# GEOTECHNICAL REPORT
## Spring of Life Church Addition
## 4711 116th Street Southwest
## Mukilteo, Washington

PROJECT NO. 21-013
August 2021

Prepared for:
National Design Corp

PanGEO INCORPORATED
*Geotechnical & Earthquake*
*Engineering Consultants*

PanGEO
INCORPORATED
Geotechnical & Earthquake
Engineering Consultants

August 18, 2021
Project No. 21-013

Mr. Forrest Jones
**National Design Corp**
14522 Manor Way
Lynnwood, Washington 98208

**Subject:** **Geotechnical Report**
**Proposed Spring of Life Church Addition**
**4711 116th Street Southwest, Mukilteo, Washington**

Dear Mr. Jones:

As requested, PanGEO completed the excavation of three test pits and has prepared the attached geotechnical report for the planned Spring of Life Church additions at 4711 116th Street Southwest in Mukilteo, Washington. Our services were performed in general accordance with our mutually agreed scope of work outlined in our proposal dated October 6, 2020.

In summary, at our test pit locations, we encountered between two and four feet of fill. Below the fill, we encountered medium dense to very dense silty sandy gravel, which we classified as Vashon till. In our opinion, the planned improvements can be constructed generally as planned, with support for church addition provided using spread footing foundations bearing on competent native soils or on structural fill after overexcavation and replacement of the existing fill.

As part of our scope of services, we attempted to conduct an infiltration test at the site. Due to the presence of low permeability soils below the site, it is unlikely infiltration will be feasible and other methods of disposing of stormwater will need to be considered.

We appreciate the opportunity to assist you with this project. If you have any questions, please call.

Sincerely,

Scott D. Dinkelman, LEG
Principal Engineering Geologist

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## ATTACHMENTS:

# GEOTECHNICAL REPORT
# PROPOSED SPRING OF LIFE CHURCH ADDITION
# 4711 116TH STREET SOUTHWEST
# MUKILTEO, WASHINGTON

## 1.0 INTRODUCTION

As requested, PanGEO, Inc. is pleased to present this geotechnical report to support the design and construction of the proposed addition to the Spring of Life Church at 4711 116$^{th}$ Street Southwest in Mukilteo, Washington. This study was performed in general accordance with our mutually agreed scope of services outlined in our proposal dated October 6, 2020. Our scope of services included reviewing readily available geologic and geotechnical data, conducting a site reconnaissance, excavating three test pits, attempting one infiltration test, and providing geotechnical design recommendations for the proposed church addition as planned.

## 2.0 SITE AND PROJECT DESCRIPTION

The subject site is located at 4711 116$^{th}$ Street Southwest in Mukilteo, Washington, approximately as shown on the attached Figure 1.

The church site is a rectangular-shaped parcel that comprises about 3.7 acres. The site is located in an office park and is bordered to the north, west and east by single story office and light manufacturing buildings and to the south by 116$^{th}$ Street Southwest. In the central portion of the site is an existing one-story church building that is surrounded by asphalt paved parking and drive areas. The attached Figure 2 shows the layout of the site and the locations of the existing structures. Plate 1 on the next page provides an aerial view of the site while Plate 2 provides a ground level view.

The site and surrounding area are relatively flat and have been sloped to drain to an underground storm drainage system. On the east side of the church is an approximately four-foot-high landscaped berm. Site vegetation consists of lawns around the church building and landscaping trees around the perimeter of the site.

We understand it is planned to construct an addition on the west side of the existing church building. The proposed addition will extend about 50 feet in the east-west direction and about 140 feet in the north south direction. The addition will be two stories in height and of lightly loaded wood or metal stud construction with a slab on grade floor. The project will also include the construction of additional asphalt paved surface parking on the east side of the church.

