GEOTECHNICAL REPORT

Suzuki Residential Development
Kitsap County Parcel Number 222502-4-006-2005
Bainbridge Island, Washington

Prepared for: Olympic Property Group

Project No. 150365-02 • November 5, 2018 Final

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1 Introduction

This report presents the results of Aspect Consulting, LLC’s (Aspect) geotechnical engineering study for the proposed Suzuki residential development (Project). The Project is located on Kitsap County Parcel No. 222502-4-006-2005, located at the southeast corner of the intersection of NE New Brooklyn Road and Sportsman Club Road NE in Bainbridge Island, Washington (Site), as shown on Figure 1, Site Location Map. We performed a background review, a subsurface exploration program, and geotechnical engineering evaluation in accordance with our agreed upon revised scope of work dated April 9, 2018 and authorized by you on August 6, 2018. We also performed a Phase 1 Environmental Site Assessment (ESA) in support of the proposed Project. The details of the Phase 1 ESA are in a separate report.

1.1 Scope of Services

Our geotechnical scope of work included gathering and reviewing existing subsurface information near the Site, a geologic reconnaissance, subsurface characterization through excavated test pits and hand tool explorations, performing laboratory testing of soils, completing geotechnical engineering analyses, and preparing this report. This report includes:

- Site and project description
- Distribution and characteristics of subsurface soils and groundwater
- Seismic design considerations in accordance with the 2015 International Building Code (IBC)
- Slope stability analysis of the moderately steep slope along the western edge of the Site and associated design criteria and construction considerations
- Suitable shallow foundation types and allowable soil bearing pressure(s)
- Geotechnical design criteria for short retaining walls
- A general (qualitative) assessment of stormwater infiltration potential at the Site
- Pavement design recommendations
- Site preparation recommendations and general construction recommendations

1.2 Project Description

Current Project plans include construction of 18 single-family residences and 7 multi-family residential buildings (attached townhomes) with associated infrastructure including new utilities, parking areas, and open spaces. The development is planned on about 4.2 acres across the northern half of the Site with 0.7 acres designated in a reserve development area. The southern half of the Site, about 9 acres, will remain undeveloped, designated open space to protect the existing pond, wetlands, and mature trees. The
southern area of the Site will also include the creation of a 300-foot-wide wildlife corridor.

In general, the Site slopes down to the west. The City of Bainbridge Island’s (City) Critical Areas Ordinance (CAO) map designates the area west of the planned development area as a Moderate Slope (15 to 40 percent) (COBI, 2018a). Based on the City’s Municipal Code related to Moderate Slopes, there is no standard setback or buffer, but a geotechnical engineering evaluation is required to assess the stability of the slope as they relate to the Project and develop appropriate design recommendations to mitigate any identified geologic hazards (COBI, 2018b).
2  Surface Conditions

We assessed the surface conditions of the Site, including any geologic hazards present, through a literature review and geologic reconnaissance with field observations. Site visits were performed on August 14, 17, 20, and 21, 2018.

2.1 Site Conditions and Topography

The Site is bordered by NE New Brooklyn Road to the north, Sportsman Club Road NE to the west, single-family residential properties to the south, and an access roadway to the maintenance facility for the Bainbridge Island School District to the east. A concrete sidewalk runs along the north side of the Site and a gravel, recreational trail runs along the west and east sides of the Site. The access roadway for the maintenance facility is paved at the northeast portion of the Site but becomes a gravel road about 300 feet to the south of NE New Brooklyn Road.

The Site is relatively level with gentle undulations on the eastern 500 feet of the Site at an average Elevation 215 feet (North American Vertical Datum 88, [NAVD88]). The western portion of the Site slopes moderately down from east to west from about Elevation 215 down to about Elevation 175 feet along Sportsman Club Road NE. The lowest area of the Site is at the southwest corner at Elevation 145 feet. The highest area of the Site is at the southeast corner at Elevation 240 feet. (AGO, 2018).

The Site topography, proposed development areas, select existing features, and the locations of our subsurface explorations are shown on Figure 2, Site Exploration Plan.

2.2 Drainage

During our Site visits in August, we did not observe any standing water or surface water flow across the Site. It is our understanding that seasonal water flow is observed west of the proposed development area, however, we did not observe flow or evidence of flowing water due to the vegetation growth. Surface drainage conditions will vary with fluctuations in precipitation, Site usage (such as irrigation), and off-Site land use.

2.3 Vegetation

The Site has two distinct areas of vegetation. The northern area, roughly the area of the proposed development area, is vegetated with a dense array of evergreen trees with up to approximately 1-foot diameter at breast height (DBH). The understory in this area is almost nonexistent, with fallen tree trunks, limbs, and moss comprising the groundcover. The southern area and the moderate slope in the western portion of the Site are vegetated with young to mature coniferous and deciduous trees with an established and relatively dense understory of woody shrubs and herbaceous ground cover. In general, the mature coniferous trees on and near the moderate slope were relatively straight.
3 Subsurface Conditions

Subsurface conditions at the Site were inferred from our review of applicable geologic literature, our completed field explorations, and our experience with the local geology.

3.1 Geologic Setting

The Site is located within the Puget Lowland, a broad area of tectonic subsidence flanked by two mountain ranges: the Cascades to the east and the Olympics to the west. The sediments within the Puget Lowland are the result of repeated cycles of glacial and nonglacial deposition and erosion. The most recent cycle, the Vashon Stade of the Fraser Glaciation (about 13,000 to 16,000 years ago), is responsible for most of the present day geologic and topographic conditions. During the Vashon Stade, the 1,000-foot-thick, Cordilleran Glacier advanced into the Puget Lowland. As the Cordilleran Glacier advanced southward, lacustrine and fluvial sediments were deposited in front of the glacier. Preglacial and proglacial sediments were overridden and consolidated by the advancing glacier, creating dense and hard soil deposits. At the interface between the advance soils and the glacial ice, the Cordilleran Glacier sculpted and smoothed the surface, and then deposited a consolidated basal till. As the Cordilleran Glacier retreated northward from Puget Lowlands to British Columbia, it left an unconsolidated sediment veneer over glacially consolidated deposits.

The geologic map of the Site (Haugerud and Troost, 2011) indicates that the Site is underlain by Vashon till (Qvt). Vashon till is the basal material deposited at the base of the Cordilleran Glacier. Therefore, it was overridden and compacted by glacial ice, creating a dense/hard configuration. Vashon till is described as a matrix-supported, dense, sandy diamict composed of a mixture of silt, sand, and gravel.

3.2 Subsurface Explorations

Aspect completed 12 test pits, TP-01 through TP-12, on August 20 and 21, 2018 at the locations indicated on Figure 2. The test pits were terminated between 5 and 13 feet below the existing ground surface (bgs). We also completed a hand exploration, HE-13, on September 20, 2018 at the location shown on Figure 2 that was terminated 3.2 feet bgs. We advanced dynamic cone penetrometer tests (DCPTs) at various depths to determine the relative density of encountered soils. A summary of the subsurface conditions encountered is described below. For a detailed description, the test pit logs and hand exploration log are presented in Appendix A of this report. Soils were classified per the Unified Soil Classification System (USCS) in general accordance with the American Society for Testing and Materials International (ASTM) D2488, Standard Practice for Description and Identification of Soils (Visual and Manual Procedure) (ASTM, 2018). A key to the symbols and terms used on the logs is provided on Figure A-1.

Our subsurface explorations encountered a thin layer of surficial material including topsoil and fill underlain by the Vashon till in agreement with the geologic map (Haugerud and Troost, 2011). The topsoil and fill did not extend deeper than 0.5 feet bgs.
3.2.1 Topsoil
Topsoil refers to a loose layer of soil that forms at the ground surface and contains a high percentage of organics. We encountered 0.2 to 0.5 feet of topsoil at the ground surface in all explorations except TP-03. The topsoil consisted of loose, dark brown, SILTY SAND WITH GRAVEL (SM) and numerous roots.

3.2.2 Fill
Fill refers to material placed by human activities. We encountered a 0.5-feet-thick layer of fill at the ground surface in TP-03. The fill consisted of loose, dark brown, SANDY SILT WITH GRAVEL (ML), with trash debris such as cans, bottles, and metal car parts.

The fill has moderate to high compressibility and low shear strength. Due to the significant fines content, the fill has moderate to high moisture sensitivity.

3.2.3 Vashon Till
Vashon till was encountered underlying the topsoil or fill in all of the explorations. All twelve test pits and the hand exploration were terminated in the Vashon till between 3 and 13 feet bgs. The Vashon till primarily consisted of SILTY SAND WITH GRAVEL (SM) with fine to coarse sand, gravel, cobbles, and rare boulders up to 1.3 feet in diameter. We encountered a medium dense to dense, weathered interval in every exploration in the upper 2 to 2.5 feet bgs. The underlying unweathered Vashon till was very dense and the gravels were socketed into the silty sand matrix. We observed 0.5 to 1.5 of horizontal sidewall caving in the weathered Vashon till, whereas the sidewall below the weathered interval remained vertical during the advancement of the explorations. The weathered Vashon till was also brown yellow to light brown in color, while the unweathered Vashon till was light gray to light brown.

In three of the test pits in the southern portion of the Site, TP-03, TP-07, and TP-08, we encountered a lens within the Vashon till unit layer consisting of very dense, moist, light gray SILT (ML). Test pits TP-03 and TP-07 were terminated in this material, however, in test pit TP-08, we observed this material from 2.5 to 6 feet bgs. Test pit TP-03 encountered this silt layer from 6.5 to 12 feet bgs. Test pit TP-07 encounter this silt layer from 9 to 13 feet bgs.

The DCPT results in the weathered Vashon till typically ranged from 9 to 13 blows per 1.75 inches and in the unweathered Vashon till exceeded 30 blows per 1.75 inches. The unweathered Vashon till possesses low compressibility and high shear strength characteristics. It also has low to moderate moisture sensitivity due to the presence of silt in the unit and low permeability.

