December 10, 2021
Project No. 20210420E001

Jireh Construction
10121 Evergreen Way, Suite 25-515
Everett, Washington 98204

Attention: Johnny Rodriguez

Subject: Subsurface Exploration and Geotechnical Engineering Evaluation
Rodriguez Commercial Site
4203 78th Street SW
Mukilteo, Washington

Dear Mr. Rodriguez:

Associated Earth Sciences, Inc. (AESI) is pleased to present this report containing the results of our subsurface exploration and geotechnical engineering evaluation for the above-referenced project. Our work has been completed in general accordance with our proposal, dated October 18, 2021, and in accordance with generally accepted geotechnical engineering practices. This report was prepared for the exclusive use of Jireh Construction, and their authorized agents, for specific application to this project. No other warranty, express or implied, is made.

At the time of our exploration, we were provided with a plan set prepared by BRL Services LLC, titled "Rodriguez Commercial Site," dated September 15, 2021. The site location is shown on the "Vicinity Map," Figure 1. The approximate locations of the exploration pits are shown on the "Existing Site and Exploration Plan," Figure 2, and the "Proposed Site and Exploration Plan," Figure 3. Interpretive exploration logs are included in Appendix A.

PROJECT AND SITE DESCRIPTION

The project site is located at 4203 78th Street SW in Mukilteo, Washington and is comprised of a vacant, partially wooded parcel (Snohomish County Parcel No. 00611600009300), totaling about 4.5 acres. The site is rectangular in shape and generally slopes down gently to the northeast with an overall vertical relief of about 30 feet over a distance of about 700 feet. Slope inclinations at the site range from about 5 to 8 percent.

Based on the referenced plan set, we understand that the project will involve the construction of an asphalt parking lot, approximately 2 acres in area, within the southern half of the site to serve as an equipment storage yard. The parking lot will be raised above existing site grades, requiring up to 6 feet of structural fill to achieve final grade. Stormwater runoff from the parking lot will be directed to a detention pond at the northern end of the site. The detention pond will be rectangular in shape with the base of the pond approximately 100 feet wide by 60 feet long and excavated to about 5 feet below existing grade. Soil berms ranging from 6 to 12 feet wide will be constructed around the pond having a maximum height of 7.5 feet and maximum side slopes at 3H:1V (Horizontal:Vertical). The pond will contain 0.5 feet of dead storage and will outfall to the east on a gently sloping area using level spreaders. A 10-foot-wide riprap emergency spillway will be constructed at the northeast corner of the pond. A pond access road will also be constructed along the eastern end of the site.

SUBSURFACE EXPLORATION

In order to evaluate subsurface conditions at the site, we performed four explorations pits (EP-1 through EP-4) within the proposed storage yard area, one exploration pit (EP-5) near the alignment of the proposed pond access road, and one exploration pit (EP-6) within the footprint of the proposed detention pond. The approximate location of each exploration pit relative to existing and proposed site features is presented on the attached "Existing Site and Exploration Plan," Figure 2, and the "Proposed Site and Exploration Plan," Figure 3. We explored subsurface conditions at the site on November 9, 2021. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in Appendix A. Soil contact depths shown on the logs should be regarded as only an approximation; the actual changes between sediment types are often gradational and/or undulating due to the complexity of the local geology.

The conclusions and recommendations presented in this report are based, in part, on the subsurface conditions encountered within our explorations. Due to the nature of subsurface exploratory work, it is necessary to interpolate and extrapolate soil conditions between and beyond the field explorations. Differing subsurface conditions could be present outside the area of the explorations due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of any variations between the field explorations might not become fully evident until construction occurs. If variations are observed at that time, it could be necessary to modify specific conclusions or recommendations in this report.

Exploration Pits

All exploration pits were performed by a client-provided excavator and operator. The exploration pits allow direct, visual observation of subsurface conditions. The exploration pits were continuously observed and logged by a geologist from our firm. The samples obtained from the exploration pits were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing. All exploration pits were backfilled with the excavated soils and the surface was tamped with the excavator bucket.

Site Stratigraphy

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of selected applicable geologic literature. As shown on the exploration logs, the site is generally underlain by existing fill of variable thickness and composition overlying native soils consisting of Vashon lodgement till. The following section presents more detailed descriptions of the sediment types encountered. The exploration logs contained in Appendix A provide additional subsurface information.

Recycled Concrete

Exploration EP-1 encountered a layer of recycled concrete aggregate approximately 4 inches in thickness. The layer of recycled concrete was observed to extend from the site entrance to the southwestern portion of the site.

Topsoil

Explorations EP-2 through EP-6 encountered a surficial layer of organic-rich topsoil directly below the existing ground surface. The observed thickness of the topsoil horizon was variable across the site, ranging from about 1 inch to 18 inches where encountered. Due to its loose composition and high organic content, topsoil is not considered suitable for pavement support or structural fill applications.

Existing Fill

Fill soils (those not naturally deposited) were encountered directly below the recycled concrete and topsoil within explorations EP-1, EP-3, and EP-4. The depth of the fill soils was variable across the site, ranging from about 2.5 to 6.5 feet below existing site grades. The fill generally consisted of loose to medium dense, brown to dark brown, silty sand with variable organics. Within EP-4, evidence of garbage debris was observed within the sidewall of the excavation at a depth of about 4 feet below the existing ground surface. Fill should also be expected in unexplored areas of the site particularly in areas that have been previously cleared of vegetation. Due to the inherent variability of the fill and unknown placement and compaction methods, the existing fill soils will require remedial measures for support of pavements.

Vashon Lodgement Till

Underlying the surficial topsoil and existing fill, all exploration pits encountered a deposit of medium dense to dense, moist, tan and reddish brown grading to brownish gray and gray with depth, silty sand with trace to some gravel and occasional cobbles. We interpret this deposit to be Vashon lodgement till, in which the lower-density zones represent a weathered rind. The

Vashon lodgement till was deposited directly from basal, debris-laden glacial ice during the Vashon Stade of the Fraser Glaciation, approximately 12,500 to 15,000 years ago. The high relative density characteristic of the Vashon lodgement till is due to its consolidation by the massive weight of the glacial ice from which it was deposited. Lodgement till soils typically contain a significant fine-grained fraction and are highly sensitive to moisture during placement in structural fill applications. The lodgement till extended to the maximum depth of our explorations, ranging from about 6.5 to 10 feet.

Hydrology

Groundwater seepage was encountered at the time of digging in explorations EP-2, EP-3, and EP-4 at depths ranging from about 3 to 6 feet below the existing ground surface. Within explorations EP-2 and EP-3, slight to moderate groundwater seepage was observed within the existing fill and weathered till horizon at about 3 feet below the existing ground surface, near the contact with the underlying, lower-permeability, unweathered till. Within exploration EP-4, rapid groundwater seepage was observed within the existing fill from about 2.5 to 6 feet below the existing ground surface.

