Conceptual Geotechnical Engineering Report
Gresham Vista Business Park – Lots 1-5
Gresham, Oregon

January 2014

SHANNON & WILSON, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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24-1-03793-002

EXECUTIVE SUMMARY

Subsurface Soil Conditions

The site is underlain by varying amounts of fill overlying Catastrophic Flood Deposits that consist of sands and gravels, which are underlain by Ancestral Sandy River Deposits. In general, fill on the lots is 3 to 9.5 feet thick, except at boring B-10 (located between Lots 3 and 4), where fill was not encountered at the ground surface. The fill consists of some gravels and medium-stiff silty soils. Underlying the ground surface and fill is the Catastrophic Flood Deposits, including dense sand and gravel.

Site Development Considerations

Based on the results of our field work and geotechnical engineering analysis, it is our opinion that the site is suitable for general industrial development. Based on our limited investigation, it is likely that the proposed structures may be supported on conventional shallow-footing foundations. However, we recommend that lot-specific geotechnical evaluations be completed once the proposed development type is more certain. The primary geotechnical factors influencing the design and construction of this project are the presence of shallow perched groundwater in areas, possible difficult excavation conditions for utilities in the underlying gravels, and moisture-sensitive silts present at the ground surface.

Site Groundwater Conditions and On-Site Infiltration Potential

The static groundwater at the site is likely more than 20 feet below the elevation of SE Glisan Street to the north. However, shallower perched water is present above the silt and clay layers that are less permeable throughout the site. This perched water was observed on the western portion of the site between approximate elevations of 208 and 294 feet and generally follows the topography of the site.

Infiltration rates at the site were highly variable based on the subsurface conditions and soils at the specific location of the test. In general, the more granular materials (sand and gravel) do provide potential onsite infiltration candidates for localized areas. These higher-permeability materials were generally more than 3 to 10 feet below the ground surface in our explorations. Based on the collected information, it is our opinion that onsite infiltration is feasible; however, due to the variability, we recommend that lot-specific infiltration testing be completed.

TABLE OF CONTENTS

FIGURES

APPENDICES

DRAFT CONCEPTUAL GEOTECHNICAL ENGINEERING REPORT
GRESHAM VISTA BUSINESS PARK – LOTS 1-5
GRESHAM, OREGON

1.0 INTRODUCTION

1.1 General

This report presents the results of our preliminary geotechnical investigation and conceptual geotechnical design recommendations for the proposed industrial development at the Gresham Vista Business Park site in Gresham, Oregon. The site is located between NE Glisan and SE Stark Streets on the east side of 223rd Avenue, as shown on the Vicinity Map, Figure 1. A geotechnical report was previously prepared for the western portion of the site (Lots 7-11) and provided to the Port on September 3, 2013. This report addresses Lots 1 through 5 on the eastern portion of the site.

1.2 Scope of Services

Shannon & Wilson, Inc., performed this geotechnical investigation in accordance with the scope of services specified in the agreement referenced in Section 8. In general, our work included the following:

- Reviewing available published and in-house geologic information as well as geotechnical information previously provided by the Port;
- Exploring the subsurface conditions with five drilled borings and collecting soil samples;
- Conducting infiltration testing in five borings;
- Conducting laboratory testing to characterize soils and develop soil properties for evaluation;
- Performing preliminary geotechnical analyses, including infiltration potential and groundwater levels;
- Providing preliminary infiltration recommendations for site development, generalized geotechnical characterization of the proposed lots, and a general discussion of geotechnical considerations for site development;
- Providing this report summarizing our explorations, preliminary geotechnical analysis, conclusions, and recommendations.