3.3 Groundwater
We did not encounter any groundwater or seepage in our test pit explorations. We anticipate that a perched groundwater (above the unweathered Vashon till) condition develops during the wet, winter months. A perched groundwater condition occurs when water percolates into the shallow subsurface and collects on relatively impermeable materials. The topsoil, fill, and lower density, weathered Vashon till are considered low permeability, while the deeper, very dense Vashon till is essentially impermeable.
Groundwater conditions at the Site will vary with fluctuations in precipitation, Site usage (such as irrigation), and off-Site land use.

### 3.4 Geotechnical Laboratory Results

Laboratory tests were conducted on select samples to characterize engineering and index properties of the Site soils, and the results are presented in Tables 1 and 2 below. Aspect completed one grain size distribution and three fines content tests, while two additional grain size distribution tests were completed by others. The natural moisture contents of these soil samples were also determined. The tables below contain summaries of the results from the grain size distributions and fines content along with soil type based on the USCS and the geologic classification. The natural moisture contents are presented on the test pit logs. The test methodology and results of all the laboratory testing are presented in Appendix B.

<table>
<thead>
<tr>
<th>Exploration Number</th>
<th>Sample Depth (feet bgs)</th>
<th>Percent Gravel</th>
<th>Percent Sand</th>
<th>Percent Fines</th>
<th>Moisture Content (percent)</th>
<th>USCS</th>
<th>Geologic Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP-02</td>
<td>2.5 – 3</td>
<td>43</td>
<td>43</td>
<td>14</td>
<td>7</td>
<td>SP</td>
<td>Vashon till</td>
</tr>
<tr>
<td>TP-08</td>
<td>0.3 - 2.5</td>
<td>5.3</td>
<td>49.8</td>
<td>44.9</td>
<td>N/R</td>
<td>SM</td>
<td>Weathered Vashon till</td>
</tr>
<tr>
<td>TP-08</td>
<td>2.5 – 4.5</td>
<td>0</td>
<td>29.4</td>
<td>70.6</td>
<td>N/R</td>
<td>ML</td>
<td>Vashon till</td>
</tr>
</tbody>
</table>

**Notes:**
- USCS = Unified Soil Classification System
- bgs = below ground surface
- N/R = not reported

<table>
<thead>
<tr>
<th>Exploration Number</th>
<th>Sample Depth (feet bgs)</th>
<th>Percent Fines</th>
<th>Moisture Content (percent)</th>
<th>Geologic Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP-03</td>
<td>11 - 11.5</td>
<td>91</td>
<td>24</td>
<td>Vashon till</td>
</tr>
<tr>
<td>TP-07</td>
<td>9.5 - 10</td>
<td>92</td>
<td>33</td>
<td>Vashon till</td>
</tr>
<tr>
<td>TP-08</td>
<td>5 - 5.5</td>
<td>97</td>
<td>26</td>
<td>Vashon till</td>
</tr>
</tbody>
</table>

**Notes:**
- bgs = below ground surface
4 Seismic Design Considerations

4.1 Earthquake Engineering

The Site is located within the Puget Lowland physiographic province, an area of active seismicity that is subject to earthquakes on shallow crustal faults and deeper subduction zone earthquakes. The Site lies about 1 mile north of the Seattle fault zone, which consists of shallow crustal tectonic structures that are considered active (evidence for movement within the Holocene [since about 15,000 years ago]) and is believed to be capable of producing earthquakes of magnitude 7.3 or greater. The recurrence interval of earthquakes on this fault zone is believed to be on the order of a thousand years or more. The most recent large earthquake on the Seattle fault occurred about 1,100 years ago (Pratt et al., 2015). There are also several other shallow crustal faults in the region capable of producing earthquakes and strong ground shaking.

The Site area also lies within the zone of strong ground shaking from earthquakes associated with the Cascadia Subduction Zone (CSZ). Subduction zone earthquakes occur due to rupture between the subducting oceanic plate and the overlying continental plate. The CSZ can produce earthquakes up to magnitude 9.3 and the recurrence interval is thought to be on the order of about 500 years. A recent study estimates the most recent subduction zone earthquake occurred around 1700 (Atwater et al., 2015).

Deep intra-slab earthquakes, which occur from tensional rupture of the sinking oceanic plate, are also associated with the CSZ. An example of this type of seismicity is the 2001 Nisqually earthquake. Deep intra-slab earthquakes typically are magnitude 7.5 or less and occur approximately every 10 to 30 years.

The following sections present descriptions of seismic design considerations for the Project.

4.1.1 Ground Response

The International Building Code (IBC) seismic design is based on the “Maximum Considered Earthquake (MCE)” with a 2 percent probability of exceedance (PE) in 50 years (2,475-year return period) (ICC, 2015). The U.S. Geological Survey (USGS, 2017) has completed probabilistic ground motion studies and maps for Washington. The various ground motions are determined by the regional seismicity and the Site Class. The Site Class accounts for the seismic response of the soil profile and is based on the density and stiffness of the soil profile underlying the Site. The Site Class can be correlated to the estimated average shear wave velocity, standard penetration resistance (NSPT), or undrained shear strength in the upper 100 feet of the soil profile. The Site Class definitions are shown on Table 3 below.
Table 3. Seismic Site Class Definitions

<table>
<thead>
<tr>
<th>Site Class</th>
<th>Soil Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Hard Rock</td>
</tr>
<tr>
<td>B</td>
<td>Rock</td>
</tr>
<tr>
<td>C</td>
<td>Very Dense Soil or Soft Rock</td>
</tr>
<tr>
<td>D</td>
<td>Stiff Soil</td>
</tr>
<tr>
<td>E</td>
<td>Soft Clay Soil</td>
</tr>
<tr>
<td>F</td>
<td>Soils Requiring Site Response Analysis (i.e. Liquefiable Soils)</td>
</tr>
</tbody>
</table>

Based on our characterization of the subsurface conditions, which include very dense soils that are anticipated to perform well during earthquakes, a Site Class C should be assumed for the Site.

Seismic design should be completed with the specific ground motion parameters listed in Table 4 below.

Table 4. Seismic Design Parameters

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Recommended Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Class</td>
<td>C</td>
</tr>
<tr>
<td>Peak Ground Acceleration (PGA)</td>
<td>0.575g(1)</td>
</tr>
<tr>
<td>Short Period Spectral Acceleration (Sₚ)</td>
<td>1.397g</td>
</tr>
<tr>
<td>1-Second Period Spectral Acceleration (S₁)</td>
<td>0.550g</td>
</tr>
<tr>
<td>Site Coefficient (Fₛ)</td>
<td>1.0</td>
</tr>
<tr>
<td>Site Coefficient (Fᵥ)</td>
<td>1.3</td>
</tr>
<tr>
<td>Design Short Period Spectral Acceleration (Sₛₛ)</td>
<td>0.931g</td>
</tr>
<tr>
<td>Design 1-Second Period Spectral Acceleration (Sₛ₁)</td>
<td>0.476g</td>
</tr>
</tbody>
</table>

Notes:
1) G = Gravitational force
2) Based on the latitude and longitude of the Site: 47.64249°N, 122.52795°W
3) The risk category used was I/II/III

4.1.2 Surficial Ground Rupture
A trace of an east-west trending thrust fault zone (Seattle fault zone) projects through Bainbridge Island, with the nearest known active fault trace mapped approximately 1 mile south of the Site (USGS, 2010). The recurrence interval of earthquakes on this fault zone is believed to be on the order of a thousand years or more. The most recent large earthquake on the Seattle fault occurred about 1,100 years ago. Due to the suspected long recurrence interval and the proximity of the Site from the mapped fault trace, the potential for surficial ground rupture at the Site is considered low during the expected life of the Project.
4.1.3 *Seismically Induced Liquefaction*

Liquefaction occurs when loose, saturated, and relatively cohesionless soil deposits temporarily lose strength from seismic shaking. The primary factors controlling the onset of liquefaction include intensity and duration of strong ground motion, characteristics of subsurface soil, *in situ* stress conditions, and the depth to groundwater.

The Washington Department of Natural Resources (DNR) maps the Site as having very low liquefaction susceptibility (DNR, 2004). Given the relative density, grain size distribution, and geologic origin of the soils at the Site, we do not consider liquefaction to be a significant hazard for the Project.
5 Erosion and Landslide Hazards

The Site contains sloping topography and a mapped geologically hazardous area (Moderate Slope). The following sections describe and discuss the pertinent erosion and landslide hazards at the Site.

5.1 Erosion Hazard

The soils encountered at the Site have a low to moderate erosion potential, due to the gently to moderately sloping topography of the area, but the erosion hazard will increase where groundcover is sparse or the Site is disturbed for the proposed construction area. Care should be taken during construction to prevent any erosion on the Site. Vegetation on the Moderate Slope should be maintained at all times or otherwise supplemented with erosion control measures during construction.

5.2 Landslide Hazards

Landslides may be triggered by natural causes, such as precipitation, freeze-thaw cycles, or a seismic event, or be man-made (e.g., broken water pipes or stormwater flow). Three types of landslides (Varnes, 1978) are common on steep slopes in the Puget Sound: topples, deep-seated rotational slides, and shallow flows.

The Site and nearby areas lack the overly steep topography associated with topples. The observations from our geologic reconnaissance including relatively straight conifer trees on and near the steep slope and an absence of prominent/concentrated groundwater seepage on/near the slope do not indicate signs of historical, recent, or incipient landslide activity.

No landslides are mapped on the Site (Haugerud, 2011; McKenna et al., 2008; and Ecology, 1979). Recent Light Detection and Ranging (LiDAR) studies (PSLC, 2015) do not indicate deep-seated landslide headscarps at or within 300 feet of the Site.

In our opinion, the risk of deep-seated rotational landslide activity at or near the Site is very low. The Moderate Slope at the Site presents a low to moderate risk of shallow flow failures. To further evaluate the stability of the Site and the implications of the landslide hazards to the Project, we completed a slope stability analysis described in Section 5.3.

