CITY OF MUKILTEO

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GEOTECHNICAL REPORT

PROPOSED THREE LOT SHORT PLAT

608 Third Avenue

Mukilteo, Washington

PROJECT NO. 21-315

September 2021

Prepared for:

Mr. Donovan Pittman

PanGEO INCORPORATED

Geotechnical & Earthquake Engineering Consultants

PanGEO
INCORPORATED
Geotechnical & Earthquake
Engineering Consultants

September 7, 2021
PanGEO Project No. 21-315

Mr. Donovan Pittman
608 Third Street
Mukilteo, Washington 98275

Subject: **Geotechnical Report**
Proposed Three Lot Short Plat
608 Third Street, Mukilteo, Washington

Dear Mr. Pittman:

As requested, PanGEO, Inc. is pleased to present this geotechnical report to assist the project team with the proposed short plat and future residence construction at 608 Third Street in Mukilteo, Washington.

In preparing this report, we observed and logged the drilling of three borings and conducted our engineering analyses. In summary, at our boring locations, we encountered fill overlying medium stiff to hard and dense to very dense native soils. Future buildings can be supported on conventional footings bearing on the undisturbed competent native soil or on structural fill.

We appreciate the opportunity to be of service. Should you have any questions, please do not hesitate to call.

Scott D. Dinkelman, LEG
Principal Engineering Geologist
SDinkelman@pangeoinc.com

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ATTACHMENTS:

GEOTECHNICAL REPORT
PROPOSED THREE LOT SHORT PLAT
608 THIRD STREET
MUKILTEO, WASHINGTON

1.0 GENERAL

As requested, PanGEO, Inc. is pleased to present this geotechnical report to assist the project team with the proposed three lot short plat at 608 Third Street in Mukilteo, Washington. This study was performed in general accordance with our mutually agreed scope of services outlined in our proposal dated June 23, 2021. Our scope of services included reviewing readily available geologic maps, drilling three borings, conducting a site reconnaissance, performing our engineering evaluation, and preparing this report.

2.0 SITE AND PROJECT DESCRIPTION

The subject site is located at 608 Third Street in Mukilteo, Washington, approximately as shown on Figure 1, *Vicinity Map.*

The subject site is located at 608 Third Street in Mukilteo, Washington. The irregular-shaped site comprises 36,532 square feet and extends about 388 feet in the north-south direction and 130 feet in the east-west direction. The site is bordered to the north by tracks for Burlington Northern Railroad (BNRR), to the east by the right of way for State Route 525, to the south by a residence and Third Avenue and to the west by a residence. In the central portion of the property is an existing two-story residence. The east central portion of the site contains a detached garage. The layout of the site is shown on the attached Figure 2, *Site and Exploration Plan.*

The site slopes down gently from the southeast to the northwest. Along the north side of the site is a 12- to 14-foot-high slope that descends to the BNRR tracks at a gradient of 35 to 45 percent. The north slope is vegetated with grass and deciduous trees. On the east side of the site is a 20- to 26-foot-high slope that ascends to the elevation of State Route 525 (Mukilteo Speedway). The east slope has gradients of 55 to 70 percent and is vegetated with ivy. Plate 1 on the next page is an aerial view of the site.

We understand it is planned to short plat the site into three lots, west, central, and east. The west lot will be sold and eventually developed with a future residence. The central lot will contain the existing residence. The east lot will include the area of the existing garage which will be demolished, and the lot developed with a new residence. We anticipate the future residences will be three stories in height and of relatively lightly loaded wood-frame construction with slab-on-grade floors.

