Appendix D

Field Inspection Photos

Attachment 15

172nd Avenue Drainage Ditch, facing north

A-1 Facing Northwest

A-1 Facing southeast

A-2 Facing east

A-3 Facing west

122nd Street Drainage Ditch, facing east

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North Redmond Elementary School
Downstream Analysis

Field Inspection Photos -TDA A

D-1

A-4 facing south

A-7 facing north

A-8 facing south

A-10 facing west

A-11 facing west

A-14 facing west

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North Redmond Elementary School
Downstream Analysis

Field Inspection Photos -TDA A

D-1

Attachment 15

A-11 facing east

A-16 facing north

A-17 facing east

A-18 facing north

A-19 facing east

A20- facing west

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**North Redmond Elementary School
Downstream Analysis**

Field Inspection Photos -TDA A

D-1

Attachment 15

B-1 facing south

B3 and B4 facing south

B-10 facing west

B-2 facing south

B-8 and B-9 facing south

B-11 facing southwest

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**North Redmond Elementary School
Downstream Analysis**

Field Inspection Photos -TDA B

D-2

B-12 facing south

B-13 facing southeast

B-14 facing southeast

B-15 facing south

B-17 facing west

B-19 facing northeast

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North Redmond Elementary School Downstream Analysis

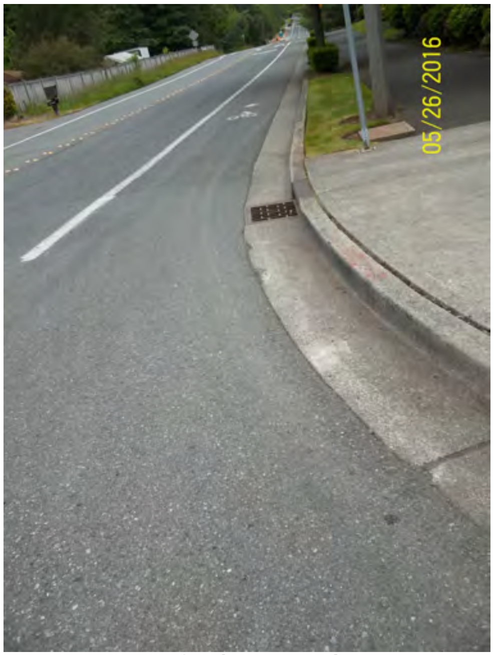
Field Inspection Photos -TDA B

D-2

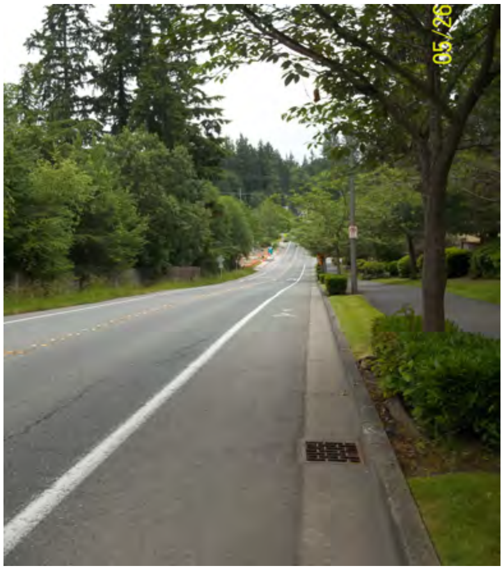
B-20 facing north

B-21 and B-22 facing south

B-23 facing east



B-24 facing south



B-25 facing south

B-26 facing southwest

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North Redmond Elementary School
Downstream Analysis

Field Inspection Photos -TDA B

D-2

Attachment 15

B-28 facing south

B-29 facing south

B-30 facing south

B-31 facing north

B-32 facing north

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North Redmond Elementary School Downstream Analysis

Field Inspection Photos -TDA B

D-2

Appendix E

Conveyance Exhibits and Calculations

- Exhibit E-1 Conveyance Map *(To be submitted at a later date)*

Attachment 15

Appendix F

Preliminary Geotechnical Engineering Report

By AMEC Environment and Infrastructure, Inc., November 14, 2013

Attachment 15

November 14, 2013
Project No. 3-917-17668-0

Lake Washington School District No. 414
15212 NE 95th Street
Redmond, Washington 98052

Attention: Mr. Michael Finnegan

Subject: **Preliminary Geotechnical Engineering Report**
Pope Property: New Elementary School
172nd Avenue NE & NE 122nd Street
Redmond, Washington

Dear Mike:

AMEC Environment & Infrastructure, Inc. (AMEC), is pleased to submit this report describing our preliminary geotechnical engineering evaluation for the Pope Property. The purpose of our evaluation was to derive preliminary conclusions and recommendations concerning site preparation, foundations, floors, stormwater infiltration, pavement sections, and structural fill for the proposed new elementary school.

As outlined in our proposal dated October 9, 2013, our scope of work comprised of field exploration, laboratory testing, geotechnical literature review and report preparation, in accordance with the scope of work outlined in Attachment A of the Contract of Professional Services. We received your written authorization by means of, a fully executed copy of the Contract of Professional Services on October 15, 2013. This report has been prepared for the exclusive use of Lake Washington School District No. 414 and their consultants, for specific application to this project, in accordance with generally accepted geotechnical engineering practice.

We appreciate the opportunity to be of service on this project. If you have any questions regarding this report, or any aspects of the project, please feel free to contact our office.

Sincerely,

AMEC Environment & Infrastructure, Inc.

Todd D. Wentworth, P.E., L.G.
Associate

AMEC Environment & Infrastructure, Inc.
11810 North Creek Parkway N
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Attachment 15

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

Pope Property: New Elementary School

Redmond, Washington

Prepared for:

Lake Washington School District No. 414
15212 NE 95th Street
Redmond, Washington 98052

Prepared by:

AMEC Environment & Infrastructure, Inc.
11810 North Creek Parkway North
Bothell, Washington 98011

November 14, 2013

Project No. 3-917-17668-0

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PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

Pope Property: New Elementary School
Redmond, Washington

1.0 SUMMARY

The following summary of project geotechnical considerations is presented for introductory purposes and should be used only in conjunction with the full text of this report.

Project Description: The Pope Property is being evaluated for a proposed new elementary school. The project site is located at the southwest corner of the intersection of 172nd Avenue NE and NE 122nd Street in Redmond, Washington. The nine acre site is currently undeveloped with gently rolling topography and heavily vegetated with blackberry brambles and other brush. No conceptual layout plans have been generated as of the date of this report

Soil Conditions: Our explorations encountered generally consistent subsurface conditions across the site. Topsoil extending from 6 to 12 inches deep was mantled the site. Below the topsoil, loose to medium dense, silty sand extended to an average depth of 3 feet, which represented weathered glacial till. Below the weathered glacial till, the explorations encountered dense to very dense silty sand with some gravel (glacial till) to the full depths explored.

Groundwater Conditions: No groundwater seepage was observed within any of the test pits excavated at the time our exploration program, although, wet soil conditions were noted within two of the test pits at depths of 10 and 13 feet. Prevalent iron oxide staining was observed in all of the explorations at the weathered till/glacial till contact, which likely is an indication of intermittent perched groundwater during the wet periods of the year. Regional groundwater has been reported approximately 100 feet below ground surface (bgs) in the nearby monitoring wells.

Environmental Conditions: No visual indications of impacted soils were noted during our investigations. An aerial photo from 1936 displayed several buildings located within the central portion of the site. Assuming these buildings were likely a residence and possibly a barn or shed, it is reasonable to assume there may be a septic tank located within the area and possibly an underground home heating oil tank. A contingency is recommended for costs associated with decommissioning, and removal of an underground storage tank. Impacted soils adjacent the tank(s) may be present and would likely need to be handled as non-hazardous waste and sent to a Non-hazardous waste landfill facility in accordance with applicable local, state, and federal regulations.

Critical Areas Review: A review of the site conditions with respect to critical areas was performed as part of our scope of work. AMEC evaluated the existing site conditions and the potential impact of the proposed improvements on the site. Based on the gentle topography across the site and no steep slopes, the site is not within any geologically hazardous areas, as defined by the City of Redmond.

Infiltration: Based upon our explorations, laboratory testing, and subsurface conditions, stormwater infiltration at the site does not appear favorable. The dense glacial till found across the entire site has been shown to have very slow infiltration rates and therefore typically not utilized for infiltration facilities. Further investigation, testing and engineering would be needed to determine designed infiltration rates, locations and depths if required.

Thermal Conductivity: Drilling a test bore hole and performing the thermal conductivity test has been scheduled but is not complete yet. Test results will be incorporated into this report when available.

Foundations: Foundations cast atop medium dense to dense native soils, or structural fill can be designed with a bearing pressure of 2,500 pounds per square foot (psf), and footings cast atop very dense glacial till can be designed with a bearing pressure of 5,000 psf. For footings designed according to these pressures, we estimate total settlement will be less than 1 inch and differential settlement between adjacent footings will be less than 0.5 inch.

Floors: The new structures will be able to use soil-supported slab-on-grade floors. The floors should be designed to include 4 inches of capillary break and a moisture/vapor barrier.

On-site Soil Considerations: The on-site soils would be suitable for re-use as structural fill provided the moisture content of the material is at or below its optimum moisture content for compaction. Because the weathered glacial till and glacial till soils have relatively high silt content, they are considered moisture-sensitive and would be difficult to compact when wet. Ideally, earthwork would be scheduled for the summer and fall months when drier weather is more conducive to earthwork.

2.0 SITE AND PROJECT DESCRIPTION

The project site is comprised of two undeveloped parcels located at the southwest corner of the intersection of 172nd Avenue NE and NE 122nd Street in Redmond, Washington, as shown on the enclosed Location Map (Figure 1). The site consists of two rectangular parcels that, in total, measures approximately 625 feet (east-west) by 625 feet (north-south) encompassing approximately 9 acres. Site boundaries are generally delineated by NE 122nd Street on the north, 172nd Avenue NE to the east, a residential development to the south, and several older residences to the west. The area is primarily residential with a mix of planned developments and older residential properties. The enclosed Site and Exploration Plan (Figure 2) illustrates these site boundaries and existing features.

A new elementary school to house approximately 550 students is proposed for the project site. Since no conceptual layout plans have been generated as of the date of this report, we have assumed a typical size and configuration for the new elementary school to accommodate the projected number of students. We anticipate the proposed building would be on the order of 60,000-square-feet, comprised of a one to two-story structure. Based on our experience with similar education facilities, we anticipate the two-story portion of the new school would impose moderate foundation loads while the one-story portion of the building will impose low to moderate loads. Site improvements will include play fields, a covered play area, stormwater facilities, new underground utilities and new landscaping. Paved surfaces are anticipated to include, parking lots and access drives, a fire lane, sidewalks, and courtyards.

The conclusions and recommendations contained in this report are based on our understanding of the currently proposed utilization of the project site, as derived from written information and verbal information supplied to us. Consequently, as plans develop for the project, we may need to modify our conclusions and recommendations to reflect those changes.

3.0 EXPLORATORY METHODS

AMEC explored surface and subsurface conditions at the project in October 2013. The preliminary phase exploration and testing program comprised the following elements:

- A visual surface reconnaissance of the site;
- Twelve test pits (designated TP-1 through TP-12), excavated across the site;
- Laboratory testing of 4 grain-size distribution analyses, five No. 200 washes, and 9 moisture contents, performed on selected soil samples obtained from the test pits; and
- A review of published geology maps, explorations located in the vicinity from AMEC's archives and other relevant documents.

Figure 2 depicts the locations of the explorations. Appendix A describes our field exploration procedures and includes detailed logs of the explorations; Appendix B describes our laboratory testing procedures and presents the test results.

The specific number, locations, and depths of our explorations were selected by AMEC, relative to the existing, under the constraints of surface access, and budget. The locations and elevations of the explorations advanced during our preliminary phase were surveyed by the site surveyor. Consequently, the elevations and locations of the explorations should be considered accurate to the degree implied by the measuring methods.

It should be noted that the explorations performed and used for this evaluation reveal subsurface conditions only at discrete locations across the project site and that actual conditions in other locations could vary. Furthermore, the nature and extent of these variations would not become evident until additional explorations are performed or until construction activities have begun. If significant variations are observed, we may need to modify our conclusions and recommendations contained in this report to reflect the actual site conditions.

4.0 SITE CONDITIONS

The Pope Property is the proposed location for a new elementary school within the north Avondale area of Redmond, Washington. The following sections of text present our observations, measurements, findings, and interpretations regarding, surface, soil, groundwater, seismic, and environmental conditions at the project site.