5.3 Slope Stability Analyses

Based on our review of the existing Site and nearby topography, we conducted a stability analysis of a critical section transecting the Site, Moderate Slope, and the proposed development area (Section A-A’) using the computer model SLIDE (Rocscience, 2017). The location of the critical section is shown on Figure 2. The soil engineering properties assumed for the model are summarized in Table 5 below.
Table 5. Summary of Soil Engineering Properties Used in Slope Stability Analyses

<table>
<thead>
<tr>
<th>Geologic Unit</th>
<th>Unit Weight (pcf)&lt;sup&gt;(1)&lt;/sup&gt;</th>
<th>Friction Angle (deg)&lt;sup&gt;(1)&lt;/sup&gt;</th>
<th>Cohesion (psf)&lt;sup&gt;(1)&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weathered Vashon Till</td>
<td>115</td>
<td>32</td>
<td>0</td>
</tr>
<tr>
<td>Vashon Till</td>
<td>130</td>
<td>45</td>
<td>200</td>
</tr>
<tr>
<td>Roadway</td>
<td>125</td>
<td>36</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes:
1) pcf = pounds per cubic foot; psf = pounds per square foot; and deg = degrees.

The engineering properties summarized in Table 5 and used in our analyses are primarily based on our experience in similar geologic settings with similar geologic materials. Back calculations of the existing slope configuration indicate the values assumed are conservative. The strength values assumed are correlated with the DCPT data and the engineering properties for the Vashon till and are within the bounds of the suggested parameters in Chapter 5 of the Washington State Department of Transportation (WSDOT) Geotechnical Design Manual (GDM; WSDOT, 2015).

Structure loads for the proposed development area were estimated using Chapter 16 of the IBC and Table C3-1 from the ASCE Standard 7-10. Details of the proposed foundation layouts were unknown at the time of reporting; therefore, a conservative aerial load of 400 pounds per square foot (psf) was applied to the slope stability model across an inferred building footprint extending up to the boundary of the proposed development area.

The SLIDE program performs slope stability computations based on the modeled slope conditions and calculates a factor of safety against slope failure, which is defined as the ratio of resisting forces to driving forces. A factor of safety of 1.0 indicates a “just-stable” condition, and a factor of safety less than one would indicate unstable conditions.

We utilized Spencer’s method in our SLIDE analyses. The results of our stability analyses for the proposed conditions are summarized in Table 6 below.

Table 6. Summary of Slope Stability Analyses Results

<table>
<thead>
<tr>
<th>Static Factor of Safety&lt;sup&gt;(1)&lt;/sup&gt;</th>
<th>Seismic&lt;sup&gt;(2)&lt;/sup&gt; Factor of Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.05</td>
<td>2.54</td>
</tr>
</tbody>
</table>

Notes:
1) Factor of Safety—The minimum FS found using Spencer’s method in computer program SLIDE.
2) Pseudostatic seismic analysis utilize a seismic coefficient (kh) of 0.2875g.

The calculated factors of safety are for failure surfaces intersecting the proposed development area and indicate the Moderate Slope is typically stable and construction within the proposed development area can result in stable conditions. Graphical and detailed results for the slope stability analyses are shown in Appendix C.
6 Conclusions and Recommendations

Based on our geotechnical evaluation of the Site that included data review, Site reconnaissance, subsurface explorations, and geotechnical engineering analyses, it is our opinion that the proposed Project is feasible at the Site provided the recommendations contained in this report are incorporated into the design and construction of the project. The key findings and conclusions include:

- The proposed buildings may be grade-supported on shallow foundations and slabs-on-grade, provided the subgrade materials under the foundations and slabs-on-grade are properly prepared and compacted.
- The Moderate Slope in the western area of the Site is stable and our analyses indicate that new residential structures located within the proposed development area will not destabilize the Moderate Slope.
- The Site soils that are moisture sensitive and shallow, perched groundwater can be expected in portions of the Site during the wet weather season. This combination will make Site grading during the wet weather season and periods of precipitation difficult and will require additional specific construction considerations during grading to protect and successfully prepare the foundation subgrade.
- Subsurface conditions at the Site consist of a shallow, continuous, and relatively thick sequence of Vashon till that is essentially an aquitard; therefore, the conditions at the Site appear unsuitable for concentrated stormwater infiltration.
- Similarly, the presence of Vashon till across the majority of the Site indicates the potential for precipitation to infiltrate through the Site soils and provide recharge to deeper aquifers is low. Existing conditions appear to shed and divert precipitation and runoff to the east and southwest towards existing wetlands and drainages.

The grading and final development plans for the project had not been completed when this report was prepared. Once completed, Aspect should be engaged to review the project plans to confirm our recommendations have been appropriately incorporated and/or to update our recommendations as necessary.

6.1 Slope Stability and Geologically Hazardous Areas Considerations

The City’s CAO map designates the area west of the proposed development area as a Moderate Slope (15 to 40 percent slopes). Based on the results of our reconnaissance and slope stability analysis, the Moderate Slope is stable and new residential structures located within the proposed development area will not destabilize the Moderate Slope. We did not observe any evidence of recent or incipient landslides or erosive stream activity. Additionally, we did not observe continuous and prominent groundwater seepage at the Site, and the geologic sequence does not appear to be prone to landslide activity within the context of the Site conditions, topography, and Project. As Project plans are finalized, Aspect should review the Site plan and development layout.
6.1.1 Temporary and Permanent Erosion Control

To prevent Site erosion during construction, appropriate temporary erosion and sedimentation control (TESC) measures should be used in accordance with the recommendations above and the local BMPs. Specific TESC measures may include appropriately placed silt fencing, straw wattles, rock check dams, and plastic covering of exposed slope cuts and soil stockpiles. Outside of the proposed construction areas, the existing vegetation should be retained.

Permanent erosion control within the areas of construction should be achieved through pavement surfacing or the re-establishment of vegetation.

Areas on/near the Site slopes exposed to construction activities should be aggressively revegetated. Depending on the weather patterns, slope inclination, and degree of disturbance, the placement of an erosion control blanket to provide temporary ground cover while vegetation takes root, or the use of live-staking, may be required to ensure successful establishment of new vegetation.

Irrigation should be installed to allow for ease of inspection and with easily accessible shut-off valves for winterizing. At no time should uncontrolled runoff or surface water be allowed to flow across the Site.

6.2 Earthwork Considerations

Based on the explorations performed across the Site and our understanding of the Project, it is our opinion that the Contractor should be able to complete planned excavations with standard construction equipment.

Oversized materials such as logs, construction debris (concrete, etc.), cobbles, and boulders that can impede earthwork activities should be anticipated in the fill and Vashon till soils. Encountering such obstructions should be expected during construction.

The Vashon till soils encountered at the Site contain a significant percentage of fines (particles passing the U.S. Standard No. 200 sieve), making them moisture sensitive and subject to disturbance upon exposure to weather and when wet. We recommend planning the earthwork portions of the Project during the drier summer months.

We encountered two types of Vashon till across the Site including more coarse-grained SILTY SAND WITH GRAVEL (SM) and a layer of more fine-grained SILT (ML) along the southern edge of the proposed development area. While the coarse-grained Vashon till is likely suitable for reuse as structural fill under dry conditions, it is likely that the fine-grained Vashon till soils will not be suitable for reuse as structural fill on the Project due to their moisture sensitivity and difficulty in achieving uniform compaction.

We recommend that earthwork activities be specified in accordance with the following Washington State Department of Transportation (WSDOT) Standard Specifications, except where specifically addressed in this report (WSDOT, 2018). Appropriate erosion control measures should be in accordance with Section 1-07.15, Temporary Water Pollution/Erosion Control, and should be implemented prior to beginning earthwork activities.
6.2.1 Wet Weather Earthwork

If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions when soil moisture content is difficult to control, the following recommendations should be incorporated into the contract specifications:

- Earthwork should be performed in small areas to minimize exposure to wet weather.
- The size and type of construction equipment used may have to be limited to prevent soil disturbance.
- Excavation or the removal of unsuitable soils 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.
- Material used as structural fill should consist of clean, granular soil containing less than 7 percent fines, such as Gravel Borrow as specified in Section 9-03.14(1) of the Standard Specifications (WSDOT, 2018). The fines should be nonplastic.
- The ground surface within the construction area should be graded to promote runoff of surface water and to prevent the ponding of water.
- The ground surface within the construction area should be sealed by a smooth drum vibratory roller (or equivalent) and under no circumstances should be left uncompacted and exposed to moisture. Soils which become too wet for compaction should be removed and replaced with clean granular materials.
- Excavation and placement of fill should be observed by the Geotechnical Engineer to verify that all unsuitable materials are removed, and suitable compaction is achieved.
- Appropriate erosion and sedimentation best management practices (BMPs) should be strategically implemented in accordance with City of Bainbridge Island BMPs.

6.2.2 Temporary Excavation Stability

Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the Contractor. All temporary cuts in excess of 4 feet in height that are not protected by trench boxes or otherwise shored should be sloped in accordance with Part N of Washington Administrative Code (WAC) 296-155 (WAC, 2009), as shown in Table 7 below.

Table 7. Temporary Excavation Cut Slope Recommendations

<table>
<thead>
<tr>
<th>Soil Unit</th>
<th>OSHA Soil Classification</th>
<th>Maximum Temporary Slope</th>
<th>Maximum Height (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill</td>
<td>C</td>
<td>1.5H:1V</td>
<td>20</td>
</tr>
<tr>
<td>Weathered Vashon Till</td>
<td>C</td>
<td>1.5H:1V</td>
<td>20</td>
</tr>
<tr>
<td>Vashon Till</td>
<td>A</td>
<td>0.75H:1V</td>
<td>20</td>
</tr>
</tbody>
</table>

Notes:
OSHA = Occupational Safety and Health Administration; H:V = Horizontal:Vertical
The estimated maximum cut slope inclinations are provided for planning purposes only and are applicable to excavations without groundwater seepage or runoff, and assume dewatered conditions. Flatter slopes will likely be necessary in areas where groundwater seepage exists, or where construction equipment surcharges are placed in close proximity to the crest of the excavation.