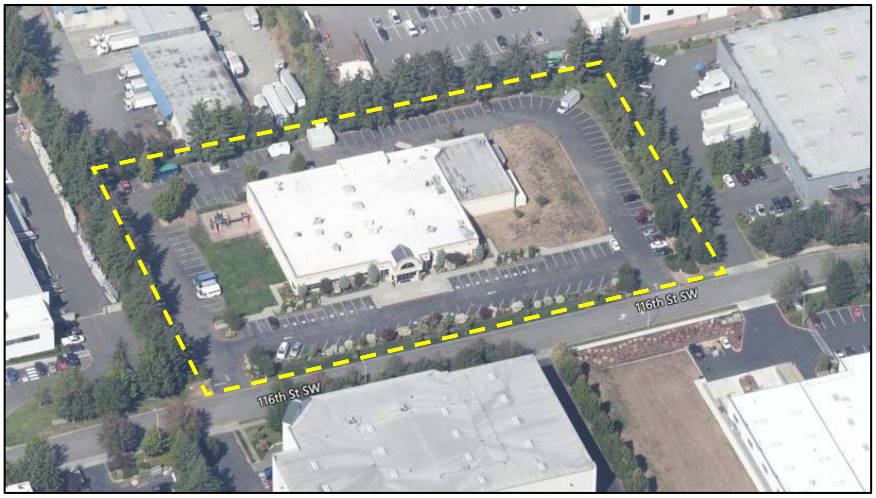



***Plate 1:*** *Oblique aerial view of the site.*

*Looking from south to north.*

*The site is outlined in yellow.*

***Plate 2:*** *Ground level view of the site, looking from the southwest to the northeast.*

*The proposed addition will be located to the left of the church in the photo.*

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

We observed and logged the excavation of three test pits at the site on July 21, 2021. The test pits were excavated using a track-mounted excavator and have been identified as Test Pits TP-1, TP-2, and PIT-1. The field exploration program was overseen by a geologist with our firm who logged and sampled the soils encountered in the test pits. The test pits were excavated to a maximum depth of about eight feet below existing grade. The approximate test pit locations were located in the field relative to the site boundaries and features and are shown on Figure 2, Site and Exploration Plan.

Summary test pit logs are included in Appendix A and provide detailed descriptions of the materials encountered, depths to soil contacts, and depths of seepage or caving, if present. The relative in-situ density of cohesionless soils, or the relative consistency of fine-grained soils, was estimated from the excavating action of the excavator, and the stability of the test pit sidewalls. Where soil contacts were gradual or undulating, the average depth of the contact was recorded on the log.

The soils were logged using the system summarized on Figure A-1, Terms and Symbols for Boring and Test Pit Logs.

## 4.0 SUBSURFACE CONDITIONS

### 4.1 SITE GEOLOGY

General subsurface conditions were evaluated based on our review of the *Distribution and Description of Geologic Map Units in the Mukilteo Quadrangle, Snohomish County, Washington* (Minard, 1982). Based on our review, the primary surficial geologic unit in the vicinity of the site is Vashon till (Geologic Map Unit Qvt). Till typically consists of an unsorted mixture of clay, silt, sand, and gravel deposited directly by a glacier. Till has been glacially overridden, and as such it is typically dense to very dense.

### 4.2 Soils

The following is a generalized description of the soils encountered in the test pits. For a more detailed description of the subsurface conditions encountered at each exploration location for this study, please refer to our test pit logs provided in Appendix A.

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

**Topsoil:** At all of our test pit locations, we encountered a surficial layer of topsoil and sod consisting of dark brown silty fine to medium sand with organics.

**Fill:** Below the topsoil, we encountered loose to medium dense silt fine to sand with gravel. Based on the presence of organic debris, angular gravel, and a reworked texture, we classified this soil as fill. The fill extended to a depth of two to four feet below grade.

**Vashon Till (Qvt)**: Underlying the fill, we encountered medium dense to very dense silty fine to medium sand with trace amounts of gravel and cobbles. We interpret this unit as consistent with Vashon till which is mapped in the vicinity of the site. All of our test pits were terminated in very dense Vashon till.

The test pits excavated for this study were backfilled after the soils were logged. The backfill was tamped with the backhoe bucket and the ground surface leveled. The backfill was not compacted to the requirements of structural fill. During grading, the earthwork contractor should locate the test pits, remove the loose backfill and replace it with structural fill.

Our subsurface descriptions are based on the conditions encountered at the time of our exploration. Soil and rock conditions between our 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.

### 4.3 Groundwater

Groundwater seepage was encountered in Test Pits TP-1 and TP-2 at eight and six feet below grade, respectively. Groundwater was not encountered in PIT-1, which was excavated to about five feet deep. With the proposed construction to occur at or near existing site grades, we do not anticipate that groundwater seepage will result in significant construction related issues.

However, the designers and contractor should be aware there will be fluctuations in groundwater conditions depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, the water level is higher and seepage rates are greater in the wetter, winter months (typically October through May).

## 5.0 INFILTRATION FEASIBILITY

We attempted one infiltration test at the location of Test Pit PIT-1 on the west side of the site. The test was set up in general accordance with the small PIT test method described in the 2014 Washington Department of Ecology Stormwater Management Manual for Western Washington (WDOE Manual) WDOE, 2014) King County Surface Water Design Manual which has been adopted by the City of Mukilteo.

