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Subsurface Exploration, Geologic Hazard, and Preliminary Geotechnical Engineering Report

ISSAQUAH MIDDLE SCHOOL #6

Issaquah, Washington

Prepared For:

ISSAQUAH SCHOOL DISTRICT

Project No. 180522E001
July 19, 2019

Associated Earth Sciences, Inc.
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July 19, 2019
Project No. 180522E001

Issaquah School District
565 NW Holly Street
Issaquah, Washington 98027

Attention: Mr. Tom Mullins

Subject: Subsurface Exploration, Geologic Hazard, and
Preliminary Geotechnical Engineering Report
Issaquah Middle School #6
50 Talus Corporate Way NW
Issaquah, Washington

Dear Mr. Mullins:

We are pleased to present the enclosed copy of the referenced report. This report summarizes the results of our subsurface exploration, geologic hazard, and geotechnical engineering studies and offers preliminary recommendations for the design and development of the proposed project. This report is based on our discussions with the design team, and a "Final Grading Plan" dated June 28, 2019 prepared by Coughlin Porter Lundeen, the project civil engineer. We recommend that we be allowed to review substantial changes to project plans and update our recommendations as needed. This document has been updated from our initial report dated April 4, 2019. The update included incorporating the project grading plan, and completing a geotechnical critical areas study based on the grading plan.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions, or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

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

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SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

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I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazard, and preliminary geotechnical engineering study for the proposed new Issaquah Middle School. The site location is shown on the "Vicinity Map," Figure 1. The approximate locations of explorations completed for this study are shown on the "Existing Site and Exploration Plan," Figure 2. Explorations are overlaid on a project grading plan on the "Proposed Site and Exploration Plan" Figure 3. This report is based on a project grading plan dated June 28, 2019. Interpretive exploration logs and associated laboratory test results are included in the Appendices. The conclusions and recommendations contained in this report should be reviewed and modified, or verified, if project plans change substantially.

1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be used in the design of the project. Our study included a review of selected geologic literature, review of previous geotechnical studies by others, excavation of exploration pits, drilling exploration borings, installing monitoring wells and groundwater level data loggers, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow groundwater. Slope stability models were constructed, and the slope stability model results were incorporated into a critical areas study presented in the "Geologic Hazards and Mitigations" section of this report. Geotechnical engineering studies were completed to formulate our recommendations for site preparation, site grading, structural fill, new foundation designs, slab-on-grade floors, retaining walls, construction, and drainage. This report summarizes our current fieldwork and offers recommendations for development based on our present understanding of the project. We recommend that we be allowed to review project plans when they are finalized and update the recommendations in this report as needed.

1.2 Authorization

This report has been prepared for the exclusive use of the Issaquah School District (District) and its agents for specific application to this project. Our work was performed in accordance with our scope of work and cost proposal, dated February 26, 2019. We were authorized to proceed by means of a District purchase order.

Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

This report was completed with an understanding of the project based on a site grading plan dated June 28, 2019, a preliminary earthwork quantity plan, and our discussions with the design team.

The proposed project will include construction of a new middle school facility and an athletic field. At the time of this report, the plans include a building pad on the north part of the site with an elevation of approximately 230 feet at Level LL2, and an athletic field on the south part of the site at approximately elevation 218 feet. Constructing the terraces will require substantial cuts on the north and west sides of the terraces and substantial fills on the south and east sides of the terraces. Cuts up to approximately 40 feet and fills up to approximately 50 feet are anticipated. We anticipate that substantial cut and fill retaining walls will be used.

The project site is the current Talus Parcel 17B, at the intersection of NW Talus Drive and Falcon Way NW. The site was constructed to its current configuration during previous earthwork. The site was previously regraded and used as a construction staging area during work on the building adjacent to the now-existing building adjacent to the west. Project plans for the building offsite to the west were reviewed as part of this study, and include regrading of Parcel 17B, the subject property.

The site is an irregularly-shaped parcel of 9 acres in plan view with slopes onsite and to the west, south, and east of the site. Total vertical relief across the site is approximately 145 feet, with the highest point in the southwest corner of the site, steeply sloping down to a relatively flat gravel lot terrace in the north-central part of the site. East of the flatter central terrace, topography slopes steeply down to the east to the lowest point in the southeast corner of the site. King County Environmentally Sensitive Area (ESA) mapping depicts mapped Seismic Hazard and Erosion Hazard Areas onsite, and Coal Mine Hazard Areas approximately 1,000 feet to the south of the property boundary. The site contains slopes that meet geometric criteria for treatment as Steep Slope and Landslide Critical Areas in accordance with *Issaquah Municipal Code* (IMC) 18.10.390.

3.0 SUBSURFACE EXPLORATION

Our field study included observing twelve exploration pits with a tracked excavator on November 11 and December 6 of 2018, drilling nine exploration borings on November 12, 13, 14, and December 6 of 2018, and installing three monitoring wells with groundwater level data loggers. Five additional exploration borings were drilled on March 21, 22, and 25 of 2019. The locations of the exploration pits, borings, and wells were measured in the field using a georeferenced site plan with a hand-held Global Positioning System (GPS) device. The locations depicted on Figures 2 and 3 were super imposed on a Light Detection and Ranging (LIDAR) plan view of the site (Figure 2) and a proposed grading plan (Figure 3). Interpretive exploration logs are presented in Appendix A. 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. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types in the field.

The conclusions and recommendations presented in this report are based, in part, on the explorations completed for this study, reviews of a LIDAR image of the property and surrounding area and on reports by others discussed in Section 3.4. The number, locations, and depths of our explorations were completed within site and budget constraints. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present 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 may not become fully evident until construction.

3.1 Exploration Pits

The exploration pits were excavated using a tracked excavator. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by a geologist from our firm. Selected samples were then placed in water-tight containers and transported to our laboratory for further visual classification and testing, as necessary. All exploration pits were backfilled after examination and logging; the disturbed surface soil was re-contoured and covered with straw when our work was complete.

3.2 Exploration Borings

We completed fourteen hollow-stem auger borings at the locations shown on Figures 2 and 3. Logs of our borings, labeled EB-1W to EB-14, are included with this report. The borings were completed by advancing a 3.5-inch inside-diameter or a 3.25-inch inside-diameter, hollow-stem auger with a track-mounted drill rig. During the drilling process, samples were obtained at generally 2.5 to 5-foot-depth intervals. The exploration borings were continuously observed and logged by a geologist or engineer from our firm. The various types of soils, as well as the depths where characteristics of the soils changed, are indicated on the exploration logs presented in Appendix A of this report. The exploration logs presented in Appendix A are based on the field logs, drilling action, and inspection of the samples secured. Our explorations were approximately located by using a georeferenced site plan, hand-held GPS, landmarks within the field, and planned building corner markers placed by others. Because of the nature of exploratory work, extrapolation of subsurface conditions between field explorations is necessary. Differing subsurface conditions may be present due to the random nature of natural sediment deposition and the alteration of topography by past grading and filling. The nature and extent of any variations between the field explorations may not become fully evident until construction. If variations are observed at the time of construction, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

Disturbed, but representative samples were obtained by using the modified Standard Penetration Test (SPT) procedure. This test and sampling method consists of driving a 2-inch outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance (“N”) or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs. If little to no recovery was obtained using a 2-inch sampler, a second sample recovery attempt was made using a 3-inch outside-diameter, split-barrel sampler.

The samples obtained from the split-barrel sampler 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, as necessary.

3.3 Monitoring Wells

Following drilling, groundwater monitoring wells were installed in exploration borings EB-1W, EB-2W, and EB-8W to allow for long-term monitoring of groundwater levels below the site. These wells each consist of a 2-inch-diameter, polyvinyl chloride (PVC) Schedule-40 well casing with threaded connections. The lower 10 feet of each well is a finely-slotted (0.020-inch machine slot) well screen to permit water inflow. The annular space around the well screens was backfilled with silica sand, and the upper portion of annulus was sealed with bentonite grout and chips. Above-ground monuments were placed over the top of the wellheads for protection and bollards were installed to protect the monuments. The as-built configurations of these wells are illustrated on the boring logs included in Appendix A. The wells were developed with a 12v Mini-Typhoon pump with a $^3/_8$-inch outside-diameter tubing assembly. The entire length of the well screens was surged incrementally from the top down at a rate of about 1 minute per foot of screen. Following surging, approximately 10 to 30 gallons of water were pumped from the wells in EB-1W, EB-2W, and EB-8W.

The water level during well development on November 20, 2018 was measured at about 7.2 feet below ground surface in EB-2W, and during development on December 10 about 20 feet below ground surface in EB-8W. No groundwater was observed in EB-1W at the time of drilling or during development. Water level data loggers have been installed in the wells. We will collect continuous water level measurements for the next year.

3.4 Reports by Others

As a part of our study we reviewed the report "Report on Subsurface Exploration and Geotechnical Engineering, Talus Corporate Center, NW Talus Drive, Issaquah, Washington," Golder Associates (Golder), February 19, 2008. The referenced report includes logs of thirteen exploration borings and six exploration pits completed onsite by Golder in 2007, two exploration borings completed by Golder in 2000, and one exploration boring completed by Icicle Creek Engineers in 1997. Associated Earth Sciences, Inc. (AESI) relied on the data by others we reviewed. Explorations by others are depicted on Figures 2 and 3, and on geologic cross-sections presented on Figures 4 and 5.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, LIDAR imagery, visual reconnaissance of the site, and review of selected geologic literature. The general distribution of geologic units is shown on the exploration logs. As shown on the field logs and detailed below, the explorations generally encountered native sediments consisting of dense Vashon lodgement till and medium dense – dense Vashon recessional outwash. One exploration pit and four exploration borings encountered rip-up debris from the Renton Formation. One exploration boring in the northeast part of the site encountered mass wasting deposits, one in the west-central part of the site encountered pre-Vashon mass wasting/alluvium, one encountered meltout till/ice-contact deposits and another encountered alluvial fan deposits. The native sediments were covered by existing fill ranging from 4.5 to 35 feet thick in two exploration pits and twelve exploration borings. Subsurface explorations completed for this study, subsurface explorations previously completed by others, and our interpretations of subsurface conditions between explorations are depicted on Cross-Sections A-A' and B-B' found on Figures 4 and 5.

We reviewed a published geologic map of the project, *Geologic Map of the East Half of the Bellevue South 7.5' x 15' Quadrangle, Issaquah Area, King County, Washington*, by Derek B. Booth et al., 2012. The referenced map indicates that the site is expected to be underlain at shallow depths by Vashon lodgement till, ice-contact deposits, and alluvial fan deposits. Fluvial outwash deposits were also mapped nearby. Our on-site explorations and interpretations are generally consistent with the conditions depicted on the published map.

4.1 Stratigraphy

Grass/Topsoil

A surficial layer of grass and topsoil was encountered in one of the exploration borings and in six of the exploration pits. This organic layer ranged from approximately 0.5 to 1.5 feet in thickness. Observed topsoil thickness is shown on the attached subsurface exploration logs. Due to their high organic content, these materials are not considered suitable for foundation, roadway, or slab-on-grade floor support, or for use in a structural fill.

Fill

We observed existing fill in twelve exploration borings and two exploration pits. The fill observed was generally within graded roads or the gravel-lot terrace in the central part of the site. We observed the fill to be highly variable, some areas of the existing fill consist of medium dense to dense sand with varying amounts of silt and gravel with minimal organics while other areas consist of loose to medium dense mostly silty sand with varying amounts of gravel, moderate fine organics and woody debris. We observed some construction debris, various crushed rock and concrete rubble in most fill soils.

We generally observed that the fill soils placed within the gravel lot in the central part of the site had minimal organics and appeared to be engineered fill. These fill soils ranged from a depth of approximately 4 feet to 20 feet. Fill soils placed on the graded road traversing the western slope from the central terrace up to Falcon Way NW typically consisted of poorly compacted soil that contained moderate fine organics and occasional root and lumber debris. We observed these fill soils to be placed in a north-south-oriented wedge shape starting approximately halfway up the slope with the thickest part of the fill in the southwest corner of the site. These fill soils extended up to 35 feet below existing ground surface.

Existing fill is not suitable for support of building foundations unless grading plans and fill compaction testing reports associated with existing fill are available. Existing fill is suitable for support of paving and lightly-loaded ancillary structures with remedial preparation as recommended in this report. Excavated existing fill material is suitable for reuse in compacted fills if allowed by project plans and specifications, if organic and other deleterious materials are removed, and if the moisture content is adjusted to -2 to +1 percent of optimum for compaction purposes.

Mass Wasting Deposits

Beneath the fill, one of our exploration borings, EB-3A/B, encountered medium stiff silt ranging to a clay with some sand and varying amounts of gravel, with fragments of Renton Formation bedrock, interpreted as a mass wasting deposit. Mass wasting is the process by which material moves downslope typically as a solid, continuous or discontinuous mass. Mass wasting may occur at a very slow rate or at a very high speed and can result in a poorly compacted chaotically structured unit. Due to the random nature of deposition and the typically poor consolidation of the material, the mass wasting deposit is not suitable for support of foundations, fill slopes, or other structures in its present condition.

Alluvial Fan Deposits

One of our exploration borings, EB-9, encountered dense gravelly sand with trace silt. After review of available geologic literature and LIDAR imagery, we interpret these sediments to be alluvial fan deposits. Alluvial fan deposits are generally suitable for lightly-loaded foundations and paving. Alluvial fan deposits encountered within our explorations were estimated to be above optimum moisture content for compaction purposes and will require drying before compaction in fill applications if such reuse is explicitly allowed by project plans and specifications.

Vashon Recessional Outwash

Nine exploration borings and three exploration pits encountered typically medium dense to dense sand with varying amounts of silts and gravels interpreted as Vashon recessional outwash. Recessional outwash was deposited from meltwater streams emanating from a retreating continental glacier and resembles alluvial sediments. The recessional outwash observed in our explorations was typically weakly stratified, with textural variations observed over lateral and vertical distances. Recessional outwash is suitable for support of foundations, floors, and paving with proper preparation as recommended in this report. Recessional outwash encountered during exploration was typically above optimum moisture content and will require moisture remediation before use in compacted fill applications if such reuse is explicitly allowed by project plans and specifications.

Meltout/Vashon Ice-Contact Deposits

Underlying the recessional outwash, exploration boring EB-5 encountered dense to very dense silt with varying amounts of sand and gravel interpreted as meltout/ice-contact deposits. Meltout/ice-contact sediments were initially deposited in contact with glacial ice and were redeposited at the time the ice melted. Ice-contact sediments can be highly variable in density and texture. All sediments of glacial origin may contain large cobbles or boulders at random locations. Vashon ice-contact sediments are suitable for support of lightly- to moderately-loaded foundations and new paving with proper preparation. Ice-contact sediments are silty and moisture-sensitive; careful management of moisture-sensitive soils, as recommended in this report, will be needed to reduce the potential for disturbance of wet ice-contact sediments and costs associated with repairing disturbed soils. Excavated ice-contact sediments are suitable for reuse in structural fill applications if specifically allowed by project specifications, and if moisture conditions are adjusted to allow compaction to a firm and unyielding condition at the specified level.

Vashon Lodgement Till

Eleven exploration borings and eleven exploration pits encountered typically dense to very dense, silty sand with varying amounts of gravel and cobbles interpreted as Vashon lodgement till. The lodgement till observed in our explorations graded from loose to very dense with increasing depth. The lodgement till observed contained frequent lenses of cleaner fine sand which provided a conduit for groundwater flow within the till. Within the lodgement till, exploration pit EP-7 and exploration borings EB-10A/B, 11, 12, and 13 encountered typically medium stiff to very stiff brownish purplish gray silt to clay with varying amounts of sand and gravel and varying amounts of coal fragments interpreted as rip-up clasts of Renton Formation. These rip-up clasts ranged from a depth of approximately 5.5 to 45 feet below ground surface and were typically 5 to 10 feet thick. Lodgement till was deposited at the base of an active ice sheet and was subsequently compacted by the weight of the overlying glacial ice. Lodgement till typically possesses high-strength and low-compressibility attributes that are favorable for support of foundations, floor slabs, and paving, with proper preparation. Lodgement till is silty and moisture-sensitive. In the presence of moisture lodgement till can be easily disturbed by vehicles and earthwork equipment. Careful management of moisture-sensitive soils, as recommended in this report, will be needed to reduce the potential for disturbance of wet lodgement till soils and costs associated with repairing disturbed soils. Reuse of excavated lodgement till sediments in structural fill applications will require drying to achieve moisture contents within 1 to 2 percent of optimum for compaction purposes.

Pre-Vashon Mass Wasting/Alluvium

One exploration boring encountered medium dense blackish gray to lavenderish gray fine to medium sand with varying amounts of gravel. The unit consisted of very stiff purplish light brown to greenish dark gray silt to clayey silt with varying amounts of sand and gravel and fragments of Renton Formation bedrock. Very dense dark gray fine sand some silt ranging to silty fine sand with varying amounts of gravel was also encountered. These sediments are interpreted as pre-Vashon mass wasting/alluvium deposit composed of material derived from the Renton Formation. These sediments are glacially consolidated but can be highly variable in density and texture. Pre-Vashon mass wasting/alluvium deposits are suitable for support of lightly- to moderately-loaded foundations and new paving with proper preparation. These sediments are silty and moisture-sensitive; careful management of moisture-sensitive soils, as recommended in this report, will be needed to reduce the potential for disturbance of wet pre-Vashon mass wasting/alluvium sediments and costs associated with repairing disturbed soils. Excavated pre-Vashon mass wasting/alluvium sediments are suitable for reuse in structural fill applications if specifically allowed by project specifications, and if moisture conditions are adjusted to allow compaction to a firm and unyielding condition at the specified level.

4.2 Hydrology

Several water-bearing zones are present beneath the site, based on our explorations. These zones include interflow, isolated groundwater within glacial till, perched groundwater within the recessional outwash and an unconfined aquifer within the recessional outwash and alluvial fan deposits. It should be noted that the occurrence and level of groundwater seepage below the site may vary in response to such factors as changes in season, amounts of precipitation, changes in site use, and other on- and off-site factors. Wells EB-1W, EB-2W, and EB-8W were completed to monitor seasonal water level changes, and groundwater monitoring is ongoing. Two surface water features were observed at the time of exploration: a 12-inch storm pipe outfall in the north of the central gravel terrace and the stormwater pond in the southeast corner of the site. Twelve of the exploration borings and five of the exploration pits encountered groundwater seepage 2.5 to 39.5 feet below existing ground surface. Groundwater was generally observed within the northwest and central west uphill area of the site, downslope within the central terrace and within the lowest part of the site in the southeast corner.

On the upland areas across the site, seasonal winter rainfall can accumulate within the weathered till and fill sediments where present across the site, forming an active interflow zone. The interflow network will fluctuate due to time of year, amount of rainfall, and other factors.

An unconfined aquifer is present within the recessional outwash and alluvial fan deposits present at ground surface. Water may collect within these deposits, if underlain by low-permeability Vashon till sediments or meltout/ice-contact deposits, which can restrict the rate of deeper infiltration. Groundwater within the recessional outwash and alluvial fan interacts with surface water features present on the site including any stormwater outfalls onsite and the lower, downgradient stormwater pond.

Isolated areas of groundwater were present within the Vashon lodgement till. Thin zones of relatively clean sand within the till were encountered in explorations and should be expected to produce seepage during excavation. Within our exploration pits, slight to moderate groundwater seepage from within the till unit was common and were generally observed between 1 to 11 feet below existing ground surface. Heavy groundwater seepage was observed within EP-3. Isolated groundwater occurs where groundwater preferentially collects in less silty strata within the lodgement till.