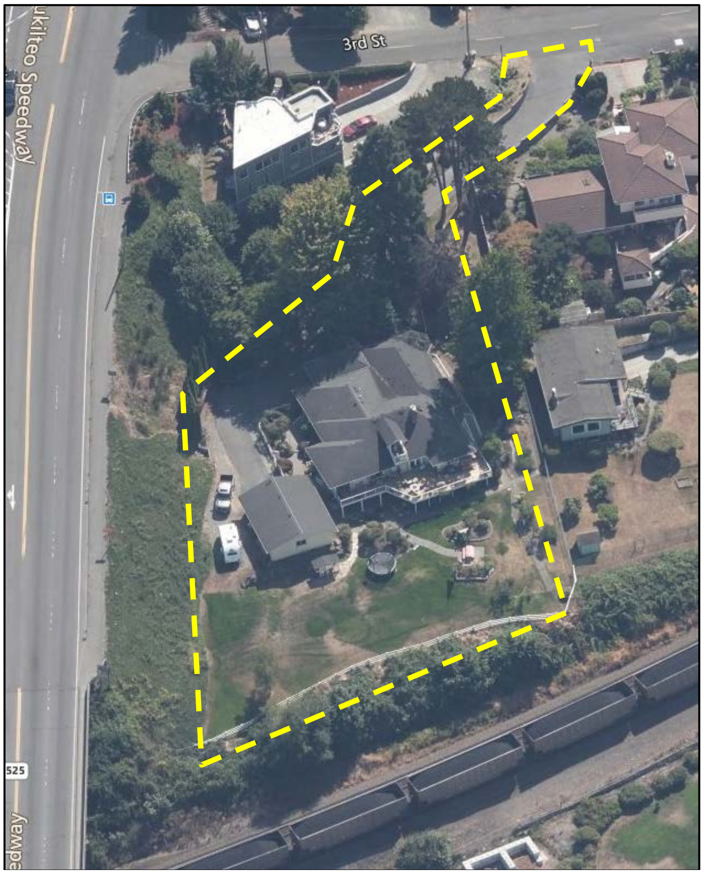


Plate 1: *Aerial view of the site looking.*

North is at the bottom of the image.

The existing residence and detached garage area visible in the central portion of the image.

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 drilled three borings at the site on July 20, 2021. The borings were drilled using a limited access drill rig equipped with 8-inch outside diameter hollow stem augers. The borings extended to a maximum depth of 16½ feet below existing grade and were logged by a geologist from PanGEO. The approximate boring locations were established in the field by measuring from site features and are shown on Figure 2.

Standard Penetration Tests (SPT) were performed in the borings at 2½- to 5-foot depth intervals using a standard, 2-inch diameter split-spoon sampler. The sampler was advanced with a 140-pound drop hammer falling a distance of 30 inches for each strike, in general accordance with ASTM D-1586, *Standard Test Method for Penetration Test and Split Barrel Sampling of Soils*.

The soils were logged in general accordance with the system summarized on Figure A-1, Terms and Symbols for Boring and Test Pit Logs included in Appendix A. The boring logs are include as Figures A-2 through A-4 in Appendix A.

4.0 SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

Regional geologic information for the project area was obtained by reviewing the *Distribution and Description of Geologic Map Units in the Mukilteo Quadrangle, Snohomish County, Washington* (Minard, 1982). Based on our review of the map, near-surface deposits in the vicinity of the site consist of Quaternary-aged deposits known as transitional beds (Qtb) and the Whidbey formation (Qw).

Transitional beds consist of glacial and non-glacial deposits and are comprised of clay, silt and fine to very fine sand. These sediments were deposited in lakes and fluvial systems and have been glacially overridden. As such they are typically hard or dense to very dense.

The Whidbey formation consists of cross-bedded medium to coarse grained sand. This deposit has also been glacially overridden and is dense to very dense.

4.2 SOILS

Based on review of the Web Soil Survey (NRCS, 2021) the site is mapped as being underlain by Everett gravelly sandy loam, 0 to 8 percent slopes. Everett soils developed in glacial outwash and are somewhat excessively drained. This soil has a slight erosion hazard.

4.3 Soil Conditions

For a detailed description of the subsurface conditions encountered at each exploration location, please refer to our boring logs provided in Appendix A. The stratigraphic contacts indicated on the boring logs represent the approximate depth to boundaries between soil units. Actual transitions between soil units may be more gradual or occur at different elevations. The descriptions of groundwater conditions and depths are likewise approximate. The following is a generalized description of the soils encountered in the borings.

Topsoil: At the locations of borings PG-2 and PG-3 we encountered a surficial layer of topsoil. The topsoil was about six inches thick and consisted of very loose silty sand with organics.

Fill: Below the topsoil in borings PG-2 and PG-3 and from existing grade at boring PG-1, we encountered fill. The fill consisted of loose silty fine to medium sand and extended to depths of 4 to 7½ feet below grade. The fill generally became thicker from south to north.

Transitional Beds (Qtb): Below the fill, we encountered stiff to hard sandy silt and medium dense to very dense silty sand. We interpret these soils to be consistent with the transitional beds geologic unit which is mapped in this area.

All three borings were terminated in very dense or hard soil.