The groundwater encountered is representative of perched groundwater. Perched groundwater occurs as surface water percolates down through the near-surface, relatively permeable soils, and becomes trapped or “perched” atop the underlying, lower-permeability, unweathered Vashon lodgement till sediments.

Depending on the time of year and prevailing weather conditions, perched groundwater may be encountered within utility trench excavations; however, we anticipate that any groundwater seepage or surface water accumulation that may occur during excavation may be removed with sump pumps.

It should be noted that the duration and quantity of groundwater seepage can be expected to vary in response to changes in season, precipitation patterns, on- and off-site land usage, site development, and other factors.

Regional Geology and Soils Mapping

Based on our review of a regional geologic map of the site (*Distribution and Description of Geologic Units in the Mukilteo Quadrangle, Washington* - U.S. Geological Survey [USGS], Miscellaneous Field Studies Map MF-1438, 1:24,000, by J.P. Minard [1982]), the site is mapped as being underlain by Vashon lodgement till. The subsurface conditions encountered within our explorations are in general agreement with the regional geologic map in that we encountered Vashon lodgement till at all locations explored.

Review of the regional soils mapping (*Soil Survey of Snohomish County Area, Washington*, U.S. Department of Agriculture [USDA], Soils Conservation Service [SCS] now referred to as Natural Resources Conservation Service [NRCS], by A. Debose and M.W. Klungland [1983]) indicates that that the subject site is underlain primarily by Alderwood gravelly sandy loam, 0 to 8 percent slopes, formed from glacial drift. Our interpretation of the shallow soils encountered within our explorations are in general agreement with the regional soils mapping in that we encountered Vashon lodgement till at all locations explored, which are representative of the Alderwood Soil series.

Laboratory Tests

Two grain-size analyses were performed on soil samples obtained from exploration EP-6, located within the proposed footprint of the detention pond, to confirm soil classification in the field and to assess the soil's feasibility for reuse as structural fill. The grain-size analysis results are summarized in Table 1 below (and attached in Appendix B) with soil descriptions based on the *ASTM International* (ASTM) D-2487 Unified Soil Classification System (USCS).

Table 1
Summary of Grain-Size Analyses

Exploration Pit No.	Sample Depth (feet)	Geologic Unit	USCS Soil Description	Fines Content (%)
EP-6	3	Vashon Lodgement Till	Gravelly silty SAND (SM)	27.1
EP-6	6	Vashon Lodgement Till	Gravelly silty SAND (SM)	23.7

USCS = Unified Soil Classification System
% = percent of total weight passing the U.S. No. 200 Sieve

GEOLOGIC, SEISMIC, AND EROSION HAZARDS

The following discussion of potential geologic, seismic, and erosion hazards at the site is based on the geologic, slope, and ground and surface water conditions, as observed and discussed herein.

Landslide Hazards

It is our opinion that the risk of damage to the proposed development by landsliding is low due to the lack of steep slopes at the project site and vicinity and the presence of dense glacially consolidated soils at shallow depths. No detailed slope stability analysis was performed for this project, and none is warranted, in our opinion.

Seismic Hazards

All of Western Washington is at risk of strong seismic events resulting from movement of the tectonic plates associated with the Cascadia Subduction Zone (CSZ), where the offshore Juan de Fuca plate subducts beneath the continental North American plate. The site lies within a zone of strong potential shaking from subduction zone earthquakes associated with the CSZ. The CSZ can produce earthquakes up to magnitude 9.0, and the recurrence interval is estimated to be on the order of 500 years. Geologists infer the most recent subduction zone earthquake occurred in 1700 (Goldfinger et al., 2012[1]). Three main types of earthquakes are typically associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound region document a distinct zone of shallow crustal seismicity (e.g., the Seattle Fault Zone). These shallow fault zones may include surficial expressions of previous seismic events, such as fault scarps, displaced shorelines, and shallow bedrock exposures. The shallow fault zones typically extend from the surface to depths ranging from 16 to 19 miles. A deeper zone of seismicity is associated with the subducting Juan de Fuca plate. Subduction zone seismic events produce intraplate earthquakes at depths ranging from 25 to 45 miles beneath the Puget Lowland including the 1949, 7.2-magnitude event; the 1965, 6.5-magnitude event; and the 2001, 6.8-magnitude event and interplate earthquakes at shallow depths near the Washington coast including the 1700 earthquake, which had a magnitude of approximately 9.0. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are three types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides or lateral spreading, and 3) liquefaction. The potential for each of these hazards to adversely impact the proposed project is discussed below.

Surface Faulting

The site falls within the suspected traces of the southeastward extension of the Southern Whidbey Island Fault Zone (SWIFZ). A recent study by the USGS (Sherod et al., 2005[2]) indicates that "strong" evidence of prehistoric earthquake activity has been observed along two fault strands thought to be part of the southeastward extension of the SWIFZ located about 1 mile north of the site. The study suggests as many as nine earthquake events along the SWIFZ may

[1] Goldfinger, C., Nelson, C.H., Morey, A.E., Johnson, J.E., Patton, J.R., Karabanov, E., Gutierrez-Pastor, J., Eriksson, A.T., Gracia, E., Dunhill, G., Enkin, R.J, Dallimore, A., and Vallier, T., 2012, *Turbidite Event History—Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone*: U.S. Geological Survey Professional Paper 1661–F, 170.

[2] Sherrod et al., 2005, *Holocene Fault Scarps and Shallow Magnetic Anomalies Along the Southern Whidbey Island Fault Zone near Woodinville, Washington*, Open-File Report 2005-1136, March 2005.

have occurred within the last 16,400 years. Understanding of this fault system is somewhat limited with studies still ongoing.

The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to be in excess of one thousand years. Due to the suspected long recurrence interval, the potential for surficial ground rupture along the SWIFZ is considered to be low during the expected life of the proposed development.

Seismically Induced Landslides

Similar to the discussion in the “Landslide Hazards” section of this report, it is our opinion that the risk of damage to the proposed development by landsliding under seismic conditions is low as the site is generally comprised of gentle slopes underlain by dense glacially consolidated soils.

Liquefaction

Based on our subsurface explorations, the site is generally underlain by glacially consolidated soils at shallow depths that are not considered susceptible to liquefaction. No detailed liquefaction hazard analysis was performed for this study, and none is warranted, in our opinion.

Erosion Hazards

The sediments underlying the site generally contain significant quantities of silt and fine sand that are sensitive to erosion and disturbance when wet. Therefore, the project should follow best management practices (BMPs) to mitigate erosion hazards and potential for off-site sediment transport.