4.3 Laboratory Test Results

Four laboratory grain-size analyses were performed in accordance with the *American Society for Testing and Materials* (ASTM) D-422 on a representative selected sample collected during our subsurface exploration for this project. Laboratory test results are included in Appendix B.

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and shallow groundwater conditions as observed and discussed herein.

5.0 STEEP SLOPE HAZARDS AND MITIGATIONS

IMC Section 18.10.390 defines Landslide Hazard Areas and Steep Slope Hazard Areas. The existing site includes areas that meet both the definitions for Landslide Hazard and Steep Slope Hazard areas. The existing slopes were created during earlier earthwork onsite. Construction plans for the existing adjacent building offsite to the east included regrading of Parcel 17B (the subject property for this study), including establishment of the existing steep slopes. The current project plan set includes a Slope Analysis plan prepared by David Evans and Associates, Inc., dated July 1, 2019, that identifies existing slopes with geometric criteria that meet IMC steep slope area and landslide hazard area definitions.

In order to investigate slope stability of the proposed project, we constructed two slope stability models using the program Slope/W. The locations of slope stability cross-sections are depicted on Figures 2 and 3. Geometry inputs, soil strength parameters, and results of slope stability modeling are presented on the following figures:

Figure 6 - Slope Stability Cross-Section C-C’ (Geometry only)
Figure 7 - Slope Stability Cross-Section C-C’ (Static Stability results)
Figure 8 - Slope Stability Cross-Section C-C’ (Seismic Stability results)
Figure 9 - Slope Stability Cross-Section D-D’ (Geometry only)
Figure 10 - Slope Stability Cross-Section D-D’ (Static Stability results)
Figure 11 - Slope Stability Cross-Section D-D’ (Seismic Stability results)

Slope stability cross-sections were selected to represent the most critical portions of the proposed west engineered wall and slope west of the playfield (C-C’) and the east engineered wall and slope on the east side of the playfield (D-D’). Slope stability inputs included subsurface exploration data from explorations by AESI and others discussed earlier in this report, topographic inputs from project survey drawings and the previously referenced June 28, 2019 grading plan, estimated strength parameters for subsurface materials that were selected based on density measurements, grain-size testing, and correlations with published strength data for similar materials in the project area. The slope stability models for this project were constructed to investigate global slope stability. The models were therefore constructed such that slope failures that penetrate proposed retaining walls were not considered.

Slope stability models were used to search for the most critical failure surfaces on each cross-section. At the most critical surface locations, the models compared slope failure driving forces to resisting forces. Minimum ratios of slope failure resisting : driving forces (factors of safety) are typically considered to be 1.5 under static conditions, and 1.1 under modeled seismic conditions. The slope stability modeling results presented on the figures attached to this report meet these minimum factors of safety requirements.

In our opinion the finished project, if constructed in accordance with the previously referenced grading plan and the recommendations contained in this report, will result in slope stability factors of safety that meet or exceed accepted minimum factor of safety requirements under static and seismic conditions. IMC Section 18.10.580 E.2. allows modification of Steep Slope Hazard and Landslide Hazard areas based on the results of a critical area study that demonstrates that the project will not result in adverse slope stability impacts. The slope analyses contained in this report are intended to serve as the critical areas study of site slopes, and we recommend approval of the project as proposed in the previously referenced grading plan.

6.0 SEISMIC HAZARDS AND MITIGATIONS

Earthquakes occur regularly in the East Puget Upland. Most of these events are small and are not felt by people. However, large earthquakes have occurred, including the 2001, 6.8-magnitude event; the 1965, 6.5-magnitude event; and the 1949, 7.2-magnitude event. 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 four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

There are several inferred faults near the subject site with the closest being a trace of the Seattle Fault located approximately 1,200 feet to the south. Studies of the Seattle Fault Zone by the U.S. Geological Survey (USGS) (e.g., Johnson et al., 1994, *Origin and Evolution of the Seattle Fault and Seattle Basin*, *Washington*, Geology, v. 22, pp. 71-74 and Johnson et al., 1999, *Active Tectonics of the Seattle Fault and Central Puget Sound Washington - Implications for Earthquake Hazards*, Geological Society of America Bulletin, July 1999, v. 111, n. 7, pp. 1042-1053) have provided evidence of surficial ground rupture along a northern splay of the Seattle Fault. According to the USGS studies, the latest movement of this fault was about 1,100 years ago when about 20 feet of surficial displacement took place. This displacement can presently be seen in the form of raised, wave-cut beach terraces along Alki Point in West Seattle and Restoration Point at the south end of Bainbridge Island. The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to be in excess of several thousand years.

Due to the suspected long recurrence intervals for this fault zone, and the distance from the site to mapped fault traces, the potential for surficial ground rupture is considered to be low during the expected life of the proposed structures.

6.2 Seismically Induced Landslides

We anticipate that project plans will include regrading and construction of engineered walls to create grade changes in the completed project. Finished slopes will not meet criteria for treatment as Landslide Hazard or Steep Slope Hazard Areas in accordance with IMC. No quantitative slope engineering was completed for this preliminary report. The final geotechnical report will include recommendations for engineered slopes and soil parameters for retaining wall design, including seismic design parameters.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by non-cohesive silt and sand with low relative densities, accompanied by a shallow water table.

Our explorations suggest that the potential risk of damage to the proposed development by liquefaction is low due to the dense glacially consolidated lodgement till sediments observed at shallow depths. Additionally, current grading concepts result in terraces separated by walls that will collect and divert groundwater flow. No quantitative liquefaction analysis was completed for this study, and none is warranted for the project as currently proposed, in our opinion. We should be allowed to review future plans to determine if a liquefaction analysis is warranted.

6.4 Seismic Site Class (2015 *International Building Code*)

At the time this report was written, Issaquah has adopted the 2015 version of the *International Building Code* (IBC). In accordance with the 2015 IBC, as well as the document *American Society of Civil Engineers* (ASCE) 7 referenced therein, the project should be designed based on seismic

Site Class "D". If the project will be submitted under the 2018 IBC we should be allowed to review our seismic site class recommendations.

6.5 Coal Mine Hazard

Coal mining companies were active in the Cougar Mountain area approximately from the early 1860's to the early 1960's. To access the coal, parallel tunnels were excavated along the strike of the coal seam with principal coal extraction occurring up dip of the tunnel. Mining of the coal seam may, or may not, have continued to the ground surface. The mining methods commonly used were room and pillar extractions, where support for the roof was maintained by leaving coal in place as "pillars" supporting mined-out "rooms." After an area had been fully mined, the pillars were often removed in a systematic fashion from the uppermost pillar down to lower levels until the tunnel level was reached; this commonly caused the collapse of the roof in mined rooms. In old coal mining areas local ground subsidence is not uncommon especially where old mine workings were near the existing ground surface. This can take the form of surface depressions in adjacent areas to subsurface mine workings.

The IMC recognizes coal mine hazard areas as those being directly underlain by or affected by abandoned coal mine workings. The nearest known King County Coal Mine Hazard Area is located approximately 1,000 feet to the south. We did not observe any coal mine workings within our exploration borings or surface indications of previous mining activity such as mine entrances, slag piles, or areas of subsidence. No coal mine hazard analysis was completed for this study, and none is warranted for the project, in our opinion.

6.6 Erosion Control

Project plans should include implementation of temporary erosion controls in accordance with local best management practices (BMPs). Control methods should include limiting earthwork to seasonally drier periods, typically April 1 to October 31, use of perimeter silt fences, and straw mulch in exposed areas. Removal of existing vegetation should be limited to those areas that are required to construct the project, and new landscaping and vegetation with equivalent erosion mitigation potential should be established as soon as possible after grading is complete. During construction, surface water should be collected as close as possible to the source to minimize silt entrainment that could require treatment or detention prior to discharge. Timely implementation of permanent drainage control measures should also be a part of the project plans, and will help reduce erosion and generation of silty surface water onsite.

III. PRELIMINARY DESIGN RECOMMENDATIONS

7.0 INTRODUCTION

Our exploration indicates that, from a geotechnical engineering standpoint, the parcel is suitable for the proposed development, provided the recommendations contained herein are properly implemented. Native sediments suitable for foundation support were observed at anticipated building pad elevation, and conventional shallow and spread footing foundations may be utilized if they bear directly on suitable native sediments, or on structural fill placed above suitable native sediments.

Most of the existing sediments onsite are silty and are expected to be highly moisture-sensitive. At the time of our subsurface exploration program, some of the site soils were above optimum moisture content for compaction purposes. Additionally, groundwater was frequently encountered within our exploration pits and borings. Structural fill placement using site soils with high silt content can only be accomplished during the dry summer months when moisture contents can be adjusted by aeration and drying during favorable weather. Significant but unavoidable effort will be required to dry site soils with high silt content prior to use in structural fill applications. If the weather conditions or construction schedule make it impossible to dry site soils or proper dewatering methods are not implemented, most of the site soils will be unsuitable for use in structural fill applications unless soil cement treatment is used.

7.1 Boulders

Boulders will be encountered during earthwork. Boulders are expected to include existing boulders stockpiled at the ground surface. Glacially transported boulders that are hard and not easily pulverized, and locally derived rip-up clasts of Renton Formation bedrock that are expected to be excavated and pulverized with conventional earthwork equipment working at lower than normal production rates. Boulders should be identified, quantified, and handled in accordance with project specifications.

8.0 SITE PREPARATION

A 12-inch water main runs approximately across the middle of the site generally 3 to 7 feet below the surface. We are not aware of any other existing structures or buried utilities onsite; however, if any are discovered in areas of planned structures or paving, they should be removed. Adequate temporary erosion and sedimentation controls (TESCs) should be constructed in accordance with the City of Issaquah requirements and the project civil design. We would like to emphasize how important effective, proactive erosion control measures will be to the completion of this project. We recommend that the project contractor work together with the design team and the City of Issaquah to install and maintain the erosion control measures. It is considered easier and much less costly to keep fine-grained soils in place than it is to remove them from site storm runoff. Temporary dewatering equipment should be available and used, as needed, to control groundwater to facilitate construction activities.

Site preparation of building and paving areas should include removal of all grass, trees, brush, debris, and any other deleterious materials. All existing fill should be addressed as recommended in Section 8.1 of this report. We recommend that any existing septic systems, wells, and other similar structures be decommissioned and removed in accordance with applicable regulations. Existing buildings, foundations, and any other buried structures should be removed from below foundation areas. Buried utilities should be removed from foundation areas, and should be abandoned in place or removed from below planned new paving. Any depressions below planned final grades caused by demolition activities should be backfilled with structural fill, as discussed under the "Structural Fill" section of this report.

Existing topsoil should be stripped from structural areas. The actual observed in-place depth of topsoil and grass at the exploration locations is presented on the exploration logs in Appendix A. After stripping, remaining roots and stumps should be removed from structural areas. All soils disturbed by stripping and grubbing operations should be recompacted as described below for structural fill.

Once excavation to subgrade elevation is complete, the resulting surface should be proof-rolled with a loaded dump truck or other suitable equipment. Any soft, loose, yielding areas or areas exposing existing fill should be excavated to expose suitable bearing soils. The subgrade should then be compacted to at least 95 percent of the modified Proctor maximum dry density, as determined by the ASTM D-1557 test procedure. Structural fill can then be placed to achieve desired grades, if needed.

8.1 Existing Fill Soils

Most of the site has been graded to form its current topography and as a result large areas of the site contain fill composed of cut native soils or imported material. On the west side of the site, approximately the southern half of the access road is characterized by areas of non-select existing fill soils that are generally unsuitable for direct structural support in their present condition. The soil observed within our explorations in this area contain moderate amounts of fine organic material, woody debris, and were generally loose to medium dense. The existing non-select fill should be removed below planned buildings, pavement, and other structures. Before reuse as fill soils elsewhere onsite, excavated existing non-select fill should be processed to remove any organic material or other deleterious material. The existing gravel lot that makes up the central terrace of the site is underlain by select fill soils that generally appear favorable for reuse as structural fill in their present condition. These fills observed within our explorations in this area contain minimal organic material and were generally medium dense to dense. The existing select fill soils are suitable for support of paving and other ancillary structures with normal preparation. If new buildings will be constructed above existing select fill, we should be allowed to offer situation-specific recommendations. It may be acceptable to leave existing select fill in place below new buildings if the fill is well compacted, is free of organic material, and if records of fill placement and compaction are available.

It would be possible to keep excavated non-select fill material onsite, if desired, in locations that can tolerate some post-construction settlement. The non-select fill should be placed in such a manner that it will not be encountered during installation of drainage systems, buried utilities, or other planned structures, particularly sewers and stormwater vaults or other structures that are settlement-sensitive. The existing non-select fill should be spread and compacted in 8-inch lifts and covered with at least 5 feet of suitable, non-organic structural fill soils as early as possible in the site grading process, and final grading of the athletic fields or other improvements above such fills should be delayed as long as possible to allow initial settlement to occur prior to fine grading. Ideally, mass grading should be completed during initial site development and athletic field completion should be delayed until the following summer.

8.2 Site Drainage and Surface Water Control

Adequate temporary and permanent control of surface water runoff and possible subsurface seepage will be required in order to allow site access and grading for construction of the new school buildings, access driveways, parking lots, installation of underground utilities, and other proposed improvements. Excavation, filling, subgrade, and grade preparation should be performed in a manner and sequence that will provide controlled drainage at all times and proper control of erosion. Surface water should be collected and pumped or drained to provide a suitable working platform. Successful drainage of wet zones due to perched or confined groundwater flow and accumulations of surface water runoff could be accomplished by ditching and/or the installation of cut-off trenches or “French” drains. We recommend the installation of permanent French drains upslope from significant cut slopes, pavement areas, and buildings. These features should be incorporated into the project design. Additional drains may be required at the time of construction to address specific springs or seeps.

The site should be graded to prevent water from ponding in construction areas and/or flowing into excavations. Exposed grades should be crowned, sloped, and smooth drum-rolled at the end of each day to facilitate drainage. Accumulated water must be removed from subgrades and work areas immediately prior to performing further work in the area. Equipment access may be limited and the amount of soil rendered unfit for use as structural fill may be greatly increased if drainage efforts are not accomplished in a timely sequence. If an effective drainage system is not utilized, project delays and increased costs could be incurred due to the greater quantities of wet and unsuitable fill or poor access and unstable conditions.

Final exterior grades should promote free and positive drainage away from the buildings at all times. Water must not be allowed to pond or to collect adjacent to foundations or within the immediate building area. We recommend that a gradient of at least 3 percent for a minimum distance of 10 feet from the building perimeters be provided, except in paved locations. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structures.

8.3 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, temporary, unsupported cut slopes can be planned at 1.5H:1V (Horizontal:Vertical) in unsaturated existing recessional outwash and alluvial fan sediments. Temporary slopes of 1H:1V can be planned in unsaturated lodgement till sediments.

These slope angles are for areas where groundwater seepage is not present at the faces of the slopes, which may require temporary dewatering in the form of pumped sumps or other measures. If ground 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, and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times.

8.4 Site Disturbance

Most of the on-site soils contain fine-grained material, which makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and the area brought to grade with structural fill.

8.5 Winter Construction

The existing lodgement till, recessional outwash, mass wasting/alluvium, and some fill sediments contain substantial silt and are considered highly moisture-sensitive. Portions of the recessional outwash and fill sediments are expected to be somewhat less moisture-sensitive. If construction proceeds during an extended wet weather construction period, and the moisture-sensitive, silty soils become wet, they will become unstable. Therefore, the bids for site grading operations should be based upon the time of year that construction will proceed. Soils excavated onsite will likely require drying during favorable dry weather conditions to allow their reuse 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.

If winter construction is expected, crushed rock fill could be used to provide construction staging areas. The stripped subgrade should be observed by the geotechnical engineer, and should then be covered with a geotextile fabric, such as Mirafi 500X or equivalent. Once the fabric is placed, we recommend using a crushed rock fill layer at least 10 inches thick in areas where construction equipment will be used.

9.0 STRUCTURAL FILL

All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials, as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used. For backfill of buried utilities in the right-of-way, the backfill should be placed and compacted in accordance with the City of Issaquah codes and standards.

After stripping, planned excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer/engineering geologist, the surface of the exposed ground should be recompacted to a firm and unyielding condition. If the subgrade contains too much moisture, adequate recompaction may be difficult or impossible to obtain, 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 is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to 95 percent of ASTM D-1557. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of the perimeter footings or roadway edges before sloping down at a maximum angle of 2H:1V.

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material at least 72 hours in advance to perform a Proctor test and determine its field compaction standard.

Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. The lodgement till, recessional outwash, mass wasting/alluvium and some fill sediments are estimated to contain substantially more than 5 percent fine-grained material. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather and dry subgrade conditions. Construction equipment traversing the site when the soils are wet can cause considerable disturbance.

9.1 Fill Slopes

Substantial fill slopes are expected, particularly on the south and west parts of the site. Fill slopes should be composed of structural fill as defined in the previous section of this report. Fill slopes should be constructed by building them past the planned finished contour and excavating into the compacted core of the slope to achieve the finished surface. This will ensure compaction of the fill to the outer face of the slope and will reduce the potential for surface erosion. Substantial erosion can result if this procedure is not used. Regardless of the care taken to construct fill slopes, the outer few inches of the slope face is susceptible to erosion and sloughing, especially the first winter season after construction.

Where fill slopes will be constructed in areas of existing uncompacted fill soils, we recommend that the existing fill soils be removed from an area that begins at the planned finished toe of the slope and extends below the fill a horizontal distance equal to one-half of the planned total height of the slope. For example, if a planned fill slope will be 30 feet tall, the existing fill should be removed from an area at least 15 feet wide, beginning at the finished toe of slope and extending below the body of the fill. The fill should be keyed and benched into underlying suitable native soils as recommended in the “Structural Fill” section of this report.

Fill slopes should be provided with a drainage swale at the top of the slope to intercept any surface water before it reaches the slope face. Fill slopes 30 feet tall or taller should be provided with terraces to intercept surface water that falls on the slope. The terraces should be situated no more than 30 vertical feet apart, and for slopes shorter than 40 feet, they should be placed at a point midway between the top of slope and base of slope. Each terrace should be a minimum of 6 feet wide. The terraces should be sloped to collect surface water and route it by gravity to a suitable discharge point. The capacity of the interceptor drain should be sufficient to ensure that it does not overflow and allow surface water to spill over onto the slope area below the terrace since substantial erosion could result. Assuming the fill slopes will be constructed with lodgement till soils excavated onsite, fills compacted as recommended in the “Structural Fill” section of this report are expected to have sufficiently low permeability that no liner is required for the terraces. If free-draining or import soils are used to construct slope terraces, terraces might require the use of a liner made of concrete or some other low-permeability material.

9.2 Overexcavation/Stabilization

During dry weather periods, soft/wet soils, which may need to be overexcavated, may be encountered in some portions of the site. 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. Admixture stabilization with cement powder or kiln dust, admixture design, and installation procedures need to be reviewed and approved by the design team and City prior to site use.

If fill is placed during wet weather or if proper compaction cannot be obtained, a select, import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil, with the amount of fine-grained material 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.