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

4.4 Groundwater

Perched groundwater seepage was encountered in our borings at 7½ to 26½ feet below grade. With groundwater seepage this depth and the anticipated future construction to occur at or near existing site grades, we do not anticipate that groundwater seepage will be a significant construction related issue.

With the planned construction to take place at or near existing site grades, we do not anticipate that groundwater seepage will be a significant construction related issue.

The designer and contractor should be aware that groundwater levels will fluctuate depending on the season and precipitation. Typically, groundwater levels are higher and seepage rates are greater during the wet season (October through May).

5.0 GEOLOGICALLY SENSITIVE AREAS CONSIDERATIONS

Geologically sensitive areas are defined in City of Mukilteo Municipal Code Chapter 17, Section 17B.52A.020 as those areas susceptible to erosion, sliding, earthquake, or other geological events and conditions. The City's designates geologically sensitive areas as the following:

A. Areas subject to erosion rated moderate to severe or higher by the U.S. Department of Agriculture's Natural Resource Conservation Service;

B. Areas subject to erosion caused by streams, surface drainage, or along the shoreline;

C. Areas within a stream's channel migration zone;

D. Areas mapped on the city of Mukilteo's Landslide Hazard Map having a moderate or higher rating;

E. Areas that are found to have, based on a site specific inspection, all of the following characteristics:

1. Springs or ground water seepage;

2. Hillsides showing intersecting geologic contacts; and

3. Slopes steeper than fifteen percent; fifteen-foot rise over one-hundred-foot run.

F. Areas that are underlain or covered by mass wastage debris or landslide materials;

G. *Areas of known landslides, earth movement, or containing evidence of past landslides or earth movement;*

H. *Areas of steep slopes; slopes that have forty percent (forty percent or a twenty-two-degree angle) or steeper gradients and having a vertical relief greater than ten feet, excluding constructed slopes;*

I. *Areas subject to liquefaction due to soil type and/or location or seismically induced ground disturbance such as surface rupture, fissuring, and lateral spreading;*

J. *Areas that have soil types that fall within soil category II or III per the Preliminary Surficial Geologic Map of the Mukilteo and Everett Quadrangles, Snohomish County, Washington, 1976; and/or*

K. *Areas that are subject to tsunami wave action.*

5.1.1 Map Review

To evaluate the geologically sensitive areas at the subject site, we reviewed the *Distribution and Description of Geologic Map Units in the Mukilteo Quadrangle, Snohomish County, Washington* (Minard, 1982), landslide inventory mapping for the site area compiled by the Washington Department of Natural Resources (DNR, 2021). And soil maps for the site.

Based on our review, no landslide features or mass wasting debris are mapped in this area.

Based on our review of the Soil Survey (NRCS, 2021) the site is mapped as underlain by Everett very gravelly sandy loam, 0 to 8 percent slopes. This soil has a slight erosion hazard.

We also reviewed LiDAR (Light Detection and Radar) imaging for the site accessed through the Washington Department of Natural Resources LiDAR Portal. LiDAR is a remote sensing technique that is used to produce high-resolution elevation data for use in mapping applications. LiDAR mapping was most recently compiled for the area including the subject site in 2016. Our review did not identify geomorphic features at the site that are consistent with landslides, such as arcuate shaped scarps or bowl-shaped depressions.

5.1.2 Site Reconnaissance

We conducted a reconnaissance of the site and site slopes on July 20, 2021 while conducting our field exploration. The purpose of our reconnaissance was to review the condition of the site slopes and identify indications of historical landslide features, scarps, bowl-shaped topography, hummocky topography, distressed vegetation and leaning or pistol butted trees.

The weather at the time our reconnaissance was fair and dry and visibility of the ground surface was good. Based on our observations of ground features and the results of our review and field explorations, it is our opinion the site slopes in the area of the planned improvements are globally stable in their current configuration. We did not observe indications of slope movement and we did not note the presence of groundwater seepage or springs. The site is also not subject to rapid stream incision or undercutting by wave action.

5.1.3 Tsunami Hazard

In order to evaluate the tsunami hazard, we reviewed of the *Tsunami Hazard Maps of the Puget Sound and Adjacent Waters—Model Results from an Extended L1 Mw 9.0 Cascadia Subduction Zone Megathrust Earthquake Scenario* (Dolcimascolo, 2021). Based on review of the map, the Puget Sound shoreline about 700 to 800 feet north and west of the site would be subject to inundation in a magnitude 9.0 subduction zone megathrust earthquake, but not the subject site.