1.3 Project Description

1.3.1 Site Description

Gresham Vista Business Park is in Gresham, Oregon, and consists of 11 lots that have a total area of approximately 220 acres. The site is bounded by NE Glisan Street to the north, SE Stark Street to the south, 223rd Avenue to the west, and Hogan Drive/242nd Drive to the west. The 11 lots surround an ON Semiconductor Components Industries facility and a PGE substation. The lots are currently undeveloped and are generally used for agriculture, both planted and nursery components. Lots 1 through 5 consist of farmed fields. The site elevations are highest in the southeast corner (approximately 365 feet above mean sea level, or MSL) and slope down to the north and west. Site grades in the northeast corner are on the order of 330 to 335 feet above MSL, and they are approximately 200 to 210 feet above MSL at Glisan Street in the northeast corner. This investigation focused on Lots 1 through 5 on the eastern half of the site, approximately 116 acres in area. This side of the site gently grades from the southeast corner of Lot 5 (elevation 365) to the northern edge of Lot 1 (elevation 320 feet).

1.3.2 Project Understanding

We understand that the Port is preparing Lots 1 through 5 for development and evaluating stormwater management options. Although future site tenants and development details are unknown at this time, Shannon & Wilson has evaluated the potential for onsite infiltration on Lots 1 through 5. Infiltration was previously evaluated on Lots 7 through 11, as described above.

The geotechnical recommendations presented in this report are based on the available project information and the subsurface conditions described in this report. If any of the noted information changes during the course of design, please inform Shannon & Wilson in writing so that we may reconsider and amend, if necessary, the recommendations presented in this report.

2.0 GEOLOGIC SETTING

2.1 Regional Geology

The project site is located within the Portland structural basin, which was formed by folding and faulting of volcanic rocks of the Columbia River Basalt Group that are more than 9 million years old. Nearly 1,000 feet of Pliocene to Recent sediment has accumulated in the basin since formation of the structure; the Pliocene-age Sandy River Mudstone and Troutdale Formation (sandstone and conglomerate) account for at least several hundred feet of the sediment. In the Gresham area, the Troutdale Formation is overlain by middle- to late-Pleistocene alluvial deposits of the ancestral Sandy River, consisting of sandy gravel with some interbedded sand layers; these are believed to be part of a broad alluvial fan or braid plain (Evarts and O'Connor, 2008). The ancestral Sandy River deposits underlie late-Pleistocene Catastrophic Flood Deposits.

Near the end of the Pleistocene epoch or "Ice Ages," between about 18,000 and 15,000 years ago, a series of catastrophic floods occurred in the Columbia River system (Allen and others, 2009). A lobe of the continental ice sheet blocked the mouth of the Clark Fork River in western Montana, which then formed an immense glacial lake called Glacial Lake Missoula. The lake grew until its depth and pressure overcame the ice dam, allowing the entire massive lake to empty catastrophically. Once the lake had emptied, the ice sheet again blocked the Clark Fork Valley, and the lake began to refill. Consequently, catastrophic floods called the Missoula Floods were unleashed repeatedly some 40 or more times, probably at intervals of several decades. During each flood event, floodwaters passed through the Columbia River Gorge, inundated the entire Portland Basin, and back-flooded up the Willamette Valley as far south as Eugene. Each of these events was short lived, but they profoundly shaped the surficial geology of the Portland Basin below an elevation of 400 feet. The Missoula Floods deposited tremendous amounts of silt, sand, and gravel within the Portland Basin.

2.1.1 Site Geology

The primary geologic units that underlie the site and vicinity are Fill, Catastrophic Flood Deposits, Ancestral Sandy River Deposits, and Troutdale Formation. These units, listed in order from youngest to oldest, are generally described as follows:

- **Fill:** Variable material placed by humans in the course of land development.
- **Catastrophic Flood Deposits:** Sediments associated with catastrophic Missoula Flood episodes. These generally include fine-grained micaceous silt and fine sand overlying coarse gravel with cobbles and boulders in a silt and sand matrix.
- **Ancestral Sandy River Deposits:** Variably cemented gravel with variable amounts of sand and fines that underlies Catastrophic Flood Deposits south of Interstate 84. The gravel deposits are crudely stratified, well sorted, and contain abundant rounded clasts of basaltic and andesitic rocks; the unit also includes interstratified and discontinuous silty sand and silt layers and lenses.