The testing procedure includes a six-hour pre-soak period, during which water was added to Test Pit PIT-1 to maintain a water level of at least 12 inches above the bottom of the test hole. During the pre-soak period we used digital flow meter to monitor the rate and volume of water that was added to the test pit.

Based on flow monitoring during the pre-soak period, we estimated a field infiltration rate of less than 1/4 inch per hour and the infiltration rate was decreasing over time.

Based on the low infiltration rate measured during the pre-soak period it is our opinion the site soils are not suitable for infiltration. In our opinion other non-infiltration stormwater measures should be considered to manage the surface runoff at the site.

## 6.0 GEOTECHNICAL RECOMMENDATIONS

### 6.1 Site Class and Liquefaction

The seismic design of the church addition should be accomplished using the 2018 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 C is appropriate.

***Liquefaction Potential*** **-** Soil liquefaction is a condition where saturated cohesionless soils undergo a substantial loss of strength due to the build-up of excess pore water pressures resulting from cyclic stress applications induced by earthquakes. Soils most susceptible to liquefaction are loose, uniformly graded sands and loose silts with little cohesion. Based on the absence of a defined groundwater table and the presence medium dense to very dense soils, it is our opinion that the susceptibility of the site to earthquake-induced soil liquefaction is considered to be negligible. It is our opinion that special design considerations associated with soil liquefaction are not necessary for this project.

## 6.2 FOUNDATIONS

Based on our understanding of the planned improvements, it is our opinion the proposed church addition may be supported on spread footing foundations bearing on competent native soils or on structural fill. We encountered two to four feet of loose fill at our test pit locations. The fill will not be suitable for direct support of foundation loads and should be overexcavated from footing areas and replaced with structural fill.

### *6.2.1 Allowable Soil Bearing Pressure*

A maximum allowable soil bearing pressure of 3,000 pounds per square foot (psf) may be used for sizing footings for the proposed church. The recommended allowable soil bearing pressure is for dead plus live loads. For allowable stress design, the recommended bearing pressure may be increased by one-third for transient loading, such as wind or seismic forces.

Footings designed and constructed in accordance with the above recommendations should experience total settlement of about one inch and differential settlement of less than ½ inch. Most of the anticipated settlement should occur during construction as dead loads are applied. Continuous footings should have a minimum width of 18 inches while isolated spread footings should have a minimum width of 24 inches.

For frost protection considerations, exterior foundation elements should be placed at a minimum depth of 18 inches below final exterior grade. Interior spread foundations should be placed at a minimum depth of 12 inches below the top of concrete slabs.

### *6.2.2 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 footings bearing on the medium dense to very dense silty sand with gravel soils or on structural fill, a frictional coefficient of 0.35 may be used to evaluate sliding resistance developed between the concrete and the compacted subgrade soil. Passive soil resistance may be calculated using an equivalent fluid weight of 350 pcf, assuming foundations are backfilled with structural fill. The above values include a factor of safety of 1.5. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected.

#### *6.2.3 Foundation Subgrade Preparation*

The existing fill should be overexcavated from the foundation areas. The overexcavation should extend at least one half the depth of the overexcavation beyond the width of the foundation elements.

The prepared foundation subgrade should be in a dense and unyielding condition prior to setting forms and placing rebar. Loose soils encountered at the foundation subgrade elevation should be compacted in-place to the requirements of structural fill. Loose or soft soils that cannot be compacted in-place should be overexcavated and replaced with structural fill.

The adequacy of the footing subgrade soils should be verified by a representative of PanGEO prior to placing forms or rebar.

#### *6.2.4 Perimeter Footing Drains*

Footing drains should be installed around the perimeter of the church, at or just below the invert of the footings and pile caps. 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. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems.

### 6.3 RETAINING WALL DESIGN PARAMETERS

#### *6.3.1 Lateral Earth Pressures*

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.

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, an equivalent fluid pressure of 55 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 height of 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 that a lateral load coefficient of 0.3 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 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 wall foundation. Passive resistance values may be determined using an equivalent fluid weight of 350 pcf. This value includes a factor of safety of 1.5, assuming the footing is backfilled with structural fill and assumes a level condition adjacent to the foundation. A friction coefficient of 0.35 may be used to determine the frictional resistance at the base of the footings. The coefficient includes a factor of safety of 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 of an 18-inch wide zone of free draining granular soils (i.e., pea gravel or washed rock) is recommended to be placed adjacent to the wall for the full height of the wall. Alternatively, a composite drainage material, such as Miradrain 6000, may be used in lieu of the clean crushed rock or pea gravel. The drainpipe at the base of the wall should be graded to direct water to a suitable outlet.