5.1.4 Topography Review

The site does contain 40 percent and steeper slopes that are more than 10 feet in height. These slopes are located on the north and east sides of the site and the lateral extent of the slopes are approximately shown on the attached Figure 2.

The north slope is parallel to the Burlington Northern Railroad tracks and has a uniform gradient. In our boring PG-3 drilled at the top of the north slope, we encountered about 7½ feet of fill. Plate 2 on the next page shows an image of the north slope.

The slope on the east side of the site also has a uniform gradient with topographic contours parallel to the alignment of State Route 525 (Mukilteo Speedway).

Based on the uniform grade of the slopes and the alignment of the slopes parallel to existing structures, it is our opinion that the east and north slopes are constructed slopes and, as such, would not meet the criteria for a geologically sensitive area.

Construction Setbacks: Although the steep slopes do not appear to meet the City of Mukilteo definition of a geologically sensitive area, in our opinion a setback should still be established from the slopes. We recommend a building setback based on a 2H:1V (Horizontal:Vertical) line extending into the site from the top of the east slope and the toe of the west slope.

Plate 2: *View of the north slope. The Burlington Northern tracks are visible in the upper right corner.*

6.0 GEOTECHNICAL RECOMMENDATIONS

6.1 Site Class And Liquefaction

The seismic design 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). It is our opinion that Site Class D is appropriate for the encountered soil conditions.

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 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, and be below the groundwater table.

Based on the presence of medium stiff to hard sandy silt and medium dense to very dense silty sand and the absence of an established groundwater table below the site, it is our opinion the susceptibility of the site to earthquake-induced soil liquefaction is low and special design considerations associated with soil liquefaction are not necessary for this project.

6.2 BUILDING FOUNDATIONS

Based on our understanding of the planned improvements, it is our opinion the proposed future residences may be supported on spread footing foundations bearing on competent native soils or on structural fill. We encountered four to five feet of loose fill at PG-1 and PG-3, in the area of the proposed future residences. The fill will not be suitable for direct support of foundation loads and should be over-excavated from footing areas and replaced with structural fill.

6.2.1 Allowable Soil Bearing Pressure

A maximum allowable soil bearing pressure of 2,500 pounds per square foot (psf) may be used for sizing footings for the future residences. 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 0.30 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 300 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 Floors Slabs

The floor slabs for the proposed residence may be constructed using conventional concrete slab-on-grade floor construction. The floor slab should be supported on at least 12 inches of structural fill. Any over-excavations, if needed, should be backfilled with structural fill.

Interior concrete slab-on-grade floors should be underlain by a capillary break. 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.

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

6.4 Retaining Wall Design Parameters

6.4.1 Retaining Walls

Retaining walls should be designed to resist the lateral earth pressures exerted by the soils behind the walls. 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 that the backfill behind the walls consists of a free draining and properly compacted fill with adequate drainage provisions.

6.4.2 Surcharge

Surcharge loads, where present, should also be included in the design of retaining walls. A lateral load coefficient of 0.4 should be used to compute the lateral pressure on the wall face resulting from surcharge loads located within a horizontal distance of one-half the wall height.

6.4.3 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. 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.

6.4.4 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. pea gravel or washed rock) is recommended to be placed adjacent to the wall for the full height of the wall. Alternatively, a composite drainage material, such as Miradrain 6000, may be used in lieu of the clean crushed rock or pea gravel. The drainpipe at the base of the wall should be graded to direct water to a suitable outlet.

6.4.5 Wall Backfill

Wall backfill should consist of imported, free draining granular material 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.

In our opinion, the site soils contain more than five percent fines (silt and clay sized particles passing the US No. 200 Sieve) 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. Adequacy of the compaction should be evaluated by PanGeo personnel. 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 the wall, the backfill should be compacted with hand-operated equipment to at least 90 percent of the maximum dry density.

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.

In our experience, 2H:1V and steeper slopes are significantly more likely to experience erosion or sloughing during the first winter season, until vegetation is well established. Aggressive erosion control measures, including utilization of plastic sheeting are sometimes needed to reduce excessive erosion.

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 TEMPORARY EXCAVATIONS

Temporary excavations should be constructed in accordance with Part N of WAC (Washington Administrative Code) 296-155. The contractor is responsible for maintaining safe excavation slopes and/or shoring. It is our opinion temporary excavations underlying native soils may be cut at a maximum 1H:1V inclination.