The Washington State Department of Ecology (Ecology) Construction Stormwater General Permit (also known as the National Pollutant Discharge Elimination System [NPDES] permit) requires weekly Temporary Erosion and Sedimentation Control (TESC) inspections and turbidity monitoring of site runoff for all sites that are one or more acres in size that discharge stormwater to surface waters of the state. The TESC inspections and turbidity monitoring of runoff must be completed by a Certified Erosion and Sediment Control Lead (CESCL) for the duration of the construction. Requirements for inspections, sampling, and reporting can be found in the Construction Stormwater General Permit online at ecology.wa.gov.

In order to meet the current Ecology requirements, a properly developed, constructed, and maintained erosion control plan consistent with local standards and best management erosion control practices will be required for this project. It is often necessary to make adjustments and provide additional measures to the TESC plan in order to improve its effectiveness. Ultimately, the success of the TESC plan depends on a proactive approach to project planning and contractor implementation and maintenance.

To mitigate and reduce the erosion hazard and potential for off-site sediment transport, we recommend the following:

1. Construction activity should be scheduled or phased as much as possible to avoid earthwork activity during the wet season.

2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and stormwater runoff. The site plan should include ground-cover measures and staging areas. The contractor should be prepared to implement and maintain the required measures to reduce the amount of exposed ground.

3. TESC elements and perimeter flow control should be established prior to the start of grading. This should include, but is not limited to, silt fencing, swales with check dams, rocked construction entrance, etc.

4. During the wetter months of the year, or when significant storm events are predicted during the summer months, the work area should be stabilized so that if showers occur, it can receive the rainfall without excessive erosion or sediment transport. The required measures for an area to be "buttoned-up" will depend on the time of year and the duration that the area will be left unworked. During the winter months, areas that are to be left unworked for more than 2 days should be mulched or covered with plastic. During the summer months, stabilization will usually consist of seal-rolling the subgrade. Such measures will aid in the contractor's ability to get back into a work area after a storm event. The stabilization process also includes establishing temporary stormwater conveyance channels through work areas to route runoff to the approved treatment/discharge facilities.

5. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport.

6. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering stockpiles with plastic sheeting, or the use of silt fences around stockpile perimeters.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate erosion mitigation (BMPs) throughout construction, the potential adverse impacts from erosion hazards on the project may be mitigated.

DESIGN RECOMMENDATIONS

Our exploration indicates that, from a geotechnical standpoint, the subject site is feasible for the proposed development provided the recommendations contained herein are properly followed. At the locations explored, we generally encountered a surficial horizon of topsoil underlain by existing fill ranging in thickness from about 2.5 to 6.5 feet, underlain by native soils consisting of medium dense to dense Vashon lodgement till. The existing fill soils will require partial removal and remedial measures for support of pavements. Mass grading at the site will require careful planning around the prevailing weather conditions at the time of construction. The on-site native soils are highly moisture-sensitive and should only be considered feasible for reuse as structural fill during the drier summer months, typically between July and September. Alternative grading techniques such as cement treatment of on-site native soils or the use of an import free-draining structural fill should be planned for during the wet season, typically from October to June.

The following sections provide our recommendations for site and subgrade preparation, temporary and permanent slopes, structural fill, pavement support, and detention pond construction.

Site and Subgrade Preparation

Site preparation should include the removal of all topsoil, trees, brush, debris, and any other deleterious materials located within the proposed pavement areas and detention pond. After stripping, planned excavation, and any required overexcavation have been performed, the resulting surface should be proof-rolled with a loaded dump truck or other suitable equipment. Any soft, loose, or yielding areas should be excavated to expose suitable bearing soils. The subgrade should then be compacted to a firm and unyielding condition as determined by the geotechnical engineer. Structural fill can then be placed to achieve desired grades, if needed.

Temporary Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes can be planned at maximum inclinations of 1.5H:1V (Horizontal: Vertical) in existing fill and medium dense Vashon lodgement till, and at 1H:1V in dense Vashon lodgement till. These slope angles are for areas where groundwater seepage is not present at the slope face. If groundwater or surface water is present when the temporary excavation slopes are exposed, flatter slope angles may be required. As is typical with earthwork operations, some sloughing and raveling may occur, especially if groundwater seepage is present in the excavation cuts, and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times.

<u>Permanent Slopes</u>

We recommend that permanent cut and fill slopes onsite be constructed at 2H:1V or flatter. Permanent slopes within the detention pond that will be exposed to surface water should be constructed at 3H:1V of flatter. It should be noted that new structural fill must be properly benched into existing slope faces onsite that are 5H:1V or steeper so that the new fill is not resting on a plane of weakness that could result in movement of the structural fill. Proper slope benching can be accomplished by cutting a series of approximately 2-foot-deep by 4-foot to 10-foot-wide (depending on the existing slope inclination) "keys" into the existing slope face to create a level bearing surface for the new structural fill to be placed and compacted. The newly constructed slope face should be established with vegetation as soon as possible to limit erosion and rills that may develop after heavy rainfall events.

<u>Overexcavation/Stabilization</u>

Construction during extended wet weather periods could create the need to overexcavate exposed soils if they become disturbed and cannot be recompacted due to elevated moisture content and/or weather conditions. Even during dry weather periods, soft/wet soils may be encountered in some portions of the site that will require overexcavation. If overexcavation is necessary, it should be confirmed through continuous observation and testing by AESI. Soils that have become unstable may require remedial measures in the form of one or more of the following:

1. Drying and recompaction. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry and warm weather.

2. Removal of affected soils to expose a suitable bearing subgrade and replacement with compacted structural fill.

3. Mechanical stabilization with a coarse crushed aggregate compacted into the subgrade, possibly in conjunction with a geotextile.

4. Soil/cement admixture stabilization.

<u>Wet Weather Considerations</u>

The on-site soils are considered to be highly moisture-sensitive. If construction takes place in, during, or immediately following the wetter periods of the year, we anticipate that a portion of the site soils will be become unsuitable for structural fill applications. If earthwork will be completed during wet season months, we recommend budgeting to construct all structural fills with select, imported fill materials. For construction immediately following wet periods, significant, but unavoidable effort will be needed to scarify, aerate, and dry site soils to reduce moisture content prior to compaction in structural fill applications. Care should be taken to seal all earthwork areas during mass grading at the end of each workday by grading all surfaces to drain and sealing them with a smooth-drum roller. Stockpiled soils that will be reused in structural fill applications should be covered whenever rain is possible.

Consideration should be given to protecting access and staging areas with an appropriate section of crushed rock or asphalt treated base (ATB). If crushed rock is considered for the access and staging areas, it should be underlain by engineering stabilization fabric (such as Mirafi 500X or approved equivalent) to reduce the potential of fine-grained materials pumping up through the rock during wet weather and turning the area to mud. The fabric will also aid in supporting construction equipment, thus reducing the amount of crushed rock required. We recommend that at least 10 inches of rock be placed over the fabric. Crushed rock used for access and staging areas should be of at least 2-inch size.

Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw and then be recompacted prior to placing subsequent lifts of structural fill or foundation components. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill or foundation components. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

Structural Fill

Placement of structural fill will be necessary to establish desired grades at the site, backfill utility trenches, and construct the detention pond berms. All references to structural fill in this report refer to subgrade preparation, fill type, and placement and compaction of materials as discussed in this section.

Subgrade Compaction

After overexcavation/stripping have been performed to the satisfaction of the geotechnical engineer or engineering geologist, the upper 12 inches of exposed ground should be recompacted to a firm and unyielding condition. If the subgrade contains too much moisture, suitable recompaction may be difficult or impossible to attain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below. After recompaction of the exposed ground is tested and approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades.

Structural Fill Compaction

Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to at least 95 percent of the modified Proctor maximum dry density using ASTM D-1557 as the standard. Utility trench backfill should be placed and compacted in accordance with applicable municipal codes and standards. If new pavement areas are located near fill slopes, the top of the compacted fill should extend horizontally a minimum distance of 3 feet beyond pavement edges before sloping down at an angle no steeper than 2H:1V. Fill slopes should either be overbuilt and trimmed back to final grade or surface-compacted to the specified density.

Use of On-Site Soils as Structural Fill

Based on the grading plan prepared by BRL Services LLC, we understand that the proposed parking lot will be raised above existing site grades, requiring up to 6 feet of structural fill to achieve final grade. Additionally, a detention pond will be excavated at the north end of the site to a depth of about 5 feet below existing grade. Based on the earthwork quantities listed on the grading plan, we anticipate that the excavated soil from the detention pond will be used to construct the pond berms and to grade most of the parking lot area. Some additional import structural fill will be required to achieve final grades across the parking lot area.

Based on the subsurface conditions encountered in exploration EP-6, the soils excavated from the detention pond footprint are anticipated to be comprised of native lodgement till consisting of silty sand with variable gravel content. The on-site lodgement till sediments are suitable for use as structural fill provided they are free of roots or other deleterious materials and have a moisture content suitable for achieving the specified compaction. At the time of our exploration, the moisture content for the majority of the lodgement till sediments encountered in our explorations appeared to be near or slightly above optimum for achieving suitable compaction.

Soils in which the amount of fine-grained material (smaller than No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. The on-site lodgement till contains a substantial amount of silt and are considered highly moisture-sensitive. Therefore, we recommend that mass grading activities for this project be planned to occur in the drier summer months between July and September; otherwise, proper moisture-conditioning in the wet season will be very difficult or impossible to obtain. Additionally, construction equipment traversing the site when the silty native sediments are very moist or wet can cause considerable disturbance. During the wetter portion of the year, typically from October to June, we recommend assuming that the on-site soils will not be suitable for reuse in structural fill applications. Possible alternatives would include cement treating on-site soils or using only a select import material consisting of a clean, free-draining gravel and/or sand. Free-draining fill consists of non-organic soil, with the amount of fine-grained material (silt and clay) limited to 5 percent by weight when measured on the minus No. 4 sieve fraction, and at least 25 percent retained on the No. 4 sieve.

Structural Fill Testing

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would involve providing us with a sample of the material at least 3 business days in advance to perform a Proctor test to determine its field compaction standard. A representative from our firm should observe the stripped subgrade and be present during placement of structural fill to document the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the owner in developing a suitable monitoring and testing frequency.

Pavement Recommendations

New pavements can be supported on medium dense to dense native sediments, on new structural fill placed above the native sediments, or on a minimum of 2 feet of new structural fill where thicker existing fill soils are present. The subgrade beneath new pavements should be prepared in accordance with the recommendations contained in the "Site and Subgrade Preparation" section of this report. We recommend that AESI be present to observe proof-rolling of prepared subgrades prior to placement of base course materials and pavements.

No asphalt pavement sections were provided on the plans at the time of this report. The design of a pavement is dependent on the traffic volume, type and weight of vehicles, and the soil subgrade strength. We anticipate that the asphalt parking lot will store conventional construction equipment such as dump trucks, vibratory rollers, and excavators. We recommend a preliminary heavy-duty pavement section that consists of 4 inches of hot-mix asphalt (HMA) over 6 inches of 1¼-inch crushed rock base course (Washington State Department of Transportation [WSDOT] 9-03.9(3) Crushed Surfacing Base Course or equivalent) placed on a firm and unyielding subgrade as determined by proof-rolling under the observation of AESI. The crushed rock base course placed beneath all pavements should be compacted to at least 95 percent of the modified Proctor maximum dry density (ASTM D-1557).

Detention Pond Considerations

We understand that the detention pond will be constructed in accordance with Ecology design standards, as indicated on the grading plan. The proposed detention pond layout and berm construction details appear suitable for the soil conditions encountered at explorations EP-5 and EP-6 (Vashon lodgement till consisting of silty sand with variable gravel content) provided that all structural fill is compacted to at least 95 percent of the modified Proctor maximum dry density (ASTM D-1557) and within 3 percent of the optimum moisture content.