With time and the presence of seepage and/or precipitation, the stability of temporary unsupported cut slopes can be significantly reduced. Therefore, all temporary slopes should be protected from erosion by installing a surface water diversion ditch or berm at the top of the slope. In addition, the Contractor should monitor the stability of the temporary cut slopes, and adjust the construction schedule and slope inclination accordingly. Vibrations created by traffic and construction equipment may cause caving and raveling of the temporary slopes. In such an event, lateral support for the temporary slopes should be provided by the Contractor to prevent loss of ground support.

Permanent slopes for the Project should be no steeper than 2H:1V (Horizontal:Vertical).

6.2.3 Site Preparation
Site preparation within the proposed construction area footprint should include removal of all debris and any other deleterious material including all fill materials and topsoil with significant root debris within the proposed footing areas. The Contractor must use care during Site preparation and excavation operations so that any bearing surfaces are not disturbed. If this occurs, the disturbed material should be removed to expose undisturbed material or compacted in-place. Overexcavated soils in footing subgrade areas should be replaced with compacted crushed surfacing base course (CSBC) as specified in Section 9-03.9(3) of the Washington State Department of Transportation (WSDOT) Standard Specifications (WSDOT, 2018) as described in Section 6.2.4.

All footing excavations should be trimmed neat and the bottom of the excavation should be carefully prepared. All loose or softened soil should be removed from the footing excavation or compacted in-place prior to placing reinforcing steel bars. We recommend that footing excavations be observed by the geotechnical engineer prior to placing steel and concrete, to verify that the recommendations of this report have been followed.

If footing excavations are open during the winter season or periods of wet weather, we recommend providing a layer of crushed rock or gravel to help preserve the subgrade until concrete is placed. Gravel used to protect the bearing surfaces should meet the gradation requirements for Class A Gravel Backfill for Foundations, as described in Section 9-03.12(1)A of the WSDOT Standard Specifications (WSDOT, 2018).

6.2.4 Structural Fill and Compaction
Structural fill is anticipated to be required for minor grade adjustments and for utility trench backfill. We anticipate that selectively screened portions of the coarse-grained Vashon till material excavated for the Project may be suitable for reuse as structural fill during the dry season. The fine-grained Vashon till encountered along the southern edge of the proposed development area is unlikely to be suitable for reuse as structural fill. Excavated material should be visually inspected by the Geotechnical Engineer to determine its potential use as structural fill. Excavated material that is unsuitable as
structural fill may be suitable as backfill for unimproved areas (i.e., landscaped areas) that are not susceptible to differential settlement over time.

Imported structural fill should consist of relatively freely draining, uniformly graded sand and gravel. We recommend Gravel Borrow, as specified in Section 9-03.14(1) of the Standard Specifications (WSDOT, 2018), be specified for imported structural fill.

Structural fill should be at or near optimum moisture content at the time of placement and should be compacted to at least 95 percent of the maximum dry density (MDD) as determined by test method ASTM International (ASTM) D1557. In new pavement areas where the fill is placed more than 2 feet below the proposed finish grade, compaction to at least 90 percent of the MDD should be achieved. In non-structural areas, fill should be placed and compacted to a moderately firm/dense condition.

Class A Gravel Backfill for Foundations as specified in Section 9-03.12(1)A of the Standard Specifications (WSDOT, 2018) should be used for base rock underneath structures. Crushed Surfacing Base Course (CSBC) as specified in Section 9-03.9(3) of the Standard Specifications (WSDOT, 2018) should be used as base rock for new pavement. If desired, lean concrete or controlled density fill (CDF) can also be used as structural fill.

The procedure to achieve the specified minimum relative compaction depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain soil properties. When size of the excavation restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough lifts to achieve the required compaction. A sufficient number of in-place density tests should be performed as the fill is placed to verify the required relative compaction is being achieved. The frequency of the in-place density testing can be determined at the time of final design, when more details of the Project grading and backfilling plans are available.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with a high percentage of silt or clay 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.

### 6.3 Foundations

Although current Site plans are conceptual, the following general foundation criteria are provided in this section. Shallow foundations or spread footings may be used for building supports gaining support from the Vashon till. Bearing surfaces for the footings should be prepared as described in Section 6.2.3. Based on our observations of the Site soil conditions, we estimate the adequate bearing strata typically consisting of dense to very dense, SILTY SAND WITH GRAVEL (SM) interpreted as unweathered Vashon till to be within approximately 2.5 to 3 feet of the existing ground surface.
6.3.1 Shallow Foundations
For shallow foundations gaining support from the bearing strata described above, we recommend an allowable foundation bearing pressure of 3,000 pounds per square foot (psf) be utilized for design purposes, including both dead and live loads for the proposed structure. Recommendations within the Site Preparation and Structural Fill sections (Sections 6.2.3 and 6.2.4, respectively) of this report must be followed in order for this allowable bearing pressure to be used. An increase in the above-mentioned bearing pressure of one-third may be used for short-term wind or seismic loading. Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection and be a minimum of 14 inches wide; interior footings require only 12 inches burial below outside grade. No footing should be founded in or above yielding/loose or organic soils.

We estimate the total settlement of the foundation designed in accordance with our recommendations will be less than 1 inch. Differential settlements can be expected to be less than half of the total settlement. Our experience indicates the majority of these settlements will occur during construction.

Wind, earthquakes, and unbalanced earth loads will subject the proposed structures to lateral forces. Lateral forces on a structure will be resisted by a combination of sliding resistance of its base or footing on the underlying soil and passive earth pressure against the buried portions of the structures.

For use in design, an ultimate coefficient of friction of 0.55 may be assumed along the interface between the base of the footing and subgrade soils. An ultimate passive earth pressure of 400 pounds per cubic foot (pcf) may be assumed for native soils adjacent to below-grade elements. The recommended passive earth pressure includes reductions for the sloping topography of the Site. The upper 1 foot of passive resistance should be neglected in design. The recommended coefficient of friction and passive pressure values are ultimate values that do not include a safety factor. We recommend applying a factor of safety of at least 1.5 in design for determining allowable values for coefficient of friction and passive pressure.

6.3.2 Slab-on-Grade Floors
Floor slabs should be supported over a drainage layer and Vashon till, or structural fill placed directly over the Vashon till.

Concrete slabs-on-grade should be designed in accordance with the American Concrete Institute (ACI) Committee 360 Guide to Design of Slabs-on-Ground (ACI, 2010). We recommend overexcavation of any loose soil or deleterious matter and replacement with structural fill beneath all slabs. To provide uniform support for the floor slab and to provide a capillary break, we recommend the floor slab be underlain by a capillary break section. The capillary break material should consist of a minimum of 6 inches of free-draining, crushed rock or well-graded sand and gravel compacted to at least 95 percent MDD. The capillary break material should have a maximum particle size of 3/4 inch, with no more than 80 percent passing the No. 4 sieve and less than 5 percent fines (material passing the U.S. Standard No. 200 sieve). In areas where moisture will be detrimental to floor coverings or equipment inside the proposed structures, a 10-mil
polyethylene vapor barrier should be placed directly over the capillary break. The vapor barrier should be installed in accordance with the manufacturer’s recommendations.

Slab-on-grade floors prepared as described above can be designed assuming a modulus of subgrade reaction of 150 pounds per cubic inch (pci).

### 6.4 Wall Considerations

Low retaining walls may be incorporated in the Project design to accommodate minor grade adjustments across the Site.

Yielding walls, such as cantilever retaining walls, should be designed using a lateral earth pressure based on an equivalent fluid having a unit weight of 35 pcf. Nonyielding or restrained walls should be designed for an equivalent fluid weight of 55 pcf. A level backslope and adequate drainage is assumed for the recommended earth pressure values. Adequate drainage should consist of a subsurface drain combined with a free-draining wall backfill material that meets the gradation requirements described in Section 9-03.12(2) of the WSDOT Standard Specifications for Gravel Backfill for Walls (WSDOT, 2018). Refer to Section 6.5, Stormwater Drainage Considerations for detailed subsurface drain recommendations.

Earthquake shaking will subject retaining walls to a temporary additional earth pressure. We estimated the lateral seismic soil pressure increment using the Mononobe-Okabe method, with consideration of the possible backfill soil properties and MCE. We recommend an average seismic soil pressure increment of 13H (where H is the height of the wall) represented by a uniform rectangular pressure along the height of the wall.

For exterior retaining walls that are separate from the new building and less than 10 feet tall, we do not recommend incorporation of seismic earth pressures.

Over-compaction of the backfill behind walls should be avoided. Over-compaction of backfill can result in increased horizontal pressures against newly cast and sensitive walls that are still acquiring strength through the concrete curing process. These elevated pressures can lead to cracking or deflection of the walls. In this regard, we recommend compacting the backfill to about 90 percent of the MDD (ASTM D1557). Heavy compactors and large pieces of construction equipment should not operate within 5 feet of any embedded wall to avoid the buildup of excessive lateral pressures. Within a lateral distance of 3 feet of any wall, smaller, possibly hand-operated equipment should be used in conjunction with thinner soil lifts to achieve the required compaction, so as not to damage the wall.

Lateral forces that may be induced on the wall due to other surcharge loads should be considered by the structural engineer.

### 6.5 Stormwater Drainage Considerations

The presence of relatively impermeable Vashon till combined with our understanding that surface water features are present during the wet, winter months indicates that large-scale, concentrated stormwater infiltration is infeasible at the Site. Our primary recommendation is to design the Site stormwater management using conventional methods. However, if Low Impact Development (LID) methods are required by the City
of Bainbridge Island, we recommend stormwater management be accomplished using LID methods combined with conventional methods, including catch basins and storm drain pipes that discharge into an appropriate system. LID methods, such as small raingardens, bioswales, and dispersion, are feasible provided the systems incorporate underdrains and/or overflow redundancy to account for the low permeability and low-infiltration capacity of the Site soils.

Final grades around the proposed structures should be sloped such that surface water drains away from the structures. Water from hard surfaces should be collected and diverted to the stormwater outfall system. Downspouts and roof drains should not be connected to the foundation drains and under-slab drains in order to reduce the potential for clogging and flooding foundation drains.