#### *6.3.5 Wall Backfill*

Wall backfill should consist of imported, free draining granular material, such as a soil meeting the requirements of Gravel Borrow as defined in Section 9-03.14(1) of the WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT, 2021). In areas where space is limited between the wall and the face of excavation, pea gravel may be used as backfill without compaction.

The predominately silty sand soil underlying the site is not free draining and would not be suitable for use as wall backfill.

Wall backfill should be moisture conditioned to near optimum moisture content, placed in loose, horizontal lifts less than 8 to 12 inches in thickness, and systematically compacted to a dense and relatively unyielding condition. If density tests will be performed, the test results should indicate at least 95 percent of the maximum dry density, as determined using test method ASTM D-1557. Within 5 feet of retaining walls, the backfill should be compacted with hand-operated equipment to at least 90 percent of the maximum dry density.

### 6.4 Floors Slabs

The floor slabs for the proposed church may be constructed using conventional concrete slab-on-grade floor construction. The floor slabs should be supported on competent native soil or structural fill. Any overexcavation of the existing fill should be backfilled with structural fill.

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

**Table 1 – Capillary Break Gradation**

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

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

Construction joints should be incorporated into the floor slab to control cracking.

Waterproofing and damp proofing measures are the responsibility of the owner.

### 6.5 Permanent Cut and Fill Slopes

Based on the anticipated soil that will be exposed in the planned excavation, we recommend permanent cut and fill slopes be constructed no steeper than 2H:1V (Horizontal:Vertical).

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, including flattening of slopes or installation of surface or subsurface drains.

Permanently exposed slopes should be seeded with an appropriate species of vegetation to reduce erosion and improve stability of the surficial layer of soil.

## 7.0 EARTHWORK CONSIDERATIONS

### 7.1 Stripping and Proofrolling

Building, pavement and areas to receive structural fill should be stripped and cleared of existing pavement, surface vegetation, organic matter, and other deleterious material. Existing utility pipes to be abandoned should be plugged or removed so they do not provide a conduit for water and cause soil saturation and stability problems.

In no case should the stripped materials be used as structural fill or mixed with material to be used as structural fill. The stripped materials may be "wasted" on site in non-structural landscaping areas or they should be exported.

Following the stripping operation and excavations necessary to achieve construction subgrade elevations, the ground surface where structural fill, foundations, slabs, or pavements are to be placed should be observed by a representative of PanGEO. Proofrolling may be necessary to identify soft or unstable areas. Proofrolling should be performed under the observation of a representative of PanGEO. Soil in loose or soft areas, if re-compacted and still yielding, should be overexcavated and replaced with structural fill to a depth that will provide a stable base beneath the general structural fill. The optional use of a geotextile fabric placed directly on the overexcavated surface may also help to bridge unstable areas.

### 7.2 Structural Fill and Compaction

Structural fill, should be free of organic and inorganic debris, be near the optimum moisture content and be capable of being compacted to the recommendations provided below. If the site soils cannot be compacted, then an imported structural fill may be needed. Fill for use during wet weather should consist of a well graded soil free of organic material with less than 5 percent fines (silt and clay sized particles passing the U.S. No. 200 sieve) based on the fraction passing the ¾-inch sieve.

Structural fill should be moisture conditioned to near their optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and compacted to at least 95 percent maximum density, determined using ASTM D-1557 (Modified Proctor).

The procedure to achieve proper density of a compacted fill depends on the size and type of compaction equipment, the number of passes, thickness of the lifts being compacted, and certain soil properties. 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.

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 aerated during dry weather, moisture conditioned by mixing with drier materials, or other methods.

### 7.3 Material Reuse

The native soils underlying the site primarily consist of silty sand. These soils are moisture sensitive and will become disturbed and soft when exposed to inclement weather conditions. We do not recommend planning to re-use the site soils as structural fill.

### 7.4 Temporary Excavations

We anticipate the excavation for this project will be relatively minor, and likely will be limited to footing excavations for the at-grade building and trenching for utilities. Temporary excavations should be constructed in accordance with Part N of the WAC (Washington Administrative Code) 296-155. The contractor is responsible for maintaining safe excavation slopes and/or shoring.

Based on the soil conditions encountered at our test pit locations, in our opinion temporary excavations may be cut at a maximum 1H:1V inclination. Trench boxes may be used to support trench excavations for utilities.