In order to reuse excavated on-site soils in structural fill applications, it will be necessary to moisture-condition wet site soils by aeration and drying during favorable dry weather conditions. Alternatives to drying site soils include using imported granular soils suitable for use in structural fill, or treating wet soils with Portland cement.

10.0 FOUNDATIONS

Spread footings may be used for building support when they are founded on approved structural fill placed as described above, or on undisturbed natural soils that are prepared as recommended in this report.

For building support, footings may be designed for an allowable foundation soil bearing pressure of 3,500 pounds per square foot (psf), including both dead and live loads. If footings are founded entirely on undisturbed, dense till soils, a higher 5,000 psf allowable soil bearing pressure can be used for design. An increase 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. However, all foundations must penetrate to the prescribed bearing strata, and no foundations should be constructed in or above loose, organic, or existing fill soils.

Anticipated settlement of footings founded as recommended should be on the order of ¾ inch or less, with differential settlement of ½ inch or less. However, disturbed material not removed from footing trenches prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the foundation subgrades are undisturbed and construction conforms to the recommendations contained in this report. Such inspections may be required by the City of Issaquah. Perimeter footing drains should be provided as discussed under the “Drainage Considerations” section of this report.

It should be noted that the area bounded by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM D-1557. In addition, a 1.5H:1V line extending down and away from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edges of steps or cuts in the bearing soils unless supported by an engineered slope.

11.0 FLOOR SUPPORT

Slab-on-grade floors may be used over medium dense to very dense native soils, or over structural fill placed as recommended in the “Site Preparation” and “Structural Fill” sections of this report. Slab-on-grade floors should be cast atop a minimum of 4 inches of washed pea gravel or washed crushed “chip” rock with less than 3 percent passing the U.S. No. 200 sieve to act as a capillary break. The floors should also be protected from dampness by covering the capillary break layer with an impervious moisture barrier at least 10 mils in thickness.

12.0 DRAINAGE CONSIDERATIONS

All footings, basement walls, and retaining walls should be provided with a drain at the footing elevation. Drains should consist of rigid, perforated, PVC pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set downward and at the bottom of the footing at all locations, and the drain collectors should be constructed with sufficient gradient to allow gravity discharge away from the buildings. In addition, all foundation walls taller than 3 feet should be lined with a minimum, 12-inch-thick, washed gravel blanket drain provided to within 1 foot of finish grade that ties into the footing drain. A prefabricated drainage mat is not recommended in lieu of free-draining backfill for buildings. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain.

In planning, exterior grades adjacent to foundations should be sloped downward away from the structures to achieve surface drainage. These recommendations apply to conventional shallow foundation walls and landscape walls less than about 4 feet tall. One should refer to the following section for walls up to 10 feet tall.

13.0 CAST-IN-PLACE RETAINING WALLS AND BASEMENT WALLS

All backfill behind foundation walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls that are free to yield laterally at least 0.1 percent of their height may be designed to resist active lateral earth pressure represented by an equivalent fluid equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for at-rest conditions and an equivalent fluid of 50 pcf. Walls with sloping backfill up to a maximum gradient of 2H:1V should be designed using an equivalent fluid of 55 pcf for yielding conditions or 75 pcf for fully restrained conditions. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces.

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of excavated on-site soils, or imported structural fill compacted to 90 percent of ASTM D-1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the walls. A lower compaction may result in settlement of the slab-on-grade or other structures supported above the walls. Thus, the compaction level is critical and must be tested by our firm during placement. Surcharges from adjacent footings or heavy construction equipment must be added to the above values. Perimeter footing drains should be provided for all retaining walls, as discussed under the “Drainage Considerations” section of this report.

It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum 1-foot-wide blanket drain to within 1 foot of finish grade for the full wall height using imported, washed gravel against the walls. If situations exist where a footing drain is not feasible for a foundation wall or retaining wall, the wall should be designed for saturated lateral earth pressures and a hydrostatic surcharge. We should be allowed to offer situation-specific recommendations if this situation arises. The use of drainage improvements as recommended herein does not alleviate the need for waterproofing where finished spaces are planned on the interior side of basement walls. Backfilled walls with finished interior space should be waterproofed in accordance with recommendations of the building designer.

14.0 PASSIVE RESISTANCE AND FRICTION FACTOR

Lateral loads can be resisted by friction between the foundation and the natural soils or supporting structural fill soils, and by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with structural fill and compacted to at least 95 percent of the maximum dry density to achieve the passive resistance provided below. We recommend the following allowable design parameters:

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.30

15.0 STORMWATER INFILTRATION FEASIBILITY

The project site and adjacent areas include several steep slopes that are laterally and vertically extensive. We do not recommend on-site stormwater infiltration due to the potential adverse slope stability impacts that could result.

16.0 PAVEMENT RECOMMENDATIONS

Paving areas should be prepared as recommended in the "Site Preparation" section of this report. The exposed ground should be recompacted to 95 percent of ASTM D-1557. If required, structural fill may then be placed to achieve desired subbase grades. Upon completion of the recompaction and structural fill, a pavement section consisting of 2½ inches of asphaltic concrete pavement (ACP) underlain by 4 inches of 1¼-inch crushed surfacing base course is the recommended minimum in areas of planned passenger car driving and parking. In heavy traffic areas, a minimum pavement section consisting of 3 inches of ACP underlain by 2 inches of $^5/_8$-inch crushed surfacing top course and 4 inches of 1¼-inch crushed surfacing base course is recommended. The crushed rock courses must be compacted to 95 percent of the maximum density, as determined by ASTM D-1557. All paving materials should meet gradation criteria contained in the current Washington State Department of Transportation (WSDOT) Standard Specifications.

Depending on construction staging and desired performance, the crushed base course material may be substituted with asphalt treated base (ATB) beneath the final asphalt surfacing. The substitution of ATB should be as follows: 4 inches of crushed rock can be substituted with 3 inches of ATB, and 6 inches of crushed rock may be substituted with 4 inches of ATB. ATB should be placed over a native or structural fill subgrade compacted to a minimum of 95 percent relative density, and a 1½- to 2-inch thickness of crushed rock to act as a working surface. If ATB is used for construction access and staging areas, some rutting and disturbance of the ATB surface should be expected. The general contractor should remove affected areas and replace them with properly compacted ATB prior to final surfacing.

17.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

This report is based on the previously referenced conceptual site plan and unlabeled earthwork quantity plan that was current at the time it was written. We are available to provide additional geotechnical consultation as the project design develops and possibly changes from that upon which this report is based. We recommend that AESI perform a geotechnical review of the plans prior to construction. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design.

We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the foundations for buildings and of retaining walls 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. Construction monitoring services are not part of the current scope of work. If these services are desired, please let us know, and we will prepare a cost proposal.

We have enjoyed working with you on this study and are confident these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Charles R. Christopher, G.I.T.
Staff Geologist

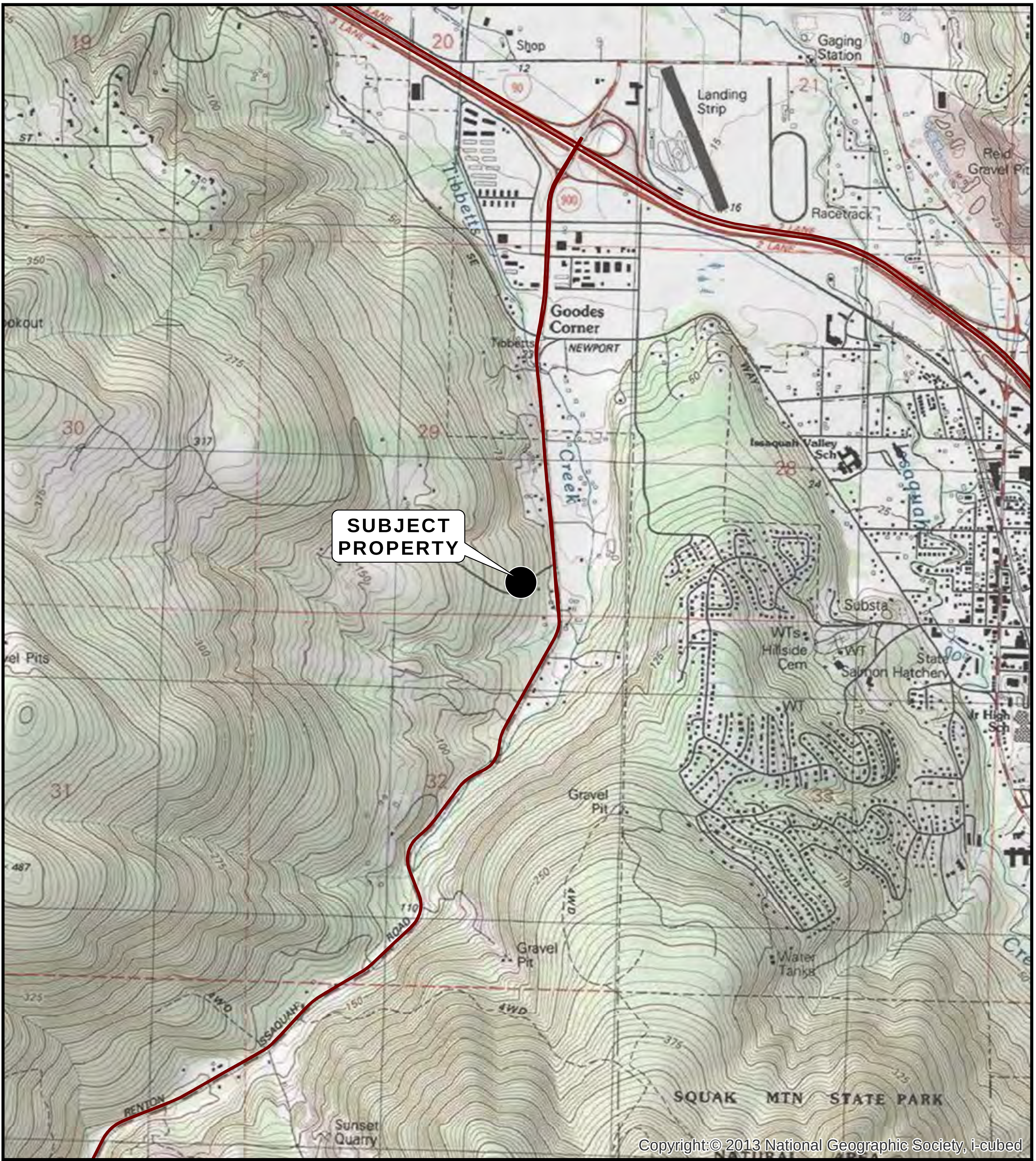
Bruce W. Guenzler, L.E.G.
Associate Geologist

KURT D. MERRIMAN
23580
7-19-19

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

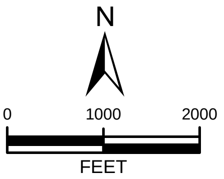
References Cited: Golder Associates, 2008, Report on subsurface exploration and geotechnical engineering, Talus Corporate Center, NW Talus Drive, Issaquah, Washington: 2008.

Attachments:
Figure 1: Vicinity Map
Figure 2: Existing Site and Exploration Plan
Figure 3: Proposed Site and Exploration Plan
Figure 4: Geologic Cross-Section A-A’
Figure 5: Geologic Cross - Section B-B’
Figure 6: Slope Stability Cross Section C-C’
Figure 7: Slope Stability - Static Cross Section C-C’
Figure 8: Slope Stability – Seismic Cross Section C-C’
Figure 9: Slope Stability Cross Section D-D’
Figure 10: Slope Stability - Static Cross Section D-D’
Figure 11: Slope Stability - Seismic Cross Section D-D’
Appendix A: Exploration Logs
Appendix B: Laboratory Testing Results



DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



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

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VICINITY MAP

ISSAQUAH MIDDLE SCHOOL #6
ISSSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522V001	1/19	1

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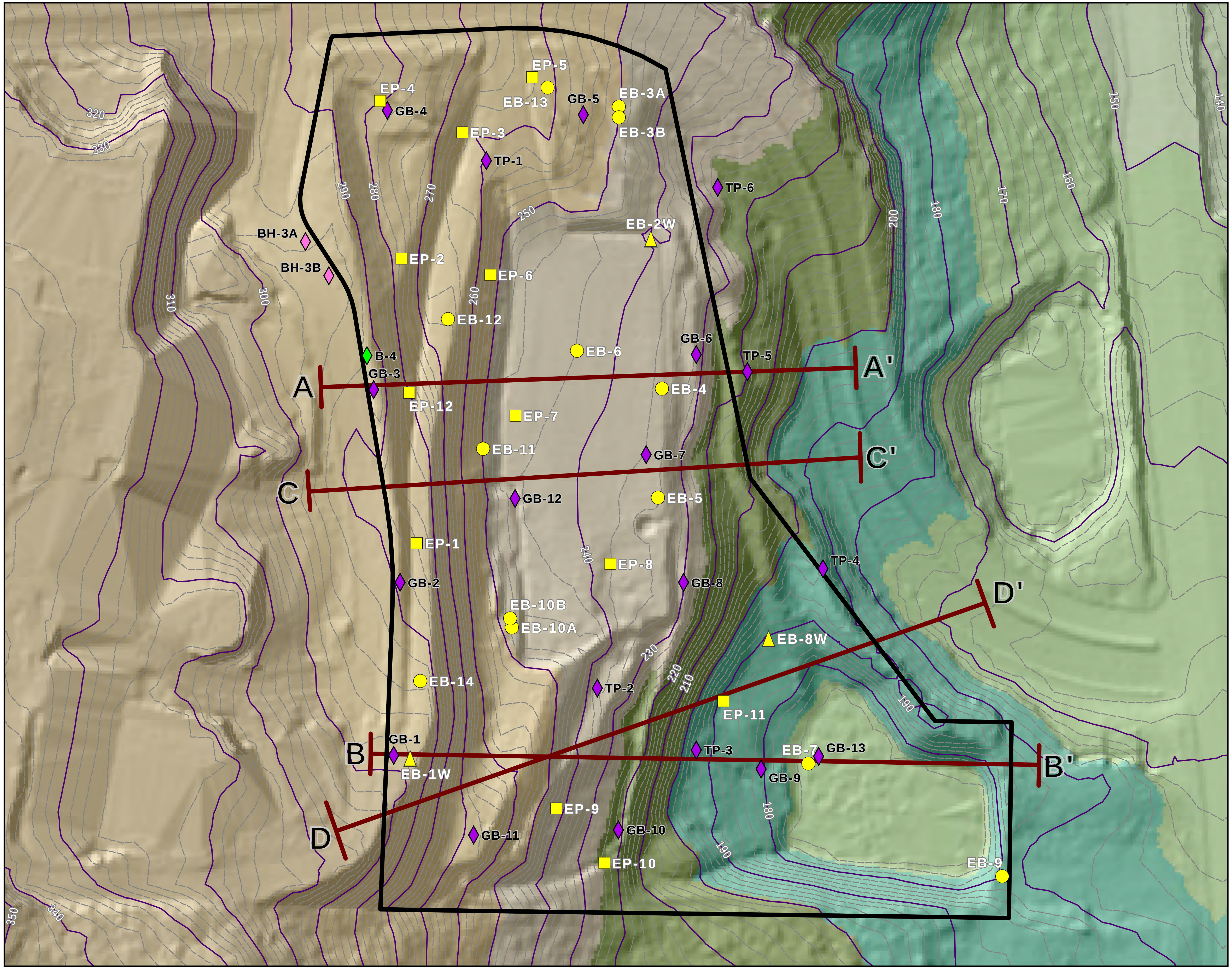


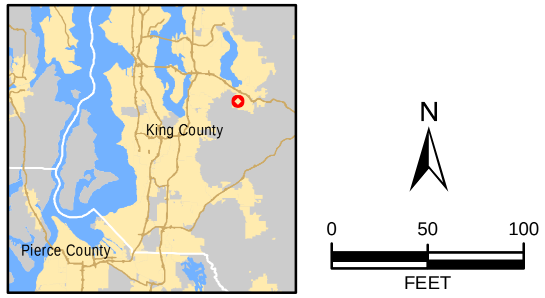
LEGEND:

- ● EXPLORATION BORING (AESI 2018, 2019)
- ▲ MONITORING WELL (AESI 2018)
- ■ EXPLORATION PIT (AESI 2018)
- ◆ 2007 - BORING, TEST PIT (GOLDER)
- ◆ 2000 - BORING, (GOLDER)
- ◆ 1997 - ICICLE CREEK ENG BORING
- SITE
- CROSS-SECTION
- CONTOUR 10 FT
- CONTOUR 2 FT

DATA SOURCES / REFERENCES:
PSLC: KING COUNTY 2016, GRID CELL SIZE IS 3'.
DELIVERY 3 FLOWN 3/2/16 - 3/29/16
WA STATE PLANE NORTH (FIPS 4601), NAD83(HARN)
NAVD88 GEOID03 (GEOID03), US SURVEY FEET
CONTOURS FROM LIDAR
KING CO: STREETS, 1/18, PARCELS 9/18

EXPLORATIONS BY OTHERS FROM GOLDER ASSOC.
TALUS CORPORATE CENTER, NW TALUS DR, ISSAQUAH, WA, 2/07
(INCLUDED ICICLE CREEK ENG. 1997 DATA)

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



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EXISTING SITE AND EXPLORATION PLAN

ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522E001	7/19	2

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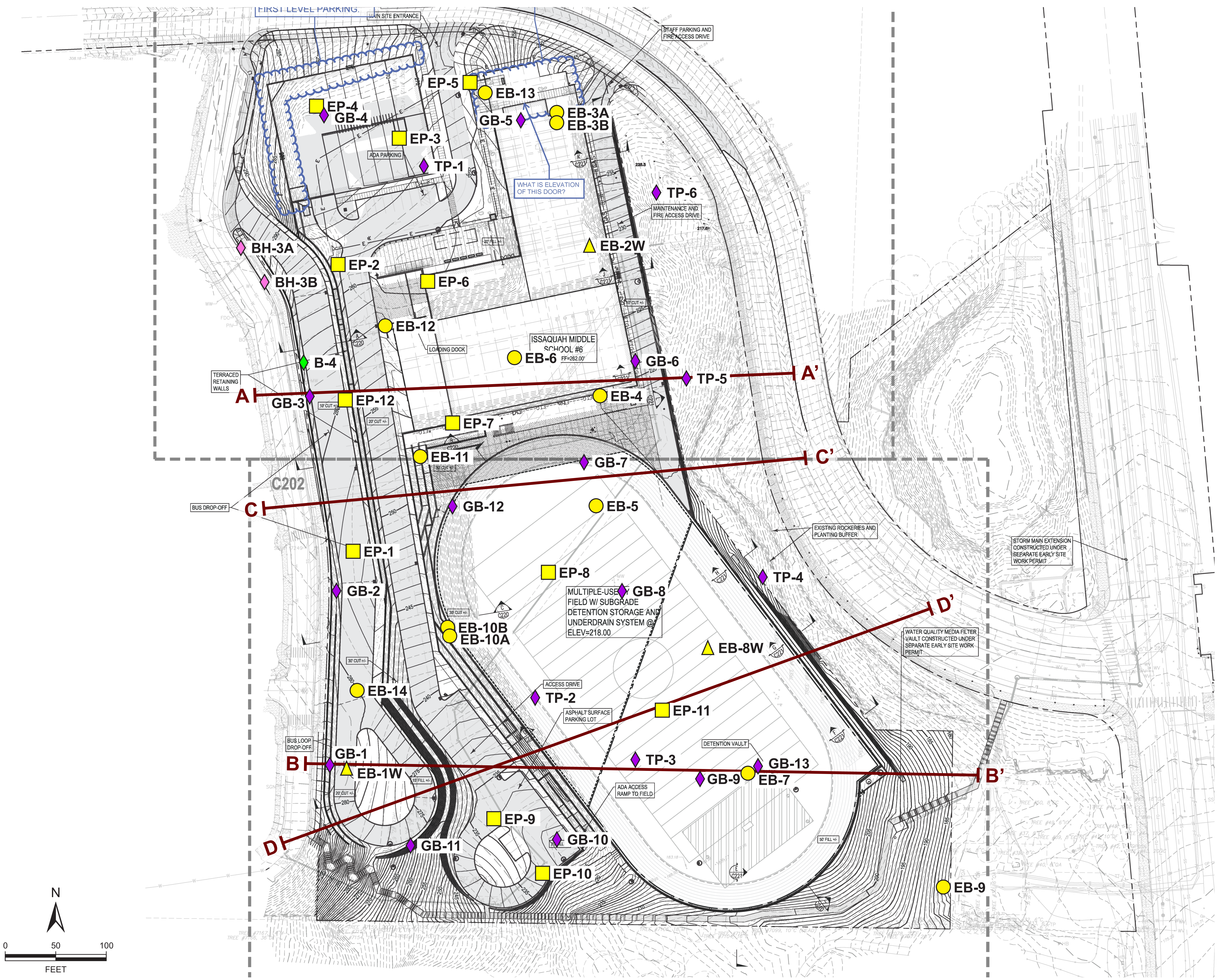