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.

7.2 STRUCTURAL FILL AND COMPACTION

Structural fill, should be free of organic and inorganic debris, be near the optimum moisture content, and capable of being compacted to the recommended requirements described below. The native soils that underlie the site would be suitable for use as structural fill during dry weather. Fill for use during wet weather should consist of a granular fill consisting of well graded material free of organic material, with less than 5 percent fines (that portion of the soil that passes the US No. 200 sieve).

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 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 compacting 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 dried as necessary, or moisture conditioned by mixing with drier materials, or other methods.

7.3 Material Reuse

The native soils underlying the site are moisture sensitive, and will become disturbed and soft when exposed to inclement weather conditions. We do not recommend reusing the native soils as structural fill.

If it is planned to use the native soil as structural fill in non-structural areas, the excavated soil should be stockpiled and protected with plastic sheeting to prevent it from becoming saturated by precipitation or runoff.

7.4 Wet Weather Construction

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.

7.5 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.

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 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 buildings, PanGEO should be retained to conduct a review of the final project plans and specifications, and to monitor the construction of geotechnical elements. The City of Mukilteo, as part of the permitting process, will also require geotechnical construction inspection services. PanGEO can provide you a cost estimate for construction monitoring services at a later date.

9.0 CLOSURE

We have prepared this report for Mr. Donovan Pittman and the project design team. 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 services.

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 services 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.

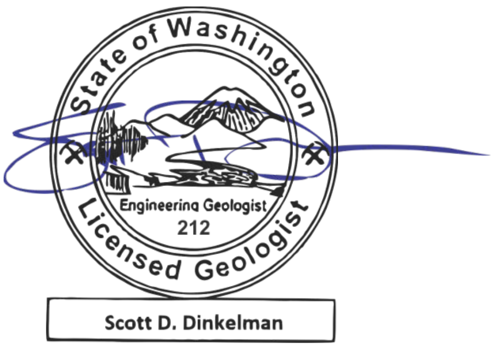
This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. 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 this report.

Sincerely,

PanGEO, Inc.



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10.0 REFERENCES

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Base Map: Snohomish County SCOPI Map

NORTH

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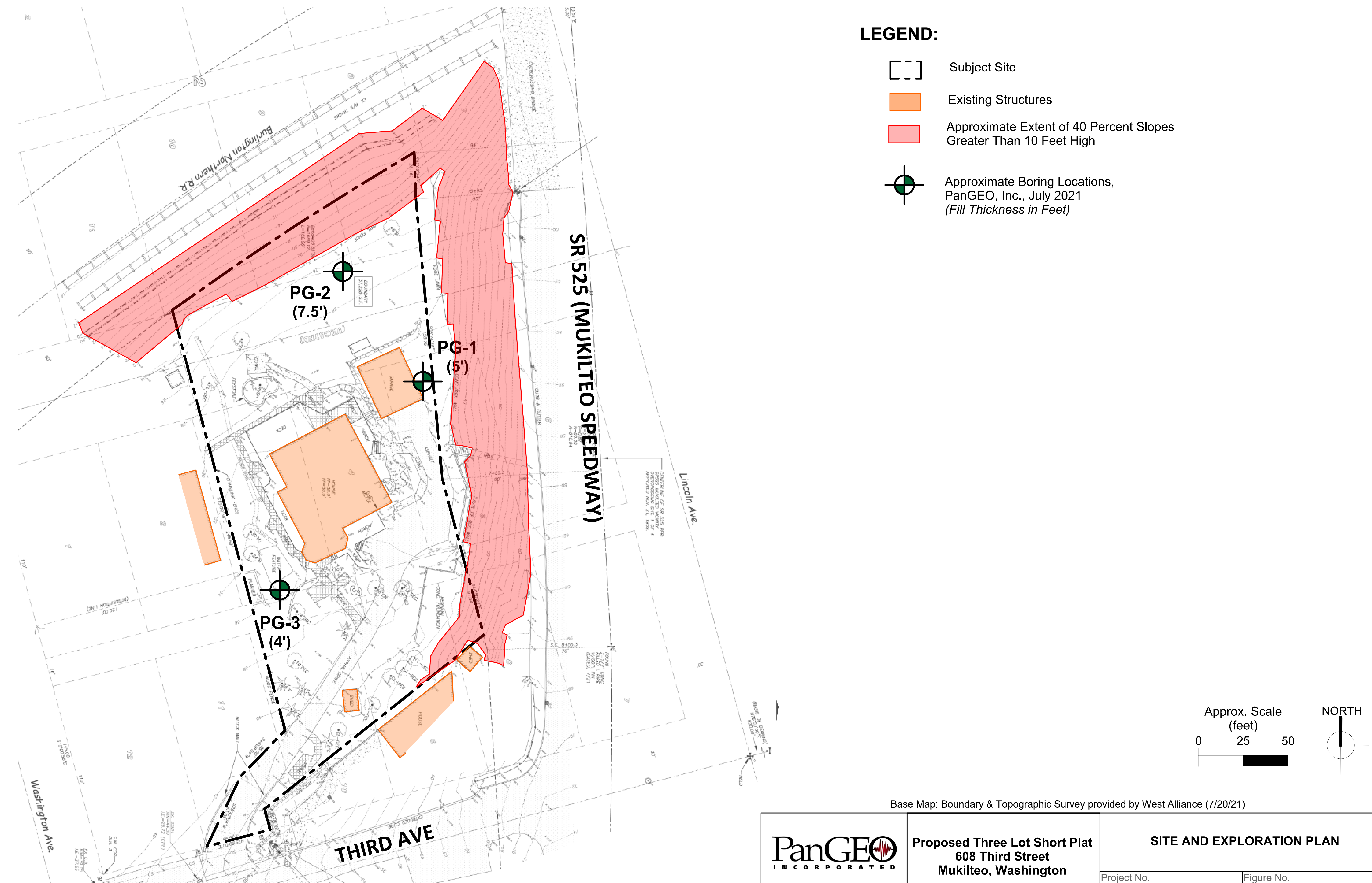
PanGEO INCORPORATED