CLOSURE

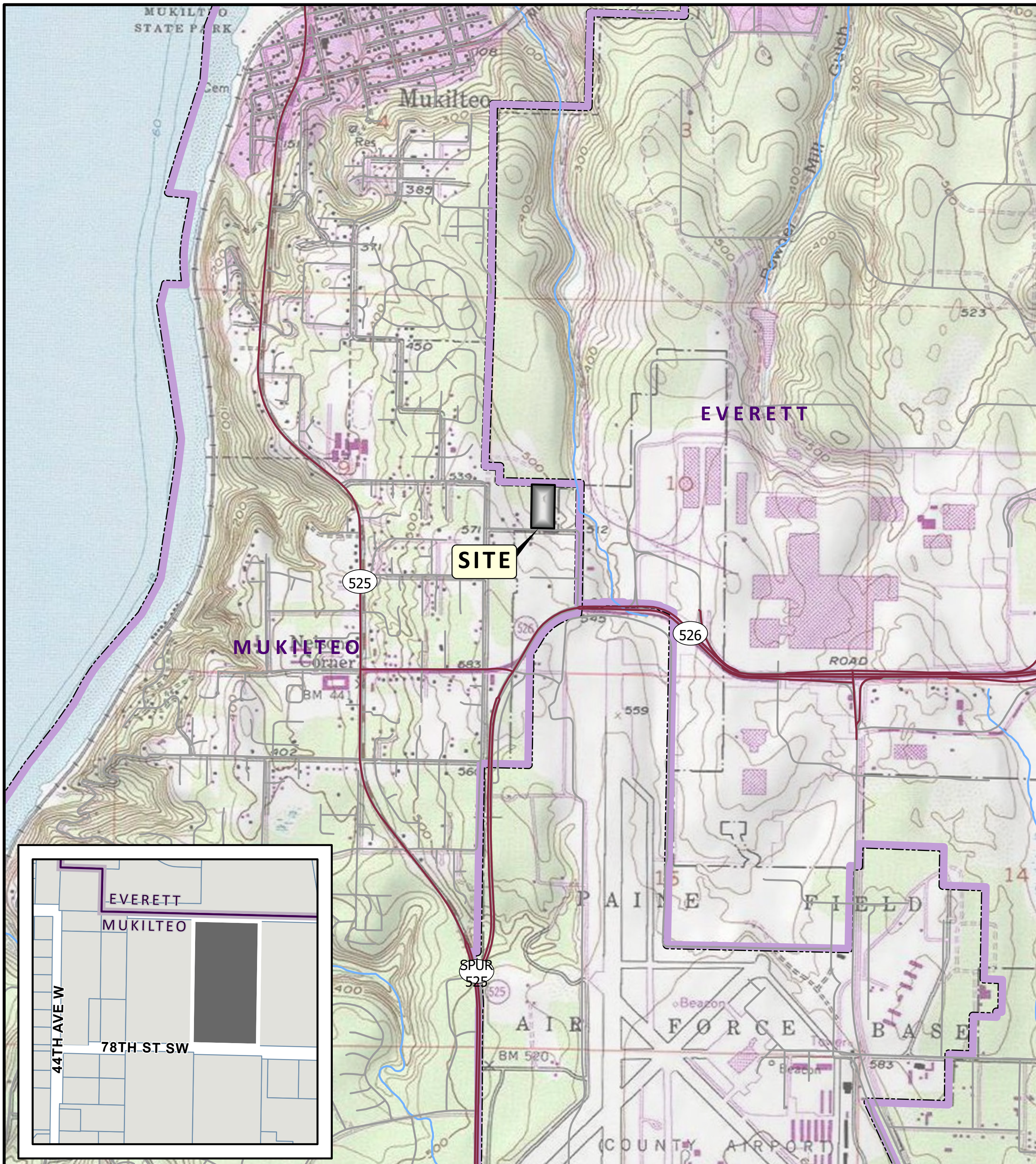
We appreciate the opportunity to have been of service to you on this project. Should you have any questions, or require additional information, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Kurt D. Merriman, P.E.
Senior Principal Engineer

G. Bradford Drew, P.E.
Senior Engineer

Attachments:	Figure 1:	Vicinity Map
	Figure 2:	Existing Site and Exploration Plan
	Figure 3:	Proposed Site and Exploration Plan
	Appendix A:	Exploration Logs
	Appendix B:	Laboratory Test Results



DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NATIONAL GEOGRAPHIC SOCIETY 2013
SNOHOMISH CO: STREETS, CITY LIMITS, PARCELS, 3/21
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

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FEET

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

associated earth sciences incorporated

VICINITY MAP

RODRIGUEZ COMMERCIAL SITE
MUKILTEO, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20210420E001	11/21	1

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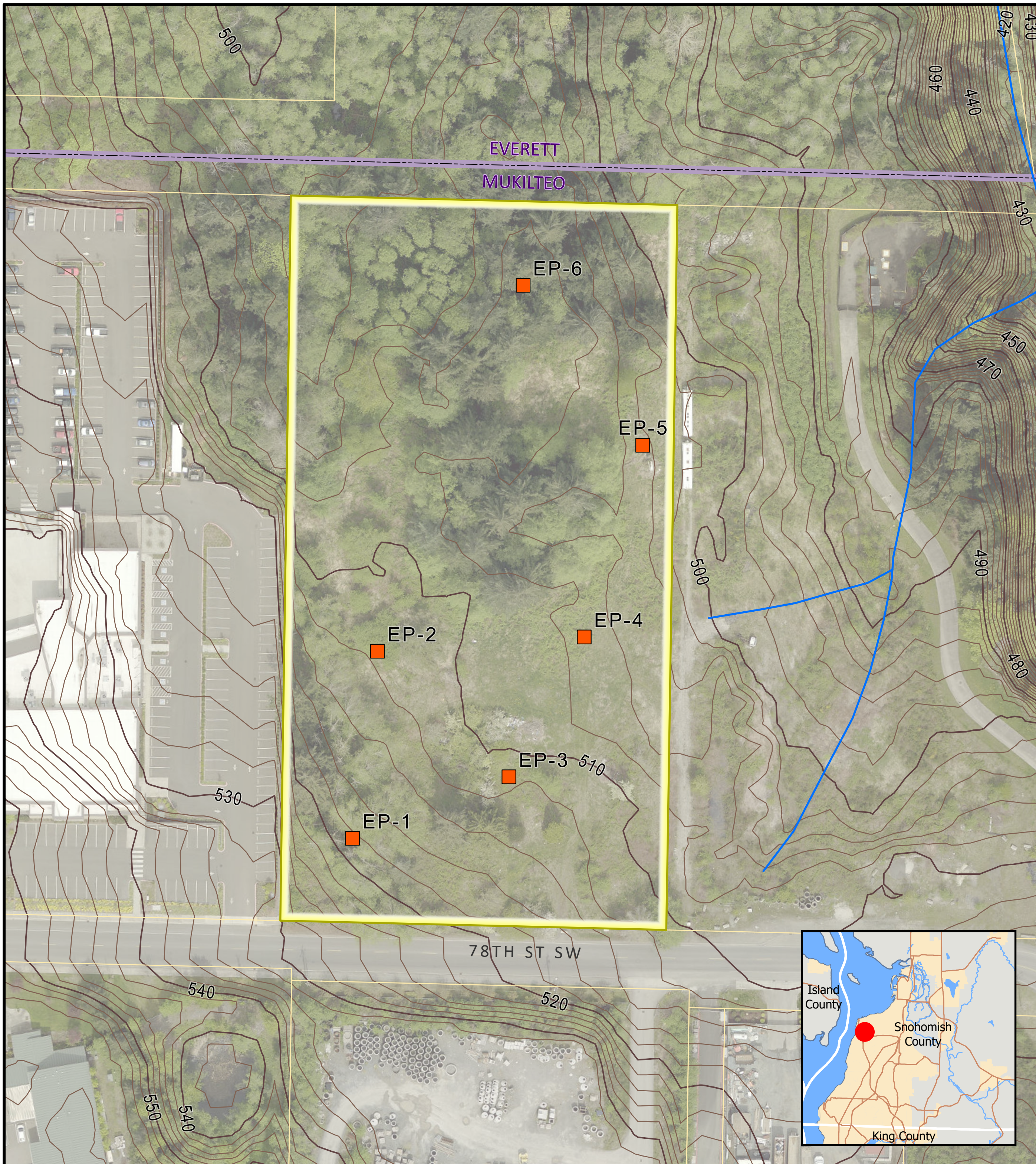