- **Troutdale Formation:** Weakly to moderately cemented gravel and cobble conglomerate with interbeds of sandstone. Sediment clasts include basalt, quartzite, and quartzofeldspathic metamorphic rocks.

Based on our interpretation of the material encountered in our borings on both sides of the site, all units were encountered at the site except the Troutdale Formation. A nearby well log obtained from the Oregon Water Resources Department reported encountering Troutdale Formation at a depth of 85 feet below the ground surface, a depth deeper than our deepest boring. Troutdale Formation likely underlies the Ancestral Sandy River Deposits at the project site.

3.0 FIELD EXPLORATIONS

As shown on Figure 2, Shannon & Wilson explored the subsurface conditions for this portion of the site with five geotechnical borings. The borings, designated B-8 through B-12, were drilled between November 20 and 22, 2013. The boring depths range between 11.3 and 31.5 feet. A Shannon & Wilson engineering geologist located the borings, collected soil samples, and logged the materials encountered during drilling. Infiltration tests were performed in or adjacent to the locations of borings. The locations of the completed explorations were measured off of existing site features in the field. Details of the exploration program, including logs of the borings and hand augers, descriptions of the techniques used to advance and sample the borings, and infiltration test procedures and results, are presented in Appendix A.

4.0 LABORATORY TESTING

Laboratory tests were performed on selected samples from the borings to determine basic index and engineering properties of the soils encountered. The laboratory testing program included moisture content analyses and particle-size analyses. All laboratory testing was performed by Shannon & Wilson in general accordance with applicable ASTM International (ASTM) standards. Results of the laboratory tests and a brief description of the testing procedures are presented in Appendix B.

5.0 SUBSURFACE CONDITIONS

5.1 Project Geotechnical Engineering Units

We grouped the materials encountered in our field explorations into four geotechnical engineering units, based on their engineering characteristics:

- Fill
- Catastrophic Flood Deposits – Sand Facies
- Catastrophic Flood Deposits – Gravel Facies
- Ancestral Sandy River Deposits

The following sections describe the general characteristics of these units. The specific terminology used in our soil description is defined in Appendix A, Figure A1. Unit contacts may be more gradational than shown in the logs, and conditions may vary significantly between explorations. The following discussion of units is intended to provide a general overview of subsurface conditions. Individual boring logs should be reviewed to understand the encountered subsurface conditions at specific locations.

5.1.1 Fill

Fill was encountered from the ground surface to depths between 3 and 9.5 feet in borings B-8, B-9, B-11, and B-12. Fill consisted of silts, sands, and gravels. Fill was deepest (9 to 9.5 feet) between lots 1, 2, and the western portion of Lot 5, and tapered to 3 to 4.5 feet near the eastern portion of the site. No fill was encountered in B-10, between Lot 3 and Lot 4.

Standard Penetration Test (SPT) N-values in the Fill generally ranged from 5 to 38 blows per foot (bpf). One refusal blow count was recorded in the Fill in boring B-9. Results of natural moisture content analysis indicated the moisture content of the fill was between 10 and 25 percent. A single fines content determined by sieve analysis for one sample in the silt Fill was 74 percent by dry weight.

5.1.2 Catastrophic Flood Deposits

The Catastrophic Flood Deposits include sediments deposited by the late-Pleistocene Missoula Floods. To more clearly define the engineering properties of the materials encountered in our borings, we divided all flood deposits into two units based on material properties: Sand Facies consisting mostly of sand; and Gravel Facies consisting mostly of gravel, cobbles, and boulders. The following paragraphs describe these flood deposit units in detail.

5.1.2.1 Catastrophic Flood Deposits – Sand-Grained Facies

The Catastrophic Flood Deposits – Sand Facies unit was encountered in boring B-12. The Sand Facies deposit at this location was 6 feet thick and was encountered below the

Fill layer. In general, the Sand Facies consists of medium dense to dense, brown, Sand with Silt (SP-SM) to Poorly Graded Sand with Gravel (SP). Within the Silty Sand, fines are nonplastic to low plasticity, sand is fine to coarse, and gravel is fine to coarse and subrounded to subangular. SPT N-values in the unit were 27 and 38 bpf.