4.1 Surface Conditions

The project site is located near the top of a regional north-south oriented upland, flanked to the west by the Sammamish River basin and to the east by the Bear Creek basin. Regional and general site topography slopes gently down to the east. The eastern half of the site has the majority of the topographic relief, while the west half of the site is relatively flat. Overall relief across the site was approximately 24 feet. A moderate sized, stockpile was noted within the east-central portion of the site which rose approximately 9 to 13 feet above surrounding grades. Also noted was a 50-foot long, 10 to 20 foot wide linear depression which was approximately 3 to 5 feet lower than the surrounding area located on the north-central end of the site that was truncated by NE 122nd Street.

The undeveloped site is vegetated with field grasses and berry vines in the open spaces within the central portion of the site, with large trees surrounding the perimeter and clustered within the central portion of the site. Previous development on the site was evidenced by the rows of ornamental trees within the northeastern portion of the site and several non-native evergreen trees located in the central portion of the site. Piles of cobbles were observed at the surface near the east-central portion of the site, presumably from former fields or pastures which likely had been plowed on a regular basis (based on subsurface information discussed in the subsurface condition section). Based on our historical documentation review and site reconnaissance, the current site topography had likely been altered by minor cutting and filling during site development to provide flat building pads for the residence and associated buildings.

4.2 Soil Conditions

According to published geologic maps, surficial geologic conditions in the site vicinity are characterized by Pleistocene Glacial Till deposits (Minard and Boothe; MF2016, 1988). The glacial till (commonly referred to as Vashon Glacial Till) is composed of a mixture of clay, silt, sand, and gravel that is characterized as a heterogeneous mix of sediment deposited beneath the advancing glacial ice mass. The sediment was subsequently overridden by the 3,000-foot thick ice mass, thereby over-consolidating the soils with the weight of the ice to densities ranging from dense to very dense. Thus, these materials possess relatively high shear strengths, low compressibility, and low permeability. Variations within the glacial till occur as a result of incorporation and re-working of pre-existing sediments by the advancing glacier and by stream action from meltwater streams emanating from the glacier.

4.2.1 Explorations

Our on-site explorations revealed generally uniform near-surface soil conditions across the site and confirmed the mapped surficial geology. In general, our explorations encountered a variable thickness of topsoil and forest duff mantling weathered glacial till which graded to dense glacial till. Each unit encountered is described in detail below:

- <u>Topsoil/forest duff:</u> Each of our explorations encountered a topsoil horizon or a forest duff mantling a topsoil horizon. The duff was comprised of primarily brown organic debris, leaf litter, and other vegetative matter in varying states of decay. Below the duff or root mat created by the field grasses and/or berry vines, topsoil comprised of brown fine silty sand with varying amounts of rootlets and organics was noted. The combined thickness of these layers was noted to range from 6-inches to 12-inches, with no general trend across the site noted.
- <u>Weathered Glacial Till:</u> Immediately below the surficial topsoil, silty fine to medium sand with some gravel was observed. This soil varied from loose to medium dense, from light brown to reddish brown and was typically rust mottled (iron-oxide staining). No distinct soil structure was noted within the upper 18 inches of the surface for the explorations in the northeastern quarter of the site, possibly due to disturbance by previous farming activities at the site. For the remaining portions of the site, the weathered glacial till was typically medium dense with a typical soil structure. Test pits TP-3 and TP-10 both encountered weathered glacial till which was comprised mostly of silt rather than sand.
- <u>Glacial Till:</u> All explorations encountered glacial till beneath the weathered glacial till, although TP-3 encountered a 1.5-foot thick interlayer of gravelly, fine to course sand, which was interpreted to represent a localized meltwater stream deposit. The glacial till was dense to very dense consisting of silty, fine to medium sand with some gravel, with some variability of the sand content noted within some of the explorations. Test pit TP-3 and TP-10 encountered glacial till which was noted to be comprised of hard, gray silt with variable sand content.

The exploration logs in Appendix A provide a detailed description of the soil strata encountered in our subsurface explorations. Table 2 summarizes the approximate thicknesses and depths of the soil layers.

4.2.2 Laboratory Testing

Our geotechnical laboratory tests (in Appendix B) revealed that the weathered glacial till soils have a fines (silt and clay) content of 19 to 33 percent and moisture content ranging from 7 to 25 percent. The fines content of the glacial till ranged from 20 to 41 percent with a moisture content ranging from 7 to 11 percent. The soils in Test Pits TP-3 and TP-10 were in exception, which encountered stiff to hard silt with some fine sand that had a silt content varying from 41 to 87 percent and moisture content from 23 to 25 percent. We interpret the weathered glacial till soils to be above their optimum moisture content for compaction, while the underlying glacial till appears to be slightly below or at its optimum moisture content for compaction. Both the weathered glacial till and glacial till are considered to be highly sensitive to changes in moisture content.

Laboratory testing results for resistivity, pH, chlorides, and sulphates are in Appendix B. The laboratory testing sheets presented in Appendix B graphically present our test results, and Table 3 summarizes these results.

Table 1 Soil Layer Thickness and Depth

Exploration ID	Thickness of Topsoil (feet)	Thickness of Weathered Glacial Till (feet)	Depth to Dense Glacial Till (feet)
TP-1	0.8	1.7	2.5
TP-2	0.8	1.7	5.0
TP-3	1.5	3.3	6.0
TP-4	0.5	2.5	3.0
TP-5	0.7	1.8	6.0
TP-6	0.8	2.2	3.0
TP-7	0.6	1.9	2.5
TP-8	1.0	2.0	3.0
TP-9	0.6	2.4	3.0
TP-10	0.8	1.7	2.5
TP-11	1.0	2.5	3.5
TP-12	0.6	1.9	2.5
B-1	0.0		

Elevation datum: Site topographic map provided by Bush, Roed, & Hitchings, Inc. dated 11/05/2013

Table 2 Laboratory Test Results

Soil Type	Moisture Content (percent)	Gravel Content (percent)	Sand Content (percent)	Silt/Clay Content (percent)
Weathered Till	7 – 25	24	43	19 – 33
Glacial Till	7 – 9	11 – 17	50 – 56	20 – 41

4.3 Groundwater Conditions

At the time of the explorations (October 2013), groundwater was not encountered within the termination depth of our test pits. However, iron oxide staining was observed within the weathered glacial till and at the contact with the glacial till in all our explorations, which likely is an indication of intermittent perched groundwater during the wetter periods of the year. A potential perched water table was noted within Test Pit TP-9 and TP-10 at depths of 13 and 8 feet, respectively as indicated by wet soils encountered at this depth.

Because our explorations have been performed in late fall after a long period of generally dry weather, the observed groundwater conditions are interpreted to represent conditions anticipated during dry weather. Limited amounts of perched groundwater seepage can be anticipated during wet periods of weather. Groundwater levels fluctuate in response to changing precipitation patterns, construction activities, and site utilization.

Our review of studies in the vicinity indicates that a regional aquifer is situated within Vashon advance outwash deposits. Regional groundwater has been measured approximately 105 feet bgs in nearby monitoring wells.

4.4 Environmental Conditions

Our research disclosed the presence of a residence formerly located within the central portion of the site (King County iMap, GIS information web page). The aerial image dated 1936 indicated at least four structures on the site, with an associated driveway and landscaping. A published topographic map originally dated 1950 and updated in 1963 then again in 1970 also indicate the presence of the structures. However, by 1998 the buildings had been removed as indicated in aerial photos from that time period. Based on our experience with similar sites, there is a high likelihood of the presence of one or more underground heating oil storage tanks and a septic tank and drain field in the vicinity of the buildings.

AMEC attempted to find underground storage tanks, without success, during a limited investigation using the sub-contracted excavator to pot-hole several locations in the approximate location of the buildings. A small concrete vault was encountered at the location indicated on Figure 2. The 3-foot by 4-foot vault appeared to be part of the septic system. A 4-inch diameter, perforated, flexible drain line was also encountered within TP-3 at a depth of approximately 2- feet. The pipe was bedded in pea gravel and appeared to be part of an abandoned french drain system and not part of a septic system. Should underground storage tanks be encountered, they would need to be removed in accordance with applicable local, state, and federal regulations. Additional monitoring during excavation to remove tanks and surrounding soils should be conducted under the guidance of a qualified environmental geologist or engineer.

4.5 Seismic Conditions

The soils beneath the site consist of dense to very dense silty sands with some gravel (Vashon Glacial Till) and dense to very dense sand and gravel (Advance Outwash). In accordance with 2012 *International Building Code*, we recommend using Site Class C, due to the density of the upper 100 feet of soil (based on geologic maps and our explorations). The soils are not likely to liquefy during an earthquake due to the depth of the groundwater and the density of the soils. Based on review of IBC maps and more detailed USGS hazard mapping[1], AMEC recommends using the following parameters:

- $S_S = 1.25g$ $S_{DS} = 0.84g$
- $S_1 = 0.48g$ $S_{D1} = 0.42g$

4.6 Critical Areas Assessment

A review of King County's critical areas mapping[2] indicated the site was not indicated to have any critical areas related to geologic conditions. However, the southwestern portion of the site falls within the Bear Creek basin which is mapped as having a "high" basin condition. The remainder of the site falls within the Sammamish River basin which is classified as having a "low" basin condition. The designation as a "high" basin condition may impact site clearing and/or stormwater design standards.

Our reconnaissance of the site with respect to critical areas was performed during our field exploration program. AMEC evaluated the existing site conditions and the potential impact of the proposed improvements on the site. Our reconnaissance disclosed gently sloping topography with no steep slopes on site or in the immediate vicinity of the site. No surface water or drainage channels were noted. It did not appear that any wetlands were present however; this assumption is based only on a visual reconnaissance and a wetland determination was not part of our scope of work. Based on the gentle topography across the site, development of the site with an elementary school is not anticipated to negatively impact the site or neighboring properties. As there is no geotechnical-related

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[1] http://earthquake.usgs.gov/hazards/designmaps/buildings.php
[2] http://www.kingcounty.gov/operations/GIS/Maps/iMAP.aspx

critical areas on site, layout of the school will not require accommodating critical area setbacks or buffers.

4.7 Stormwater Infiltration Assessment

Based upon our explorations, laboratory testing, and subsurface conditions, stormwater infiltration at the site does not appear favorable. Grain size analyses of samples of the subsurface soils obtained from across the site indicated a relatively high percentage of fines (20 to 41 percent) within the weathered glacial till and underlying glacial till soils. The high fines content and the high density of the glacial deposits results in a very slow infiltration rate which is typically not conducive to infiltration of the site surface water runoff.

5.0 RECOMMENDATIONS

The following text sections of this report present our preliminary geotechnical conclusions and recommendations for, site preparation, foundations, floors, walls, utilities, pavements, and structural fill. American Society for Testing and Materials (ASTM) specification codes cited herein refer to the current ASTM manual. Washington State Department of Transportation (WSDOT) specification codes and plan designations cited herein refer to current WSDOT publications M41-10, *Standard Specifications for Road, Bridge, and Municipal Construction*.

5.1 Site Preparation

Preparation of the project site will include; clearing, stripping, grading, and subgrade compaction. The paragraphs below discuss our geotechnical comments and recommendations concerning site preparation.

Clearing and Stripping: After temporary erosion and sediment control features have been installed, the construction areas should be cleared and stripped of all vegetation, sod, topsoil, debris, asphalt, and concrete. Our explorations disclosed between 6 inches and 12 inches of sod/topsoil, but variations could exist. Furthermore, it should be noted that if the stripping operation proceeds during wet weather, a generally greater stripping depth might be necessary to remove disturbed moisture-sensitive soils; therefore, stripping is best performed during a period of dry weather. Where trees are to be removed, the entire root ball should be removed and then backfilled with compacted structural fill.

Subgrade Compaction: Exposed subgrades for footings, floors, pavements, other structures, and over-excavations should be compacted to a dense, unyielding state. Any organic, soft, or pumping soils observed within a subgrade should be overexcavated and replaced with a suitable structural fill.

On-Site Soils: We offer the following evaluation of the on-site soils relative to potential use as structural fill.