LEGEND

- SITE
- EXPLORATION PIT
- STREAM
- CITY BOUNDARY
- PARCEL
- CONTOUR 10 FT
- CONTOUR 2 FT

DATA SOURCES / REFERENCES:
WA STATE LIDAR PORTAL: NORTH PUGET SOUND 2016
ACQUIRED MARCH - SEPT 2016, GRID CELL SIZE IS 3'
CONTOURS FROM LIDAR
SNOHOMISH CO: STREETS, PARCELS 3/21
KING CO: EAGLEVIEW TECHNOLOGIES, INC., AERIAL 2019
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

N

0 120
FEET

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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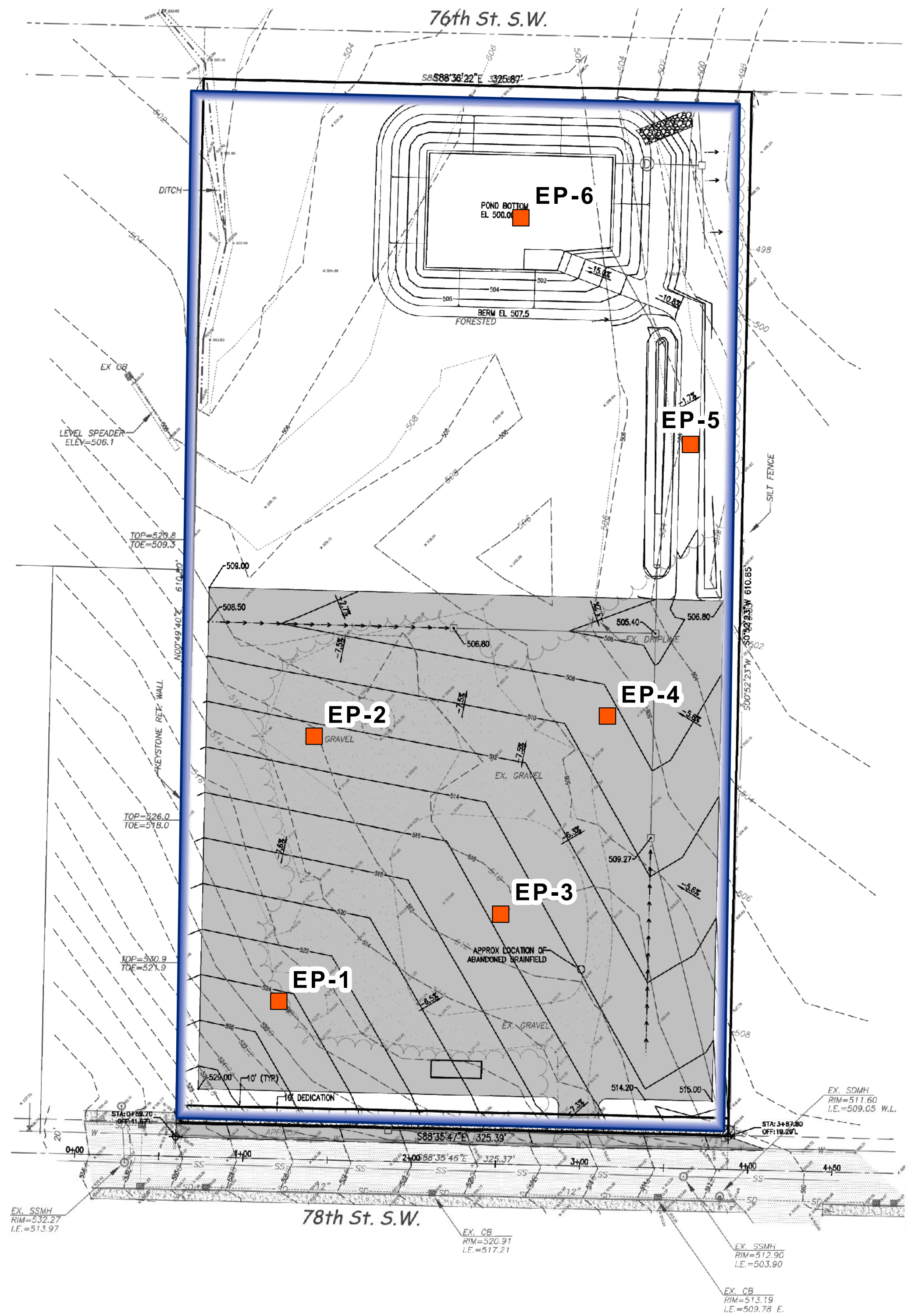
EXISTING SITE AND EXPLORATION PLAN

RODRIGUEZ COMMERCIAL SITE
MUKILTEO, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20210420E001	11/21	2

\\kirkfile2\GIS\GIS_Projects\aaY2021\210420 Rodriguez Commercial\aprx\20210420E001 F2 ES_Rodriguez.aprx | 20210420E001 F2 ES_Rodriguez | 11/15/2021 10:09 AM



LEGEND

SITE

EXPLORATION PIT

NOTE: SITE BOUNDARY FROM SNOHOMISH CO. PARCEL DATA

DATA SOURCES / REFERENCES:
BRL SERVICES LLC, RODRIGUEZ COMMERCIAL SITE, ONSITE GRADING PLAN, SHEET 2 OF 5, 9/15/21
SNOHOMISH CO: PARCELS 3/21
GEOREFERENCED USING KING CO: EAGLEVIEW TECHNOLOGIES, INC., AERIAL 2019
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

N

0 100

FEET

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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SITE AND EXPLORATION PLAN

RODRIGUEZ COMMERCIAL SITE MUKILTEO, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20210420E001	11/21	3

APPENDIX A

Exploration Logs

Major Division	Group	Fines	Symbol	Description
Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines[5]	**GW**	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥12% Fines[5]	**GM**	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines[5]	**SW**	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥12% Fines[5]	**SM**	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		**ML**	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		**MH**	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			**PT**	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT[2] blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT[2] blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

(3) Estimated Percentage

Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch

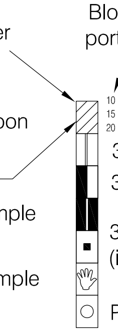
Slightly Moist - Perceptible moisture

Moist - Damp but no visible water

Very Moist - Water visible but not free draining

Wet - Visible free water, usually from below water table

Symbols



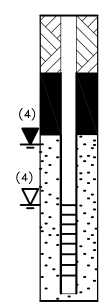
Sampler Type Description

3.0" OD Split-Spoon Sampler

3.25" OD Split-Spoon Ring Sampler

3.0" OD Thin-Wall Tube Sampler (including Shelby tube)

Portion not recovered



(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 ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

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.