LEGEND:

●	EB	EXPLORATION BORING - AESI 2018-2019
▲	EBW	MONITORING WELL - AESI 2018
■	EP	EXPLORATION PIT - AESI 2018
◆		BORING / TEST PIT - GOLDER 2007
◆		BORING - GOLDER 2000
◆		BORING - ICICLE CREEK ENGINEERS 1997

CONTOUR INTERVAL = 1'

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

NOTES:
1. BASE MAP REFERENCE: INTEGRUS, ISSAQUAH SCHOOL DISTRICT NO. 6, DRAFT - FINAL GRADING INDEX PLAN, SHEET C300, 6/28/19

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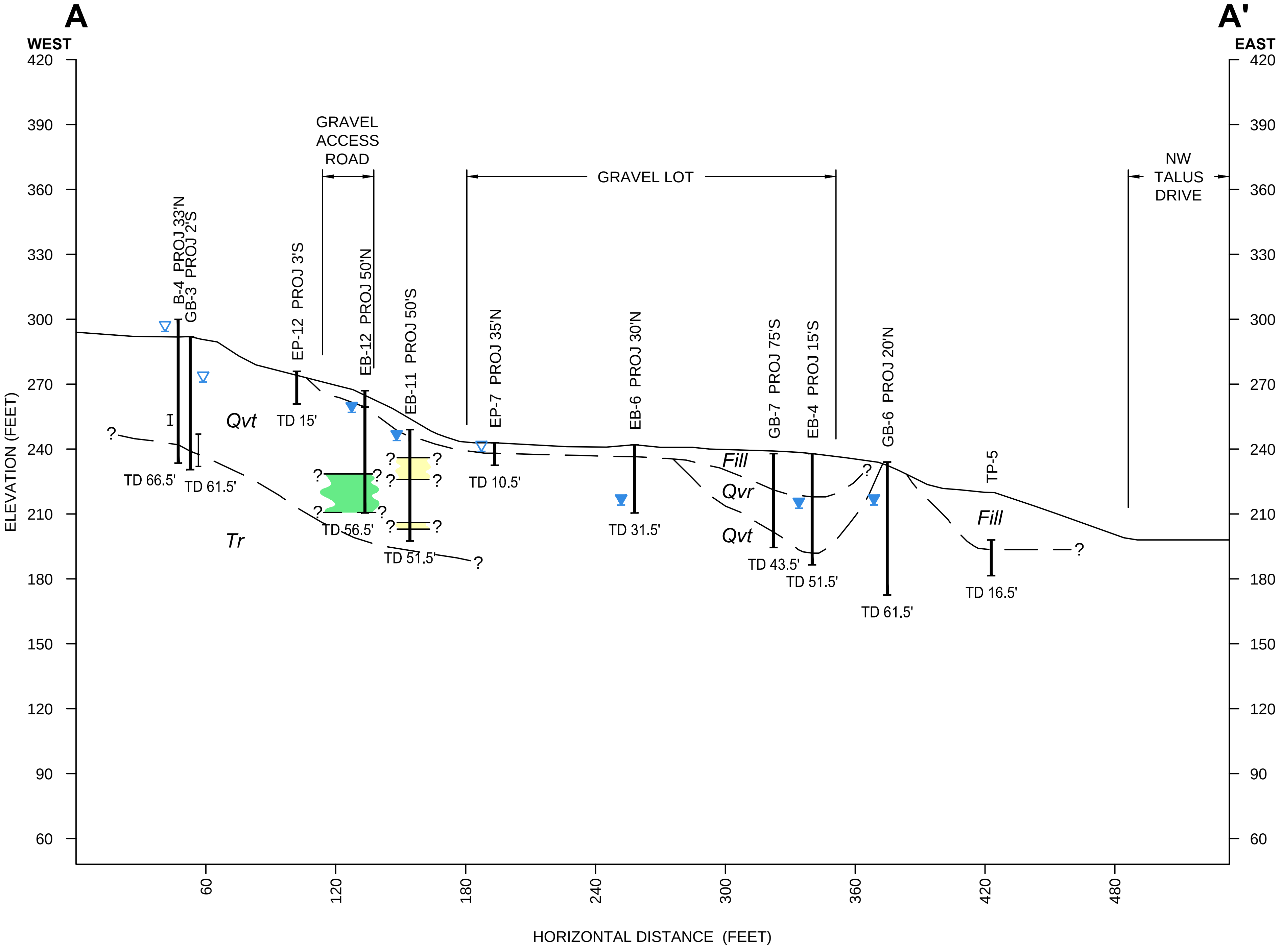
PROPOSED SITE AND
EXPLORATION PLAN
ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522E001	7/19	3

180522 Issaquah MS \ 180522E001 F3 S-E Grading.cdr



LEGEND:

Fill	FILL
Qf	ALLUVIAL FAN DEPOSITS
Qvt	VASHON LODGEMENT TILL
Qvr	VASHON RECESSIONAL OUTWASH
Tr	SANDSTONE - RENTON FORMATION
🟩	PRE-VASHON MASS WASTING? / ALLUVIUM?
🟨	RIP-UP CLAST - RENTON FORMATION
|	EXPLORATION EB - AESI 2018 / 2019 EP - AESI 2018 GB - GOLDER 2007 TP - GOLDER 2007 B - ICICLE CREEK ENGINEERS 1997
▼	WATER LEVEL AT TIME OF DRILLING
▽	STATIC WATER LEVEL - DATE PROVIDED IN BORING LOG
|I	SCREENED INTERVAL
TD	TOTAL DEPTH OF BORING
— —	GEOLOGIC CONTACT

VERTICAL EXAGGERATION = 1X

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE

NOTES:

1. THE SUBSURFACE CONDITIONS PRESENTED IN THIS GEOLOGIC CROSS-SECTION ARE BASED ON AN INTERPRETATION OF CONDITIONS ENCOUNTERED IN WIDELY SPACED EXPLORATIONS COMPLETED AT THE SUBJECT SITE AND RELEVANT SITE INFORMATION DEVELOPED AND PROVIDED BY OTHERS. THE SUBSURFACE INTERPRETATIONS PRESENTED IN THIS GEOLOGIC CROSS-SECTION SHOULD NOT BE CONSTRUED AS A WARRANTY OF ACTUAL SUBSURFACE CONDITIONS AT THE SITE. OUR EXPERIENCE HAS SHOWN THAT SOIL AND GROUNDWATER CONDITIONS CAN VARY SIGNIFICANTLY OVER SMALL DISTANCES.

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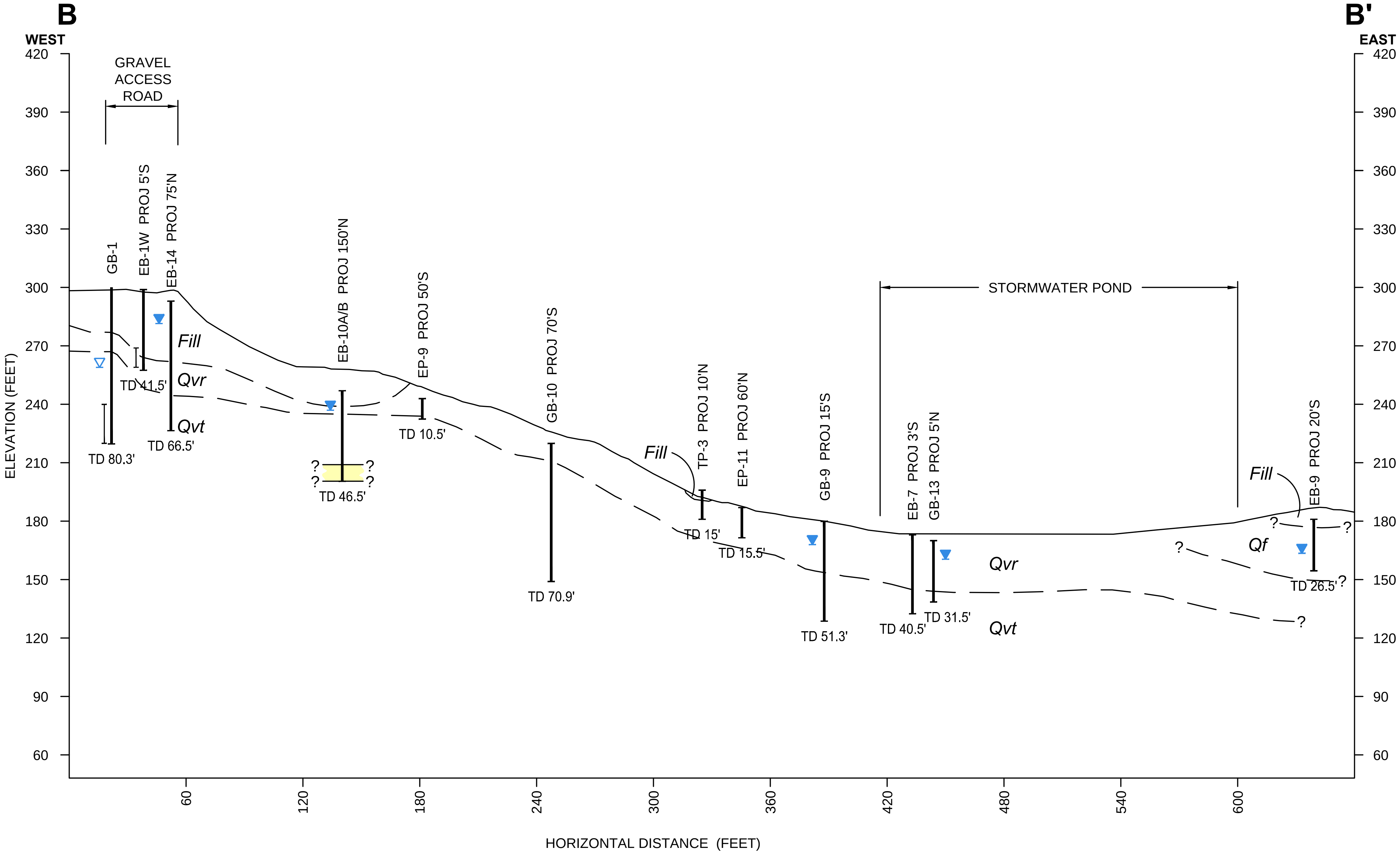
GEOLOGIC CROSS-SECTION A - A'

ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522E001	7/19	4

180552 Issaquah MS \ 180552 GeoSects.dwg   LAYOUT: E001 F4 Sect A-A 7-19



LEGEND:

Fill	FILL
Qf	ALLUVIAL FAN DEPOSITS
Qvt	VASHON LODGEMENT TILL
Qvr	VASHON RECESSIONAL OUTWASH
Tr	SANDSTONE - RENTON FORMATION
🟩	PRE-VASHON MASS WASTING? / ALLUVIUM?
🟨	RIP-UP CLAST - RENTON FORMATION
│	EXPLORATION EB - AESI 2018 / 2019 EP - AESI 2018 GB - GOLDER 2007 TP - GOLDER 2007 B - ICICLE CREEK ENGINEERS 1997
▼	WATER LEVEL AT TIME OF DRILLING
▽	STATIC WATER LEVEL - DATE PROVIDED IN BORING LOG
│I	SCREENED INTERVAL
TD	TOTAL DEPTH OF BORING
— —	GEOLOGIC CONTACT

VERTICAL EXAGGERATION = 1X

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE

NOTES:
1. THE SUBSURFACE CONDITIONS PRESENTED IN THIS GEOLOGIC CROSS-SECTION ARE BASED ON AN INTERPRETATION OF CONDITIONS ENCOUNTERED IN WIDELY SPACED EXPLORATIONS COMPLETED AT THE SUBJECT SITE AND RELEVANT SITE INFORMATION DEVELOPED AND PROVIDED BY OTHERS. THE SUBSURFACE INTERPRETATIONS PRESENTED IN THIS GEOLOGIC CROSS-SECTION SHOULD NOT BE CONSTRUED AS A WARRANTY OF ACTUAL SUBSURFACE CONDITIONS AT THE SITE. OUR EXPERIENCE HAS SHOWN THAT SOIL AND GROUNDWATER CONDITIONS CAN VARY SIGNIFICANTLY OVER SMALL DISTANCES.

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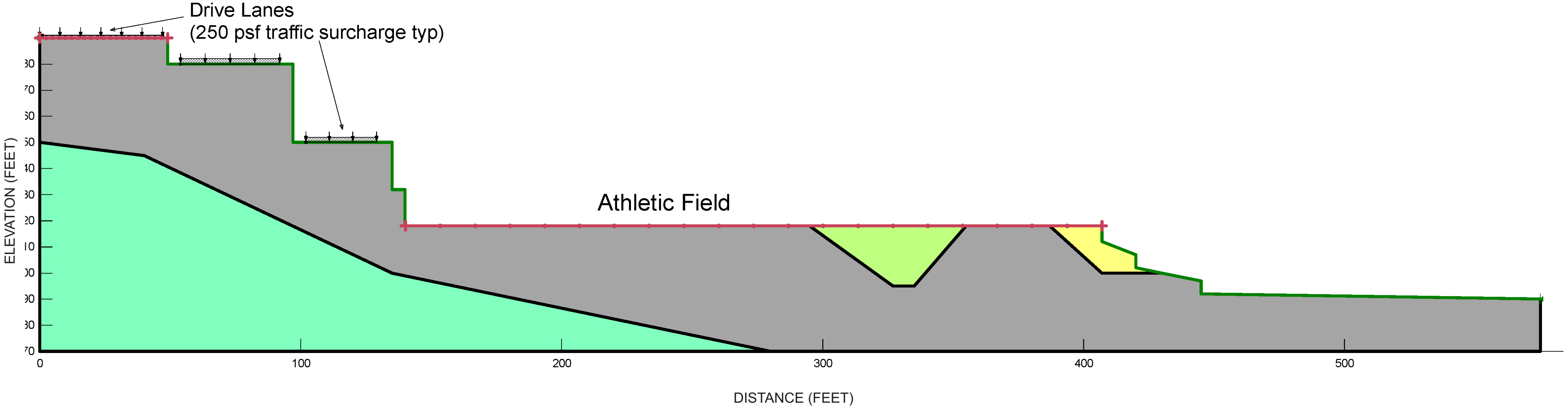
GEOLOGIC CROSS-SECTION B - B'

ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO. 180522E001	DATE: 7/19	FIGURE: 5

180552 Issaquah MS \ 180552 GeoSects.dwg LAYOUT: E001 F5 Sect B-B 7-19



LEGEND:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Existing Fill	120	0	30
🟩	Sandstone Bedrock (Tr)			
🟩	Vashon Recessional Outwash (Qvr)	130	0	35
◼	Vashon Till (Qvt)	140	200	38

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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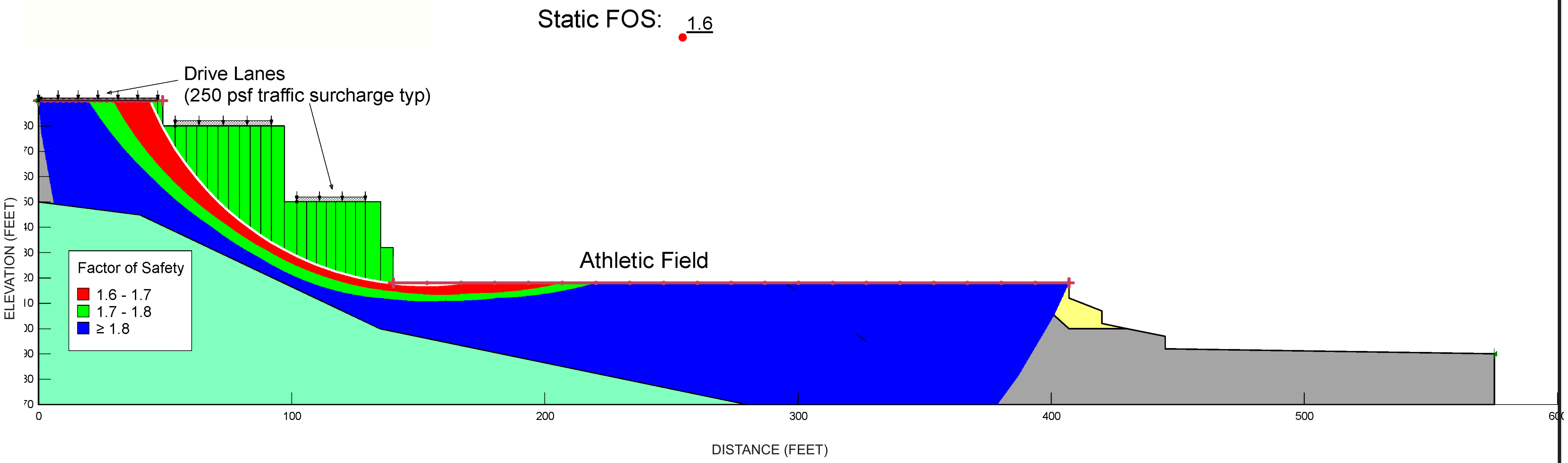
SLOPE STABILITY
CROSS-SECTION C - C’
ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522E001	7/19	6



LEGEND:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Existing Fill	120	0	30
🟩	Sandstone Bedrock (Tr)			
🟩	Vashon Recessional Outwash (Qvr)	130	0	35
⬛	Vashon Till (Qvt)	140	200	38

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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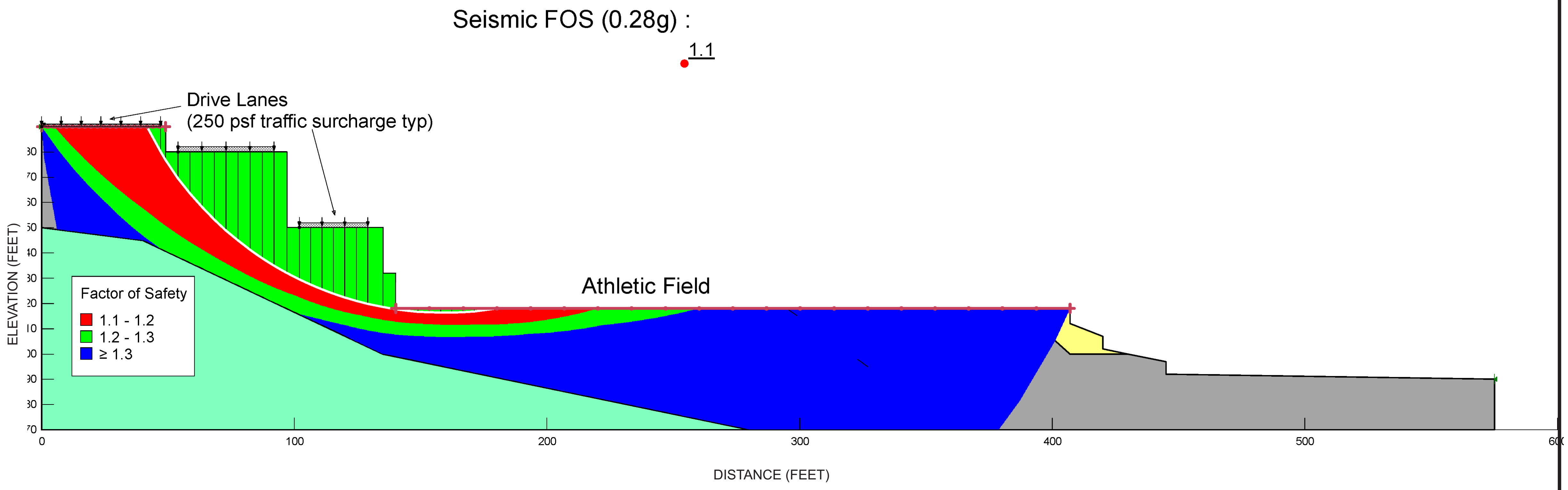
SLOPE STABILITY - STATIC
CROSS-SECTION C - C'
ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522E001	7/19	7

LEGEND:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Existing Fill	120	0	30
🟩	Sandstone Bedrock (Tr)			
🟩	Vashon Recessional Outwash (Qvr)	130	0	35
⬜	Vashon Till (Qvt)	140	200	38

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.