Temporary excavations should be evaluated in the field during construction based on actual observed soil conditions. If seepage is encountered, excavation slope inclinations may need to be reduced. During wet weather, the cut slopes may need to be flattened to reduce potential erosion or should be covered with plastic sheeting.

### 7.5 Pavement Recommendations

Vehicle traffic will primarily consist of passenger vehicles and occasional delivery and service trucks. Based on the anticipated traffic and the subsurface conditions, it is our opinion a minimum pavement section consisting of two inches of hot mixed asphalt (HMA) over six inches of crushed surfacing base course (CSBC) will be adequate for areas subjected to passenger vehicle traffic. In areas where delivery or services vehicles will access the site, the pavement section should consist of three inches of HMA over six inches of CSBC.

The performance of the site pavements will be related in part to the condition of the underlying subgrade. The pavement subgrade should be proofrolled using a fully loaded dump truck to identify soft and yielding areas. Soft areas identified by proofrolling should be overexcavated and replaced with structural fill.

The uppermost 12 inches of subgrade, the granular subbase, and the aggregate base should be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D 1557, Modified Proctor. Due to the moisture sensitive nature of the near surface soils at the site, localized removal and recompaction of the subgrade may be required in order to be able to compact the uppermost 12 inches to 95 percent of the maximum dry density.

Subgrade drainage is an important factor that will enhance the pavement performance. Subgrade surfaces below the pavement structural sections should be sloped to direct runoff to suitable collection points and to prevent ponding. Concrete curbs separating pavement from landscape areas should extend at least 6 inches below subgrade surfaces to reduce the potential for the migration of moisture from the landscaped areas through the aggregate base-course layers.

### 7.6 Wet Weather Construction

The soils underlying the site are moisture sensitive. These soils will become disturbed and soft when exposed to inclement weather conditions and construction traffic. To avoid disturbance, construction traffic should refrain from travelling on prepared native subgrade soils during wet weather.

General recommendations relative to earthwork performed in wet weather or in wet conditions are presented below. The following procedures are best management practices recommended for use in wet weather construction:

- 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 the 0.75-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 installed at strategic locations around the site to control erosion and the movement of soil.
- Excavation slopes and soils stockpiled on site should be covered with plastic sheeting.

### 7.7 Erosion 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 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.

Surface gradients and drainage systems should be incorporated into the design such that surface runoff is collected and directed away from the structure to a suitable outlet. Potential issues associated with erosion may also be reduced by establishing vegetation within disturbed areas immediately following grading operations.

## 8.0 ADDITIONAL SERVICES

To confirm that our recommendations are properly incorporated into the design and construction of the proposed development, PanGEO should be retained to conduct a review of the final project plans and specifications, and to monitor the construction of geotechnical elements. PanGEO can provide you a cost estimate for construction monitoring services at a later date.

## 9.0 LIMITATIONS

We have prepared this report for use by National Design Corp, Spring of Life Church and their designers and consultants. Conclusions and recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, 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 locations of 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.

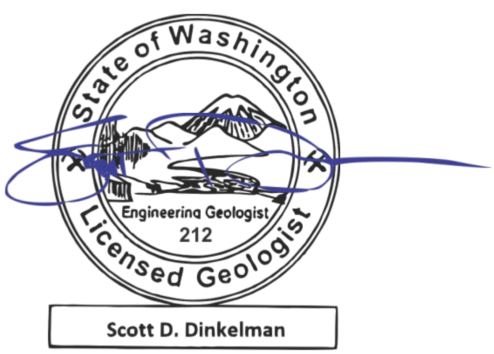
This report has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

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 this report.

We appreciate the opportunity to be of service.

Sincerely,





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## 10.0 REFERENCES

International Code Council, 2018, *International Building Code (IBC), 2018.*

Minard, J.P., 1982, *Distribution and Description of Geologic Units in the Mukilteo Quadrangle, Washington*: U.S. Geological Survey Miscellaneous Field Studies Map MF-1438, scale 1:24,000.

Washington State Department of Ecology, 2014, *Stormwater Management Manual for Western Washington*.