- *Surficial Organic Soils*: The sod, duff, topsoil, and organic-rich soils mantling most of the site are *not* suitable for use as structural fill under any circumstances, due to their long-term compressibility. Consequently, these materials can be used only for non-structural purposes, such as in landscaping areas. For planning purposes, based on our initial explorations across the site, we recommend assuming an average of 8-inches of topsoil stripping will be required across the site.
- *Uncontrolled Fill*: Although not encountered during our exploration program, the site history indicates there is a possibility of encountering uncontrolled fill soils within the central portion of the site. Any uncontrolled fill soils should be evaluated prior to reuse. Under no circumstances should fill soils containing refuse, significant organic debris or other deleterious materials be used as structural fill.
- *Weathered Glacial Till and Glacial Till*: The weathered glacial till soils underlying the site were generally above their optimum moisture content, while the underlying glacial till soils were near or at their optimum moisture content. As the fines content of both of these soils were relatively high, both are considered moisture sensitive. The soils would be difficult to reuse as structural fill except under ideal moisture and weather conditions and could require aerating in order to reduce the moisture content to acceptable levels for use as structural fill. To maximize the potential reuse of on-site soils, earthwork should be scheduled for the dry season. Additionally, the contractor should be prepared to moisture condition on-site soils to attain their optimum moisture content.

Wet-Weather Considerations: As discussed above, the on-site soils will be difficult to reuse as structural fill during wet weather. Consequently, the project specifications should include provisions for using imported, clean, granular fill in case site filling must proceed during wet weather. For general structural fill purposes, we recommend using a well-graded sand and gravel, such as “Ballast” or “Gravel Borrow” per WSDOT 9-03.9(1) and 9-03.14, respectively, except that the percent passing the U.S. No. 200 Sieve should be less than 5 percent.

Permanent Slopes: All permanent cut slopes and fill slopes should be adequately inclined to minimize long-term raveling, sloughing, and erosion. We generally recommend that no slopes be steeper than 2H:1V. For all soil types, the use of flatter slopes (such as 3H:1V) would further reduce long-term erosion and facilitate revegetation.

5.2 Spread Footings

Medium dense, undisturbed weathered glacial till was found to be present under the most of the project site and would support moderate foundations. High foundation loads could be supported on the very dense, glacial till at slightly deeper depths.

Bearing Subgrades: The native, undisturbed medium-dense to very dense silty sand and sandy silt soils underlying the majority of the site are suitable for supporting spread footings. The depth to a suitable bearing soil varies somewhat across the site, with the depth generally greatest in the east-central portion of the site where previous farming activities disturbed the upper 18- to 24-inches of the subsurface soils

Footing Depths and Widths: For frost and erosion protection, the bottoms of all exterior footings should bear at least 18 inches below adjacent outside grades, whereas the bottoms of interior footings need bear only 12 inches below the surrounding slab surface level. To minimize post-construction settlements, continuous (wall) and isolated (column) footings should be at least 18- and 24-inches wide, respectively.

Bearing Capacities: AMEC recommends that building footings bearing on structural fill or medium-dense weathered till be designed for a static soil bearing pressure of 2,500 psf. For building footings founded on the native very dense glacial till, a static soil bearing pressure of 5,000 psf may be used. If higher capacities are required, a specific design for those footing locations could be performed. For seismic design, the above bearing pressures may be increased by one-third.

Footing Settlements: We estimate that total post-construction settlements of properly designed footings bearing on properly prepared subgrades will not exceed 1 inch. Differential settlements could approach one-half of the actual total settlement between adjacent footings. Settlements will be less if the actual bearing pressures are lower than our recommended maximum pressures.

Footing and Stemwall Backfill: To provide erosion protection and lateral load resistance, we recommend all footing excavations be backfilled on both sides of the footings and stemwalls after the concrete has cured. The excavations should be backfilled with structural fill and compacted to a density of at least 90 percent (based on ASTM D-1557).

Lateral Resistance: Footings and stemwalls that have been properly backfilled as described above will resist lateral movements by means of passive earth pressure and base friction. We recommend using the following design values, which incorporate static and seismic safety factors of at least 1.5 and 1.1, respectively. Base friction can be combined with the respective passive pressure to resist static and seismic loads.

Design Parameter	Allowable Value
Static Passive Pressure	300 pcf
Seismic Passive Pressure	400 pcf
Base Friction Coefficient	0.4

Note: pcf = pounds per cubic foot

5.3 Slab-on-Grade Floors

In our opinion, soil-supported slab-on-grade floors can be used in the proposed buildings if the subgrades are properly prepared. We offer the following comments and recommendations concerning this floor type.

Floor Subgrade: All soil-supported slab-on-grade floors should bear the medium dense, weathered glacial till or structural fill within the footprint of the building. The condition of subgrade soils should be evaluated by an AMEC representative prior to placement of the capillary break material to identify any loose soil conditions that may require additional remedial repairs to provide a suitable slab subgrade.

Capillary Break: To reduce the upward wicking of groundwater beneath the floor slab, we recommend a capillary break be placed over the subbase. This capillary break should consist of a 4-inch thick layer of pea gravel or other clean, uniform gravel, such as 〝Gravel Backfill for Drains〞 per WSDOT Standard Specification 9-03.12(4).

Vapor Barrier: We recommend a vapor barrier at least 10-mils thick (such as those manufactured by Stego Industries, W.R. Meadows, or Alumiseal) be placed directly between the capillary break and the floor slab to prevent moisture from migrating upward through the slab.

Vertical Deflections: Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. In our opinion, a subgrade reaction modulus of 200 pounds per cubic inch can be used to estimate these deflections.

5.4 Drainage Systems

The school buildings should be provided with permanent drainage systems to minimize the risk of future moisture problems. We offer the following recommendations and comments for drainage design and construction purposes.

Perimeter Drains: We recommend each building be encircled with a perimeter drain system to collect possible seepage water. This drain should consist of a 4-inch diameter perforated PVC pipe within an envelope of pea gravel or washed rock, extending at least 6 inches on all sides of the pipe, and the gravel envelope should be wrapped with filter fabric to reduce the migration of fines from the surrounding soils. Ideally, the drain invert would be installed no more than 4 inches above or below the base of the perimeter footings.

Runoff Water: Roof-runoff and surface-runoff water should *not* be allowed to flow into the foundation drainage systems. Instead, these sources should flow into separate tightline pipes and be routed away from the buildings to an appropriate location. In addition, final site grades should slope downward away from each building so that runoff water will flow by gravity to suitable collection points, rather than ponding near the buildings. Ideally, the area surrounding the buildings would be capped with concrete, asphalt, or low-permeability (silty) soils to minimize or preclude surface-water infiltration.

5.5 Backfilled Walls

Although we are not aware of any proposed retaining walls, we offer the following recommendations for relatively short walls. Underground vaults should also be designed as backfilled walls. Our backfilled wall design recommendations and comments are presented below.

Footing Depths: For frost and erosion protection, all backfilled retaining wall footings should bear at least 18 inches below the adjacent ground surface. However, greater depths might be necessary to develop adequate passive resistance and/or bearing resistance in certain cases.

Curtain Drains: To preclude hydrostatic pressure development behind the backfilled retaining wall, we recommend a curtain drain be placed behind the entire wall. This curtain drain should consist of pea gravel, washed rock, or some other clean, uniform, well-rounded gravel, extending outward a minimum of 2 feet from the wall and extending upward from the footing drain to within about 12 inches of the ground surface. For walls that do not include a footing drain, we recommend a 4-inch diameter perforated drain pipe be installed behind the heel of the wall.

Backfill Soil: Ideally, all retaining wall backfill placed behind the curtain drain would consist of clean, free-draining, granular material, such as “Gravel Backfill for Walls” per WSDOT Standard Specification 9-03.12(2). Alternatively, on-site granular soils could be used as backfill if they are placed at a moisture content near optimum. If silty soils are used as backfill, a geotextile should be placed between the curtain drain and the backfill soil, to prevent drain clogging.

Backfill Compaction: Because soil compactors place significant lateral pressures on retaining walls, we recommend only small, hand-operated compaction equipment be used within 3 feet of a backfilled wall. In addition, all backfill should be compacted to a density between 90 and 95 percent of the maximum dry density (based on ASTM D-1557); a greater degree of compaction closely behind the wall would increase the lateral earth pressure, whereas a lesser degree of compaction might lead to excessive post-construction settlements.

Applied Loads: Overturning and sliding loads applied to retaining walls can be classified as static earth pressures, surcharge pressures, and hydrostatic pressures. We offer the following specific values for design purposes.

- *Static Earth Pressures*: Yielding (cantilever) retaining walls should be designed to withstand an appropriate active lateral earth pressure, whereas non-yielding (restrained) walls should be designed to withstand an appropriate at-rest lateral earth pressure. These pressures act over the entire back of the wall and vary with the backslope inclination. Assuming a level backslope, we recommend using active and at-rest pressures of 35 pcf and 55 pcf, respectively.
- *Surcharge Pressures*: Static lateral earth pressures acting on a retaining wall should be increased to account for surcharge loadings resulting from any traffic, construction equipment, material stockpiles, or structures located within a horizontal distance equal to the wall height. For simplicity, a traffic surcharge can be modeled as a uniform horizontal pressure of 75 psf acting against the upper 6 feet of wall.

Resisting Forces: Static pressures, surcharge pressures, and hydrostatic pressures are resisted by a combination of passive lateral earth pressure, base friction, and subgrade bearing capacity. Passive pressure acts over the embedded front of the wall (neglecting the upper 1 foot for paved foreslopes, or the upper 2 feet for soil foreslopes), whereas base friction and bearing capacity act along the bottom of the footings. Assuming a level foreslope at the wall location, we recommend the following design values, which incorporate static and seismic safety factors of at least 1.5 and 1.1, respectively. Base friction can be combined with the respective passive pressure to resist static and seismic loads.

Design Parameter	**Allowable Value**
Static Passive Pressure	300 pcf
Seismic Passive Pressure	400 pcf
Base Friction Coefficient	0.4
Static Bearing Capacity	2,500 psf
Seismic Bearing Capacity	3,300 psf

5.6 Underground Utilities

Underground utilities such as waterlines, storm drains, sewer pipes, manholes, and catch basins will be included in the site development. Our comments and recommendations concerning the installation of these utilities are presented below.

Temporary Slopes: Configuration and maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. All applicable local, state, and federal safety codes should be followed. Temporary excavation should either be shored or sloped in accordance with *Safety Standards for Construction Work,* Part N, WAC 296-155-650 through 66411. Appropriate inclinations will ultimately depend on the actual soil conditions exposed during earthwork. For planning purposes, the soil type classification and maximum inclination based on Part N of the *Safety Standards for Construction Work*, WAC 296-155-66401 and 66403 is provided below.

Soil Type	**WAC Soil Type**	**Maximum Inclination**
Existing Fill	C	1.5H:1V
Glacial Till	A	0.75H:1V

Bedding Soils: Utility pipes should be bedded on an appropriate material that extends at least 6 inches outward from the pipe in all directions. For level or gently sloping pipes, we recommend using a clean, uniform, well-rounded material such as pea gravel or “Gravel Backfill for Pipe Bedding” per WSDOT 9-03.12(3).

Backfill Soils: The on-site soils are moisture sensitive and will be difficult to use as utility excavation backfill. During the wet season or during rainy periods, all backfill material used for utility trenches and other excavations will probably need to consist of well-graded granular soils such as “Gravel Borrow” per WSDOT 9-03.14.

Backfill Compaction: We recommend utility backfill soils be compacted to a density commensurate with surrounding fill or native soils, as well as with the requirements of any overlying structures.

5.7 Asphalt Pavements

Asphalt pavements will be used for new car-parking areas, bus driveways and service roads. The following comments and recommendations are given for pavement design and construction purposes.

Subgrade Preparation: All pavement subgrades should be proof-rolled with a loaded dump truck or heavy compactor to verify the density. Any areas of yielding subgrade disclosed during this proof-rolling operation should be overexcavated and replaced with a suitable structural fill material. The upper 2 feet of fill placed under the pavement section should be compacted to at least 95 percent, and all fill placed below 2 feet should be compacted to at least 90 percent (based on ASTM D-1557).

Soil Design Values: Soil conditions can be defined by a California Bearing Ratio (CBR), which quantitatively predicts the effects of wheel loads imposed on a saturated subgrade. Based on our classifications of on-site soils and our previous laboratory testing performed on similar soils, we estimate that the near-surface soils will provide a CBR value of at least 15 percent.

Pavement Sections: Since design hasn't started, the traffic volumes and location of pavement hasn't been determined. Detailed pavement design will be needed for final design. This report provides typical sections that have been used on previous elementary school projects. A conventional pavement section typically comprises a hot mix asphalt (HMA) pavement over a crushed rock base (CRB) course, over a gravel subbase (GSB).

