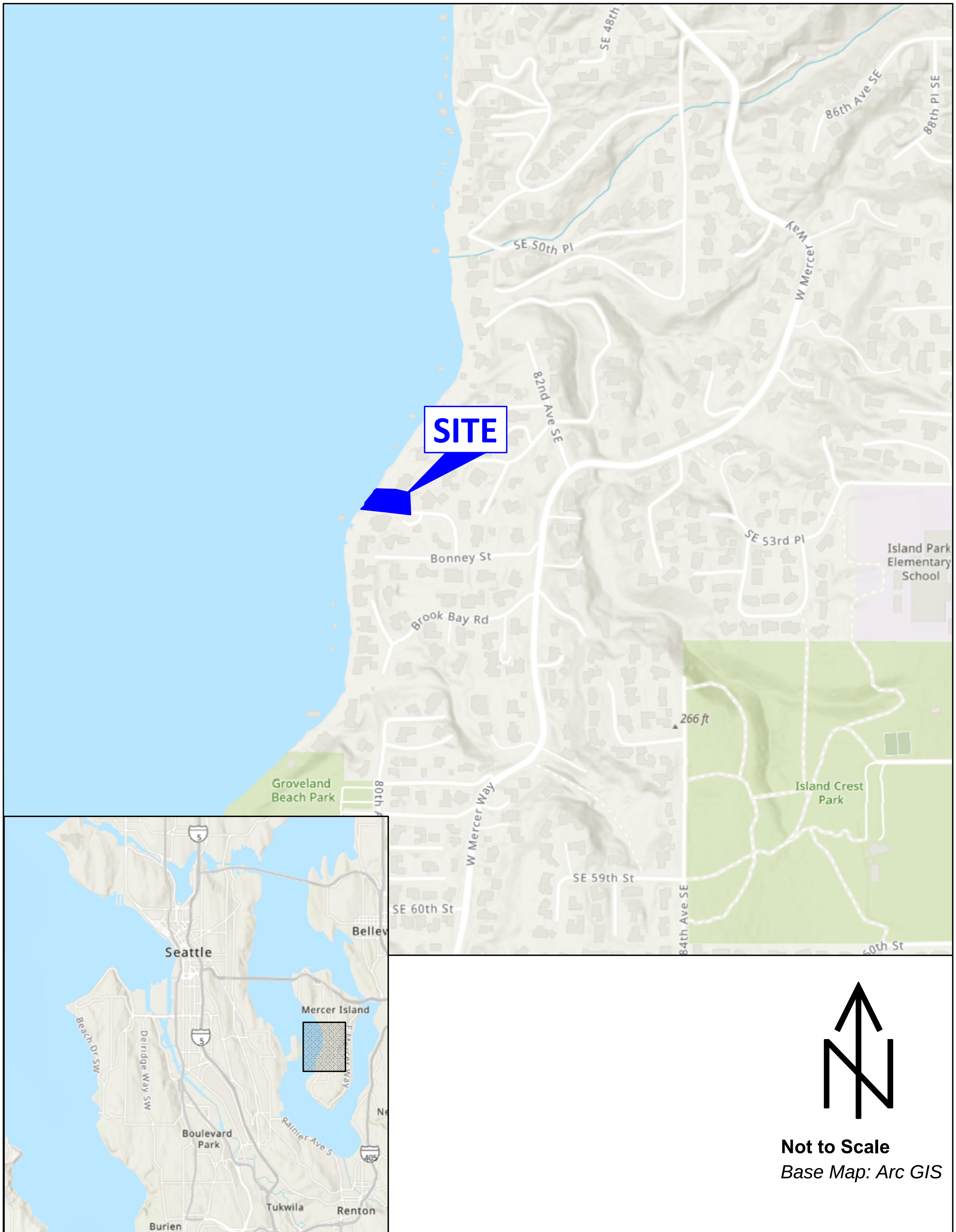

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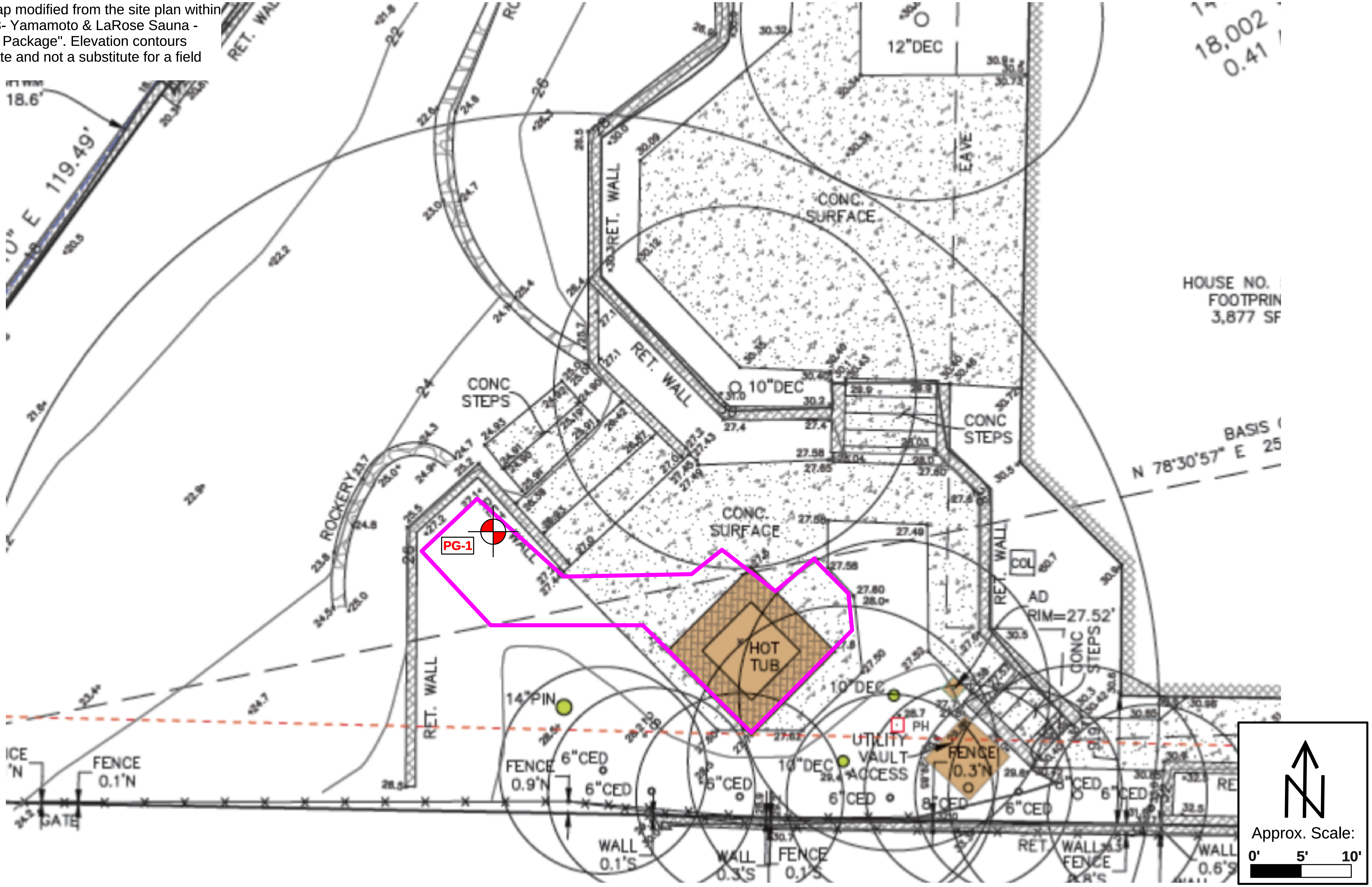
Proposed Sauna
5245 Forest Avenue SE
Mercer Island Wa.

VICINITY MAP

Project No.	25-130	Figure No.	1

Note: Base map modified from the site plan within the "20250403- Yamamoto & LaRose Sauna - Sauna Design Package". Elevation contours are approximate and not a substitute for a field survey.



Legend:

PG-1 Approx. Boring Location *PanGEO, Inc - April 2025*

Approx. Proposed Sauna Outline

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Proposed Sauna
5245 Forest Avenue SE
Mercer Island Wa.