### 6.5.1 Foundation and Wall Drainage

The outside edge of all perimeter footings and upslope side of all walls should be provided with a drainage system consisting of 4-inch-diameter, perforated, rigid plastic pipe embedded in a clean, free-draining sand and gravel meeting the requirements of Section 9-03.24(4) of the WSDOT Standard Specifications for Gravel Backfill for Drains (WSDOT, 2018). The drainpipe and surrounding drain rock should be wrapped in filter fabric to minimize the potential for clogging and/or ground loss due to piping. A washed rock drain curtain at least 1-foot-thick should extend from the footing continuously upward to within 1 foot of the ground surface. A layer of low permeability soils should be used on the upper foot to reduce potential for surface water to enter the drain curtain. The footing drains should include cleanouts to allow periodic maintenance and inspection.

### 6.6 Pavement Design and Construction Considerations

Flexible (asphalt) pavements are feasible for the Project. New pavements can be constructed over the weathered and unweathered Vashon till with appropriate subgrade preparation and slightly more robust pavement sections. The following sections present recommended pavement sections for flexible pavements and associated construction considerations.

#### 6.6.1 Pavement Design

In non-roadway and non-heavy traffic parking areas, a pavement section consisting of 3 inches of hot mix asphalt (HMA) over 6 inches of CSBC is recommended. However, along access drives or in the areas of heavy traffic, we recommend a minimum section of 4 inches of HMA over 8 inches of CSBC. We recommend CSBC for the pavement base course, and Crushed Surfacing Top Course (CSTC) may be used over the CSBC for the upper 2 to 3 inches of the base course section. CSBC and CSTC, as specified in Section 9-03.9(3) of the WSDOT Standard Specifications (WSDOT, 2018), should be used as base course for pavements.

#### 6.6.2 Pavement Construction Considerations

Within the footprint of proposed pavement areas, the loose and organic-rich topsoil and possibly some weathered Vashon till should be removed. Pavement sections should either gain support from undisturbed, medium dense or better, weathered or unweathered...
Vashon till or from structural fill placed directly over the Vashon till. All pavement subgrades should be carefully prepared. Prior to placing base course and pavement, all pavement subgrades should be proof-rolled with a fully loaded 10-cubic-yard dump truck or equivalent. An Aspect representative should observe and evaluate the proof rolling operation. Any soft areas detected by the proof-rolling or other methods should be compacted in-place or overexcavated to firm ground and backfilled with compacted structural fill to the design subgrade elevation. To provide for quality construction practices and materials, we recommend all pavement work and mix-design considerations conform to WSDOT standards.

The recommended pavement section is not intended to support extensive construction traffic, such as dump trucks and concrete Redi-Mix trucks. Pavements subject to heavy construction traffic may be damaged and require repair.

Proper drainage is essential to long-term pavement performance. We recommend providing all paved areas with positive drainage to remove surface water and water within the base course. This will be particularly important in cut sections or at low points within the paved areas, such as at catch basins.

### 6.7 Additional Project Design and Construction Monitoring

At the time of this report, site grading, structural plans, and construction methods were not finalized, and the recommendations presented herein are preliminary. We are available to provide additional geotechnical consultation as the Project design develops, and possibly changes, from that upon which this report is based. Additional explorations, testing, and assessments may be needed as the Project plans develop. The information and recommendations contained herein should be brought to the attention of the appropriate design team personnel and incorporated into the Project plans and specifications.

We recommend a pre-construction meeting be organized at the start of construction including you, your contractor, and Aspect. During this meeting, we will understand the goals and schedule to be upheld during construction. We will also discuss effective lines of communication. The integrity of the Project and the overall Site stability depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent.

Upon completion of construction, the City will require Aspect to complete a Step 3 Form prior to issuing the Certificate of Occupancy. For Aspect to complete this form, we must be involved during certain construction activities, including but not limited to, foundation subgrade preparation, installation of the stormwater outfall system, and installation of the site and foundation drainage elements.
7 References


American Concrete Institute (ACI), 2010, Guide to Design of Slabs-on-Ground, Reported by ACI Committee 360, April 2010.


Washington State Department of Transportation (WSDOT), 2015, Geotechnical Design Manual M46-03.11.


8 Limitations

Work for this project was performed for Olympic Property Group (Client), and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting, LLC (Aspect).

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Client. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations.

Risks are inherent with any site involving slopes and no recommendations, geologic analysis, or engineering design can assure slope stability. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the Client.

It is the Client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, design plans and construction methods have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this report should be revised and/or expanded upon.

The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor’s site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

All reports prepared by Aspect for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect. Aspect’s original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix D titled “Report Limitations and Guidelines for Use” for additional information governing the use of this report.
We appreciate the opportunity to perform these services. If you have any questions please call Alison Dennison, Project Geologist, at 206-780-7717 or Andrew Holmson, Associate, at 206-780-7731.
FIGURES
Site Location Map
Geotechnical Report
Kitsap County Parcel No. 222502-4-006-2005
Bainbridge Island, Washington

Legend

- Test Pit Location
- Hand Exploration
- Site Boundary
- Section Location For Stability Analysis

Site Exploration Plan
Kitsap County Parcel Number 222502-4-006-2005
Bainbridge Island, Washington

Nov-2018
AJD/CMV
160365
APPENDIX A

Subsurface Explorations
A. Test Pits and Hand Explorations

Test pits TP-01 through TP-12 were excavated using a tracked Hitachi 85USB excavator. The excavation was completed by High Meadows Excavating, LLC under direction of Aspect. Hand exploration HE-13 was advanced by an Aspect geologist using hand tools. The locations of explorations are shown on Figure 2 and were collected in the field using a global positioning system (GPS). Copies of the exploration logs are included in Appendix A. The terminology used in the soil classifications and other modifiers are defined and presented on the attached Figure A-1 included in Appendix A.

Samples were obtained from select soil units to aid in the determination of engineering properties of the subsurface materials. The relative density/consistency of the soils was evaluated qualitatively with a 0.5-inch-diameter steel t-probe and DCPT and observation of digging difficulty at various depth intervals within the test pits, as noted on the test pit logs. The test pits were backfilled with the native soils and compacted with the excavator bucket.

The DCPT method involves a 15-pound steel mass falling 20 inches to strike an anvil, which drives a 1.5 inch-diameter, 45-degree cone into the soil. The number of blows required to drive the cone 1.75 inches is considered one data point. The DCPT data has been calibrated with Standard Penetration Test (SPT, ASTM Method D 1586) results to provide a more refined estimate of soil relative density and consistency.

Detailed descriptions of the subsurface conditions encountered in our explorations, as well as the depths where characteristics of the soils changed, are indicated on the test pit logs. The depths indicated on the logs where conditions changed may represent gradational variations between soil types. Soils were classified per the Unified Soil Classification System (USCS) in general accordance with ASTM International (ASTM) D-2488, Standard Practice for Description and Identification of Soils (Visual and Manual Procedure).
Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

### Explorations Log Key

<table>
<thead>
<tr>
<th>Component Definitions</th>
<th>Size Range and Sieve Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gravel</strong></td>
<td>Larger than 12”</td>
</tr>
<tr>
<td><strong>Cobble</strong></td>
<td>3” to 12”</td>
</tr>
<tr>
<td><strong>Gravel</strong></td>
<td>3” to No. 4 (4.75 mm)</td>
</tr>
<tr>
<td><strong>Coarse Gravel</strong></td>
<td>3” to 3/4”</td>
</tr>
<tr>
<td><strong>Fine Gravel</strong></td>
<td>3/4” to No. 4 (4.75 mm)</td>
</tr>
<tr>
<td><strong>Sand</strong></td>
<td>No. 4 (4.75 mm) to No. 200 (0.075 mm)</td>
</tr>
<tr>
<td><strong>Coarse Sand</strong></td>
<td>No. 4 (4.75 mm) to No. 10 (2.00 mm)</td>
</tr>
<tr>
<td><strong>Medium Sand</strong></td>
<td>No. 10 (2.00 mm) to No. 40 (0.425 mm)</td>
</tr>
<tr>
<td><strong>Fine Sand</strong></td>
<td>No. 40 (0.425 mm) to No. 200 (0.075 mm)</td>
</tr>
</tbody>
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### Estimated Percentage

<table>
<thead>
<tr>
<th>Percentage by Weight</th>
<th>Modifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5</td>
<td>Trace</td>
<td>Slightly (sandy, silty, gravelly)</td>
</tr>
<tr>
<td>5 to 15</td>
<td>Moist</td>
<td>Slightly moist - perceptible moisture</td>
</tr>
<tr>
<td>15 to 30</td>
<td>Very moist</td>
<td>Moist - damp but no visible water</td>
</tr>
<tr>
<td>30 to 49</td>
<td>Wet</td>
<td>Very moist - water visible but not free draining</td>
</tr>
</tbody>
</table>

### Terms Describing Relative Density and Consistency

<table>
<thead>
<tr>
<th>Density</th>
<th>SPT (b) blows/foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td>0 to 4</td>
</tr>
<tr>
<td>Loose</td>
<td>4 to 10</td>
</tr>
<tr>
<td>Medium Dense</td>
<td>10 to 30</td>
</tr>
<tr>
<td>Dense</td>
<td>30 to 50</td>
</tr>
<tr>
<td>Very Dense</td>
<td>&gt; 50</td>
</tr>
</tbody>
</table>

### Moisture Content

- **Dry** - Absence of moisture, dusty, dry to the touch
- **Slightly moist** - Perceptible moisture
- **Moist** - Damp but no visible water
- **Very moist** - Visible but not free draining
- **Wet** - Visible free water, usually from below water table

### Symbols

1. Percentage by dry weight
2. (SPT) Standard Penetration Test (ASTM D-1586)
3. In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
4. Depth of groundwater
5. Combined USCS symbols used for fines between 5% and 15% as estimated in General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

- **SPT (b) Blows/foot**
- **ADT = At time of drilling**
- **DD = Dry Density**
- **C = Consolidation**
- **M = Moisture Content**
- **FC = Fines Content**
- **Str = Shear Strength**
- **Env = Environmental**
- **P/D = Photoionization Detector**
- **CW = Cement grout**
- **Filter pack with blank casing section**
- **Seal**
- **End cap**
- **Grout**
- **Transducer**
- **Chips**
Hole backfilled with excavated soil.