5.1.2.2 Catastrophic Flood Deposits – Gravel-Grained Facies

The Catastrophic Flood Deposits – Gravel Facies unit was encountered in boring B-10 from the ground surface to the explored depth of 11.5 feet, and in the remaining borings below the Fill and Sand Facies deposits. Borings B-8 and B-12 were also terminated in this unit, and the deposit was underlain by Ancestral Sandy River Deposits in borings B-9 and B-11.

In general, the Gravel Facies consists of medium dense to very dense, brown and gray Poorly Graded Gravel with Silt and Sand and Cobbles to Silty Gravel with Sand and Cobbles (GP-GM, GM). Based on our observation of the drilling conditions, the unit contains scattered cobbles at least 8 inches in diameter and possible boulders. While no boulders were directly observed during drilling, boulders up to 3 feet in diameter were observed at the ground surface on the west portion of the site near B-4, and were likely derived from this unit. One of the eight SPTs attempted in the unit met refusal, where more than 50 blows were required to drive the sampler through a 6-inch interval. The non-refusal SPT N-values ranged from 25 to 78 bpf and averaged 43 bpf. Results from two natural moisture content analyses were 14 and 17 percent. Fines content determined by sieve analysis for one sample was 18 percent.

5.1.3 Ancestral Sandy River Deposits

The Ancestral Sandy River Deposits were encountered below the Gravel Facies in borings B-9 and B-11. The borings were terminated in this unit, with the thickest penetration being 19.5 feet in boring B-9. In general, the Ancestral Sandy River Deposits consist of stiff eleastic silt and dense to very dense Silty Gravel with Sand (GM) in boring B-11 and stiff to very stiff Elastic Silt, Silt, and Sandy Silt (ML/MH) in boring B-9. The SPT attempted in the Gravel in boring B-11 unit met refusal. The non-refusal SPT N-values in boring B-9 ranged from 10 to 21 bpf and averaged 13 bpf. Results from two natural moisture content analyses in the silt layers were 32 and 39 percent.

5.2 Groundwater

Groundwater was not directly observed in our borings on the eastern portion of the site, but soil conditions during drilling in boring B-9 indicate that a perched groundwater is likely present at a depth of approximately 15 feet below ground surface (bgs). During drilling on the western portion of the site, the measured water level in boring B-2 was 8.8 feet below the ground surface, and the measured water level in boring B-4 was 20.7 feet below the ground surface. This is consistent with perched groundwater expected within the fine-grained layers in the site vicinity. Groundwater levels should be expected to fluctuate seasonally and with changes in precipitation, land use, and other factors. In general, we expect groundwater levels in this area to be at a seasonal high during the winter and late spring and at a seasonal low during the late summer and early fall.

6.0 SEISMIC DESIGN CONSIDERATIONS

In accordance with the site classification criteria set forth in 2012 International Building Code (2012 IBC), we recommend a Site Class D for this site. The following paragraphs describe required seismically related hazard evaluations on-site.

- **Strong Ground Motions:** The maximum considered earthquake (MCE) ground motions at the bedrock level of S_S = 0.95 g and S_1 = 0.39 g were obtained from the United States Geological Survey (USGS) Earthquake Hazards Program – 2008 interactive deaggregation website. Based on the site class and these values, the design earthquake spectral response coefficients are Fa = 1.12 and Fv = 1.62. The ground motions are based on a probabilistic hazard analysis performed by the USGS and the seismic site classification of the project site.
- **Fault Rupture:** In the vicinity of the project site, the nearest mapped faults are the Damascus-Tickle Creek fault and Grant Butte fault, about 1.8 miles to the south, and the Lacamas Lake fault, about 4.5 miles to the northeast. All three faults are designated as Class A by the USGS and are thought to have been active within the last 750 thousand years (Personius, 2002). Due to their mapped distance from the site, it is our opinion that the risk for fault rupture at the site is low.
- **Liquefaction and Lateral Spread**: Based on the gravely nature of the coarse-grained soils, the plasticity of the fine-grained soils, and the perched nature of the groundwater at the site, the risk for widespread liquefaction and lateral spread is low at the site.
- **Other Seismic Risks:** The risk for tsunami or seiche at the site is neglible.