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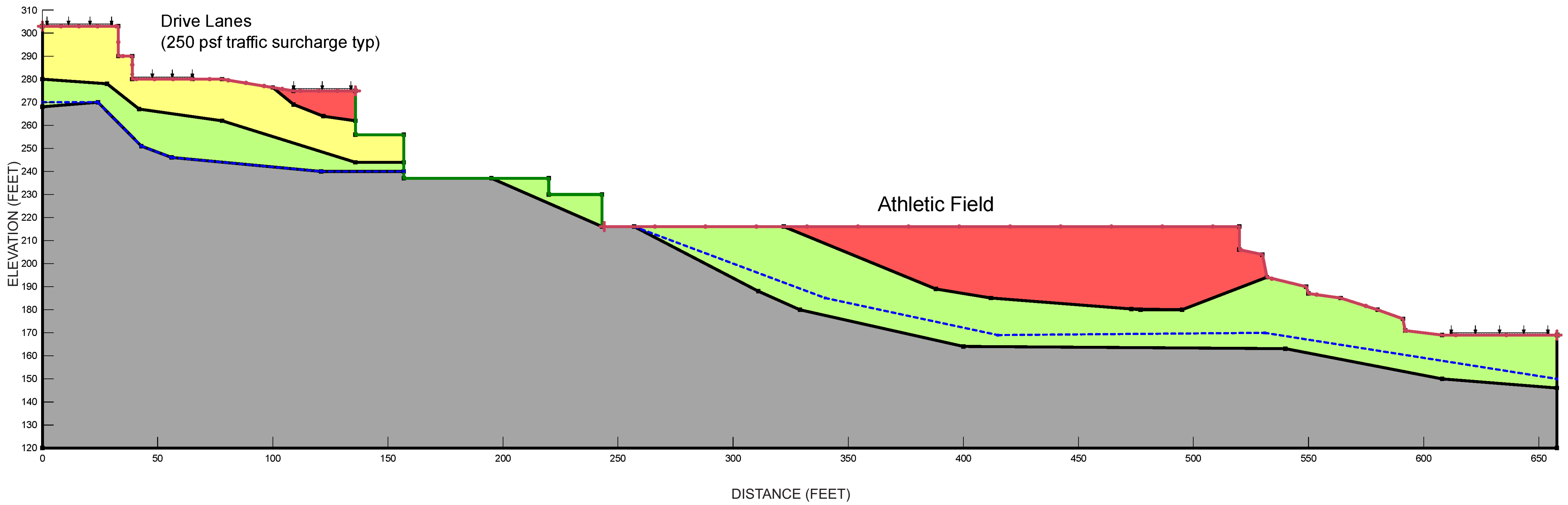
SLOPE STABILITY - SEISMIC
CROSS-SECTION C - C'

ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522E001	7/19	8

180522 Issaquah MS \ 180522E001 F8 Slope CC3.cdr



LEGEND:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Existing Fill	120	0	30
🟥	New Structural Fill	130	0	35
🟩	Vashon Recessional Outwash (Qvr)	130	0	35
⬛	Vashon Till (Qvt)	140	200	38

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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

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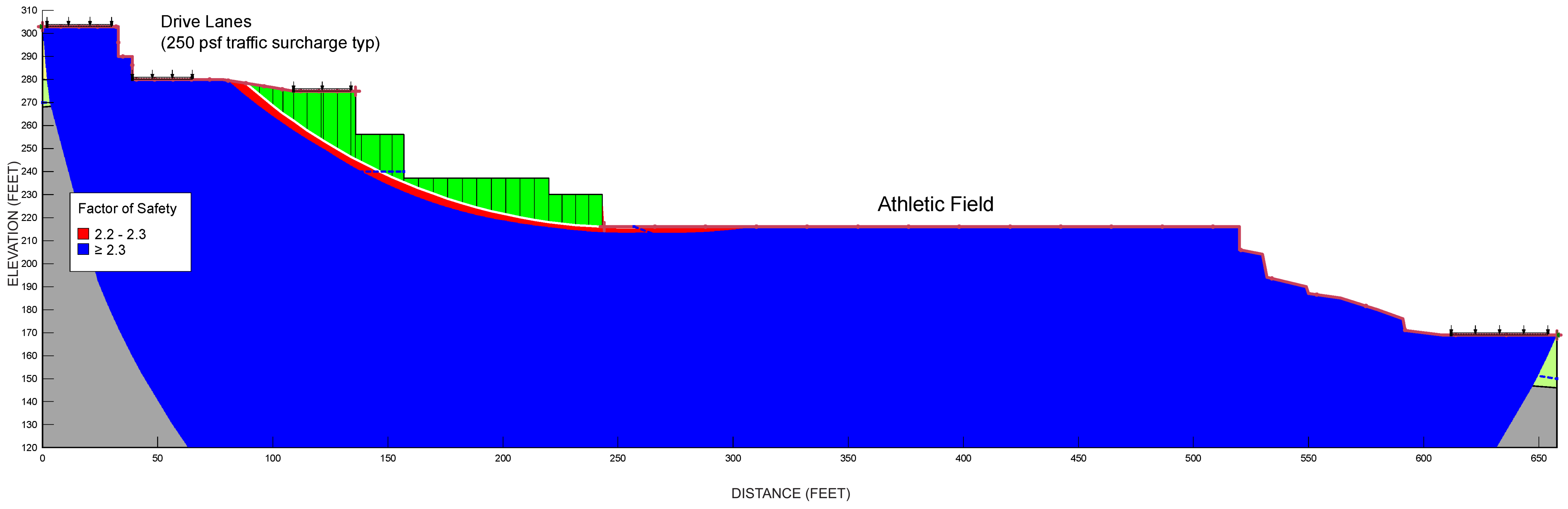
SLOPE STABILITY
CROSS-SECTION D - D'

ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522E001	7/19	9

180522 Issaquah MS \ 180522E001 F9 Slope DD1.cdr

Static FOS: 2.2



LEGEND:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Existing Fill	120	0	30
🟥	New Structural Fill	130	0	35
🟩	Vashon Recessional Outwash (Qvr)	130	0	35
▨	Vashon Till (Qvt)	140	200	38

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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SLOPE STABILITY - STATIC
CROSS-SECTION D - D’

ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522E001	7/19	10

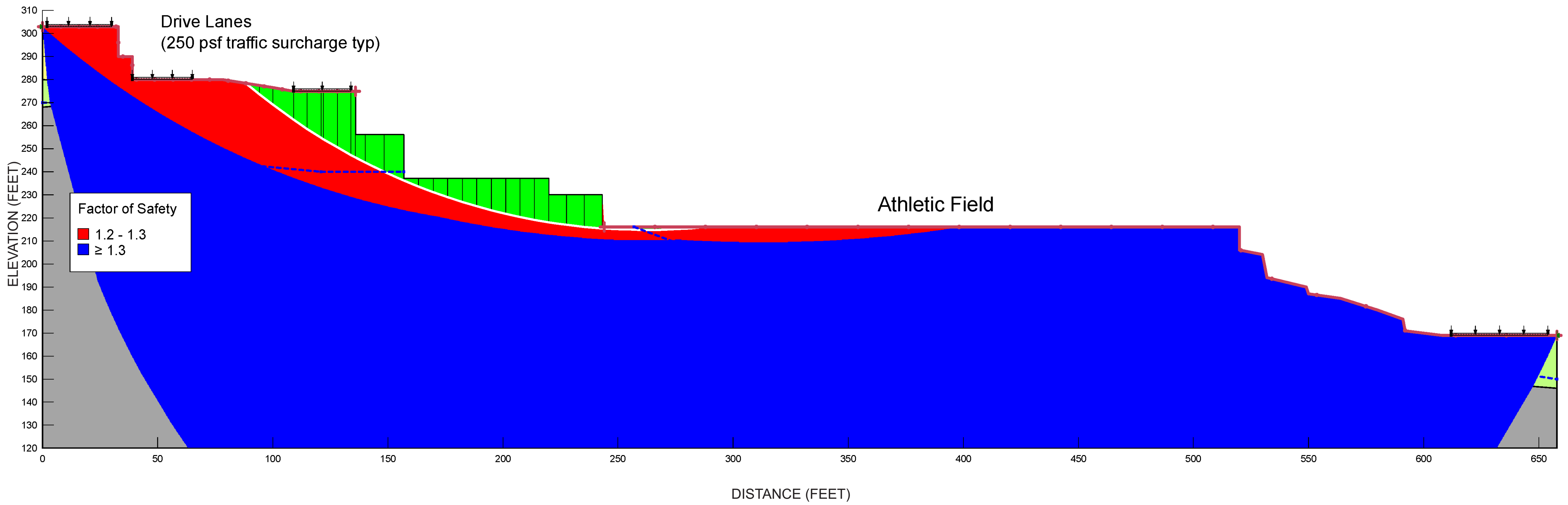
180522 Issaquah MS \ 180522E001 F10 Slope DD2.cdr

LEGEND:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟨	Existing Fill	120	0	30
🟥	New Structural Fill	130	0	35
🟩	Vashon Recessional Outwash (Qvr)	130	0	35
▨	Vashon Till (Qvt)	140	200	38

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

Seismic FOS (0.28g): 1.2



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

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SLOPE STABILITY - SEISMIC
CROSS-SECTION D - D’
ISSAQUAH MIDDLE SCHOOL #6
ISSAQUAH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
180522E001	7/19	11

180522 Issaquah MS \ 180522E001 F11 Slope DD3.cdr

APPENDIX A

Exploration Logs

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)

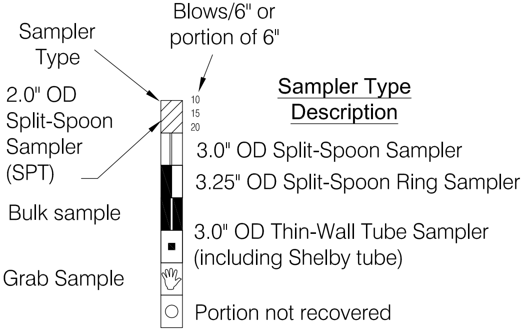
(3) Estimated Percentage

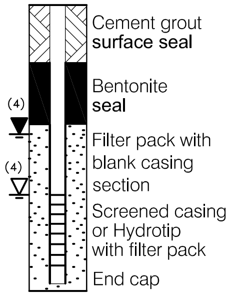
Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

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





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(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.

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EXPLORATION LOG KEY

FIGURE A1

blocks \ dwg \ log_key.dwg LAYOUT: Layout 4 -2014 Qty Chng

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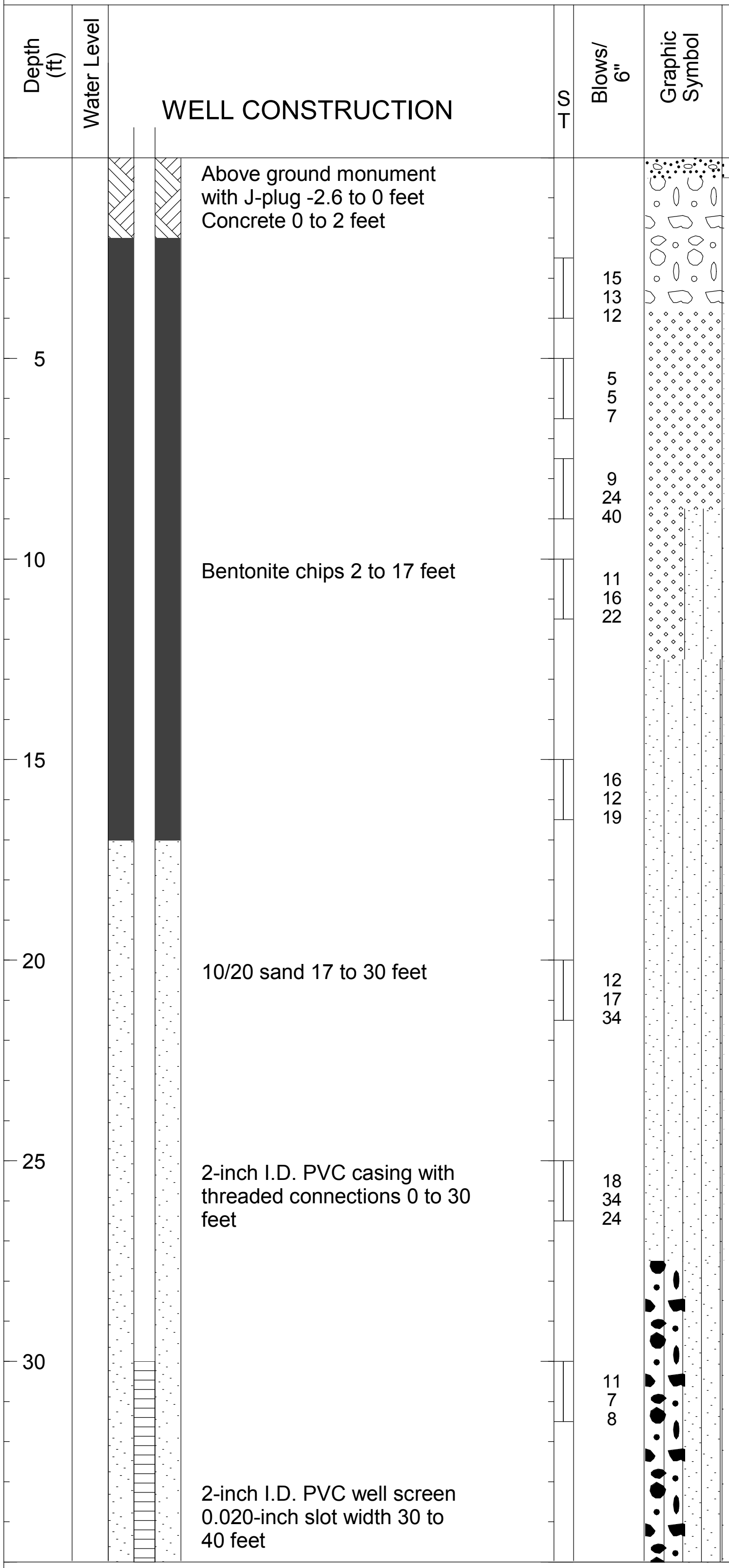
Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
180522E001	EB-1W	1 of 2

Project Name: Issaquah Middle School #6
Elevation (Top of Well Casing): ~301.6 (NAVD88 LiDAR)
Water Level Elevation: N/A
Drilling/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"
Location: Issaquah, WA
Surface Elevation (ft): ~299 (NAVD88 LiDAR)
Date Start/Finish: 11/12/18,11/12/18
Hole Diameter (in): 7.25 inches



Depth (ft)	WELL CONSTRUCTION	Blows/ 6"	DESCRIPTION
	Above ground monument with J-plug -2.6 to 0 feet Concrete 0 to 2 feet		**Gravel and Concrete Recycle** **Non-Select Fill**
		15 13 12	Moist, slightly oxidized brownish gray, sandy, GRAVEL, trace to some silt; chaotic structure (GW).
5		5 5 7	Moist, slightly oxidized dark brownish gray, gravelly, fine to medium SAND, some silt; construction debris (nail, fabric); gravel in sampler shoe; unsorted (SW).
		9 24 40	Moist, slightly oxidized brownish gray, fine to medium SAND, some gravel, some silt; concrete smell; asphalt debris lens at 8 feet; unsorted (SW).
10	Bentonite chips 2 to 17 feet	11 16 22	As above; ranges to silty; asphalt debris at 10 feet; gravel stuck in sampler shoe (SM-SW).
15		16 12 19	Moist to very moist, light to blackish gray, fine SAND, some gravel; occasional rootlets; fine organics (SM).
20	10/20 sand 17 to 30 feet	12 17 34	No recovery with 2-inch sampler, switched to 3-inch. Moist to very moist, slightly oxidized brownish dark gray, silty, fine SAND, some gravel; unsorted; occasional rootlets and woody debris (SM).
			Difficult drilling at 23 feet.
25	2-inch I.D. PVC casing with threaded connections 0 to 30 feet	18 34 24	As above (SM).
30		11 7 8	Moist to very moist, slightly oxidized brownish dark gray, silty, fine SAND, some gravel to gravelly; occasional rootlets and fabric debris (SM-GM).
	2-inch I.D. PVC well screen 0.020-inch slot width 30 to 40 feet		

Sampler Type (ST):

- ◫ 2" OD Split Spoon Sampler (SPT)
- ◫ 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- ☐ No Recovery
- ▮ Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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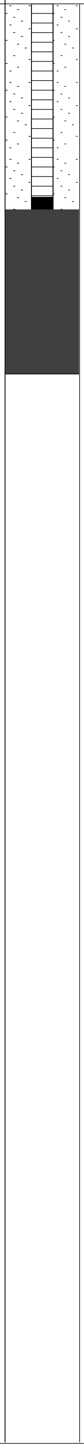
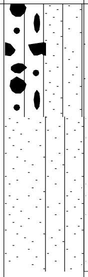
Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
180522E001	EB-1W	2 of 2

Project Name Issaquah Middle School #6
Elevation (Top of Well Casing) ~301.6 (NAVD88 LiDAR)
Water Level Elevation N/A
Drilling/Equipment Advance Drill Tech / D50
Hammer Weight/Drop 140# / 30"
Location Issaquah, WA
Surface Elevation (ft) ~299 (NAVD88 LiDAR)
Date Start/Finish 11/12/18,11/12/18
Hole Diameter (in) 7.25 inches