Proposed Three Lot Short Plat
608 Third Street
Mukilteo, Washington

VICINITY MAP

Project No. **21-315** Figure No. **1**



Base Map: Boundary & Topographic Survey provided by West Alliance (7/20/21)

PanGEO INCORPORATED	Proposed Three Lot Short Plat 608 Third Street Mukilteo, Washington	SITE AND EXPLORATION PLAN
		Project No. 21-315 / Figure No. 2

13-011_Fig 2 Site & Exploration Plan.grf 9/3/21 JCR

APPENDIX A

SUMMARY BORING LOGS

RELATIVE DENSITY / CONSISTENCY

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

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)	GW	Well-graded GRAVEL
		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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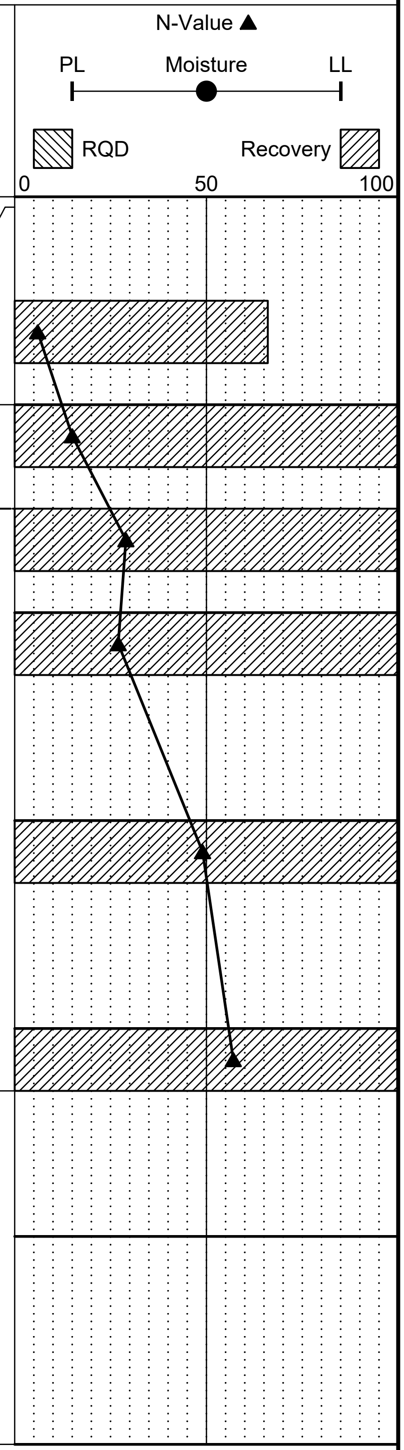
Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	Proposed Three Lot Short Plat	Surface Elevation:	~33 feet
Job Number:	21-315	Top of Casing Elev.:	Not Applicable
Location:	608 Third Street, Mukilteo, Washington	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						~3 inches of gravel.
						[FILL] Loose, brown to gray, silty fine to medium SAND with trace gravel; moist .
	S-1	SPT	3 3 3			--trace organics, light iron oxide staining.
5	S-2	SPT	7 9 6			**[TRANSITIONAL BEDS]** Stiff to very stiff, brown to gray, sandy SILT; moist, light iron oxide staining.
	S-3	SPT	8 13 16			Very stiff, gray, sandy SILT with trace gravel; moist. -- becomes brown to gray at tip of Sample S-3.
10	S-4	SPT	6 9 18			--increase in silty sand lenses.
15	S-5	SPT	18 25 24			--becomes hard.
20	S-6	SPT	45 28 29			
						Boring was terminated at an approximate depth of 21.5 feet below ground surface (bgs). Wet sand seam encountered at an approximate depth of 11.5 feet at the time of drilling.
25						
30						