7.0 CONCEPTUAL GEOTECHNICAL RECOMMENDATIONS

7.1 General

Based on the results of our field explorations, infiltration tests, and geotechnical engineering evaluations, it is our opinion that the site is suitable for general industrial development. Based on our limited investigation, the proposed structures may be supported on conventional shallow-footing foundations. However, we recommend that lot-specific geotechnical evaluations be completed once the proposed development type is more certain. The primary geotechnical factors influencing the design and construction of this project are the presence of shallow perched groundwater in areas, possible difficult excavation conditions for utilities in the underlying gravels, and moisture-sensitive silts present at the ground surface.

7.2 Site Groundwater Conditions and On-Site Infiltration Potential

As discussed above, the static groundwater at the site is likely more than 20 feet below the elevation of SE Glisan Street to the north. However, shallower perched water is present above the silt and clay layers that are less permeable throughout the site, and within the gravel layers above the cemented or fine-grained portions of the Ancestral Sandy River mudflow deposits that act as an aquitard in this area. The perched water in the area of the reservoir on the western portion of the site is an indication of the presence of this aquitard. These perched water levels were present during the previous August 2012 and July 2013 explorations, indicating that they will likely be present year-round, even in the drier summer months. Based on our observations and the previous studies at the site, this perched water was observed between approximate elevations of 208 and 294 feet and generally follows the topography of the site.

Further, infiltration rates at the site were highly variable based on the subsurface conditions and soils at the specific location of the test. In general, the more granular materials (sand and gravel) do provide potential onsite infiltration candidates for localized areas. In general, these higher-permeability materials were generally more than 5 to 10 feet below the ground surface in our explorations. Based on our limited field explorations, it is our opinion that onsite infiltration may be feasible on Lots 1 through 5; however, due to the variability, we recommend that lot-specific infiltration testing be completed. Rain gardens and other shallow installations may require over-excavation to communicate with deeper, more permeable layers. In general, all infiltration features and installations should be placed to avoid shallow perched groundwater.

7.3 Construction Considerations

7.3.1 Earthwork Considerations

Temporary shoring and dewatering may be required during excavation at the site due to shallow perched groundwater and dense to very dense gravels with frequent cobbles and possible boulders. Temporary earth slopes may be cut at a steepness of about 1.5 horizontal to 1 vertical (1.5H:1V) above the groundwater table. Permanent earth slopes should be dressed to 2H:1V or flatter and protected from erosion.

Excavation and construction operations may expose the on-site silty surficial soils to inclement weather conditions. These soils can be easily disturbed when wet, and the stability of exposed soils may rapidly deteriorate due to a change in moisture content (i.e. wetting or drying) or the actions of heavy or repeated construction traffic. Accordingly, foundation and pavement area excavations should be adequately protected from the elements and from the actions of repetitive or heavy construction loadings.

7.3.2 Dewatering Considerations

As discussed in out report for the western portion of the site, the previous explorations on Lot 6 and our explorations have shown the potential for the presence of shallow perched groundwater at the site. Utility trench and other excavations may encounter groundwater seepage and the associated instability, especially in sandy soils.