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				34 35 50		**Vashon Recessional Outwash** Moist to wet, oxidized grayish orangish brown, silty, fine SAND, some gravel to gravelly; gravel lodged in sampler; slightly stratified; unsorted; blowcounts overstated due to gravel (SM-GM). Difficult drilling at 36 feet.
40		Threaded end cap		23 50/4"		Wet, oxidized grayish orangish brown, silty, fine SAND, trace gravel; contains lenses of fine sand, trace to some silt to sandy, silt; stratified (SM-SP).
		Bentonite chips 40 to 44 feet				Boring terminated at 41.5 feet. Well completed at 40 feet on 11/12/18. No groundwater encountered. Revised 4/19 - Updated terminology.
45						
		Well tag # BKU 912				
50						
55						
60						
65						





Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
▽ Water Level ()
▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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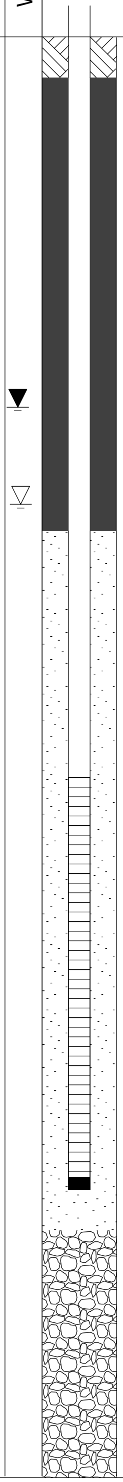
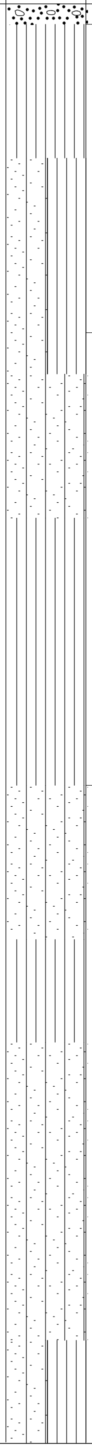
Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
180522E001	EB-2W	1 of 2

Project Name: Issaquah Middle School #6
Elevation (Top of Well Casing): ~242.8 (11/29/18) (NAVD88 LiDAR)
Water Level Elevation: ~232.87 (11/29/18) (NAVD88 Lidar)
Drilling/Equipment: Advance Drill Tech
Hammer Weight/Drop: 140# / 30"
Location: Issaquah, WA
Surface Elevation (ft): ~240 (NAVD88 LiDAR)
Date Start/Finish: 11/12/18,11/12/18
Hole Diameter (in): 9 inches





Depth (ft)	Water Level	WELL CONSTRUCTION	ST	Blows/ 6"	DESCRIPTION
		Above ground monument with J-plug -2.8 to 0 feet Concrete 0 to 1 foot			**Gravel** **Select Fill**
				9 12 13	Moist, oxidized orangish brown, sandy, SILT, trace gravel; unsorted; top 6 inches consist of recycled concrete (ML).
5		Bentonite chips 1 to 12 feet		4 20 11	Moist to very moist, oxidized grayish brown, silty, fine SAND to sandy, SILT, trace to some gravel; unsorted (SM-ML).
	▼			4 17 28	Top 6 inches: As above; ranges to wet. **Vashon Recessional Outwash** Bottom 6 inches: wet, orangish brown, silty, fine SAND to fine SAND, some silt, trace gravel (SM-ML). Sampler bouncing on rock at 8.5 feet, poor recovery, repound with 3-inch sampler.
10	▽	2-inch I.D. PVC casing with threaded connections 0 to 18 feet		5 4 9	Moist, oxidized orangish brown, fine SAND, trace silt, trace gravel; massive; gravel in sampler shoe (SM).
15		10/20 sand 12 to 29 feet		9 14 22	Wet, oxidized orangish grayish brown, sandy, SILT; slightly stratified; poor recovery with 2-inch sampler, used 3-inch sampler with no recovery (ML).
20		2-inch I.D. PVC well screen 0.020-inch slot width 18 to 28 feet		14 19 26 19 18 22	**Vashon Lodgement Till** Moist, gray, silty, gravelly, fine SAND; unsorted (SM). Difficult drilling at 19 feet, sampler bent. As above; very moist to wet (SM).
25				14 18 33	Top 6 inches: wet, gray, SILT, trace to some fine sand, trace gravel; slightly laminated (ML). Bottom 6 inches: moist, gray, silty, gravelly, fine SAND; unsorted (SM). Sampler wet 25.5 to 26.5 feet.
		Threaded end cap			
30		Slough 29 to 41 feet		18 30 45	Very moist to wet, silty, fine SAND, trace gravel; unsorted; poor recovery with 2-inch sampler, switched to 3-inch sampler but no recovery, driller notes gravel likely (SM).

Sampler Type (ST):

▯	2" OD Split Spoon Sampler (SPT)	▯	No Recovery	M -	Moisture
▯	3" OD Split Spoon Sampler (D & M)	▮	Ring Sample	▽	Water Level (12/10/18)
▯	Grab Sample	▯	Shelby Tube Sample	▼	Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
180522E001	EB-2W	2 of 2

Project Name	Issaquah Middle School #6	Location	Issaquah, WA
Elevation (Top of Well Casing)	~242.8 (11/29/18) (NAVD88 LiDAR)	Surface Elevation (ft)	~240 (NAVD88 LiDAR)
Water Level Elevation	~232.87 (11/29/18) (NAVD88 Lidar)	Date Start/Finish	11/12/18,11/12/18
Drilling/Equipment	Advance Drill Tech	Hole Diameter (in)	9 inches
Hammer Weight/Drop	140# / 30"		

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				21 21 26		Moist, gray, sandy, SILT, trace to some gravel; unsorted; lens (1-inch thick) of silt, trace sand (ML-SM).
40				24 30 34		Moist, gray, sandy, SILT, some gravel; unsorted; outside of sampler wet (ML).
		Well tag # BKU 912				Boring terminated at 41.5 feet. Well completed at 28 feet on 11/12/18. Groundwater encountered at ~9 feet. Revised 4/19 - Updated terminology.
45						
50						
55						
60						
65						

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	No Recovery	M - Moisture	**Logged by:** CRC
3" OD Split Spoon Sampler (D & M)	Ring Sample	▽ Water Level (12/10/18)	**Approved by:** CJK
Grab Sample	Shelby Tube Sample	▼ Water Level at time of drilling (ATD)	

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-3A/B	1 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~249
Datum: NAVD 88
Date Start/Finish: 11/13/18,11/13/18
Hole Diameter (in): 9 inches

Depth (ft)	ST	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
			Grass **Select Fill**					
		S-1	Moist, oxidized orangish grayish brown, sandy, SILT, trace to some gravel; occasional rootlets; unsorted; chaotic structure (ML).			5 9 15	▲24	
5		S-2	Moist, oxidized orangish grayish brown, silty, fine SAND, some gravel; unsorted (SM).			8 10 10	▲20	
		S-3	Moist to very moist, slightly oxidized in top 6 inches and heavily oxidized in bottom 6 inches grayish to orangish brown, very silty, fine SAND to sandy, SILT; unsorted (SM-ML).			4 4 5	▲9	
10		S-4	**Non-Select Fill ? / Mass Wasting Deposits ?** Moist to very moist, brownish orange to greenish gray with depth, SILT, some fine sand ranging to CLAY, some silt with depth; heavily oxidized in top 6 inches and moderately oxidized in bottom 6 inches; coal fragments; massive to unsorted (ML-CL).			3 3 3	▲6	
15		S-5	Moist, slightly oxidized gray, SILT, some fine sand, trace gravel; unsorted; fragmented coal pieces (ML).			3 4 5	▲9	
20		S-6	**Vashon Lodgement Till** Moist, slightly oxidized grayish brown, gravelly, SILT, some fine sand; unsorted (ML). Refusal on boulder. Hole abandoned and relocated 5 feet to the south to continue drilling.			1 11 50/3"	▲50/3"	
25		S-7	Moist to very moist, oxidized grayish brown, silty, fine SAND, some gravel; occasional rootlets; unsorted (SM).			17 17 14	▲36	
			Difficult drilling at 28 feet.					
30		S-8	No recovery, gravel in sampler shoe.			15 20 40	▲60	

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-3A/B	2 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): ~249
Datum: NAVD 88
Date Start/Finish: 11/13/18,11/13/18
Hole Diameter (in): 9 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
		S-9		Moist to very moist, slightly oxidized gray, silty to very silty, fine SAND, trace to some gravel; unsorted (SM). No recovery with 2-inch sampler at 35 feet. Switched to 3-inch Cal. sampler.			14 24 32	▲56	
				Difficult drilling at 38 feet.					
40		S-10		Moist to very moist, gray, very silty, fine SAND, trace to some gravel; unsorted (SM-ML).			13 17 20	▲37	
				Bottom of exploration boring at 41.5 feet No groundwater encountered. Revised 4/19 - Updated terminology.					
45									
50									
55									
60									
65									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-4	1 of 2

Project Name Issaquah Middle School #6
Location Issaquah, WA
Driller/Equipment Advance Drill Tech
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) ~238
Datum NAVD 88
Date Start/Finish 11/13/18,11/13/18
Hole Diameter (in) 9 inches

Depth (ft)	Samples	DESCRIPTION	Water Level	Blows/6"	Blows/Foot
0		**Gravel / Recycled Concrete**			
		Select Fill			
	S-1	Moist, oxidized orangish grayish brown, sandy, SILT, trace to some gravel; chaotic structure (ML).		8 9 11	20
5	S-2	Moist, oxidized orangish brown, silty, fine SAND, trace to some gravel; unsorted (SM). No recovery with 2-inch sampler at 5 feet, switched to 3-inch Cal. sampler.		21 32 37	69
	S-3	Moist to very moist, oxidized grayish brown, sandy, SILT, some gravel; unsorted (ML).		4 6 10	16
10	S-4	Moist to very moist, oxidized grayish brown, silty, fine SAND, trace to some gravel; unsorted to slightly stratified; decreasing fines with depth; gravel stuck in sampler shoe (SM).		7 12 12	24
15	S-5	Moist to very moist, orangish gray with oxidation staining, silty, fine SAND, some gravel; unsorted (SM). Very poor recovery with 2-inch sampler, switched to 3-inch Cal sampler.		27 43 28	71
20		**Vashon Recessional Outwash**			
	S-6	Very moist to wet, oxidized grayish brown, fine SAND, some silt to silty, fine SAND; massive to unsorted (SM).		20 30 20	50
25	S-7	Wet, oxidized brown, silty, fine SAND ranging to fine SAND, trace to some silt; water suspended in sampler; unsorted (SM).	▼	17 27 30	57
30	S-8	Wet, oxidized orangish brown, silty, fine SAND to sandy, SILT; stratified to massive; lens (2.5 inches thick) of oxidized silt, trace to some sand; laminated; water suspended in top of sampler (SM-ML).		5 9 10	19

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- ☐ No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-4	2 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): ~238
Datum: NAVD 88
Date Start/Finish: 11/13/18,11/13/18
Hole Diameter (in): 9 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
		S-9		Wet, oxidized orangish brown, silty, fine SAND to fine SAND, some silt, trace gravel; massive ranging to unsorted; slightly stratified in bottom 6 inches (SM). Mostly heave in 2-inch sample, switched to 3-inch Cal. sampler at 35 feet.			17 28 35	▲63	
40		S-10		Top 12 inches: wet, orangish brown, fine to medium SAND, trace to some silt, trace gravel; slightly laminated; massive to slightly stratified (SM-ML). Lower 6 inches: wet, orangish brown, silty, fine to medium SAND to sandy, SILT, trace gravel; massive to slightly stratified (SM-ML).			3 4 10	▲14	
45		S-11		Top 6 inches: moist to very moist, sandy, SILT, trace to some gravel; unsorted (ML). **Vashon Lodgement Till** Bottom 12 inches: wet, slightly oxidized light grayish brown, fine to medium SAND, trace to some silt, trace gravel; massive (SP).			12 16 25	▲41	
50		S-12		Slough, fine sand within silty groundwater; no recovery.			25 50/6"	▲75	
55									
60									
65									

Blows/Foot scale: 10 20 30 40

Bottom of exploration boring at 51.5 feet
Groundwater encountered at 25.3 feet.

Revised 4/19 - Updated terminology.

Sampler Type (ST):

- ◫ 2" OD Split Spoon Sampler (SPT)
- ◫ 3" OD Split Spoon Sampler (D & M)
- ✋ Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-5	1 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~237
Datum: NAVD 88
Date Start/Finish: 11/13/18,11/13/18
Hole Diameter (in): 9 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Gravel / Recycled Concrete **Select Fill**					
		S-1	Moist, grayish brown, sandy, GRAVEL; abundant concrete recycle debris; occasional asphalt debris (GW).			16 50/6"	50/6"	
5		S-2	Moist to slightly moist, slightly oxidized brownish gray to gray, sandy, GRAVEL, some silt; abundant concrete recycle debris; occasional asphalt debris (GW).			19 33 19	52	
		S-3	Very moist, slightly oxidized grayish brown, silty to very silty, fine SAND, trace gravel; heavily oxidized vein of silt, trace sand; unsorted (SM-ML).			13 20 12	32	
10		S-4	**Vashon Recessional Outwash** Wet, oxidized brown, silty, fine SAND, trace gravel; slightly stratified (SM). Bouncing on rock at 10 feet, gravel in sampler shoe with 2-inch sampler; no recovery. Resampled with 3-inch Cal. sampler.		▼	20 18 20	38	
15		S-5	Wet, oxidized brown, fine SAND, some silt to SILT, some sand, some gravel; stratified; interbeds of silt (SM-ML).			19 17 24	41	
20		S-6	Wet, oxidized grayish brown, fine SAND, trace to some silt; massive; bottom 6 inches transitions to silty, gravel, some sand; unsorted (SM-GM). Driller begin adding water at 20 feet.			19 17 42	59	
25		S-7	Wet, slightly oxidized orangish brown, gravelly, fine SAND, some silt; unsorted (SM-GM).			15 18 21	39	
30		S-8	Wet, heavily oxidized orangish brown, sandy, GRAVEL, some silt; contains sand lens (2 inches thick); slightly stratified (GM).			19 19 19	38	

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
☐ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: CRC
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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-5	2 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~237
Datum: NAVD 88
Date Start/Finish: 11/13/18,11/13/18
Hole Diameter (in): 9 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Meltout Till / Ice Contact					
		S-9		Wet, slightly oxidized orangish brown, gravelly, SILT, some sand; slightly stratified to unsorted; gray, sandy, silt in sampler shoe (ML).			16 21 38	▲59	
				Increased drill difficulty at 38 feet.					
40		S-10		Wet, gray with minor oxidation, sandy, SILT to silty, fine SAND, some gravel; interbeds of silt, some fine sand, and fine sand, trace silt, ranges to unsorted (SM-ML).			16 26 50/5"	▲50/5"	
45		S-11		Top 6 inches: wet, gray, fine SAND, some silt, trace gravel; massive; lens (2 inches thick) of brown, fine sand contact of silt, some sand, trace gravel; slightly laminated (SM-ML). Bottom 12 inches: wet, slightly oxidized grayish brown, fine SAND, trace to some silt, trace gravel; slightly stratified to massive (SM-ML).			7 14 18	▲32	
				Bottom of exploration boring at 46.5 feet Groundwater encountered at 11.6 feet. Revised 4/19 - Updated terminology.					
50									
55									
60									
65									

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-6	1 of 1

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): ~242
Datum: NAVD 88
Date Start/Finish: 11/14/18,11/14/18
Hole Diameter (in): 9 inches

Depth (ft)	Samples	DESCRIPTION	Water Level	Blows/6"	Blows/Foot
		Gravel / Recycled Concrete			
		Select Fill			
	S-1	Moist, slightly oxidized brownish gray, sandy, GRAVEL, some silt; abundant concrete recycle debris; occasional asphalt debris (GW).		20 20 15	35
5	S-2	Top 6 inches: as above **Vashon Lodgement Till** Bottom 12 inches: wet, grayish brown with oxidation staining and banding, fine SAND, some silt, trace gravel ranging to silty, fine SAND; slightly stratified; occasional mica (SM).		12 15 34	49
	S-3	Very moist to wet, oxidized orangish brown, silty, fine SAND to SILT, some sand, trace gravel; lens (2-inches thick) of fine sand, trace to some silt at high angle; chaotic structure (SM-ML).		7 14 19	33
10	S-4	Very moist to wet, orangish brown with oxidation staining and banding, fine SAND, some silt to silty, fine SAND, trace gravel; slightly stratified (SM).		30 19 18	37
15	S-5	Wet, orangish grayish brown with oxidation staining and banding, fine SAND, some silt to silty, fine SAND, trace to some gravel; moderately stratified (SM).		8 12 19	31
20	S-6	Very moist, orangish brown with oxidation staining and banding, fine SAND, some silt to silty, fine SAND, trace gravel; slightly laminated; poor recovery, gravel lodged in sampler (SM).		30 30 24	54
25	S-7	Wet, slightly oxidized grayish brown, silty, fine SAND, trace gravel, slightly laminated; water suspended at top of sampler (SM).		32 50/6"	82
		Vashon to Pre-Vashon Undifferentiated	▼		
30	S-8	Wet, oxidized orangish grayish brown, fine SAND, some silt to silty, trace to some sand, trace gravel; chaotic structure; vertical bedding of silt with soft sediment deterioration (SM-ML).		11 12 18	30

Bottom of exploration boring at 31.5 feet
Groundwater encountered at 28 feet.

Revised 4/19 - Updated terminology.