**TOPSOIL**
- Moist, dark brown; numerous organics, roots

**WEATHERED VASHON TILL**
- Silty sand with gravel (SM); slightly moist, light brown; fine to coarse sand, fine to coarse rounded to subangular gravel

**VASHON TILL**
- Silty sand with gravel (SM); very dense, slightly moist, light brown to light gray; fine to coarse sand, fine to coarse rounded to subangular gravel, hard to dig at 2.2 ft. bgs.

Bottom of exploration at 3.2 ft. bgs.

Note: Post hole digger to 2.6 ft.; hand auger from 2.6 ft. to bottom.
Test pit backfilled with excavated soil and tamped in place with excavator bucket.

**TOPSOIL**

Silty Sand With Gravel (SM); loose, slightly moist, dark brown; numerous roots and rootlets.

**WEATHERED VASHON TILL**

Silty Sand With Gravel (SM); medium dense, dry, light brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; trace roots up to 1" diameter.

2 ft: Becomes dense.

**VASHON TILL**

Silty Sand With Gravel (SM); very dense, slightly moist to moist, light gray; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; socketed gravels and cobbles.

Bottom of exploration at 8.5 ft. bgs.

Note: Refusal with excavator at bottom of test pit; up to 0.5 ft of caving observed from 0 to 2 ft bgs.
**Geotechnical Exploration Log**

**Project Address & Site Specific Location**
New Brooklyn Rd & Sportsman Club Rd, Bainbridge Island, WA, west part of site

**Coordinates (Lat/Lon WGS84)**
47.64252, -122.52904

**Exploration Number**
TP-02

**Contractor**
High Meadows Excavating

**Equipment**
Hitachi 85USB

**Sampling Method**
Grab

**Ground Surface (GS) Elev. (COBI VCN)**
208'

**Operator**
Andrew Monsaas

**Exploration Method(s)**
Trackhoe

**Work Start/Completion Dates**
8/20/2018

---

**Exploration Completion and Notes**

<table>
<thead>
<tr>
<th>Depth(ft)</th>
<th>Exploration Completion and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Test pit backfilled with excavated soil and tamped in place with excavator bucket.</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>T-probe = 1-2' DCPT = 42 GS = 14%</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
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<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

**Top of Casing Elev. (COBI VCN)**
NA

**Depth to Water (Below GS)**
No Water Encountered

---

**Depth(ft) | Water Level | Material Type | Description**

| 1 | No Water Encountered |
| 2 | No Water Encountered |
| 3 | No Water Encountered |
| 4 | No Water Encountered |
| 5 | No Water Encountered |
| 6 | No Water Encountered |
| 7 | No Water Encountered |
| 8 | No Water Encountered |
| 9 | No Water Encountered |
| 10 | No Water Encountered |
| 11 | No Water Encountered |
| 12 | No Water Encountered |
| 13 | No Water Encountered |
| 14 | No Water Encountered |

**Exploration Log Key for explanation of symbols**

- **No Water Encountered**
- **Grab sample**

---

**Logged by:** NHC

**Approved by:** AJD 9/17/2018
Suzuki Development - 150365-01

Geotechnical Exploration Log

Project Address & Site Specific Location
New Brooklyn Rd & Sportsman Club Rd, Bainbridge Island, WA, near SW Corner

Coordinates (Lat,lon WGS84)
47.64216, -122.52906

Exploration Number
TP-03

Contractor
High Meadows Excavating

Equipment
Hitachi 85USB

Sampling Method
Grab

Ground Surface (GS) Elev. (COBI VCN)
210"

Work Start/Completion Dates
8/20/2018

Top of Casing Elev. (COBI VCN)
NA

Operator
Andrew Monsaas

Depth to Water (Below GS)
No Water Encountered

FILL
SANDY Silt (ML); loose, dry, dark brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles; numerous rootlets and roots up to 2" diameter.

WEATHERED VASHON TILL
Silty Sand with Gravel (SM); dense, dry, brown yellow; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1' diameter; trace rootlets.

VASHON TILL
Silty Sand with Gravel (SM); very dense, slightly moist, light gray to light brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1' diameter; socketed gravels and cobbles; trace rootlets.

2.5 ft: Becomes moist; no organics observed.

Silt (ML); dense, moist, light gray; low plasticity; thickly laminated with iron-oxide stained layers.

Bottom of exploration at 12 ft. bgs.

Note: Up to 0.5 ft of caving observed from 0 to 1.5 ft bgs.
### Exploration Log

#### Suzuki Development - 150365-01

**Project Address & Site Specific Location**
New Brooklyn Rd & Sportsman Club Rd, Bainbridge Island, WA, west part of site

**Contractor**
High Meadows Excavating

**Operator**
Andrew Monsaas

**Equipment**
Hitachi 85USB

**Sampling Method**
Grab

**Exploration Number**
TP-04

**Ground Surface (GS) Elev. (COBI VCN)**
213'

---

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Exploration Completion and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>212 Test pit backfilled with excavated soil and tamped in place with excavator bucket.</td>
</tr>
<tr>
<td>2</td>
<td>211 T-probe = 1-2&quot;</td>
</tr>
<tr>
<td>3</td>
<td>210 TOPSOIL</td>
</tr>
<tr>
<td>4</td>
<td>209 WEATHERED VASHON TILL</td>
</tr>
<tr>
<td>5</td>
<td>208 VASHON TILL</td>
</tr>
<tr>
<td>6</td>
<td>207 5 ft: Becomes very dense and moist.</td>
</tr>
<tr>
<td>7</td>
<td>206 Bottom of exploration at 8 ft. bgs.</td>
</tr>
<tr>
<td>8</td>
<td>205 Note: Up to 1 ft of caving observed from 0 to 1.5 ft bgs.</td>
</tr>
<tr>
<td>9</td>
<td>204</td>
</tr>
<tr>
<td>10</td>
<td>203</td>
</tr>
<tr>
<td>11</td>
<td>202</td>
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<tr>
<td>12</td>
<td>201</td>
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<td>13</td>
<td>200</td>
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<td>14</td>
<td>199</td>
</tr>
</tbody>
</table>

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**Legend**

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water Level</td>
<td>No Water Encountered</td>
</tr>
</tbody>
</table>

**Exploration Completion and Notes**

- Test pit backfilled with excavated soil and tamped in place with excavator bucket.
- T-probe = 1-2" |
- TOPSOIL: SILTY SAND WITH GRAVEL (SM); loose, slightly moist, dark brown; numerous roots up to 2" diameter.
- WEATHERED VASHON TILL: SILTY SAND WITH GRAVEL (SM); medium dense, dry, light brown; fine to coarse sand; rounded to subangular; fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; trace roots up to 1" diameter.
- VASHON TILL: SILTY SAND WITH GRAVEL (SM); dense, slightly moist, light brown to light gray; fine to coarse sand; rounded to subangular; fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; socketed gravels and cobbles.

---

**Exploration Completion and Notes**

- 8/20/2018 Work Start/Completion Dates
- Blows/foot Water Content (%)
- Tests Material Type

---

**Exploration Log Key for explanation of symbols**

- No Water Encountered

---

**Logged by:** NHC
**Approved by:** AJD 9/17/2018
Suzuki Development - 150365-01

New Brooklyn Rd & Sportman Club Rd, Bainbridge Island, WA, north part of site

Exploration Log

Coordinates (Lat, Lon WGS84): 47.64279, -122.52792

Exploration Number: TP-05

Geotechnical Exploration Log

Logged by: NHC
Approved by: AJD 9/17/2018

Operator: Andrew Monsaas
Work Start/Completion Dates: 8/21/2018

Equipment: Hitachi 85USB
Sampling Method: Grab

Top of Casing Elev. (COBI VCN): 214'
Depth to Water (Below GS): No Water Encountered

Exploration Completion and Notes:
Test pit backfilled with excavated soil and tamped in place with excavator bucket.

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Exploration Completion and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-213</td>
<td>T-probe = 3&quot;</td>
</tr>
<tr>
<td>2-212</td>
<td>T-probe = 1&quot;</td>
</tr>
<tr>
<td>3-211</td>
<td></td>
</tr>
<tr>
<td>4-210</td>
<td></td>
</tr>
<tr>
<td>5-209</td>
<td></td>
</tr>
<tr>
<td>6-208</td>
<td></td>
</tr>
<tr>
<td>7-207</td>
<td></td>
</tr>
<tr>
<td>8-206</td>
<td></td>
</tr>
<tr>
<td>9-205</td>
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<td>10-204</td>
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<td>11-203</td>
<td></td>
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<tr>
<td>12-202</td>
<td></td>
</tr>
<tr>
<td>13-201</td>
<td></td>
</tr>
<tr>
<td>14-200</td>
<td></td>
</tr>
</tbody>
</table>

Material Type:
- TOPSOIL: SILTY SAND WITH GRAVEL (SM); loose, slightly moist, dark brown; numerous roots up to 1" diameter.
- WEATHERED VASHON TILL: SILTY SAND WITH GRAVEL (SM); medium dense, dry, brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1.3' diameter; trace roots up to 1" diameter.
- VASHON TILL: SILTY SAND WITH GRAVEL (SM); very dense, moist, light gray; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; socketed gravels and cobbles.

Bottom of exploration at 8.5 ft. bgs.