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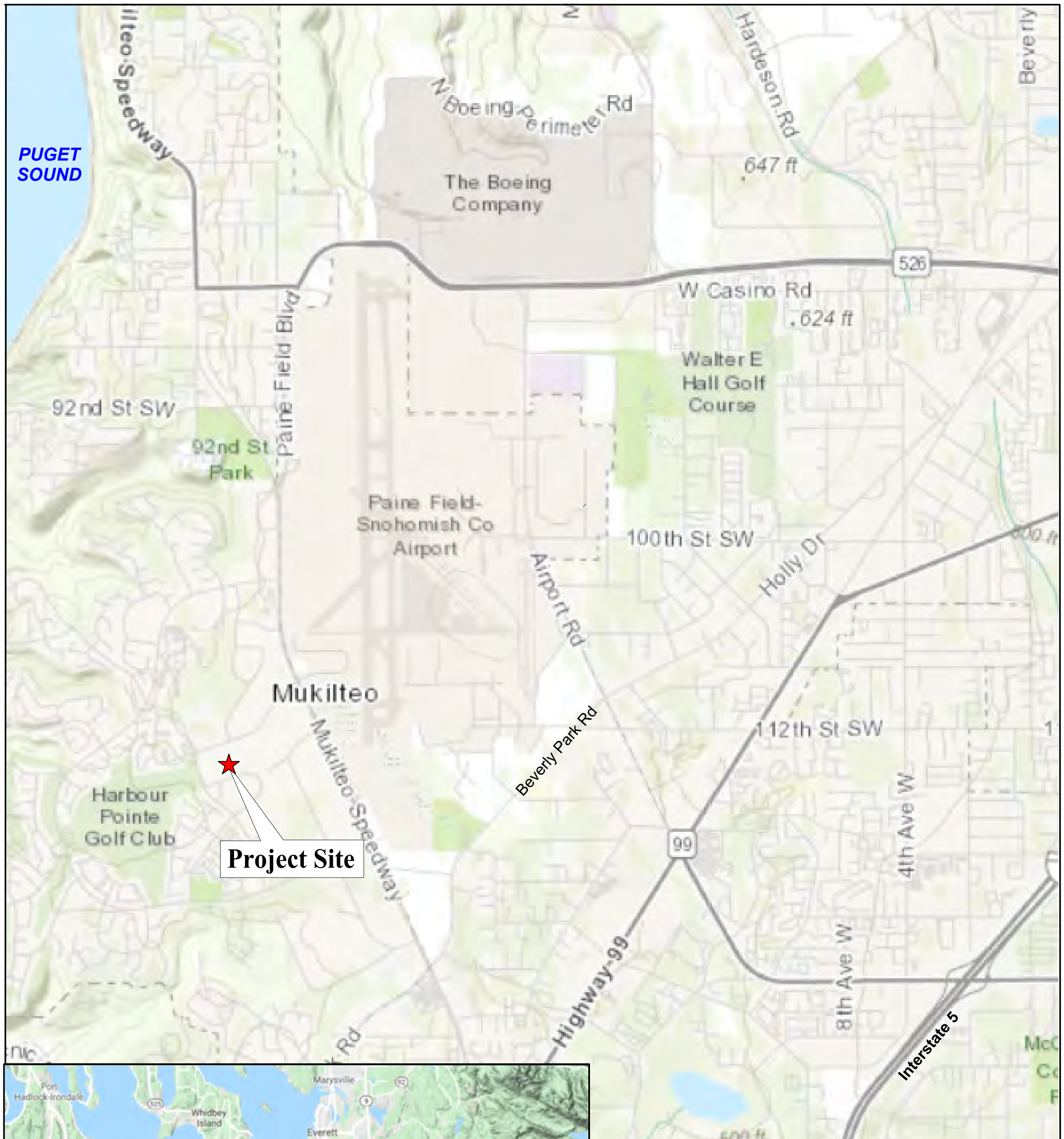
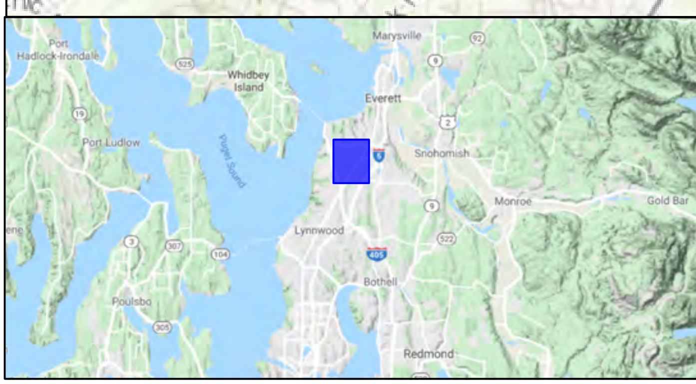