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ✋ Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-7	1 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): ~173
Datum: NAVD 88
Date Start/Finish: 12/6/18,12/6/18
Hole Diameter (in): 8 inches

Depth (ft)	ST	Samples	DESCRIPTION	Water Level	Blows/6"	Blows/Foot	Other Tests
			Vashon Recessional Outwash				
				▼			
		S-1	Wet, brown, silty, fine SAND, trace gravel; poor recovery (SM).		17 12 14	26	
5		S-2	Wet, brown, very sandy, GRAVEL, some silt; one gravel in sampler near tip (GP-GM).		7 8 10	18	
		S-3	Wet, brown, gravelly, fine to medium SAND, some silt; massive to weakly stratified; several gravel in sampler; sampler overfilled (SP-SM).		5 8 11	19	
10		S-4	As above.		7 8 12	20	
15		S-5	Driller notes some heave. As above; contains seam (2 inches thick) of wet, brown, silt; sampler overfilled (ML).		6 6 14	20	
		S-6	Wet, brown, gravelly, fine to medium SAND, trace silt (SP).		6 9 14	23	
20							
25		S-7	Driller notes too much heave to sample, added thin grout mud at 23.5 feet. As above; fairly stratified; two gravel in sampler; sampler overfilled.		8 11 13	24	
30		S-8	As above; less stratified; less coarse gravel.		9 15 22	37	
			Driller notes suspected till at 32 feet.				
			Vashon Lodgement Till				
		S-9	Very moist, gray, gravelly, silty, fine SAND; unsorted; lightly cemented (SM).		33 50/2"	50/2"	

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-7	2 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): ~173
Datum: NAVD 88
Date Start/Finish: 12/6/18,12/6/18
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
		S-35	As above; well cemented.			50/3"	▲50/3"	
40			Bottom of exploration boring at 40 feet Groundwater encountered at 2.5 feet. Revised 4/19 - Updated terminology.					
45								
50								
55								
60								
65								

Sampler Type (ST):

- ◫ 2" OD Split Spoon Sampler (SPT)
- ◫ 3" OD Split Spoon Sampler (D & M)
- ✋ Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▱ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

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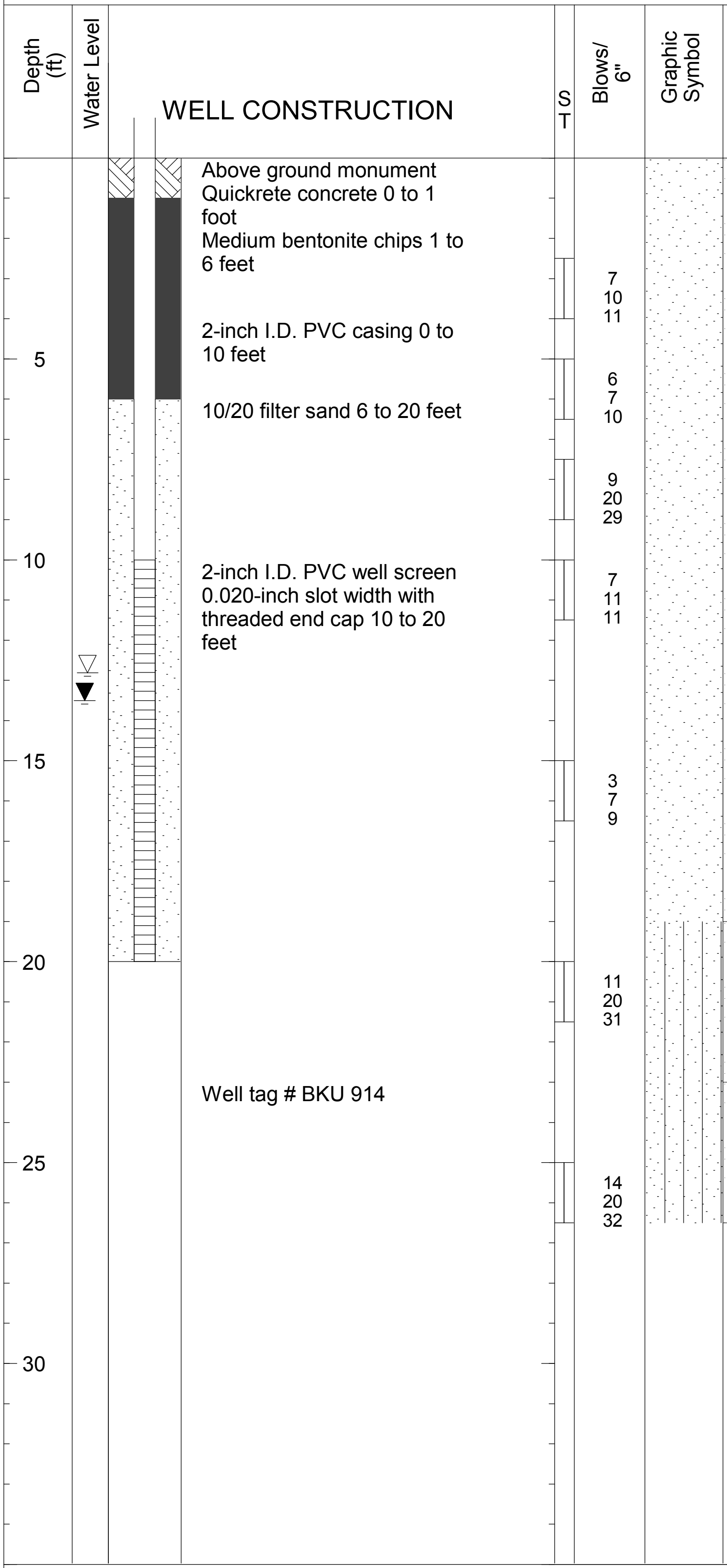
Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
180522E001	EB-8W	1 of 1

Project Name: Issaquah Middle School #6
Elevation (Top of Well Casing): ~192.43
Water Level Elevation: ~170 (12/10/18)
Drilling/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"
Location: Issaquah, WA
Surface Elevation (ft): ~190 (NAVD88 LiDAR)
Date Start/Finish: 12/6/18,12/6/18
Hole Diameter (in): 8 inches



Above ground monument
Quickrete concrete 0 to 1 foot
Medium bentonite chips 1 to 6 feet

2-inch I.D. PVC casing 0 to 10 feet

10/20 filter sand 6 to 20 feet

2-inch I.D. PVC well screen 0.020-inch slot width with threaded end cap 10 to 20 feet

Well tag # BKU 914

DESCRIPTION

Vashon Recessional Outwash

Moist, gray, gravelly, fine to medium SAND, trace silt (SP).

Moist, brownish gray, fine to medium SAND, some gravel, trace silt; weakly stratified (SP).

Poor recovery, suspected rock blocking sampler, blowcounts overstated.

Moist, gray, gravelly, fine to medium SAND, trace silt; nonstratified (SP).

Wet, brown, gravelly, fine to medium SAND, trace silt (SP).

Weathered Vashon Lodgement Till

Driller notes change in drilling at ~19 feet.
Moist, grayish brown, very silty, gravelly, fine SAND; gravel is unsorted (SM).

Vashon Lodgement Till

Moist, gray, silty, gravelly, fine SAND; cemented; unsorted (SM).

Boring terminated at 26.5 feet.
Well completed at 20 feet on 12/6/18.
Groundwater encountered at 13.5 feet.

Revised 4/19 - Updated terminology.

Sampler Type (ST):
- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ▯ Grab Sample
- ▯ No Recovery
- ▮ Ring Sample
- ▯ Shelby Tube Sample

M - Moisture
▽ Water Level (12/10/18)
▼ Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-9	1 of 1

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~181
Datum: NAVD 88
Date Start/Finish: 12/6/18,12/6/18
Hole Diameter (in): 8 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10, 20, 30, 40)	Other Tests
				Non-Select Fill					
		S-1		Moist, brown, gravelly, silty, fine SAND; abundant black organic debris (SM).			5 7 10	▲17	
5		S-2		Moist, gray, silty, fine SAND, some gravel; driving on rocks; poor recovery (SP-SM).			50/6"	▲50/6"	
		S-3		Brown, moist, gravelly, silty, fine SAND; scattered decayed fine organics and one stick; driving on rock? (fill?/slough?); blowcounts overstated (SM).			50/6"	▲50/6"	
		S-4		**Alluvial Fan Deposits** Moist, tan to brown, gravelly, fine SAND, some silt; unsorted; broken gravel; blowcounts overstated (SP-SM).			36 40 36	▲76	
10		S-5		As above; contains broken gravel/rock (3 inches). Grinding and slow drilling at 11 feet.			35 40 39	▲79	
15		S-6		Wet, brown, gravelly, fine to medium SAND, trace silt; weakly stratified; blowcounts overstated (SP).			35 20 28	▲48	
						▼			
20		S-7		As above; nonstratified; one large piece of gravel in sampler; blowcounts overstated.			20 30 35	▲65	
25		S-8		As above; somewhat stratified; coarser near top; blowcounts overstated.			13 18 21	▲39	
				Bottom of exploration boring at 26.5 feet Groundwater encountered at 17.5 feet. Revised 4/19 - Updated terminology.					
30									

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-10A/10B	1 of 2

Project Name Issaquah Middle School #6
Location Issaquah, WA
Driller/Equipment Advance Drill Tech / D50
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) ~247
Datum NAVD 88
Date Start/Finish 3/21/19,3/21/19
Hole Diameter (in) 8 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
			Gravel					
			Select Fill					
5		S-1	Slightly moist, grayish light brown, gravelly, fine to medium SAND, trace to some silt; occasional woody debris; abundant concrete recycle in bottom 6 inches (SP). Blowcounts variable at 5 feet; bouncing intermittently.			19 50/4"	▲50/4"	
			Vashon Recessional Outwash					
10		S-2	Wet, light brown, gravelly, fine to medium SAND, some silt; occasional rootlets; poor recovery; suspended water in top foot of sampler; unsorted (SP).		▼	13 12 11	▲23	
			Weathered Vashon Lodgement Till Grinding drill action at 12 feet.					
15		S-3	Wet, gray, silty, mostly fine to medium SAND, trace to some gravel; occasional rootlets; unsorted (SM).			12 13 16	▲29	
20		S-4	Very moist to wet, gray, sandy, SILT, trace gravel ranging to fine SAND, some silt, trace gravel; unsorted; lens (2 inches thick) of fine sand, trace to some silt (SM-ML).			5 9 13	▲22	
			Vashon Lodgement Till					
		S-5	Refusal on boulder. Hole abandoned and relocated 5 feet to the north to continue drilling.			50/1"	▲50/1"	
25		S-6	Very moist, gray, very silty, fine SAND, trace to some gravel; unsorted; outside of sampler wet (SM).			12 23 35	▲58	
30		S-7	As above; becomes silty (SM).			15 40 26	▲66	

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- ☐ No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-10A/10B	2 of 2

Project Name Issaquah Middle School #6
Location Issaquah, WA
Driller/Equipment Advance Drill Tech / D50
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) ~247
Datum NAVD 88
Date Start/Finish 3/21/19,3/21/19
Hole Diameter (in) 8 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
		S-8		Very moist to wet, gray, silty, fine SAND to fine SAND, some silt, trace to some gravel; lens (3 inches thick) of wet, fine sand, trace to some silt; unsorted (SM). Driller notes grinding drill action 35 to ~39 feet.			15 24 21	▲45	
40		S-9		Upper 6 inches: very moist, gray, silty, fine SAND, trace to some gravel ranging to SILT, some fine sand (SM-ML). Lower 6 inches: lenses (<1 inch thick) of very moist, brownish purplish gray, SILT to clayey, SILT, some fine sand; occasional coal fragments; chaotic structure; one thin parting of orange, fine to mostly medium sand; contains rip up clasts of Renton Formation.			47 50/3"	▲50/3"	
45		S-10		Upper 6 inches: Moist to very moist, gray, sandy, SILT, trace to some gravel; unsorted (ML). Lower 6 inches: contains bands of moist to very moist, brownish purplish gray, SILT to clayey, SILT; occasional coal; chaotic structure; contains rip up clasts of Renton Formation.			37 48 50/4"	▲50/4"	
				Bottom of exploration boring at 46.5 feet Perched groundwater encountered at 10 feet. Confined groundwater encountered at 20 feet and 35 feet.					
50									
55									
60									
65									

Blows/Foot scale: 10 20 30 40

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-11	1 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): ~249
Datum: NAVD 88
Date Start/Finish: 3/21/19,3/21/19
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Gravel					
			Select Fill					
5		S-1	Very moist to wet, moderately oxidized gray, silty, fine SAND, trace to some gravel; unsorted; lens (3 inches thick) of brown, mostly fine to medium sand, some silt; moderate organic debris (SM). Outside of sampler is wet at 5 feet. Difficult drill action at 6 feet; abundant gravel.		▼	9 16 14	▲30	
			Vashon Lodgement Till					
10		S-2	Very moist to wet, gray, silty, fine SAND, trace to some gravel; unsorted (SM).			15 14 14	▲28	
15		S-3	Upper 6 inches: as above; lens (2 inches thick) of moist to very moist, grayish green, silty, fine SAND; unsorted (SM). Lower 6 inches: moist to very moist, gray to dark gray, silty, fine SAND, some silt, trace gravel; unsorted; lens (0.5 inch thick) of grayish purplish brown, silt to clayey silt; contains rip up clasts of Renton Formation (SM-ML).			16 10 8	▲18	
20		S-4	Moist, gray to dark gray, very silty, fine SAND, trace gravel; unsorted; thin partings of brownish dark gray silt to clayey silt; occasional coal fragments; contains rip up clasts of Renton Formation (SM-ML).			18 27 28	▲55	
25		S-5	Very moist, dark gray, silty, fine SAND, some gravel; unsorted (SM).			50/3"	▲50/3"	
30		S-6	Upper 6 inches: wet, dark gray, gravelly, mostly fine to medium SAND, trace to some silt (SP-SM). Lower 6 inches: moist, gray, silty, fine SAND, trace gravel; unsorted (SM).			38 50/5.5"	▲50/5.5"	

Blows/Foot scale: 10 20 30 40

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
▽ Water Level ()
▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-11	2 of 2

Project Name	Issaquah Middle School #6	Ground Surface Elevation (ft)	~249
Location	Issaquah, WA	Datum	NAVD 88
Driller/Equipment	Advance Drill Tech / D50	Date Start/Finish	3/21/19,3/21/19
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	8 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
		S-7		Moist, gray, silty, fine SAND, some gravel; unsorted (SM).			38 50/4"	50/4"	
40		S-8		Moist, gray, fine SAND, some silt, trace gravel; unsorted; lens (2 inches thick) of silty, fine sand (SM).			40 50/4"	50/4"	
45		S-9		Moist, gray to dark gray, silty, fine SAND, trace gravel; unsorted; thin partings of purplish brown, silt to clayey silt, with occasional coal fragments in bottom 6 inches; slightly cooked; unsorted/chaotic structure; contains rip up clasts of Renton Formation (SM-ML). Difficult drilling begins.			32 50/4"	50/4"	
50		S-10		Moist, gray, fine SAND, some silt, trace gravel; unsorted (SM).			50/4"	50/4"	
				Bottom of exploration boring at 50.3 feet Perched groundwater encountered at 5 feet. Confined groundwater encountered at 30 feet.					
55									
60									
65									

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture	**Logged by:** CRC
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()	**Approved by:** CJK
☐ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)	

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-12	1 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~267
Datum: NAVD 88
Date Start/Finish: 3/22/19,3/22/19
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	DESCRIPTION	Water Level	Blows/6"	Blows/Foot
			Gravel / Concrete Recycle Grinding drill action begins.			
			Select Fill			
5	▯	S-1	Moist to very moist, light to dark gray, silty, fine SAND, some gravel; unsorted; thin partings of brown, silty, fine sand in lower 6 inches; slightly stratified (SM). Intermittent grinding drill action begins.		7 12 12	▲24
			Vashon Lodgement Till			
10	▯	S-2	Very moist to wet, moderately oxidized grayish light brown to gray with occasional oxidized bands, fine SAND, some gravel to gravelly, some silt; unsorted (SP-SM). Outside of sampler wet at 10 feet.	▼	8 10 17	▲27
15	▯	S-3	Moist to wet, slightly oxidized light brown to light brownish gray, silty, fine SAND, some gravel to gravelly; lower 6 inches contains fine sand, trace to some silt; gravel lodged in sampler head, blowcounts likely overstated (SP-SM).		10 8 15	▲23
20	▯	S-4	Very moist, gray, silty, fine SAND; unsorted; wet within sampler head (SM).		10 12 20	▲32
25	▯	S-5	Very moist to wet, gray, silty, fine SAND, some gravel; occasional lenses (1 inch thick) of fine sand, some silt; unsorted; outside of sampler is wet (SM). Grinding drill action at 26 feet.		13 20 14	▲34
30	▯	S-6	Very moist to wet, gray, silty, fine SAND, some gravel; unsorted; outside of sampler is wet; suspended water in top of sampler; occasional red medium sand; driller notes pounding on rock in top 6 inches (SM).		21 10 11	▲21

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ☐ Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-12	2 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~267
Datum: NAVD 88
Date Start/Finish: 3/22/19,3/22/19
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
		S-7		Wet, gray, silty, fine SAND, some gravel ranging to fine SAND, some silt with depth; unsorted (SM).			10 12 17	29	
				Pre-Vashon Mass Wasting ? / Alluvium ?					
40		S-8		Wet, blackish gray to lavenderish gray, silty, fine to medium SAND ranges to SILT, some fine sand, trace gravel becoming medium to coarse sand, trace to some silt with moderate pinkish to lavender medium to coarse sand with depth; lenses (1 to 2 inches thick) of light brownish gray, fine to medium sand, some silt in top 6 inches; mottled (SM-ML).			7 9 11	20	
45		S-9		Moist, purplish light brown to greenish dark gray, SILT, some fine sand, trace to some gravel ranging to clayey, SILT; lenses (2 inches thick) of purplish dark gray, silt to clayey silt; occasional siltstone fragments; occasional coal fragments; unsorted/chaotic structure; contains rip up clasts of Renton Formation (ML).			6 8 9	17	
50		S-10		Moist, gray to dark gray with light gray discoloration banding, fine SAND, some silt, trace gravel; lenses (1 inch thick) of sandy, silt; slightly laminated to unsorted (SM-ML). Driller notes gravelly drill action begins.			50/6"	50/6"	
55		S-11		Moist, dark gray, silty, fine SAND, some gravel; unsorted (SM). Bottom of exploration boring at 55.4 feet Perched groundwater encountered at 10 feet.			50/5"	50/5"	
60									
65									

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: CRC
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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-13	1 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~260
Datum: NAVD 88
Date Start/Finish: 3/22/19,3/22/19
Hole Diameter (in): 8 inches

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Select Fill					
5		S-1		Moist to very moist, moderately oxidized light brown, silty, mostly fine to medium SAND, some gravel; chaotic structure (SM).			11 7 11	▲18	
10		S-2		Very moist to wet, light brownish gray to dark gray, silty, fine to medium SAND, trace to some gravel; lens (2 inches thick) of gray, silty, fine sand, trace gravel (SM).		▼	13 13 18	▲31	
				Vashon Recessional Outwash Water rising around auger at 14 to 15 feet.					
15		S-3		Upper 3 inches: wet, dark gray, fine to coarse SAND, some gravel, trace silt (SM). Mid 12 inches: wet, dark gray, fine to medium SAND, trace silt; massive (SP).			7 8 3	▲11	
				Vashon Lodgement Till Lower 3 inches: very moist, dark gray, silty, mostly fine to medium SAND, trace gravel; unsorted; occasional coal fragments; contains rip up clasts of Renton Formation (SM).					
20		S-4		Upper 15 inches: wet, dark gray, fine to medium SAND, trace to some silt, trace gravel becoming silty, fine sand with depth; unsorted; Lower 3 inches: moist, heavily oxidized orangish grayish light brown, SILT to clayey, SILT, trace gravel; occasional coal fragments; chaotic structure; occasional grayish light brown siltstone; contains rip up clasts of Renton Formation (SM-ML).			9 10 22	▲32	
25		S-5		Moist, slightly oxidized grayish light brown, silty, fine SAND, some gravel; unsorted; moderate gravel (2 inches I.D.) in sampler, blowcounts likely overstated (SM). Driller notes possible heave at 25 feet. Grinding drill action 26 to 29 feet.			18 43 35	▲78	
30		S-6		Very moist, slightly oxidized, grayish light brown, silty, fine SAND, some gravel ranging to fine SAND, trace silt in top 2 inches of sampler; unsorted; massive; sluff in top 6 inches of sampler (SM).			10 15 17	▲32	