Note: Up to 1.5 ft of caving observed from 0 to 2.5 ft bgs.
New Brooklyn Rd & Sportsman Club Rd, Bainbridge Island, WA, central part of site

**Contractor:** High Meadows Excavating

**Equipment:** Hitachi 85USB

**Sampling Method:** Grab

**Ground Surface (GS) Elev. (COBI VCN):** 216'

**Exploration Number:** TP-06

**Operator:** Andrew Monsaas

**Work Start/Completion Dates:** 8/21/2018

**Top of Casing Elev. (COBI VCN):** NA

**Depth to Water (Below GS):** No Water Encountered

<table>
<thead>
<tr>
<th>Exploration Completion and Notes</th>
<th>Sample Type/ID</th>
<th>Blows/foot</th>
<th>Water Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 10 20 30 40 50</td>
<td></td>
</tr>
<tr>
<td>1-215</td>
<td>Test pit backfilled with excavated soil and tamped in place with excavator bucket.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-214</td>
<td>T-probe =1&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-213</td>
<td>TOPSOIL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILTY SAND WITH GRAVEL (SM); loose, dry, dark brown; numerous roots up to 1/2&quot; diameter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-212</td>
<td>WEATHERED VASHON TILL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILTY SAND WITH GRAVEL (SM); medium dense, dry, brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1' diameter; iron-oxide staining; numerous roots up to 1/2&quot; diameter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-211</td>
<td>VASHON TILL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILTY SAND WITH GRAVEL (SM); very dense, moist, light gray; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1' diameter; socketed gravels and cobbles.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bottom of exploration at 7 ft. bgs.

Note: Up to 1 ft of caving observed from 0 to 1 ft bgs.

**Legend:**

- Plastic Limit
- Liquid Limit
- No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: NHC
Approved by: AJD 9/17/2018
<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Exploration Completion and Notes</th>
<th>Sample Type/ID</th>
<th>Blows/foot Water Content (%)</th>
<th>Blows/6&quot; Tests</th>
<th>Material Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-214</td>
<td>Test pit backfilled with excavated soil and tamped in place with excavator bucket.</td>
<td>51</td>
<td>10</td>
<td>T-probe =3-5&quot; DCPT =10,13,9</td>
<td>TOPSOIL</td>
<td>SILTY SAND WITH GRAVEL (SM); loose, slightly moist, dark brown; numerous rootlets.</td>
</tr>
<tr>
<td>2-213</td>
<td></td>
<td>52</td>
<td>20</td>
<td>T-probe =1&quot; DCPT =30/0.75&quot;</td>
<td>WEATHERED VASHON TILL</td>
<td>SILTY SAND WITH GRAVEL (SM); medium dense, dry, brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1' diameter; numerous rootlets.</td>
</tr>
<tr>
<td>3-212</td>
<td></td>
<td>237</td>
<td>30</td>
<td></td>
<td>VASHON TILL</td>
<td>SILTY SAND WITH GRAVEL (SM); very dense, moist, light gray; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1' diameter; socketed gravels and cobbles.</td>
</tr>
<tr>
<td>4-211</td>
<td>4.5 ft to 5.5 ft: Increased sand content and reduced gravel socketing observed.</td>
<td>244</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-210</td>
<td>4.5 ft to 5.5 ft: Increased sand content and reduced gravel socketing observed.</td>
<td>234</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-209</td>
<td></td>
<td>233</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-208</td>
<td></td>
<td>232</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-207</td>
<td></td>
<td>231</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-206</td>
<td></td>
<td>230</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10-205</td>
<td></td>
<td>229</td>
<td>40</td>
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<td></td>
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<tr>
<td>11-204</td>
<td></td>
<td>228</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-203</td>
<td>4.5 ft to 5.5 ft: Increased sand content and reduced gravel socketing observed.</td>
<td>227</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-202</td>
<td>Bottom of exploration at 13 ft. bgs.</td>
<td>226</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14-201</td>
<td></td>
<td>225</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Grab sample
- No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: NHC
Approved by: AJD 9/17/2018
**Geotechnical Exploration Log**

**Project Address & Site Specific Location**
New Brooklyn Rd & Sportsman Club Rd, Bainbridge Island, WA, SE part of site

**Contractor**
High Meadows Excavating

**Operator**
Andrew Monsaas

**Equipment**
Hitachi 85USB

**Sampling Method**
Grab

**Ground Surface (GS) Elev. (COBI VCN)**
215' V

**Exploration Number**
TP-08

**Exploration Completion and Notes**
Test pit backfilled with excavated soil and tamped in place with excavator bucket.

**Top of Casing Elev. (COBI VCN)**
NA

**Depth to Water (Below GS)**
No Water Encountered

---

**Exploration Log Key for explanation of symbols**

- **Sample Type/ID**
  - Grab sample

- **Material Type**
  - TOPSOIL
    - SILTY SAND WITH GRAVEL (SM); loose, slightly moist, dark brown; numerous roots up to 1.5" diameter.
  - WEATHERED VASHON TILL
    - SILTY SAND WITH GRAVEL (SM); medium dense to dense, dry to slightly moist, brown to brown yellow; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; numerous roots up to 1.5" diameter.
  - VASHON TILL
    - SILT (ML); very dense, moist, light gray; non-plastic; thickly laminated fine sand layers; iron-oxide staining.

---

**Exploration Completion and Notes**

**Sample Type/ID**
- Grab sample

**Description**
- TOPSOIL
  - SILTY SAND WITH GRAVEL (SM); loose, slightly moist, dark brown; numerous roots up to 1.5" diameter.
- WEATHERED VASHON TILL
  - SILTY SAND WITH GRAVEL (SM); medium dense to dense, dry to slightly moist, brown to brown yellow; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; numerous roots up to 1.5" diameter.
- VASHON TILL
  - SILT (ML); very dense, moist, light gray; non-plastic; thickly laminated fine sand layers; iron-oxide staining.

---

**Log**

**TP-08**

**Logged by:** NHC
**Approved by:** AJD 9/17/2018

---

**Water Level**
- No Water Encountered
### Suzuki Development - 150365-01

**Geotechnical Exploration Log**

**Project Address & Site Specific Location**
New Brooklyn Rd & Sportsman Club Rd, Bainbridge Island, WA, east part of site

**Contractor**
High Meadows Excavating

**Equipment**
Hitachi 85USB

**Sampling Method**
Grab

**Surface Elev. (COBI VCN)**
217`

**Ground Surface (GS) Elev. (COBI VCN)**
NA

**Exploration Number**
TP-09

**Work Start/Completion Dates**
8/20/2018

**Operator**
Andrew Monsaas

**Exploration Completion and Notes**
Test pit backfilled with excavated soil and tamped in place with excavator bucket.

---

### Exploration Log

**Depth (feet)**

<table>
<thead>
<tr>
<th>Elevation (feet)</th>
<th>Material Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TOPSOIL</td>
<td>SILTY SAND WITH GRAVEL (SM); loose, slightly moist, dark brown; numerous rootlets and roots up to 1.5&quot; diameter.</td>
</tr>
<tr>
<td>1</td>
<td>VASHON TILL</td>
<td>SILTY SAND WITH GRAVEL (SM); medium dense, dry, brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1&quot; diameter; numerous roots up to 0.5&quot; diameter.</td>
</tr>
<tr>
<td>3</td>
<td>VASHON TILL</td>
<td>SILTY SAND WITH GRAVEL (SM); dense, slightly moist, brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1&quot; diameter; socketed gravels and cobbles.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>4 ft: Becomes very dense.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>5 ft: Becomes moist and light gray.</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Bottom of exploration at 7 ft. bgs.</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Note: Up to 1 ft of caving observed from 0 to 2 ft bgs.</td>
</tr>
</tbody>
</table>

**Blows/foot**

<table>
<thead>
<tr>
<th>Blows/6&quot;</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td></td>
</tr>
<tr>
<td>20-30</td>
<td></td>
</tr>
<tr>
<td>40-50</td>
<td></td>
</tr>
</tbody>
</table>

**Water Content (%)**

<table>
<thead>
<tr>
<th>Water Content (%)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Blows/foot**

<table>
<thead>
<tr>
<th>Blows/6&quot;</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td></td>
</tr>
<tr>
<td>20-30</td>
<td></td>
</tr>
<tr>
<td>40-50</td>
<td></td>
</tr>
</tbody>
</table>

---

**Exploration Log Key for explanation of symbols**

**Legend**

- No Water Encountered

**Logged by:** NHC

**Approved by:** AJD 9/17/2018

**New Brooklyn Rd & Sportsman Club Rd, Bainbridge Island, WA, east part of site**

**Logged by:** NHC

**Approved by:** AJD 9/17/2018
**TOPSOIL**
- Silty sand with gravel (SM); loose, slightly moist, dark brown; numerous roots up to 0.5" diameter.

**WEATHERED VASHON TILL**
- Silty sand with gravel (SM); medium dense, dry, light brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; numerous roots up to 0.5" diameter.

**VASHON TILL**
- Silty sand with gravel (SM); very dense, moist, light gray; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; socketed gravels and cobbles.

**Bottom of exploration at 6 ft. bgs.**

Note: Up to 0.5 ft of caving observed from 0 to 2.5 ft bgs.

---

**Geotechnical Exploration Log**

**TP-10**

**Exploration Number**

**Ground Surface (GS) Elev. (COBI VCN)** 217"  
**Top of Casing Elev. (COBI VCN)** NA  
**Depth to Water (Below GS)** No Water Encountered

**Operator** Andrew Monsaas

**Work Start/Completion Dates** 8/21/2018

**Exploration Completion and Notes**
- Test pit backfilled with excavated soil and tamped in place with excavator bucket.
- T-probe = 3"
TOPSOIL
SILTY SAND WITH GRAVEL (SM); loose, slightly moist, dark brown; numerous roots up to 0.5" diameter.

WEATHERED VASHON TILL
SILTY SAND WITH GRAVEL (SM); medium dense, dry, light brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; numerous roots up to 1" diameter.

VASHON TILL
SILTY SAND WITH GRAVEL (SM); very dense, moist, light gray; fine to coarse sand; rounded to subangular, fine to coarse gravel; few cobbles and trace boulders up to 1" diameter; socketed gravels and cobbles.

Bottom of exploration at 5 ft. bgs.

Note: Refusal with excavator at bottom of test pit.
Test pit backfilled with excavated soil and tamped in place with excavator bucket.