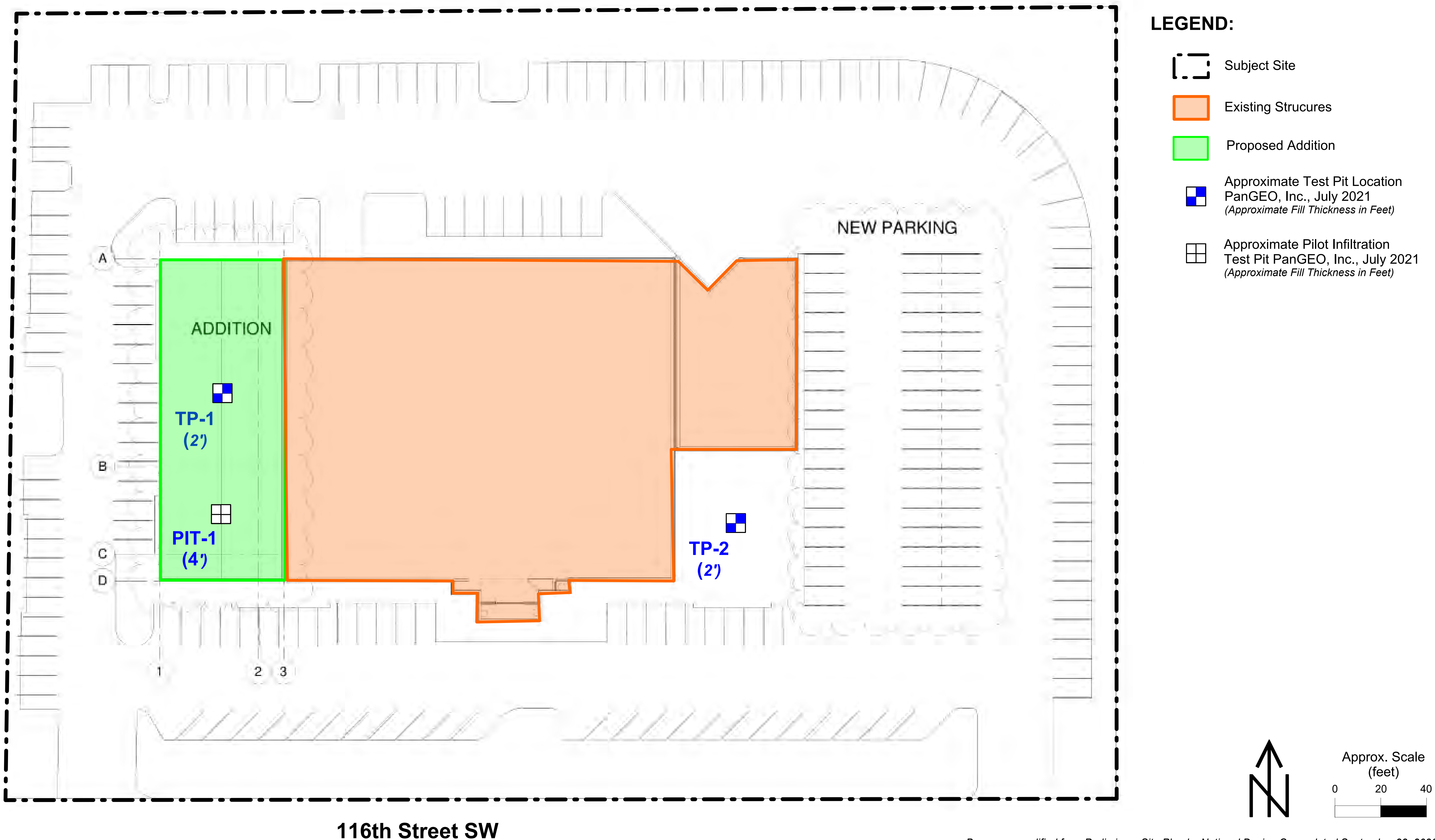

*Base Map: ESRI Topographic*

NORTH

**Approx. Scale: Not to Scale**



| PanGEO INCORPORATED | Spring of Life Church Addition<br>4711 116th Street SW<br>Mukilteo, WA | VICINITY MAP | |
|---|---|---|---|
| | | Project No. **21-013** | Figure No. **1** |




*Base map modified from Preliminary Site Plan by National Design Corp., dated September 22, 2020*

| PanGEO INCORPORATED | Spring of Life Church Addition 4711 116th Street SW Mukilteo, WA | SITE AND EXPLORATION PLAN |
|---|---|---|
| | | Project No. 21-013 · Figure No. 2 |