EXPLORATION PIT NO. EP-1

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION** **Elevation (ft): ~518**
	Recycled Concrete - 4 inches
1 2	**Fill** Loose to medium dense, moist, brown to dark brown, silty, fine SAND, trace gravel; contains organics (SM).
3 4 5 6	**Vashon Lodgement Till** Medium dense, moist, tan and reddish brown, silty, fine SAND, some gravel; unsorted (SM). Becomes medium dense to dense. Dense, moist, tan with occasional reddish brown staining, silty, fine SAND, some gravel; unsorted; difficult digging (SM).
7 8 9 10 11 12	Bottom of exploration pit at depth 6.5 feet No seepage. No caving.

Rodriguez Commercial Site
Mukilteo, WA

Logged by: PL
Approved by: JHS

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Project No. 20210420E001

11/9/21

EXPLORATION PIT NO. EP-2

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION — Elevation (ft): ~512
	Topsoil
	Loose, moist, dark brown, silty, fine SAND, trace gravel; organic (SM).
1	
	Weathered Vashon Lodgement Till
2	Loose to medium dense, dark reddish brown, silty, fine SAND, trace gravel; unsorted (SM).
3	**Vashon Lodgement Till**
	Medium dense to dense, moist, tan and mottled reddish brown, silty, fine SAND, trace to some gravel; unsorted (SM).
4	
5	
	Dense, moist, grayish brown, silty, fine SAND, some gravel; unsorted; breaks off in chunks (SM).
6	
7	Becomes gray to brownish gray.
8	Bottom of exploration pit at depth 7.5 feet Slight to moderate seepage at 3 feet. No caving.
9	
10	
11	
12	

KCTP3 20210420E001.GPJ December 9, 2021

Rodriguez Commercial Site
Mukilteo, WA

Logged by: PL

Approved by: JHS

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Project No. 20210420E001

11/9/21

EXPLORATION PIT NO. EP-3

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION — Elevation (ft): ~511
	Fill
	Loose, dark brown, silty, fine SAND; highly organic (SM).
1	
2	Becomes wet.
3	**Vashon Lodgement Till**
	Dense, moist to very moist, mottled tan and reddish brown, silty, fine SAND, trace to some gravel; unsorted; sharp contact (SM).
4	
5	
	Dense, moist, brownish gray, silty, fine SAND, trace gravel; unsorted; breaks off in chunks; difficult digging (SM).
6	
7	
	Bottom of exploration pit at depth 7 feet Moderate seepage at 3 feet. Slight caving 0 to 3 feet.
8	
9	
10	
11	
12	

Rodriguez Commercial Site
Mukilteo, WA

Logged by: PL

Approved by: JHS

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Project No. 20210420E001

11/9/21

EXPLORATION PIT NO. EP-4

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION** **Elevation (ft): ~507**
	Topsoil - 1 inches
	Fill
1	Medium dense to dense, mottled grayish brown and reddish brown, silty, fine SAND, trace gravel (SM).
2	
	Medium dense to loose, very moist to wet, dark brown, silty, fine SAND; abundant organics (SM).
3	
4	Garbage debris in side wall at 4 feet.
5	
6	
7	**Vashon Lodgement Till** - Medium dense, very moist to wet, brown, silty, fine SAND, some gravel; tough scraping on gravel 6.5 to 7 feet (SM). Becomes dense, mottled grayish brown and reddish brown, moist, silty, fine SAND, some gravel; unsorted (SM).
8	Bottom of exploration pit at depth 7.5 feet Rapid seepage 2.5 to 6 feet. Moderate caving 3 to 6 feet.
9	
10	
11	
12	

KCTP3 20210420E001.GPJ December 9, 2021

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Mukilteo, WA

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Approved by: JHS

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Project No. 20210420E001

11/9/21

EXPLORATION PIT NO. EP-5

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION — Elevation (ft): ~504
	Topsoil
	Loose, moist, dark brown, silty, fine SAND; organic (SM).
1	
	Weathered Vashon Lodgement Till
2	Medium dense, moist, brown and tan, silty, fine SAND, trace to some gravel (SM).
	Becomes grayish brown with depth and some mottled reddish brown oxidation; unsorted.
3	
4	Occasional cobbles.
5	
6	**Vashon Lodgement Till**
	Dense, moist, brownish gray, silty, fine SAND, trace to some gravel; unsorted (SM).
7	
8	
9	Dense, moist, gray, silty, fine SAND, trace gravel; unsorted (SM).
10	
	Bottom of exploration pit at depth 10 feet No seepage. No caving.
11	
12	

Rodriguez Commercial Site
Mukilteo, WA

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Project No. 20210420E001

11/9/21

EXPLORATION PIT NO. EP-6

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION** **Elevation (ft): ~507**
	Topsoil - 4 inches
	Weathered Vashon Lodgement Till
1	Loose, moist, reddish brown, silty, fine SAND, trace gravel; unsorted (SM).
2	
	Becomes medium dense, tan.
3	
4	
	Vashon Lodgement Till
5	Dense, moist, brownish gray, silty, fine SAND, trace to some gravel; unsorted; breaks off in chunks; difficult digging (SM).
6	
	Becomes dense to very dense.
7	
8	
	Bottom of exploration pit at depth 8 feet No seepage. No caving.
9	
10	
11	
12	