TOPSOIL
Silty sand with gravel (SM); loose, slightly moist, dark brown; numerous roots up to 1" diameter.

WEATHERED VASHON TILL
Silty sand with gravel (SM); medium dense, dry, light brown; fine to coarse sand; rounded to subangular; fine to coarse gravel; few cobbles and trace boulders up to 1' diameter; numerous roots up to 1" diameter.

VASHON TILL
Silty sand with gravel (SM); very dense, moist, light gray; fine to coarse sand; rounded to subangular; fine to coarse gravel; few cobbles and trace boulders up to 1' diameter; socketed gravels and cobbles.

Bottom of exploration at 6 ft. bgs.
APPENDIX B

Geotechnical Laboratory Testing Results
B. Geotechnical Laboratory Testing

Geotechnical laboratory tests were conducted on selected soil samples collected during the field exploration program. The tests performed and the procedures followed are outlined below. The laboratory tests were conducted in general accordance with appropriate ASTM International (ASTM) test methods and were completed by Aspect and by Phoenix Soil Research subcontracted to Browne Wheeler Engineers, Inc. Test procedures are discussed below.

Moisture Content Determination, MC

The moisture content of selected soil samples was determined in general accordance with ASTM D2216. The results of the tests are shown on the exploration logs.

Fines Content Determination, FC

The fines contents of selected soil samples was determined in general accordance with ASTM D1140. The results of the tests are shown on the exploration logs.

Grain Size Analysis, GS

Grain size analyses were performed on selected soil samples in general accordance with ASTM D6913. The results of the tests are presented in this appendix as curves depicting the percent finer by weight versus grain size.
**Grain Size Distribution**

**ASTM D6913**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Exploration, Sample, Depth</th>
<th>Moisture Content (%)</th>
<th>Silt/Clay Content (%)</th>
<th>Sand Content (%)</th>
<th>Gravel Content (%)</th>
<th>Coefficient of Uniformity, Cu</th>
<th>Coefficient of Curvature, Cc</th>
<th>USCS Soil Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>TP-02, S1, 2.5-3.0*</td>
<td>7</td>
<td>14.1</td>
<td>43.2</td>
<td>42.6</td>
<td>164.6</td>
<td>0.8</td>
<td>SM</td>
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<tr>
<td>●</td>
<td>TP-03, S3, 11-11.5**</td>
<td>24</td>
<td>90.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ML</td>
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<tr>
<td>▲</td>
<td>TP-07, S3, 9.5-10**</td>
<td>33</td>
<td>92.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ML</td>
</tr>
<tr>
<td>■</td>
<td>TP-08, S3, 5-5.5**</td>
<td>26</td>
<td>96.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ML</td>
</tr>
</tbody>
</table>

*The sample(s) tested may not include oversized particles and may only be representative of a portion of the sample/site soil conditions.

**Fines content test only in accordance with ASTM D1140

**Project Name: SUZUKI

Project Number: 150365
**Particle Size Distribution Report**

<table>
<thead>
<tr>
<th>SIEVE number size</th>
<th>PERCENT FINER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>o</td>
</tr>
<tr>
<td>#4</td>
<td>94.7</td>
</tr>
<tr>
<td>#10</td>
<td>92.5</td>
</tr>
<tr>
<td>#20</td>
<td>90.0</td>
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<tr>
<td>#40</td>
<td>86.6</td>
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<td>#60</td>
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<tr>
<td>#140</td>
<td>64.3</td>
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<tr>
<td>#200</td>
<td>44.9</td>
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</tbody>
</table>

**GRAIN SIZE - mm.**

- 6 in.
- 3 in.
- 2 in.
- 1½ in.
- 1 in.
- ¾ in.
- ½ in.
- 3/8 in.
- #4
- #10
- #20
- #30
- #40
- #60
- #100
- #140
- #200

**PERCENT FINER**

- 0.0
- 0.0970

**Material Description**

- ○ silty sand
- □ silt with sand

**REMARKS:**

- ○ Classification based on grain size only
- □ Classification based on grain size only

---

**Phoenix Soil Research**

**Kingston, WA**

Client: Browne Wheeler Engineers, Inc

Project: Suzuki

Project No.: PSR18-40-0804
APPENDIX C

Slope Stability Analyses
<table>
<thead>
<tr>
<th>Material Name</th>
<th>Color</th>
<th>Unit Weight (lbs/ft³)</th>
<th>Strength Type</th>
<th>Cohesion (psf)</th>
<th>Phi (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weathered Vashon Till</td>
<td></td>
<td>115</td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>32</td>
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<tr>
<td>Vashon Till</td>
<td></td>
<td>130</td>
<td>Mohr-Coulomb</td>
<td>200</td>
<td>45</td>
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<tr>
<td>Roadway</td>
<td></td>
<td>125</td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>36</td>
</tr>
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</table>

**Analysis Methods used:**
- Spencer
- Surface Options
- Search Method: Grid Search
- Radius increment: 10
- Composite Surfaces: Enabled
- Reverse Curvature: Create Tension Crack

**Loading**
- Seismic Load Coefficient (Horizontal): 0.2875g
- General Development Surcharge: 400 PSF

**Section A-A' - Model Setup**

**Suzuki Residential Development**
Kitsap County Parcel Number 222502-4-006-2005
Bainbridge Island, Washington

**APPENDIX:**
### Analysis Methods used:
- Spencer
- Surface Options
- Surface Type: Circular
- Search Method: Grid Search
- Radius increment: 10
- Composite Surfaces: Enabled
- Reverse Curvature: Create Tension Crack
- Loading
- Seismic Load Coefficient (Horizontal): 0g
- General Development Surcharge: 400 PSF

### Safety Factor

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<tr>
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</tr>
<tr>
<td>5.400</td>
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<td>8.100</td>
</tr>
<tr>
<td>8.550</td>
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<td>9.000+</td>
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</tbody>
</table>

### Material Properties

<table>
<thead>
<tr>
<th>Material Name</th>
<th>Color</th>
<th>Unit Weight (lbs/3)</th>
<th>Strength Type</th>
<th>Cohesion (psf)</th>
<th>Phi (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weathered Vashon Till</td>
<td>115</td>
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<td>200</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Roadway</td>
<td>125</td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

### Project Details

**Suzuki Residential Development**

- Kitsap County Parcel Number 222502-4-006-2005
- Bainbridge Island, Washington

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**Section A-A' - Static Conditions**

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**Legend**

- Search Grid
- Search Limits
- Modelled Groundwater Level
- Boring Location and Depth

---

**APPENDIX:**

---

**REVISED BY:**

---

**PROJECT NO.:** 150365-02

---

**10/1/2018**

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**SCALE: 1" = 45'**

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**C-2**
**Material Name** | **Color** | **Unit Weight (lbs/ft³)** | **Strength Type** | **Cohesion (psf)** | **Phi (deg)**
--- | --- | --- | --- | --- | ---
Weathered Vashon Till | | 115 | Mohr-Coulomb | 0 | 32
Vashon Till | | 130 | Mohr-Coulomb | 200 | 45
Roadway | | 125 | Mohr-Coulomb | 0 | 36

Analysis Methods used:
- Spencer
- Surface Options
- Surface Type: Circular
- Search Method: Grid Search
- Radius increment: 10
- Composite Surfaces: Enabled
- Reverse Curvature: Create Tension Crack

Loading:
- Seismic Load Coefficient (Horizontal): 0.2875g
- General Development Surcharge: 400 PSF

**Section A-A' - Seismic Conditions**

Suzuki Residential Development
Kitsap County Parcel Number 222502-4-006-2005
Bainbridge Island, Washington

**Legend**
- Search Grid
- Search Limits
- Modelling Groundwater Level
- Boring Location and Depth

**APPENDIX:**

SLIDEINTERPRET 7.024 10/1/2018

\biserver1\projects\UCOTECH\Suzuki Property, New Brooklyn\Data\Analyses\SSA\Suzuki West Slope, seismic.slim

SCALE: 1" = 45'

This image appears to be a technical document related to a geotechnical analysis for a residential development project. The document includes tables with material properties, analysis methods used, and a diagram illustrating seismic conditions with specific safety factors and other relevant data. The project is located in Bainbridge Island, Washington, and involves analyzing the soil properties and their effects under seismic conditions.
APPENDIX D

Report Limitations and Guidelines for Use
REPORT LIMITATIONS AND GUIDELINES FOR USE

Geoscience is Not Exact

The geoscience practices (geotechnical engineering, geology, and environmental science) are far less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or property, you should contact Aspect Consulting, LLC (Aspect).

This Report and Project-Specific Factors

Aspect’s services are designed to meet the specific needs of our clients. Aspect has performed the services in general accordance with our agreement (the Agreement) with the Client (defined under the Limitations section of this project’s work product). This report has been prepared for the exclusive use of the Client. This report should not be applied for any purpose or project except the purpose described in the Agreement.

Aspect considered many unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you;
- Not prepared for the specific purpose identified in the Agreement;
- Not prepared for the specific subject property assessed; or
- Completed before important changes occurred concerning the subject property, project, or governmental regulatory actions.

If changes are made to the project or subject property after the date of this report, Aspect should be retained to assess the impact of the changes with respect to the conclusions contained in the report.

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared.

Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods,
earthquakes, slope instability, or groundwater fluctuations. If any of the described events
may have occurred following the issuance of the report, you should contact Aspect so
that we may evaluate whether changed conditions affect the continued reliability or
applicability of our conclusions and recommendations.

Geotechnical, Geologic, and Environmental Reports Are
Not Interchangeable

The equipment, techniques, and personnel used to perform a geotechnical or geologic
study differ significantly from those used to perform an environmental study and vice
versa. For that reason, a geotechnical engineering or geologic report does not usually
address any environmental findings, conclusions, or recommendations (e.g., about the
likelihood of encountering underground storage tanks or regulated contaminants).
Similarly, environmental reports are not used to address geotechnical or geologic
cconcerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions please
contact the Aspect Project Manager for this project.