		Remarks
Completion Depth:	21.5ft	Remarks: Standard Pentration Test (SPT) sampler driven with a 140-lb. safety hammer. Hammer operated with a rope and cathead mechanism. Boring drilled using a RCT 60 Track Drill. Surface elevation estimated based Boundary and Topographic Survey provided by West Alliance (7/20/2021).
Date Borehole Started:	7/20/21	
Date Borehole Completed:	7/20/21	
Logged By:	R. Ragudos	
Drilling Company:	Boretec 1, Inc	

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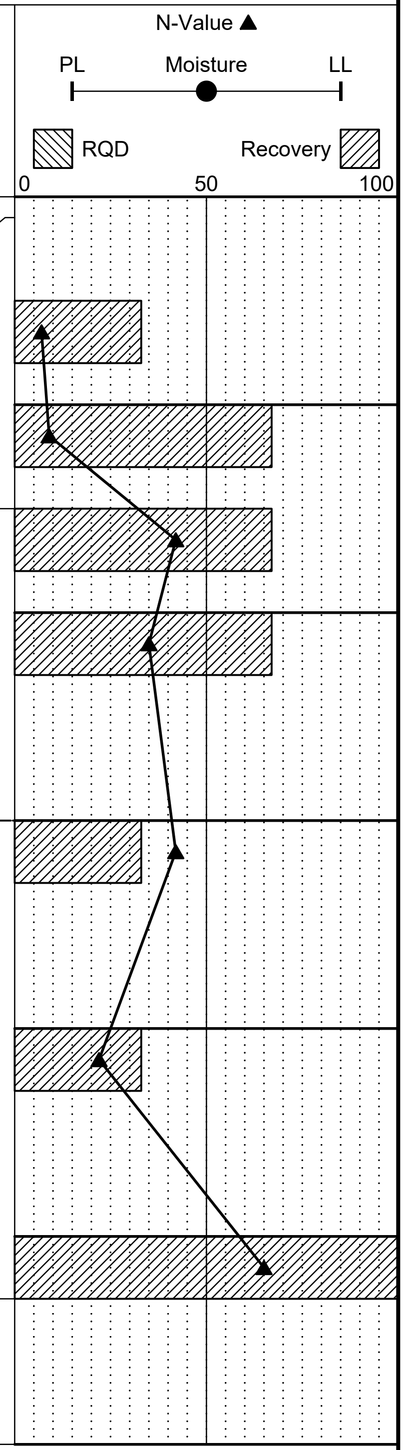
LOG OF TEST BORING PG-1

Figure A-2

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

Project:	Proposed Three Lot Short Plat	Surface Elevation:	~26 feet
Job Number:	21-315	Top of Casing Elev.:	Not Applicable
Location:	608 Third Street, Mukilteo, Washington	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						~6 inches of topsoil.
						[FILL] Loose, brown to gray, silty fine to medium SAND with trace gravel; moist, light iron oxide staining .
	S-1		8 4 3			
5	S-2		3 3 6			
	S-3		16 26 16			**[TRANSITIONAL BEDS]** Hard, brown to gray, sandy SILT; moist, light iron oxide staining.
10	S-4		16 15 20			--silt lens observed.
15	S-5		16 18 24			Dense to very dense, gray, silty fine to medium SAND with trace gravel; moist.
20	S-6		12 12 10			--wet sand seams observed.
25	S-7		15 23 42			
						Boring was terminated at an approximate depth of 26.5 feet below ground surface (bgs). Wet sand seams observed between 17.5 to 20 feet bgs at the time of drilling.
30						