Rodriguez Commercial Site
Mukilteo, WA

Logged by: PL
Approved by: JHS

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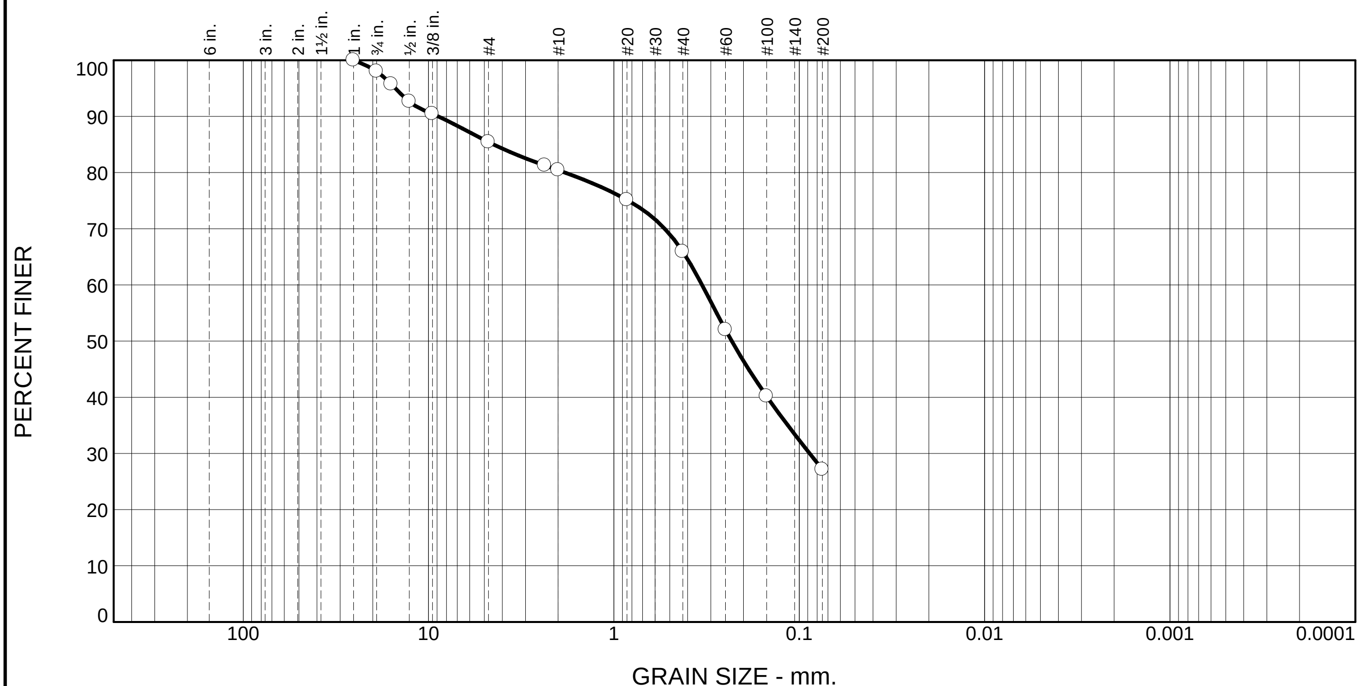
Project No. 20210420E001

11/9/21

APPENDIX B

Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.0	12.6	5.0	14.5	38.8	27.1	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
3/4"	98.0		
5/8"	95.7		
1/2"	92.6		
3/8"	90.5		
#4	85.4		
#8	81.3		
#10	80.4		
#20	75.1		
#40	65.9		
#60	52.0		
#100	40.2		
#200	27.1		

* (no specification provided)

Material Description

gravelly, silty SAND

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 8.8692 D_{85}= 4.4595 D_{60}= 0.3347
D_{50}= 0.2312 D_{30}= 0.0879 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 11/10/2021 **Date Tested:** 11/15/2021

Tested By: CI

Checked By: PL/BD

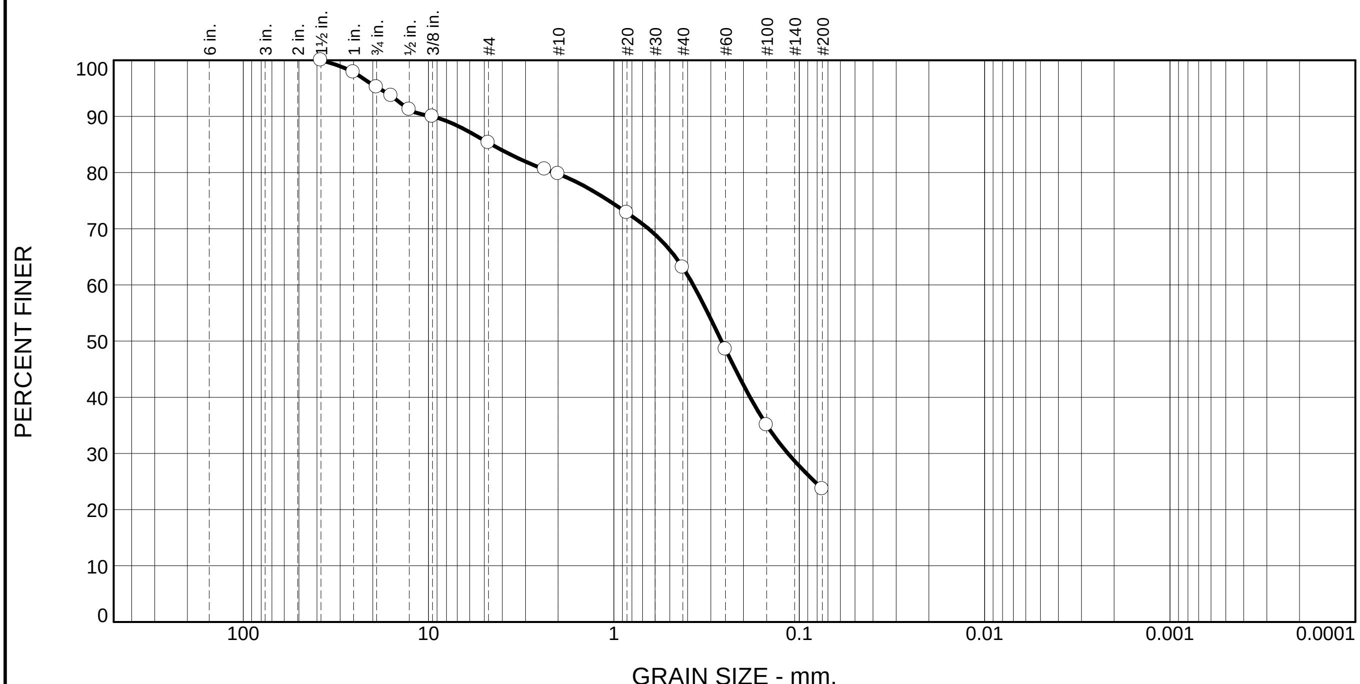
Title:

Location: Onsite
Sample Number: EP-6 **Depth:** 3'
Date Sampled: 11/9/2021

associated earth sciences incorporated

Client: Jireh Construction
Project: Rodriguez Commercial Site
Project No: 20210420 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.8	9.9	5.5	16.7	39.4	23.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	97.8		
3/4"	95.2		
5/8"	93.7		
1/2"	91.2		
3/8"	90.0		
#4	85.3		
#8	80.6		
#10	79.8		
#20	72.8		
#40	63.1		
#60	48.5		
#100	35.1		
#200	23.7		

* (no specification provided)

Material Description

gravelly, silty SAND

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SM **AAASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 9.5569 D_{85}= 4.5709 D_{60}= 0.3734
D_{50}= 0.2627 D_{30}= 0.1152 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 11/10/2021 **Date Tested:** 11/15/2021

Tested By: CI

Checked By: PL/BD

Title:

Location: Onsite
Sample Number: EP-6 **Depth:** 6'
Date Sampled: 11/9/2021

associated earth sciences incorporated

Client: Jireh Construction
Project: Rodriguez Commercial Site
Project No: 20210420 E001 **Figure**