	(Minimum Thickness)	
Conventional Pavement Course	**Car Only Areas**	**Heavy Vehicle Driveways**
HMA	3 inches	4 inches
CRB	4 inches	6 inches

Alternative Pavement Section: A layer of asphalt-treated base (ATB) can be used to create a temporary driving surface, and to reduce the final thickness of the HMA and CRB. Alternate surfacing options such as concrete or porous pavement may also be considered. Specific recommendations for these options can be provided during final design.

Pavement Materials: We recommend 3/8 inch HMA for the top asphalt layer. For the base course, we recommend using imported clean, crushed rock, such as "Crushed Surfacing Top and Base Course" per WSDOT 9-03.9(3). The gravel subbase should consist of imported structural fill, such as "Gravel Borrow" per WSDOT 9-03.14. ATB could be used in place of some of the CRB for a temporary construction road surface, in which case the ATB should be inspected and repaired as needed prior to placing the final HMA.

Compaction and Verification: Structural fill used to achieve subgrade, subbase material and base course material should be compacted to at least 95 percent of the Modified Proctor maximum dry density (ASTM D-1557), and all asphalt concrete should be compacted to at least 92 percent of the Rice value (ASTM D-2041). We recommend an AMEC representative be retained to verify the compaction of the base course before any overlying layer is placed. For the subgrade and subbase, compaction is best verified by means of frequent density testing; for the base course, methodology observations and hand-probing are more appropriate than density testing.

5.8 Structural Fill

The term “structural fill” refers to any materials used for building pads, as well as materials placed under foundations, slab-on-grade floors, sidewalks, pavements, under and behind retaining walls, and other features. Our comments, conclusions, and recommendations concerning structural fill are presented in the following paragraphs.

Materials: Typical structural fill materials include well-graded mixtures of sand and gravel (commonly called “gravel borrow” or “pit-run”), crushed rock, quarry spalls, CDF, lean-mix concrete, and for some applications, mixtures of silt, sand, and gravel. Recycled concrete, crushed to a suitable size, is also potentially useful as structural fill in certain applications. Soils used for structural fill should not contain any organic matter or debris, or any individual particles greater than approximately 6 inches in diameter.

Fill Placement: Structural fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness, and each lift should be thoroughly compacted with a mechanical vibratory compactor. Other procedures may be appropriate for some materials.

Compaction Criteria: Using the Modified Proctor test (ASTM D1557) as the standard, we recommend structural fill be used for various on-site applications and compacted to the following minimum densities:

Fill Application	Minimum Compaction
Footing subgrade	95 percent
Footing and stemwall backfill	90 percent
Slab-on-grade floor subgrade and subbase	90 percent
Retaining wall subgrade	95 percent
Retaining wall backfill	90 percent
Concrete sidewalk subgrade	90 percent
Asphalt pavement subgrade (upper 2 feet)	95 percent
Utility trench backfill	90 percent
General site filling	90 percent

Subgrade Verification and Compaction Testing: All structural fill should be placed over dense, unyielding subgrades prepared in accordance with the Site Preparation section of this report. The condition of all subgrades should be verified by an AMEC representative before filling or construction begins. In addition, fill soil compaction should be verified by means of in-place density tests performed during fill placement so the adequacy of the soil compaction efforts may be evaluated as earthwork progresses.

Soil Moisture Considerations: The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the “fines” content (the soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum. For fill placement during wet-weather site work, we recommend using “clean” fill, which refers to soils that have a fines content of 5 percent or less (by weight) based on the soil fraction passing the U.S. No. 4 Sieve.

6.0 RECOMMENDED ADDITIONAL SERVICES

After the specific locations, architectural layouts, and primary structural details of the buildings and associated structures and their locations have been established, we should perform a design-phase geotechnical evaluation. This type of evaluation may include advancing additional borings within the specific building footprint, conducting laboratory tests, performing geotechnical engineering analyses, and preparing a *Geotechnical Engineering Report.* Once this information is available and have reviewed the design, we will submit a proposal for providing the design phase study.

7.0 CLOSURE

The preliminary conclusions and recommendations presented in this report are based, in part, on the explorations AMEC performed and used for this study; therefore, if variations in the subgrade conditions are observed at a later time, we may need to modify this report to reflect those changes.

We appreciate the opportunity to be of service on this project. If you have any questions regarding this report, or any aspects of the project, please feel free to contact our office.

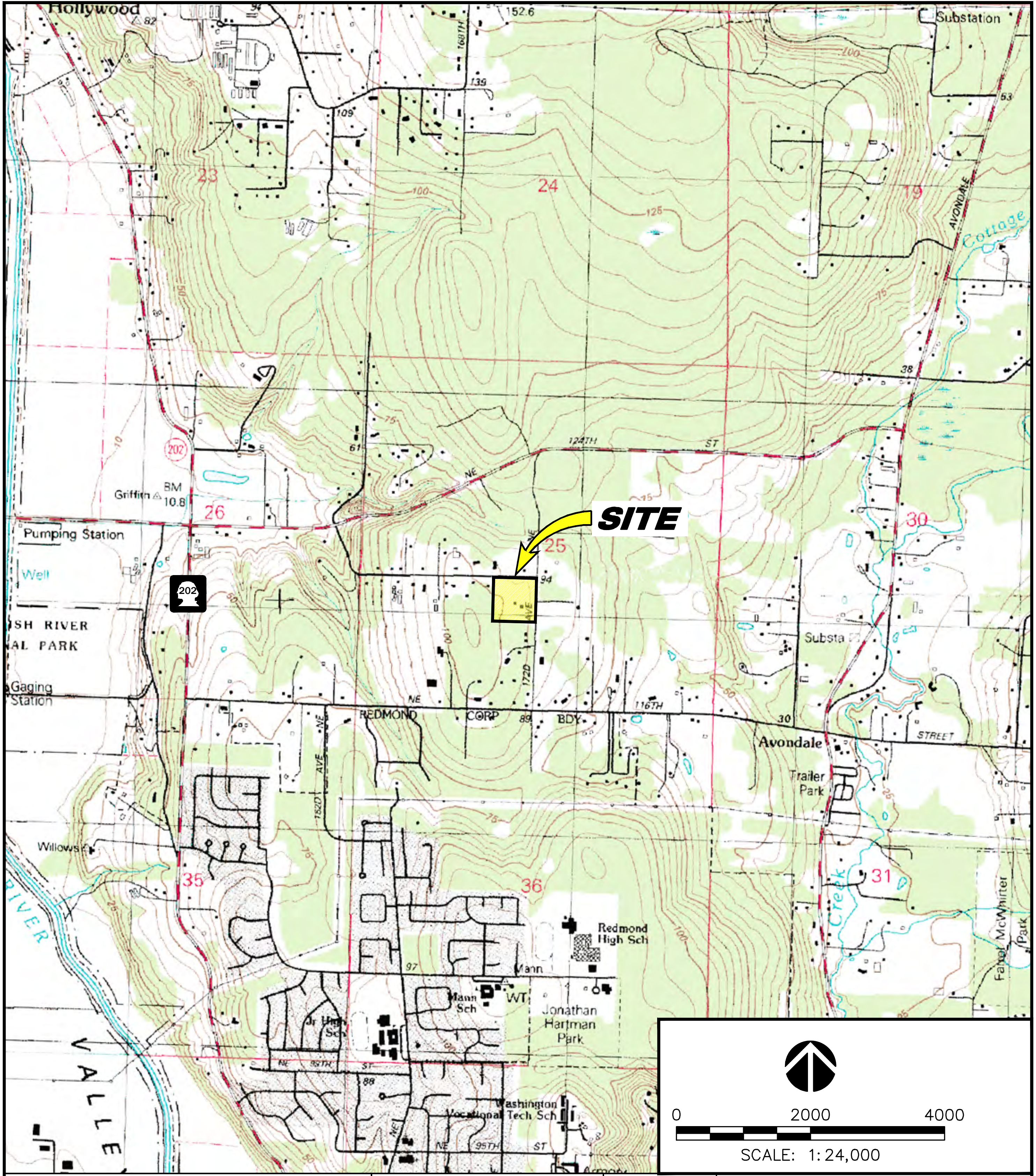
Sincerely,

AMEC Environment & Infrastructure, Inc.

William J. Lockard, L.E.G.	Todd D. Wentworth, P.E., L.G.
Senior Geologist	Associate

FIGURES

Attachment 15



AMEC Environment & Infrastructure
11810 North Creek Parkway North
Bothell, WA, U.S.A. 98011-8201

CLIENT LOGO

CLIENT

PROJECT: POPE PROPERTY, NEW ELEMENTARY SCHOOL

DWN BY: JRS

DATUM: NAD83

DATE: NOVEMBER 2013

TITLE: SITE LOCATION MAP

CHK'D BY: WJL

REV. NO.:

PROJECT NO: 3-917-17668-0

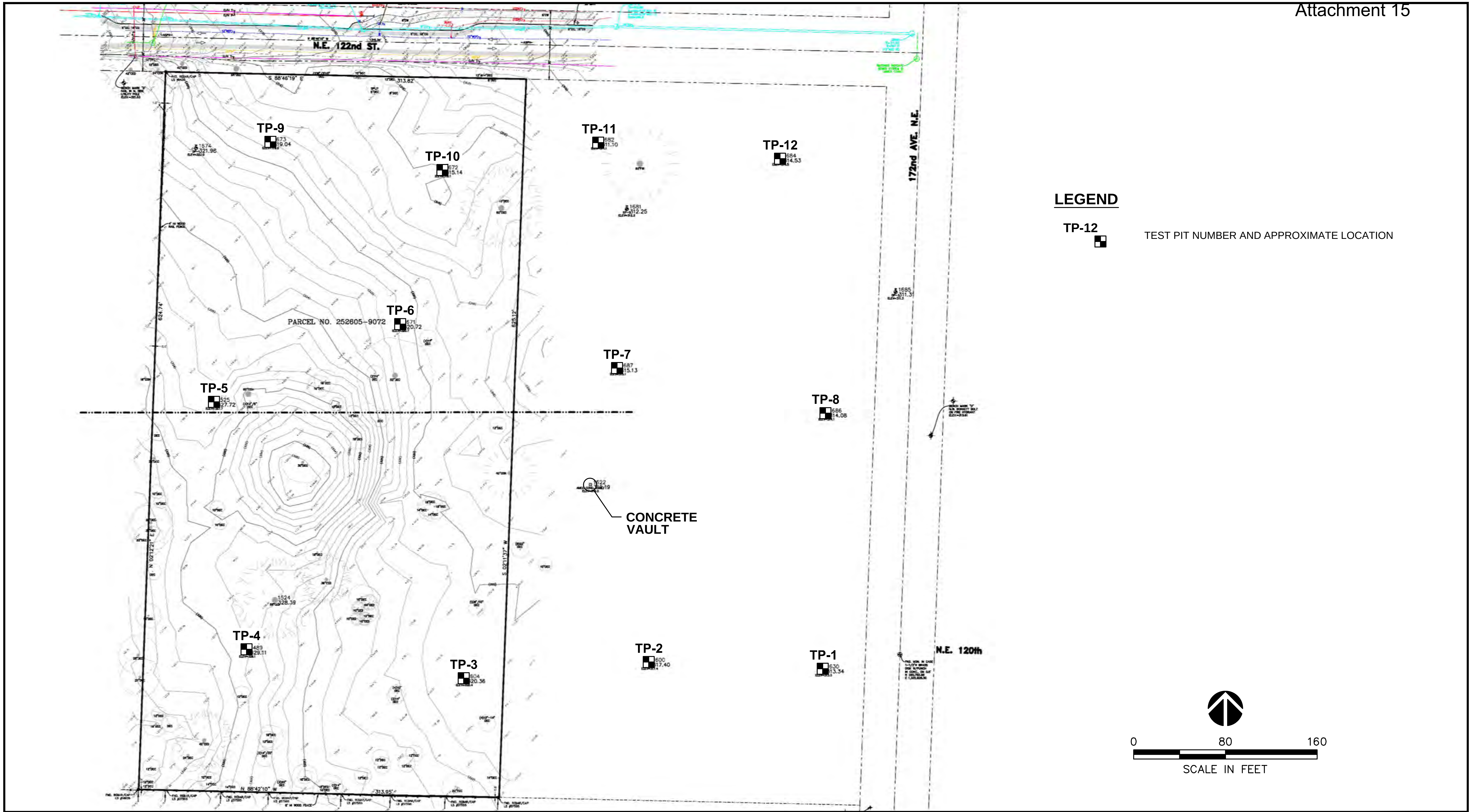
PROJECTION: WA STATE PLANE

SCALE: AS SHOWN

FIGURE No. 1

C:\Users\jeffrey.sanders\appdata\local\temp\AcPublish_924\17668-01.dwg - SITE PLAN - Nov. 14, 2013 9:05am - jeffrey.sanders

Attachment 15



LEGEND

TP-12 ▨	TEST PIT NUMBER AND APPROXIMATE LOCATION

CLIENT LOGO	CLIENT:	DWN BY: JRS	PROJECT POPE PROPERTY NEW ELEMENTARY SCHOOL	DATE: NOVEMBER 2013
		CHK'D BY: WJL		PROJECT NO: 3-917-17668-0
	AMEC Environment & Infrastructure 11810 North Creek Parkway North Bothell, WA, U.S.A. 98011-8201	DATUM:	TITLE SITE AND EXPLORATION PLAN	REV. NO.:
		PROJECTION:		FIGURE No. 2
		SCALE: AS SHOWN		

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Attachment 15

APPENDIX A

Field Exploration Procedures and Logs

APPENDIX A
FIELD EXPLORATION PROCEDURES AND LOGS
3-917-17668-0

The following paragraphs describe our procedures associated with the field explorations and field tests AMEC Environment & Infrastructure, Inc. (AMEC), conducted for this project. Descriptive logs of our explorations are enclosed in this appendix.