SITE AND EXPLORATION PLAN

Project No.	25-130	Figure No.	2

APPENDIX A

SUMMARY TEST BORING LOG

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
Laminated:	Layers of soil typically 0.05 to 1mm thick, max. 1 cm
Lens:	Layer of soil that pinches out laterally
Interlayered:	Alternating layers of differing soil material
Pocket:	Erratic, discontinuous deposit of limited extent
Homogeneous:	Soil with uniform color and composition throughout
Fissured:	Breaks along defined planes
Slickensided:	Fracture planes that are polished or glossy
Blocky:	Angular soil lumps that resist breakdown
Disrupted:	Soil that is broken and mixed
Scattered:	Less than one per foot
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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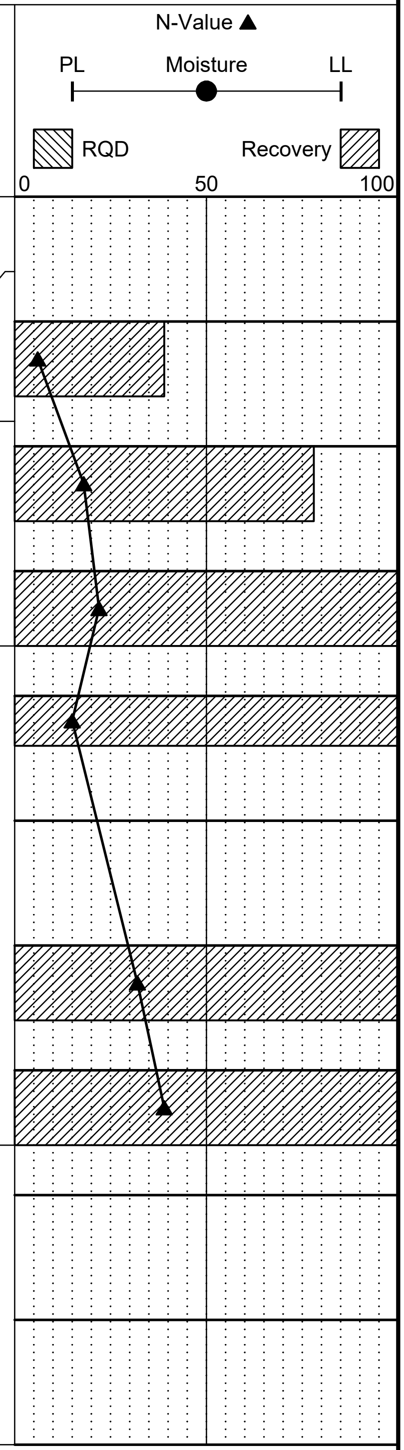
Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	Proposed Sauna	Surface Elevation:	27.5 ft
Job Number:	25-130	Top of Casing Elev.:	N/A
Location:	5245 Forest Ave SE, Mercer Island, WA	Drilling Method:	Portable Acker, hollow stem auger
Coordinates:	Northing: 47.555296, Easting: -122.231677	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						**TOPSOIL** Loose, dark brown to black, silty SAND; moist; organic-rich, numerous roots and rootlets.
2.5	S-1		1 3 3			**FILL** Loose, light brown to gray, silty SAND with gravel; moist, minor iron-oxide staining, disturbed appearance.
5.0	S-2		6 8 10			**LAKE DEPOSITS - Ql** Medium dense, gray, silty SAND, trace gravel; moist to wet. Becomes wet at about 6 feet deep.
7.5	S-3		8 10 12			
10.0	S-4		6 8 7			**PRE-OLYMPIA FINE-GRAINED GLACIAL DEPOSITS - Qpogf** Very stiff, gray to blue-gray CLAY, trace sand and gravel, medium plasticity, wet.
12.5						
15.0	S-5		7 14 18			Becomes hard and moist.
17.5	S-6		9 14 25			
20.0						Boring terminated at 19 feet below ground surface. Groundwater observed from 6 to 15 feet at the time of drilling.
22.5						
25.0						



Completion Depth:	19.0ft
Date Borehole Started:	4/4/25
Date Borehole Completed:	4/4/25
Logged By:	Solomon Clapshaw
Drilling Company:	CN Drilling

Remarks: Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer w/ 30" drop. Hammer operated with a rope and cathead mechanism. Coordinates and elevation are approximate and based on their relative location to known site features. Approximate elevation based on the Site Plan provided by Office of Ordinary Architecture, dated April 4, 2025. **Datum: WSG84/NAVD88.**

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LOG OF TEST BORING PG-1

Figure A-2

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