8.0 LIMITATIONS

Our services are being performed based on the Shannon & Wilson proposal (Proposal #24-2-04550-002) executed October 22, 2013, as Task Order 6 - PO #111201 assigned under our on-call contract (Contract #612) with the Port of Portland. The analyses, conclusions, and recommendations contained in this report are based on site conditions as they presently exist, and further assume that the explorations are representative of the subsurface conditions throughout the site; that is, the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

If subsurface conditions different from those encountered in the explorations are encountered or appear to be present during construction, we should be advised at once so that we can review these conditions and reconsider our recommendations, where necessary. If there is a substantial lapse of time between the submission of this report and the start of construction at the site, or if conditions have changed because of natural forces or construction operations at or adjacent to the site, we recommend that we review our report to determine the applicability of the conclusions and recommendations.

Within the limitations of scope, schedule, and budget, the analyses, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice in this area at the time this report was prepared. We make no other warranty, either express or implied. These conclusions and recommendations were based on our understanding of the project as described in this report and the site conditions as observed at the time of our explorations.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples from test borings. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

This report was prepared for the exclusive use of the owner and architect/engineer in the design of the Gresham Vista Business Park. The data and report can be provided to the contractors for their information, but our report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions included in this report.

The scope of our present work did not include environmental assessments or evaluations regarding the presence or absence of wetlands, or hazardous or toxic substances in the soil, surface water, groundwater, or air, on or below or around this site, or for the evaluation or disposal of contaminated soils or groundwater, should any be encountered.

Shannon & Wilson, Inc., has prepared and included in Appendix C, “Important Information About Your Geotechnical/Environmental Report,” to assist you and others in understanding the use and limitations of our reports.

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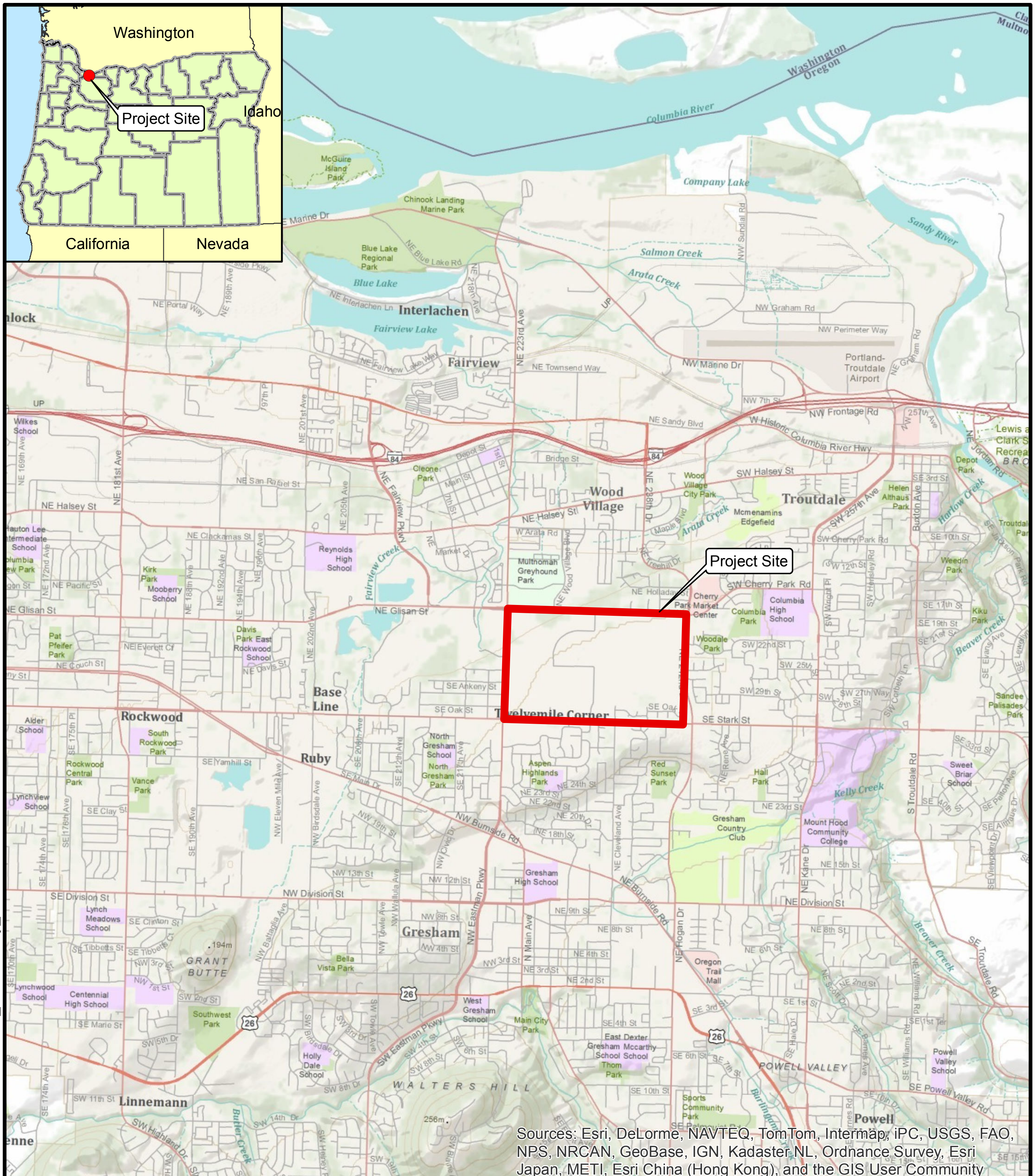