Test Pit Procedures

Our exploratory test pits were excavated with a rubber-tired backhoe operated by an independent firm working under subcontract to AMEC. A geologist from AMEC continuously observed the test pit excavations, logged the subsurface conditions, and obtained representative soil samples. All samples were stored in watertight containers and later transported to our laboratory for further visual examination and testing. After we logged each test pit, the hoe operator backfilled it with excavated soils and tamped the surface.

The enclosed Test Pit Logs indicate the vertical sequence of soils and materials encountered in each test pit, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradational or undulating, our logs indicate the average contact depth. We estimated the relative density and consistency of the in-situ soils by means of the excavation characteristics and the stability of the test pit sidewalls. Our logs also indicate the approximate depths of any sidewall caving or groundwater seepage observed in the test pits, as well as all sample numbers and sampling locations.

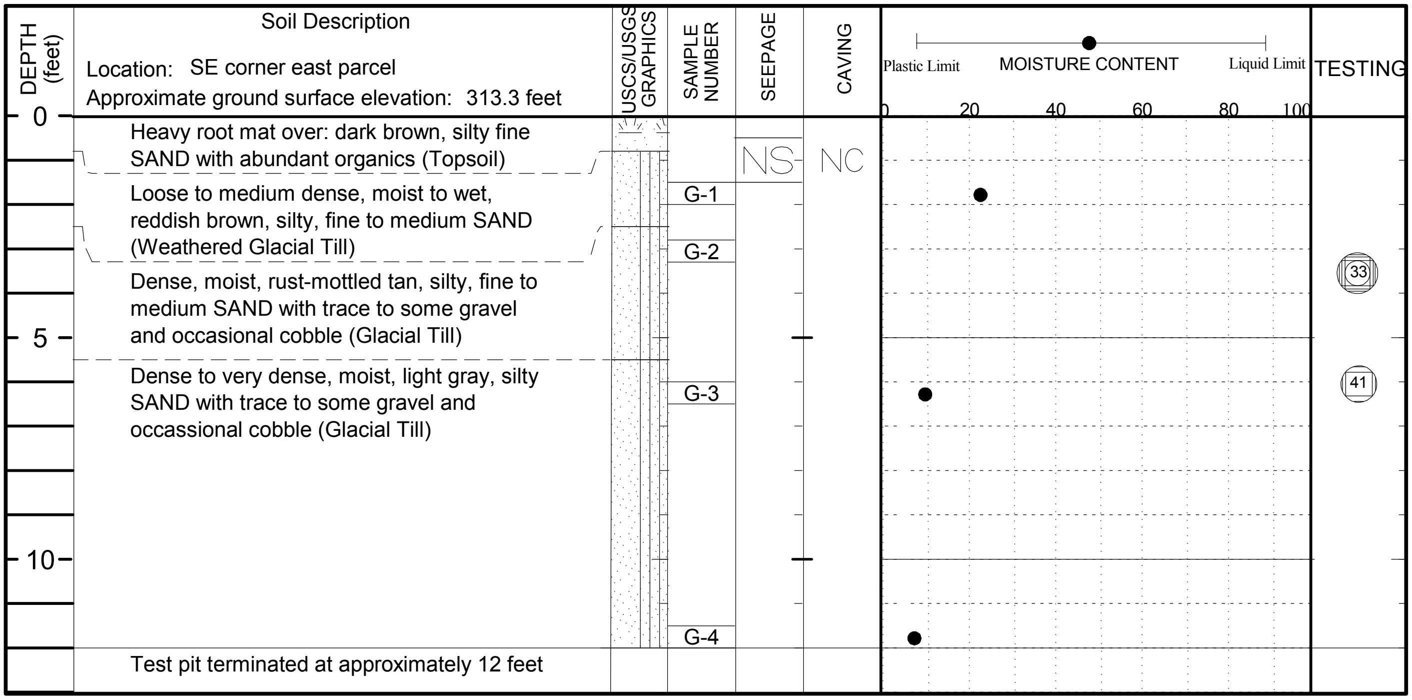
Attachment 15

Test Pit No.: TP-01

Soil Description

Location: SE corner east parcel

Approximate ground surface elevation: 313.3 feet



Heavy root mat over: dark brown, silty fine SAND with abundant organics (Topsoil)

Loose to medium dense, moist to wet, reddish brown, silty, fine to medium SAND (Weathered Glacial Till)

Dense, moist, rust-mottled tan, silty, fine to medium SAND with trace to some gravel and occasional cobble (Glacial Till)

Dense to very dense, moist, light gray, silty SAND with trace to some gravel and occassional cobble (Glacial Till)

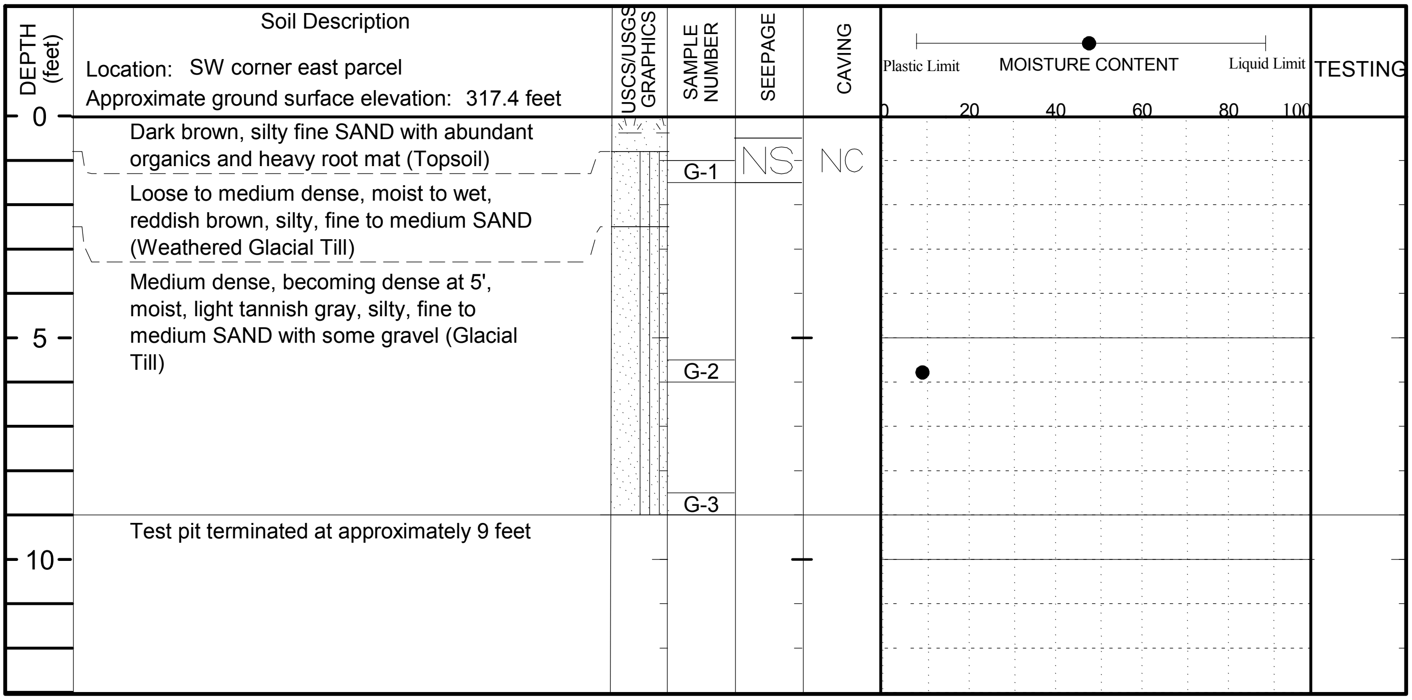
Test pit terminated at approximately 12 feet

Test Pit No.: TP-02

Soil Description

Location: SW corner east parcel

Approximate ground surface elevation: 317.4 feet



Dark brown, silty fine SAND with abundant organics and heavy root mat (Topsoil)

Loose to medium dense, moist to wet, reddish brown, silty, fine to medium SAND (Weathered Glacial Till)

Medium dense, becoming dense at 5', moist, light tannish gray, silty, fine to medium SAND with some gravel (Glacial Till)

Test pit terminated at approximately 9 feet

LEGEND

NS no seepage observed

NC no caving observed

▢ 200 Wash (% fines shown)

◎ Grain Size Analysis (% fines shown)

Excavation Method: Trackhoe

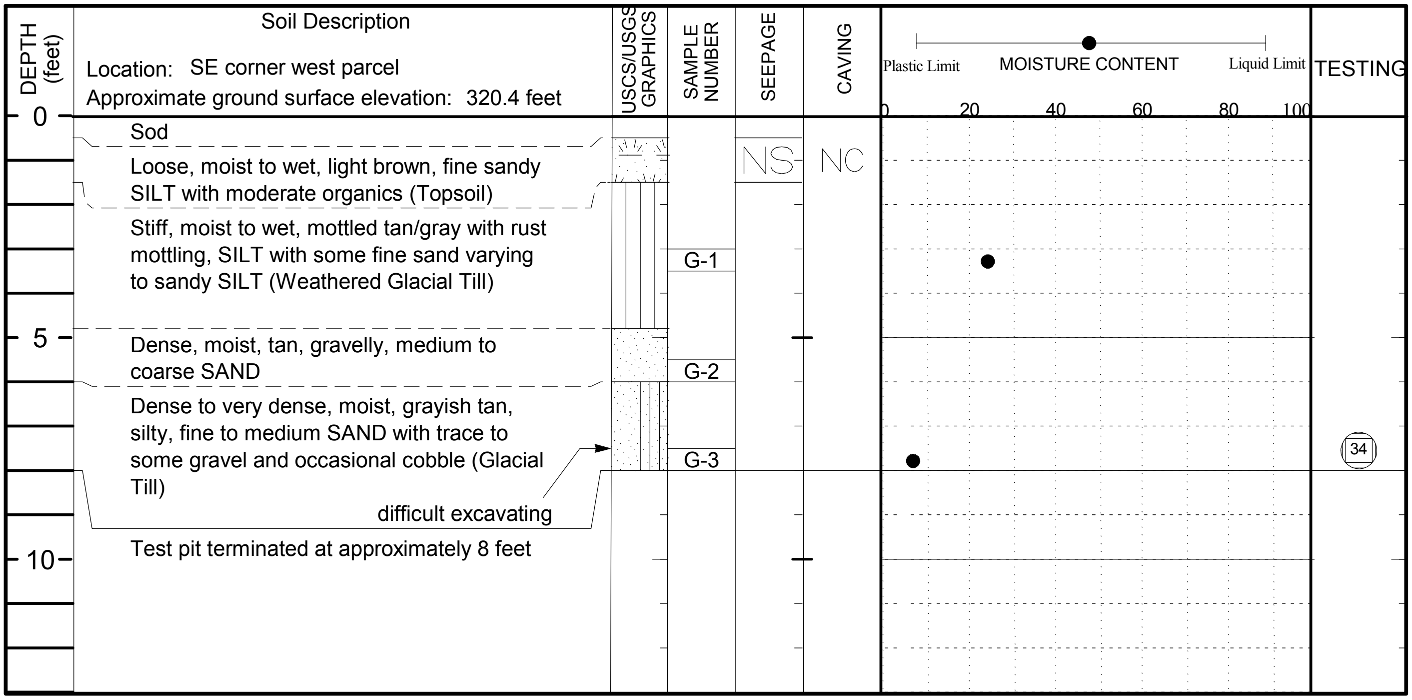
Date Excavated: *October 23, 2013*

Logged By: *WJL*

amec

11810 North Creek Parkway N
Bothell, Washington 98011

Test Pit No.: TP-03



Soil Description

Location: SE corner west parcel

Approximate ground surface elevation: 320.4 feet

Sod

Loose, moist to wet, light brown, fine sandy SILT with moderate organics (Topsoil)