Completion Depth:	26.5ft
Date Borehole Started:	7/20/21
Date Borehole Completed:	7/20/21
Logged By:	T. Townsend
Drilling Company:	Boretec 1, Inc

Remarks: Standard Pentration Test (SPT) sampler driven with a 140-lb. safety hammer. Hammer operated with a rope and cathead mechanism. Boring drilled using a RCT 60 Track Drill. Surface elevation estimated based Boundary and Topographic Survey provided by West Alliance (7/20/2021).

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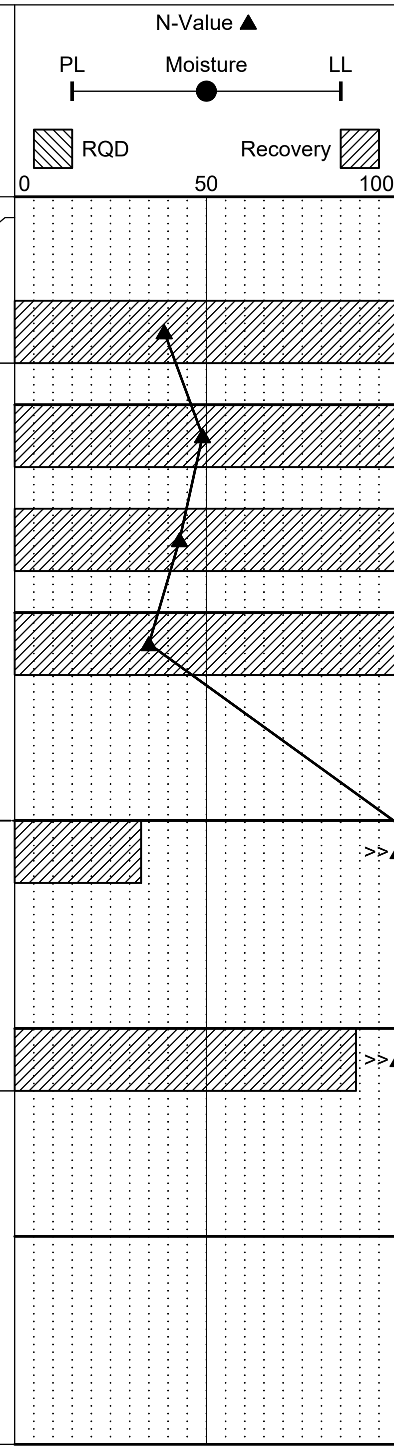
LOG OF TEST BORING PG-2

Figure A-3

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

Project:	Proposed Three Lot Short Plat	Surface Elevation:	~35 feet
Job Number:	21-315	Top of Casing Elev.:	Not Applicable
Location:	608 Third Street, Mukilteo, Washington	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						~6 inches of topsoil.
						[FILL] Brown to gray, silty fine to medium SAND with trace gravel; moist, light iron oxide staining .
	S-1		12 17 22			
						[TRANSITIONAL BEDS] Medium dense to dense, brown, fine to medium silty SAND and trace gravel; moist, light iron oxide staining.
5	S-2		15 24 25			
	S-3		9 24 19			--wet sand seams observed.
10	S-4		7 12 23			
15	S-5		50/6			Hard, gray, sandy SILT with trace gravel; moist.
20	S-6		40 21 50/4			--silt lens observed.
						Boring was terminated at an approximate depth of 21.5 feet below ground surface (bgs). Wet sand seams observed between 7.5 to 10 feet bgs at the time of drilling. Used post hole digger to about 2.5 feet due to possible utilities.
25						
30						



Completion Depth:	21.3ft
Date Borehole Started:	7/20/21
Date Borehole Completed:	7/20/21
Logged By:	T. Townsend
Drilling Company:	Boretec 1, Inc

Remarks: Standard Pentration Test (SPT) sampler driven with a 140-lb. safety hammer. Hammer operated with a rope and cathead mechanism. Boring drilled using a RCT 60 Track Drill. Surface elevation estimated based Boundary and Topographic Survey provided by West Alliance (7/20/2021).

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LOG OF TEST BORING PG-3

Figure A-4

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