N
W E
S

0 4,000 8,000 Feet

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

VICINITY MAP

January 2014 24-1-03793-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 1

Path: T:\Projects\24-1\3793 Gresham Vista Business Park\AV_mxd\Vicinity_002.mxd 1/27/2014 ath

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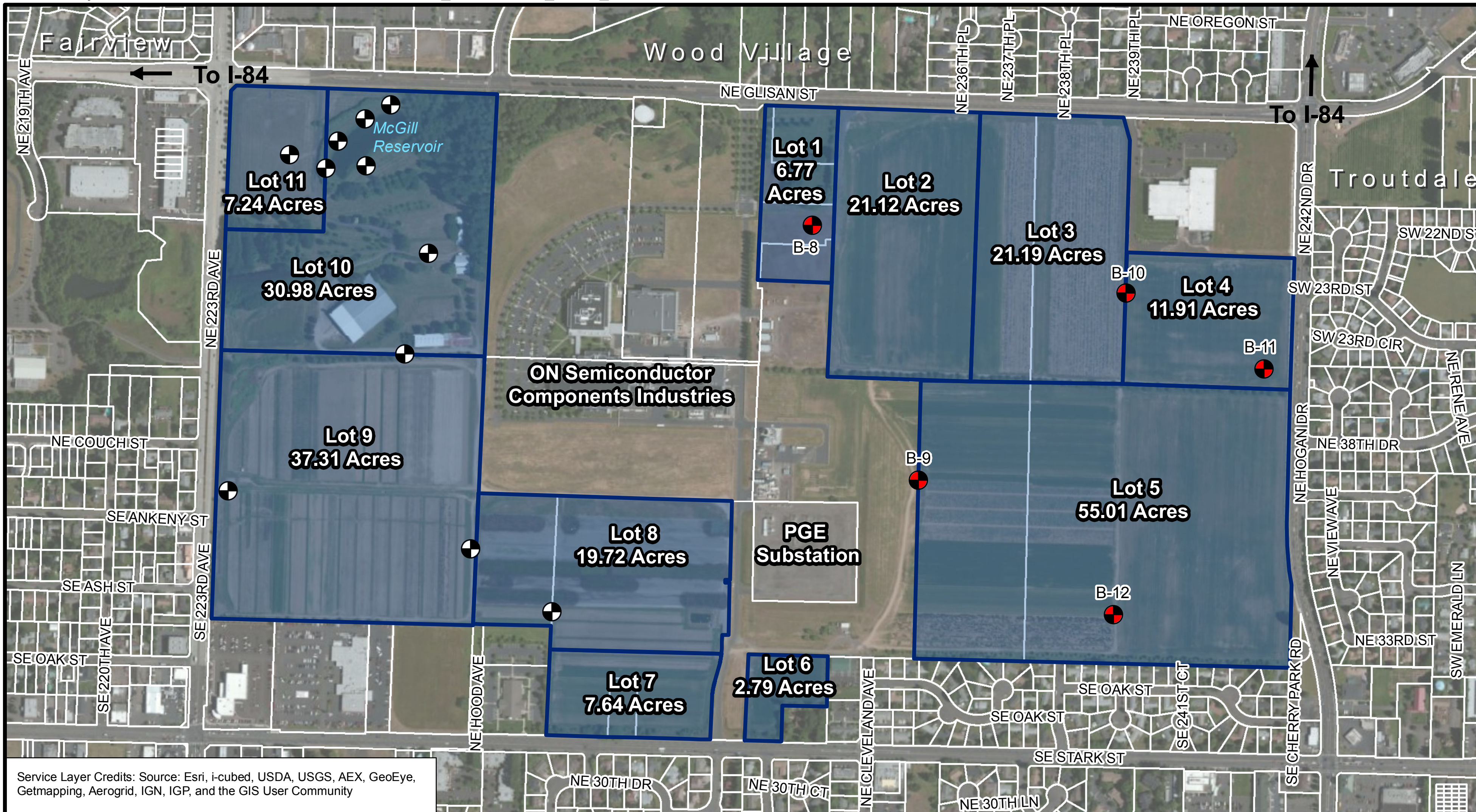