Stiff, moist to wet, mottled tan/gray with rust mottling, SILT with some fine sand varying to sandy SILT (Weathered Glacial Till)

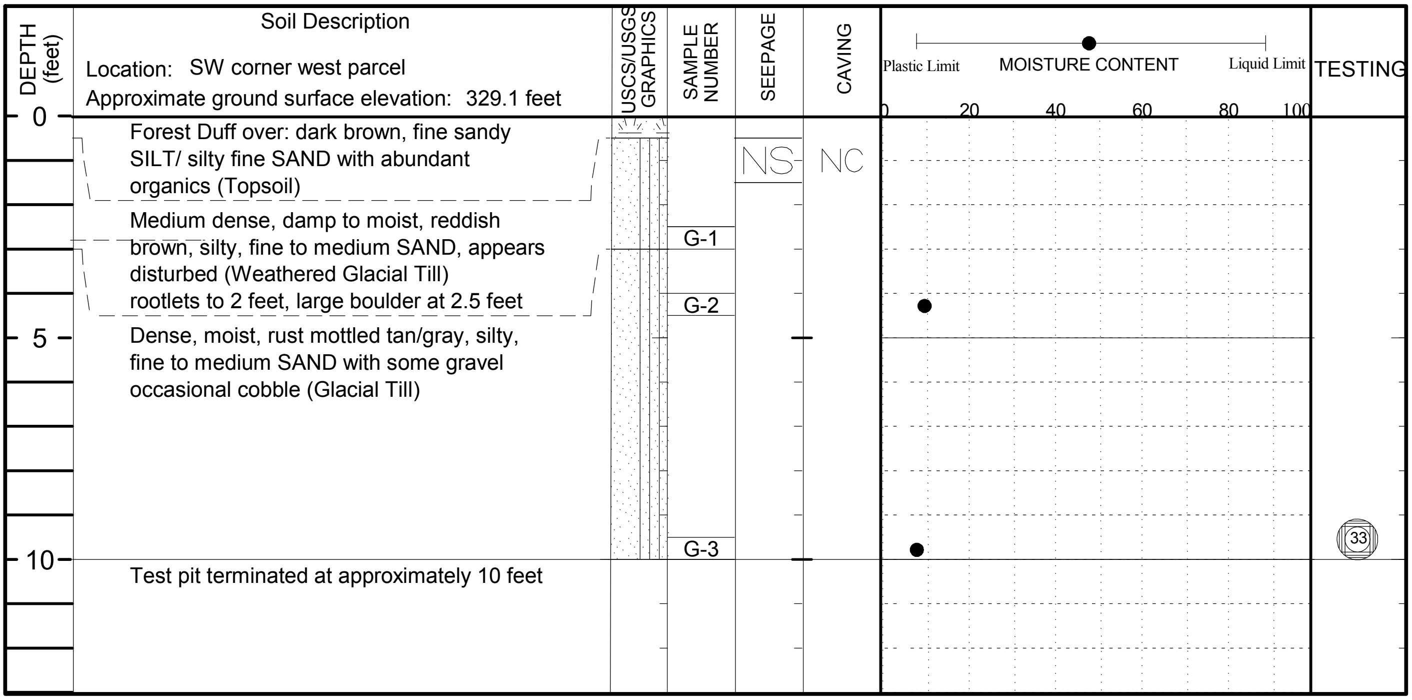
Dense, moist, tan, gravelly, medium to coarse SAND

Dense to very dense, moist, grayish tan, silty, fine to medium SAND with trace to some gravel and occasional cobble (Glacial Till)

difficult excavating

Test pit terminated at approximately 8 feet

Test Pit No.: TP-04



Soil Description

Location: SW corner west parcel

Approximate ground surface elevation: 329.1 feet

Forest Duff over: dark brown, fine sandy SILT/ silty fine SAND with abundant organics (Topsoil)

Medium dense, damp to moist, reddish brown, silty, fine to medium SAND, appears disturbed (Weathered Glacial Till) rootlets to 2 feet, large boulder at 2.5 feet

Dense, moist, rust mottled tan/gray, silty, fine to medium SAND with some gravel occasional cobble (Glacial Till)

Test pit terminated at approximately 10 feet

LEGEND

NS	no seepage observed
NC	no caving observed
▢	200 Wash (% fines shown)
◎	Grain Size Analysis (% fines shown)

Excavation Method: Trackhoe

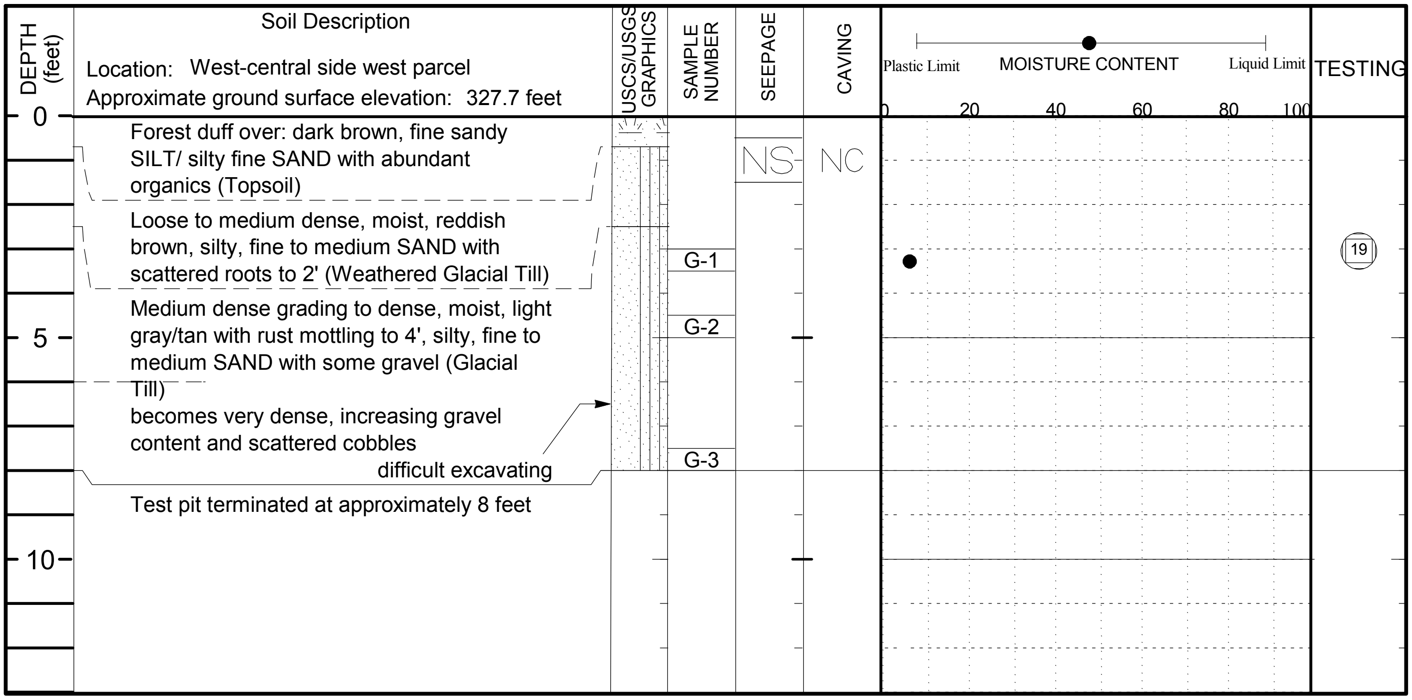
Date Excavated: *October 23, 2013*

Logged By: *WJL*

11810 North Creek Parkway N
Bothell, Washington 98011

Test Pit No.: TP-05

Location: West-central side west parcel
Approximate ground surface elevation: 327.7 feet



Forest duff over: dark brown, fine sandy SILT/ silty fine SAND with abundant organics (Topsoil)

Loose to medium dense, moist, reddish brown, silty, fine to medium SAND with scattered roots to 2' (Weathered Glacial Till)

Medium dense grading to dense, moist, light gray/tan with rust mottling to 4', silty, fine to medium SAND with some gravel (Glacial Till)

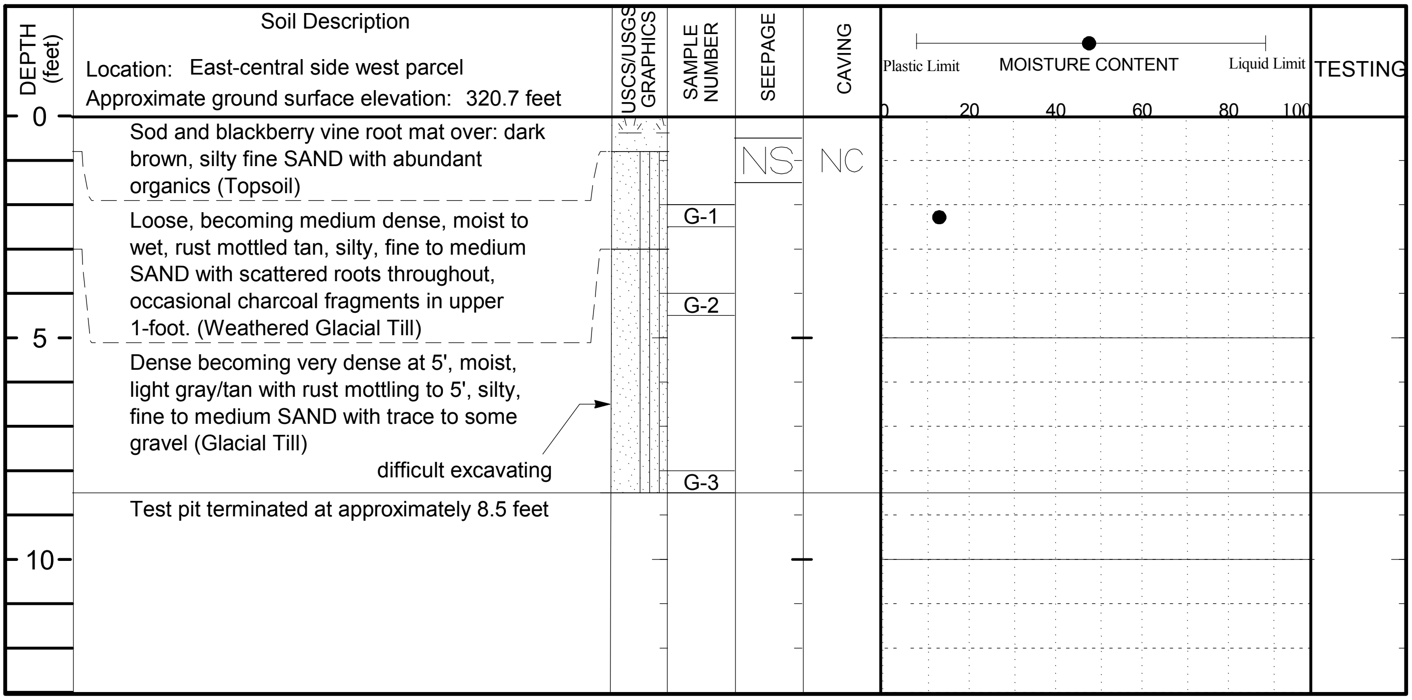
becomes very dense, increasing gravel content and scattered cobbles

difficult excavating

Test pit terminated at approximately 8 feet

Test Pit No.: TP-06

Location: East-central side west parcel
Approximate ground surface elevation: 320.7 feet



Sod and blackberry vine root mat over: dark brown, silty fine SAND with abundant organics (Topsoil)

Loose, becoming medium dense, moist to wet, rust mottled tan, silty, fine to medium SAND with scattered roots throughout, occasional charcoal fragments in upper 1-foot. (Weathered Glacial Till)

Dense becoming very dense at 5', moist, light gray/tan with rust mottling to 5', silty, fine to medium SAND with trace to some gravel (Glacial Till)

difficult excavating

Test pit terminated at approximately 8.5 feet

LEGEND

NS no seepage observed
NC no caving observed
200 Wash (% fines shown)
Grain Size Analysis (% fines shown)