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-13	2 of 2

Project Name Issaquah Middle School #6
Location Issaquah, WA
Driller/Equipment Advance Drill Tech / D50
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) ~260
Datum NAVD 88
Date Start/Finish 3/22/19,3/22/19
Hole Diameter (in) 8 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
		S-7		Moist to very moist, slightly oxidized, grayish light brown, silty, fine SAND, some gravel; unsorted; sluff in top 6 inches of sampler (SM).			9 17 23	▲40	
40		S-8		Upper 6 inches: wet, light brownish gray, fine to medium SAND, some silt, some gravel; massive to unsorted (SM-SP). Lower 12 inches: moist to very moist, gray, silty, fine SAND, some gravel; unsorted (SM).			12 12 17	▲29	
45		S-9		As above; poor recovery; top foot of sampler consists of sluff.			18 23 21	▲44	
				Bottom of exploration boring at 46.5 feet Perched groundwater encountered at 10. Confined groundwater at 40 feet.					
50									
55									
60									
65									

Sampler Type (ST):

◫ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
◫ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: CRC
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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-14	1 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~293
Datum: NAVD 88
Date Start/Finish: 3/25/19,3/25/19
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Gravel / Concrete Recycle					
				Non-Select Fill					
5		S-1		Moist, moderately oxidized light grayish brown, gravelly, fine to medium SAND, some silt; occasional fine organics; moderate concrete recycle debris; concrete odor (SP-SM).			4 8 20	▲28	
10		S-2		As above; moderate asphalt debris; sample wet in sampler head.		▼	15 12 8	▲20	
15		S-3		Moist, slightly oxidized dark gray, silty, fine to medium SAND, some gravel; occasional fine organics and woody debris; occasional concrete recycle debris; concrete odor; chaotic structure (SM). Grinding drill action at 17 feet.			11 10 10	▲20	
20		S-4		Moist, slightly oxidized greenish light brown, silty, fine to medium SAND, some gravel; occasional rootlets and woody debris; concrete odor; unsorted (SM).			8 12 13	▲25	
25		S-5		Moist, light brown to greenish dark gray, silty, fine to medium SAND, some gravel; occasional woody debris and rootlets; unsorted; thin bands (<1 inch thick) of light gray silt (SM).			9 17 23	▲40	
30		S-6		Top 12 inches: moist, dark gray, gravelly, fine to medium SAND, some silt; occasional concrete recycle debris; lens (1 inch thick) of asphalt debris; concrete odor; chaotic structure (SM). **Vashon Lodgement Till** Lower 6 inches: moist, gray, silty, fine to medium SAND, trace gravel; unsorted (SM). Intermittent grinding drill action begins at 32 feet.			20 30 49	▲79	

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ✋ Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
180522E001	EB-14	2 of 2

Project Name: Issaquah Middle School #6
Location: Issaquah, WA
Driller/Equipment: Advance Drill Tech / D50
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~293
Datum: NAVD 88
Date Start/Finish: 3/25/19,3/25/19
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
		S-7		Moist becoming very moist with depth, gray to dark gray, silty, fine SAND, some gravel; lens (<1 inch thick) of wet, gravelly, fine sand, trace silt; unsorted (SM).			29 44 50/3"	▲50/3"	
40		S-8		Moist, gray, mostly fine to medium SAND, some silt to silty, some gravel; unsorted (SM).			50/6"	▲50/6"	
45		S-9		Moist, gray, silty, mostly fine to medium SAND, some gravel; unsorted (SM).			50/6"	▲50/6"	
50		S-10		As above.			50/5"	▲50/5"	
				Driller adds water to ease difficult drilling at 53 feet.					
55		S-11		As above.			44 50/4"	▲50/4"	
				Grinding on rock at 57 feet.					
60		S-12		As above; becomes olive gray. Driller notes bouncing on rock at 60 feet; blowcounts overstated.			50/3"	▲50/3"	
65		S-13		As above; becomes dark gray.			22 50/6"	▲50/6"	
				Bottom of exploration boring at 66.5 feet Groundwater encountered at 11.5 feet.					

Sampler Type (ST):

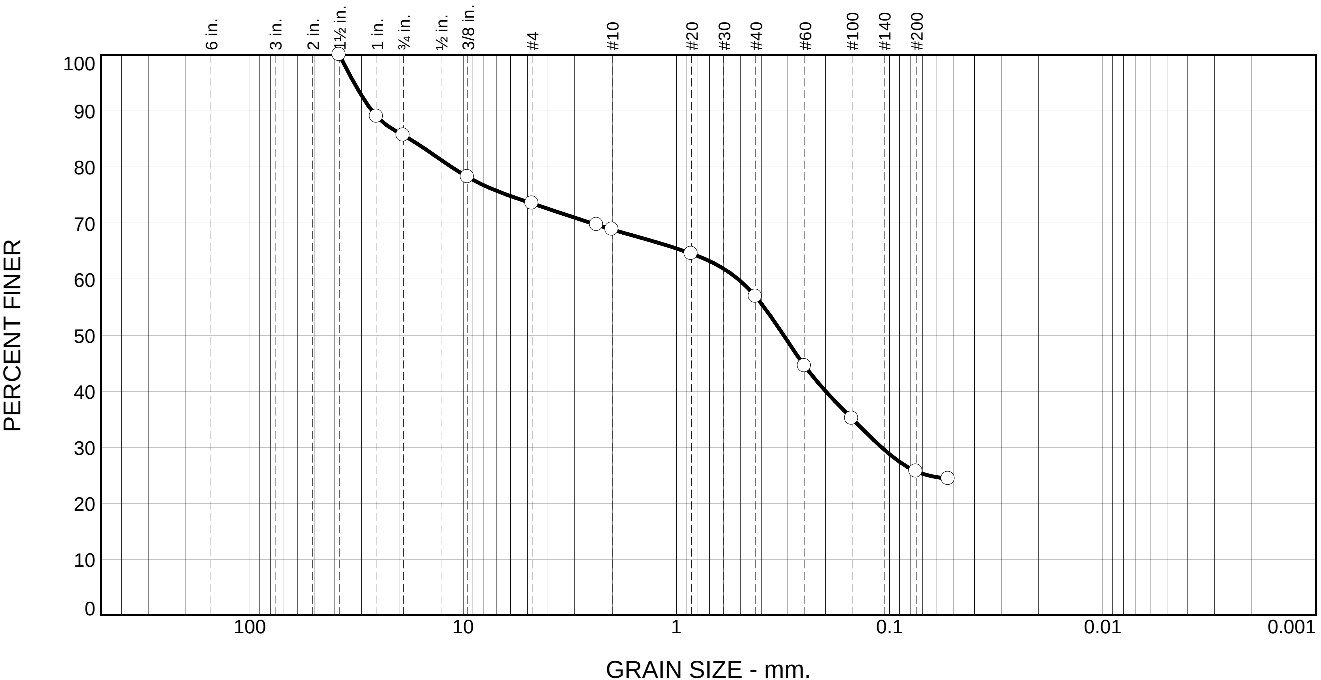
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: CRC
Approved by: CJK

APPENDIX B

Laboratory Testing Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.3	12.2	4.7	11.9	31.2	25.7	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	89.0		
.75	85.7		
.375	78.2		
#4	73.5		
#8	69.7		
#10	68.8		
#20	64.5		
#40	56.9		
#60	44.5		
#100	35.1		
#200	25.7		
#270	24.3		

* (no specification provided)

Material Description

Silty Gravelly 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}=	26.7477	D_{85}=	17.8194	D_{60}=	0.5142
D_{50}=	0.3148	D_{30}=	0.1094	D_{15}=	
D_{10}=		C_u=		C_c=	

Remarks

Date Received: 11-29-18 **Date Tested:** 11-29-18

Tested By: BN

Checked By: BG

Title:

Location: Onsite
Sample Number: EP-3 **Depth:** 3'

Date Sampled: 11-10-18

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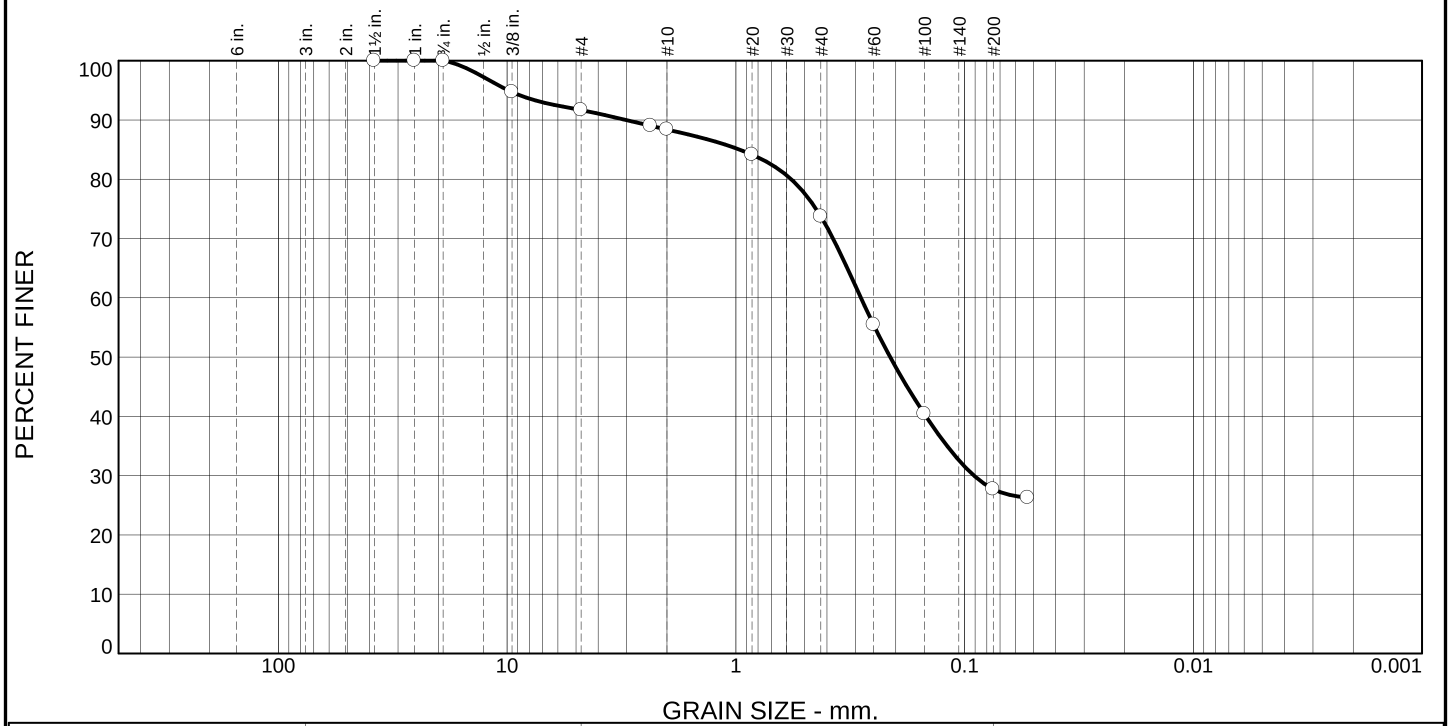
Client: Issaquah School District
Project: Issaquah MS #6

Project No: 180522 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.3	3.3	14.7	46.0	27.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	100.0		
.75	100.0		
.375	94.7		
#4	91.7		
#8	89.0		
#10	88.4		
#20	84.1		
#40	73.7		
#60	55.4		
#100	40.4		
#200	27.7		
#270	26.3		

* (no specification provided)

Material Description

silty SAND, some gravel

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}=	3.0259	D_{85}=	0.9643	D_{60}=	0.2839
D_{50}=	0.2116	D_{30}=	0.0910	D_{15}=	
D_{10}=		C_u=		C_c=	

Remarks

Collected by: CC

Date Received: 11/29/2018 **Date Tested:** 12/03/2018

Tested By: BN

Checked By: BG

Title:

Location: Onsite

Sample Number: EP-7 **Depth:** 10.5'

Date Sampled: 11/16/2018

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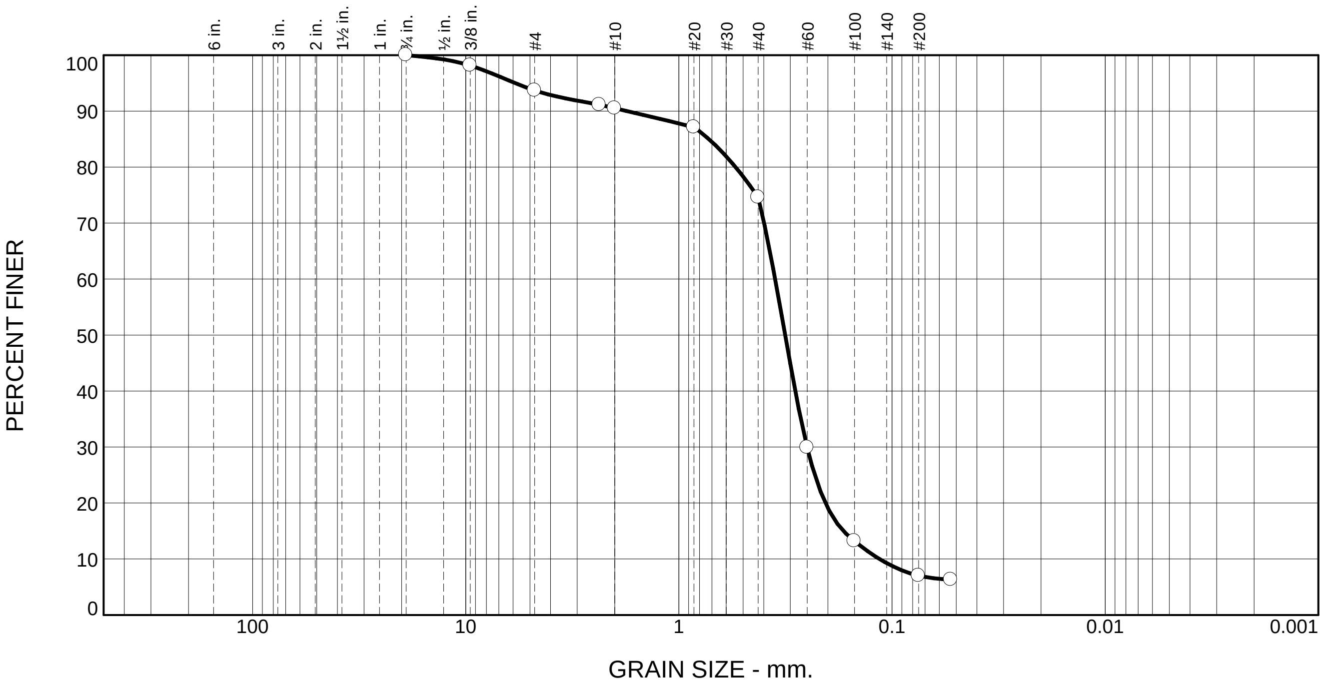
Client: Issaquah School District

Project: Issaquah MS #6

Project No: 180522 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.3	3.2	15.9	67.6	7.0	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	98.1		
#4	93.7		
#8	91.1		
#10	90.5		
#20	87.1		
#40	74.6		
#60	29.9		
#100	13.2		
#200	7.0		
#270	6.3		

* (no specification provided)

Material Description

SAND Some Silt Some Gravel

Atterberg Limits (ASTM D 4318)

PL= np **LL=** nv **PI=**

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}=	1.7507	D_{85}=	0.7238	D_{60}=	0.3537
D_{50}=	0.3174	D_{30}=	0.2504	D_{15}=	0.1690
D_{10}=	0.1145	C_u=	3.09	C_c=	1.55

Remarks

Date Received: 11-29-18 **Date Tested:** 11-29-18

Tested By: BN

Checked By: BG

Title:

Location: Onsite

Sample Number: EP-8 **Depth:** 5'

Date Sampled: 11-10-18

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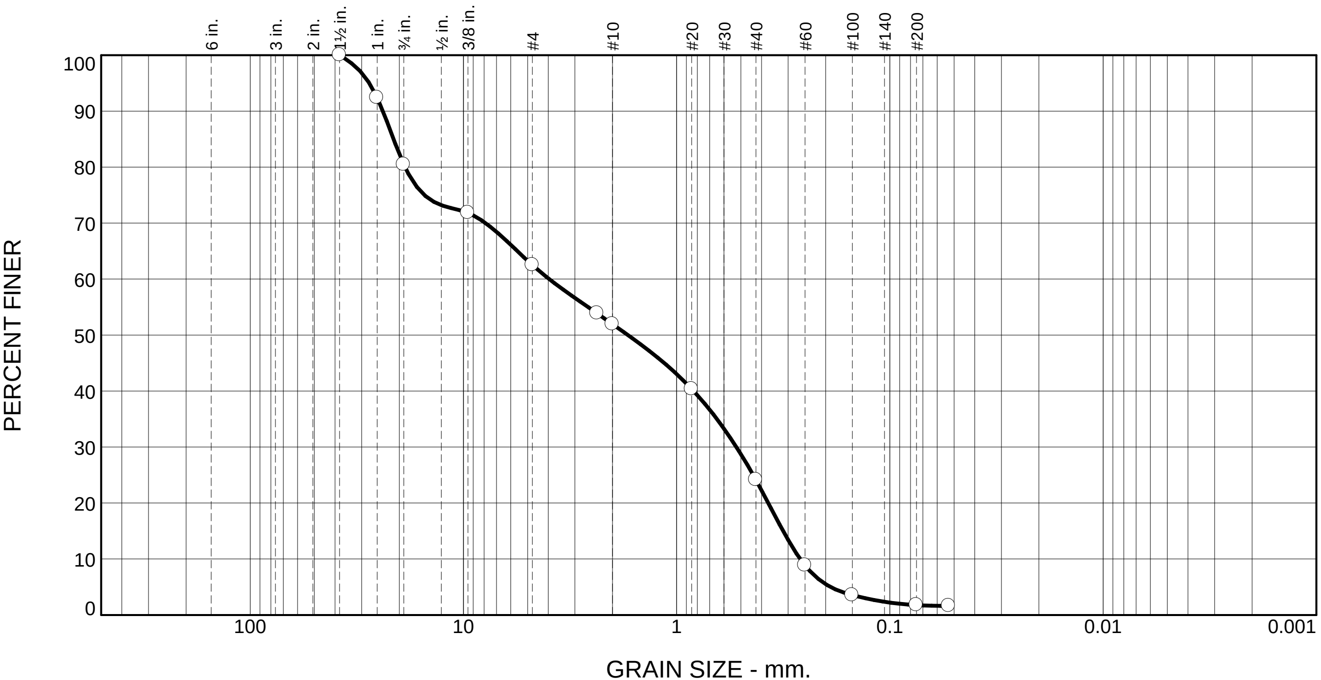
Client: Issaquah School District

Project: Issaquah MS #6

Project No: 180522 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.5	18.0	10.6	27.8	22.3	1.8	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	92.4		
.75	80.5		
.375	71.8		
#4	62.5		
#8	53.9		
#10	51.9		
#20	40.4		
#40	24.1		
#60	8.9		
#100	3.6		
#200	1.8		
#270	1.6		

* (no specification provided)

Material Description

Very Gravelly SAND Trace Silt

Atterberg Limits (ASTM D 4318)

PL= np **LL=** nv **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}=	23.8637	D_{85}=	21.2822	D_{60}=	3.9605
D_{50}=	1.6946	D_{30}=	0.5246	D_{15}=	0.3167
D_{10}=	0.2633	C_u=	15.04	C_c=	0.26

Remarks

Date Received: 11-29-18 **Date Tested:** 11-29-18

Tested By: BN

Checked By: BG

Title:

Location: Onsite
Sample Number: EP-9 **Depth:** 5'

Date Sampled: 11-10-18

associated
earth sciences
incorporated

Client: Issaquah School District
Project: Issaquah MS #6

Project No: 180522 E001 **Figure**