21-013 Fig 2 Site and Exploration Plan.grf 8/18/21 (10:48:37) SPS

# APPENDIX A
# SUMMARY TEST PIT LOGS

## RELATIVE DENSITY / CONSISTENCY

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

## UNIFIED SOIL CLASSIFICATION SYSTEM

| MAJOR DIVISIONS | | GROUP DESCRIPTIONS | |
|---|---|---|---|
| Gravel<br>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<br>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<br>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 |
|---|---|
| Boulder: | > 12 inches |
| Cobbles: | 3 to 12 inches |
| Gravel | |
| Coarse Gravel: | 3 to 3/4 inches |
| Fine Gravel: | 3/4 inches to #4 sieve |
| Sand | |
| Coarse Sand: | #4 to #10 sieve (4.5 to 2.0 mm) |
| Medium Sand: | #10 to #40 sieve (2.0 to 0.42 mm) |
| Fine Sand: | #40 to #200 sieve (0.42 to 0.074 mm) |
| 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**

## Test Pit PIT-1

Location: 329496, 1281208 (WA State Plane North)
Approximate ground surface elevation: 514 feet (NAVD88 – Google Earth)

| **Depth (ft)** | **USCS** | **Material Description** |
|---|---|---|
| 0 – 0.5 | Topsoil | **Topsoil**<br>Approximately 6 inches of topsoil and sod |
| 0.5 – 4.0 | SM | **Fill**<br>Loose to medium dense, dark brown to blue-gray, silty fine SAND; trace gravel and cobble, trace angular cobbles, organic odor; non-plastic, moist<br>- *Heavy organic layer, burnt wood, roots from 3- to 4-feet* |
| 4.0 – 5.0 | SM | **Vashon Till - Qvt**<br>Dense to very dense, gray-brown to gray, silty fine to medium SAND; trace gravel and cobble; non-plastic, moist |


**Photo PIT-1:** Image of Test Pit PIT-1;Approximately 5 feet below grade during prior to infiltration testing

Test Pit PIT-1 was excavated to 5 feet for infiltration testing
Groundwater was not encountered during exploration.

## Test Pit TP-1

Location: 329550, 1281190 (WA State Plane North)
Approximate ground surface elevation: 514 feet (NAVD88 – Google Earth)

| **Depth (ft)** | **USCS** | **Material Description** |
|---|---|---|
| 0 – 0.5 | Topsoil | **Topsoil**<br>Approximately 6 inches of topsoil and sod above: |
| 0.5 – 3.0 | SM | **Fill**<br>Loose to medium dense, light brown, silty fine to medium SAND; trace gravel and cobble, some iron-oxide staining, trace roots and rootlets; reworked texture; non-plastic, moist |
| 3 – 10 | SM | **Vashon Till - Qvt**<br>Dense to very dense, gray-brown to gray, silty fine to medium SAND; trace gravel and cobble; trace iron-oxide staining; non-plastic, moist to wet<br>- *Top 1-foot weathered with some iron-oxide staining* |


*(Left)* Image of Test Pit TP-1; Approximately 10 feet in depth


*(Right)* Soils from Test Pit TP-1 from approximately 10 feet below grade

Test Pit TP-1 was excavated to approximately 10 feet below ground surface.
Groundwater seepage was encountered during exploration at approximately 8 feet below grade.

## Test Pit TP-2

Location: 329581, 1281415 (WA State Plane North)
Approximate ground surface elevation: 514 feet (NAVD88 – Google Earth)

| **Depth (ft)** | **USCS** | **Material Description** |
|---|---|---|
| 0 – 0.5 | Topsoil | **Topsoil**<br>Approximately 6 inches of topsoil and sod |
| 0.5 – 2.0 | SM | **Fill**<br>Medium dense, gray-brown to light brown, silty fine to medium SAND; trace gravel and cobble, some iron-oxide staining, till-like; non-plastic, dry |
| 2.0 – 8.0 | SM | **Vashon Till - Qvt**<br>Dense to very dense, gray-brown to gray, silty fine to medium SAND; trace gravel and cobble; iron-oxide staining; non-plastic, moist to wet<br>- *Top 1-foot weathered with some iron-oxide staining* |


*(Left)* Image of Test Pit TP-2; at approximately 8 feet in depth


*(Right)* Soils from Test Pit TP-2 from approximately 8 feet below grade

Test Pit TP-3 was excavated to approximately 8 feet below ground surface.
Groundwater seepage was encountered during exploration at approximately 6 feet below grade.

**Test Pit Explorations:** July 21, 2021 with a Caterpillar 305.5 Rubber Tracked Excavator
**Test Pit Logged by:** Spenser P. Scott