Excavation Method: Trackhoe

Date Excavated: *October 23, 2013*

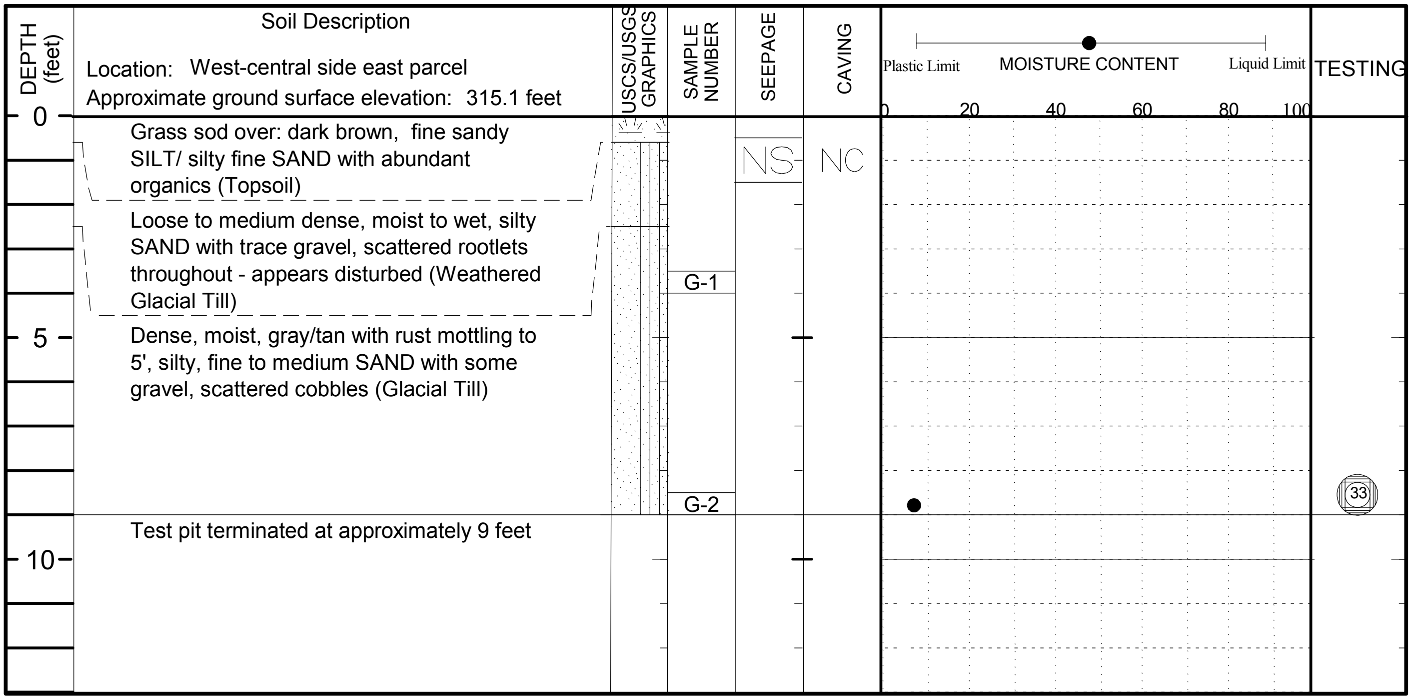
Logged By: *WJL*

amec

11810 North Creek Parkway N
Bothell, Washington 98011

Attachment 15

Test Pit No.: TP-07



Soil Description

Location: West-central side east parcel
Approximate ground surface elevation: 315.1 feet

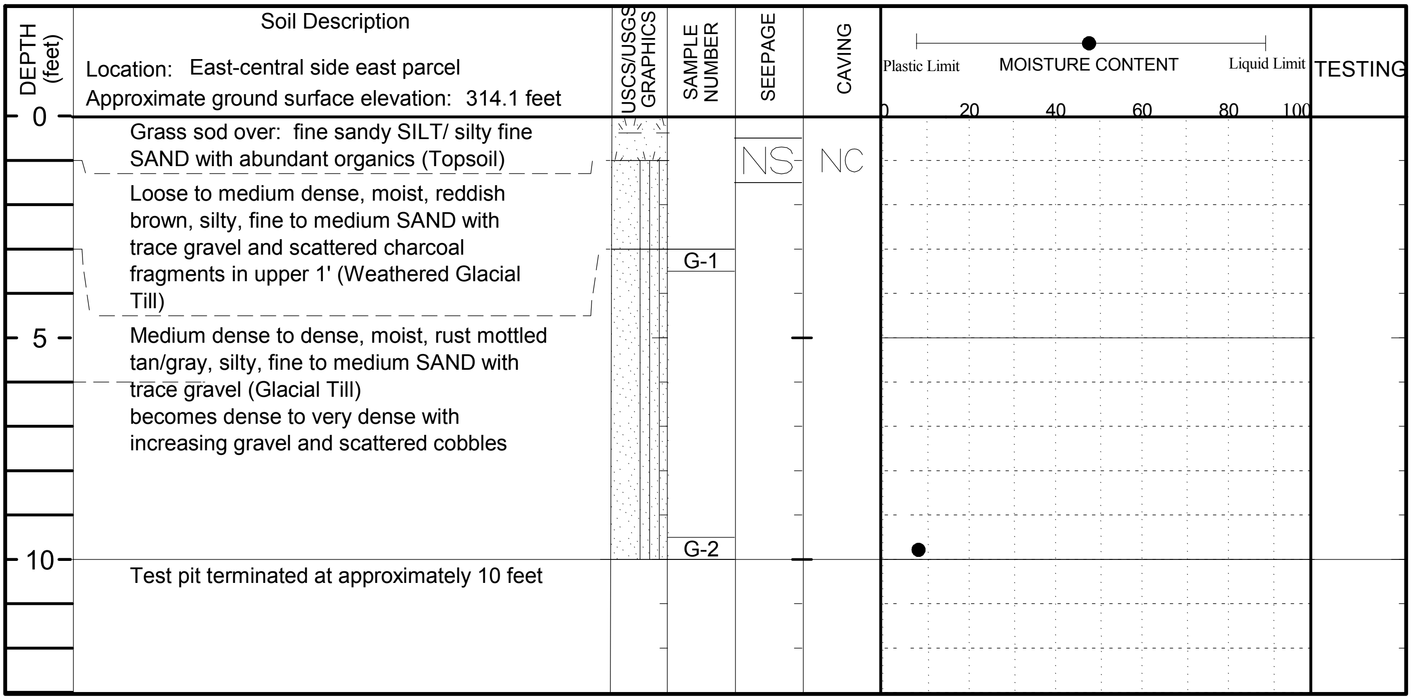
Grass sod over: dark brown, fine sandy SILT/ silty fine SAND with abundant organics (Topsoil)

Loose to medium dense, moist to wet, silty SAND with trace gravel, scattered rootlets throughout - appears disturbed (Weathered Glacial Till)

Dense, moist, gray/tan with rust mottling to 5', silty, fine to medium SAND with some gravel, scattered cobbles (Glacial Till)

Test pit terminated at approximately 9 feet

Test Pit No.: TP-08



Soil Description

Location: East-central side east parcel
Approximate ground surface elevation: 314.1 feet

Grass sod over: fine sandy SILT/ silty fine SAND with abundant organics (Topsoil)

Loose to medium dense, moist, reddish brown, silty, fine to medium SAND with trace gravel and scattered charcoal fragments in upper 1' (Weathered Glacial Till)

Medium dense to dense, moist, rust mottled tan/gray, silty, fine to medium SAND with trace gravel (Glacial Till)
becomes dense to very dense with increasing gravel and scattered cobbles

Test pit terminated at approximately 10 feet

LEGEND

NS no seepage observed
NC no caving observed
☐ 200 Wash (% fines shown)
▣ Grain Size Analysis (% fines shown)

Excavation Method: Trackhoe

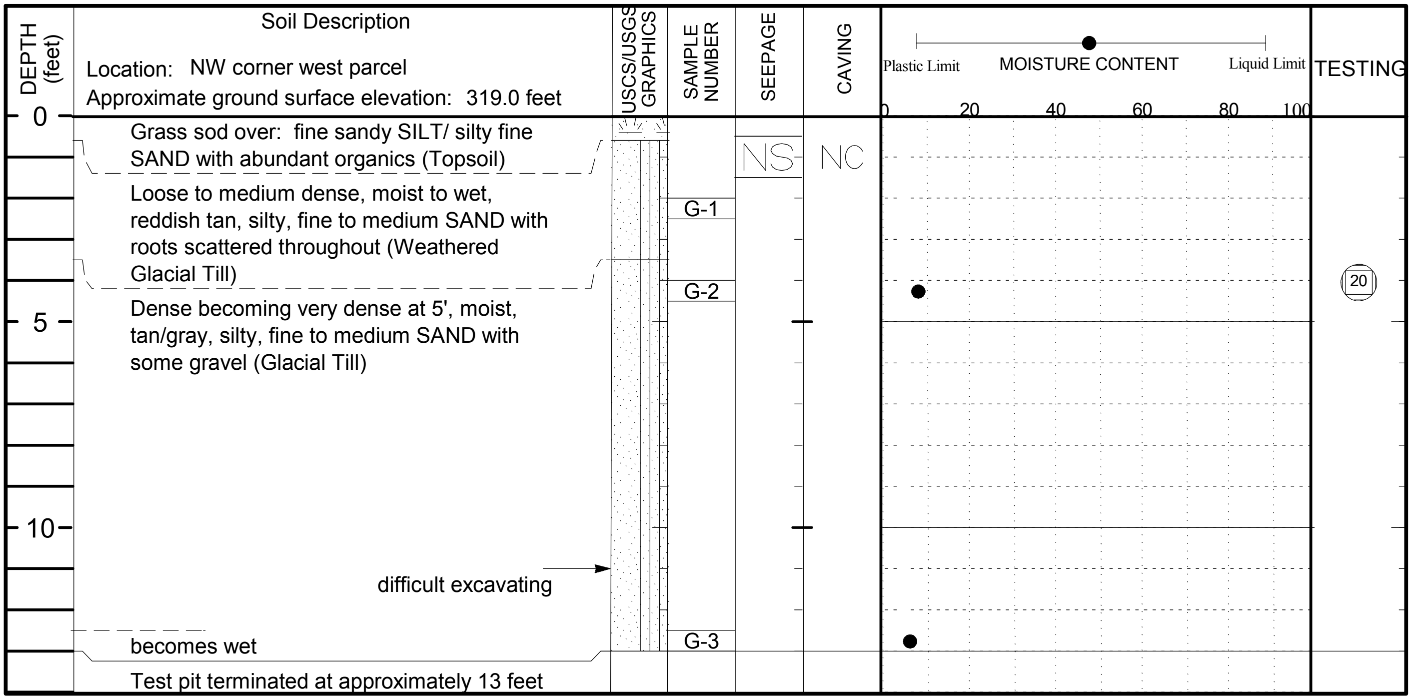
Date Excavated: *October 23, 2013*

Logged By: *WJL*

amec

11810 North Creek Parkway N
Bothell, Washington 98011

Test Pit No.: TP-09



Location: NW corner west parcel
Approximate ground surface elevation: 319.0 feet

Grass sod over: fine sandy SILT/ silty fine SAND with abundant organics (Topsoil)

Loose to medium dense, moist to wet, reddish tan, silty, fine to medium SAND with roots scattered throughout (Weathered Glacial Till)

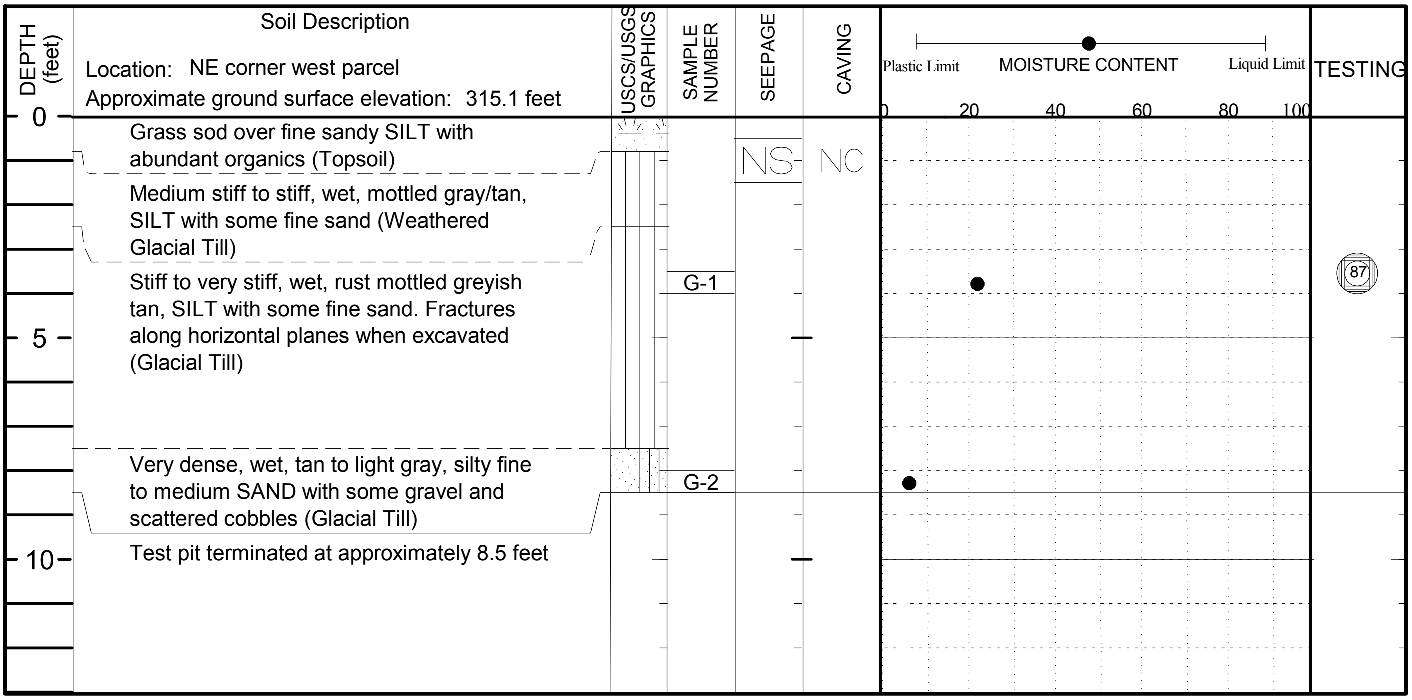
Dense becoming very dense at 5', moist, tan/gray, silty, fine to medium SAND with some gravel (Glacial Till)

difficult excavating

becomes wet

Test pit terminated at approximately 13 feet

Test Pit No.: TP-10



Location: NE corner west parcel
Approximate ground surface elevation: 315.1 feet

Grass sod over fine sandy SILT with abundant organics (Topsoil)

Medium stiff to stiff, wet, mottled gray/tan, SILT with some fine sand (Weathered Glacial Till)

Stiff to very stiff, wet, rust mottled greyish tan, SILT with some fine sand. Fractures along horizontal planes when excavated (Glacial Till)

Very dense, wet, tan to light gray, silty fine to medium SAND with some gravel and scattered cobbles (Glacial Till)

Test pit terminated at approximately 8.5 feet

LEGEND

NS no seepage observed
NC no caving observed
▢ 200 Wash (% fines shown)
◎ Grain Size Analysis (% fines shown)

Excavation Method: Trackhoe

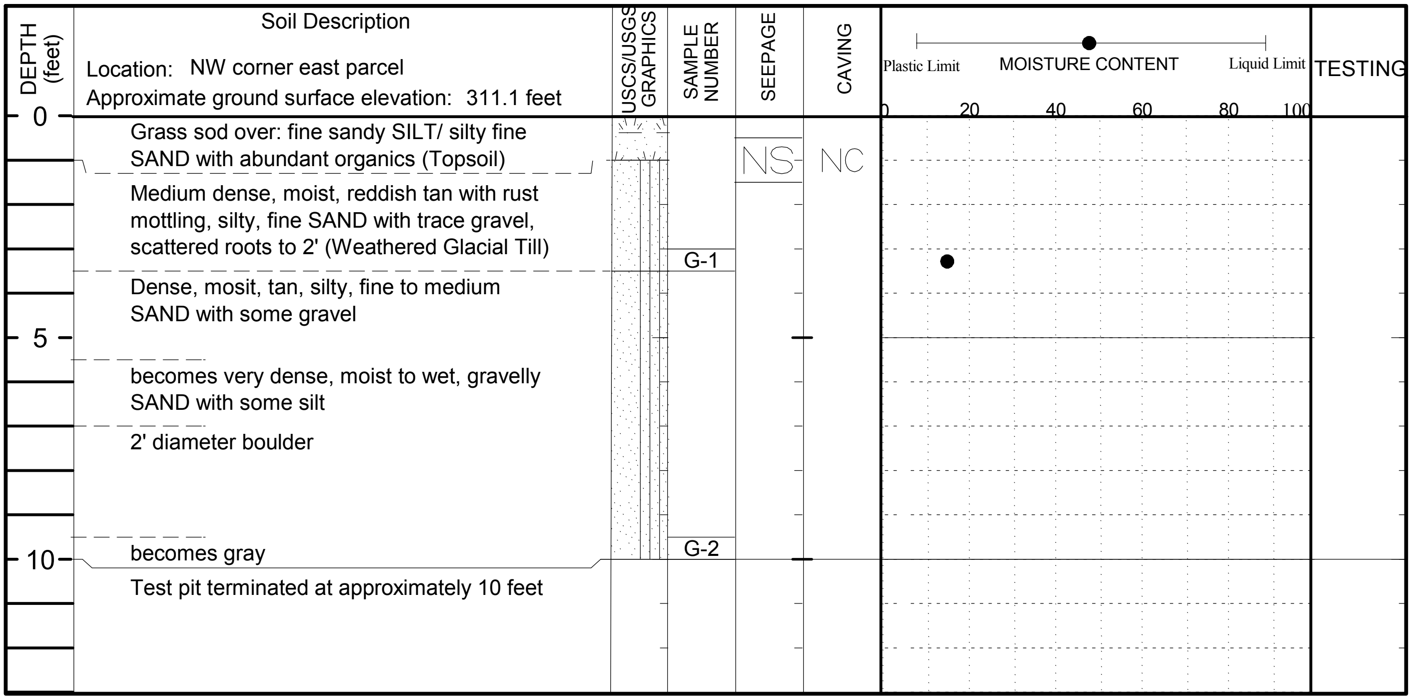
Date Excavated: *October 23, 2013*

Logged By: *WJL*

amec

11810 North Creek Parkway N
Bothell, Washington 98011

Test Pit No.: TP-11



Soil Description

Location: NW corner east parcel
Approximate ground surface elevation: 311.1 feet

Grass sod over: fine sandy SILT/ silty fine SAND with abundant organics (Topsoil)

Medium dense, moist, reddish tan with rust mottling, silty, fine SAND with trace gravel, scattered roots to 2' (Weathered Glacial Till)

Dense, mosit, tan, silty, fine to medium SAND with some gravel

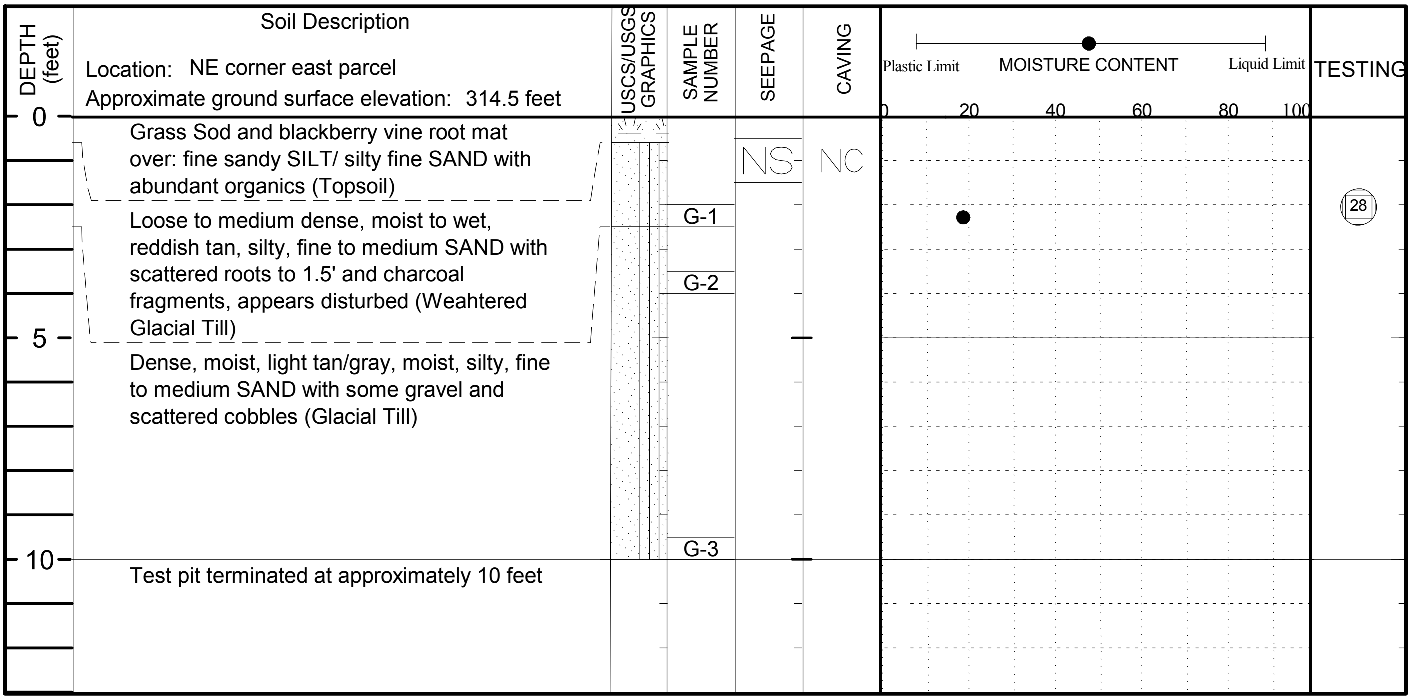
becomes very dense, moist to wet, gravelly SAND with some silt

2' diameter boulder

becomes gray

Test pit terminated at approximately 10 feet

Test Pit No.: TP-12



Soil Description

Location: NE corner east parcel
Approximate ground surface elevation: 314.5 feet

Grass Sod and blackberry vine root mat over: fine sandy SILT/ silty fine SAND with abundant organics (Topsoil)

Loose to medium dense, moist to wet, reddish tan, silty, fine to medium SAND with scattered roots to 1.5' and charcoal fragments, appears disturbed (Weahtered Glacial Till)

Dense, moist, light tan/gray, moist, silty, fine to medium SAND with some gravel and scattered cobbles (Glacial Till)

Test pit terminated at approximately 10 feet

LEGEND

NS no seepage observed
NC no caving observed
▢ 200 Wash (% fines shown)
▣ Grain Size Analysis (% fines shown)

Excavation Method: Trackhoe

Date Excavated: *October 23, 2013*

Logged By: *WJL*

amec

11810 North Creek Parkway N
Bothell, Washington 98011

APPENDIX B

Laboratory Testing Procedures and Results

APPENDIX B
LABORATORY TESTING PROCEDURES AND RESULTS
3-917-17668-0

The following paragraphs describe our procedures associated with the laboratory tests AMEC conducted for this project. Graphical results of certain laboratory tests are enclosed in this appendix.

Visual Classification Procedures

Visual soil classifications were conducted on all samples in the field and on selected samples in our laboratory. All soils were classified in general accordance with the United Soil Classification System, which includes color, relative moisture content, primary soil type (based on grain size), and any accessory soil types. The resulting soil classifications are presented on the exploration logs contained in Appendix A.

Moisture Content Determination Procedures

Moisture content determinations were performed on representative samples to aid in identification and correlation of soil types. All determinations were made in general accordance with ASTM D-2216. The results of these tests are shown on the exploration logs contained in Appendix A.

Grain-size Analysis Procedures

A grain-size analysis indicates the range of soil particle diameters included in a particular sample. Grain-size analyses were performed on representative samples in general accordance with ASTM D-422. The results of these tests are presented on the enclosed grain-size distribution graphs and were used in soil classifications shown on the exploration logs contained in Appendix A.

Minus 200-Wash Procedures

A “minus 200-wash” analysis indicates the “fines” range of soil particle diameters included in a particular sample. “Fines” are defined as silt and clay size particles which are able to pass the US No. 200 sieve. “Minus 200-wash” analyses were performed on representative samples in general accordance with ASTM D-1140-97. The results of these tests are presented on the enclosed spreadsheet and were used in soil classifications shown on the exploration logs contained in Appendix A.

Corrosivity Test Procedures

A corrosivity test typically comprises individual measurement of pH, electrical resistivity, and sulfate content, which together indicate the corrosiveness of a soil. Corrosivity tests were performed on selected samples by an independent analytical laboratory working under subcontract to AMEC. The results of these tests are presented on the enclosed analytical certificates.