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LEGEND

- Phase 1 - Boring Locations
- Phase 2 - Boring Locations
- Gresham Vista Business Park Lot
- Taxlot

NOTE
Lot boundaries georeferenced from Port of Portland figure.

0 700 1,400 Feet

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

SITE PLAN

January 2014 24-1-03793-002

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Geotechnical and Environmental Consultants

FIG. 2

APPENDIX A

FIELD EXPLORATIONS

TABLE OF CONTENTS

TABLES

FIGURES

APPENDIX A

FIELD EXPLORATIONS

A.1 GENERAL

Shannon & Wilson, Inc., explored subsurface conditions at the project site with five geotechnical borings. The borings were designated B-8 through B-12 and ranged in depth from 11.3 to 31.5 feet below the ground surface (bgs). Infiltration tests were performed in or adjacent to the locations of borings. The locations of the completed explorations were measured off of existing site features in the field using a tape measure. Approximate locations of the explorations are shown on the Site Plan, Figure 2. This appendix describes the techniques used to advance and sample the explorations and presents logs of the materials encountered during drilling. It also presents infiltration testing procedures and results.

A.2 BORINGS

A.2.1 Drilling

Borings B-8 through B-12 were drilled between November 20 and 22, 2013. The borings were drilled using a WS45 track-mounted drill rig provided and operated by Western States Soil Conservation, Inc., of Hubbard, Oregon. The infiltration tests were conducted through the hollow-stem auger used for the geotechnical hole or in an adjacent hollow-stem auger set within 5 feet of the geotechnical hole location. Boring B-9 was drilled using mud-rotary drilling techniques. A Shannon & Wilson engineering geologist was present during the explorations to locate the borings, observe the drilling, collect soil samples, log the materials encountered, and conduct infiltration testing.

A.2.2 Disturbed Sampling

Disturbed samples were collected in the borings, typically at 2.5- to 5-foot depth intervals, using a standard 2-inch outside diameter (O.D.) split spoon sampler in conjunction with Standard Penetration Testing. In a Standard Penetration Test (SPT), ASTM D1586, the sampler is driven 18 inches into the soil using a 140-pound hammer dropped 30 inches. The number of blows required to drive the sampler the last 12 inches is defined as the standard penetration resistance, or N-value. The SPT N-value provides a measure of in situ relative density of cohesionless soils (silt, sand, and gravel), and the consistency of cohesive soils (silt and clay). In some instances, a 3-inch O.D. split spoon sampler was used through the same interval as, or in lieu of, an SPT sample in order to obtain additional material for testing. All disturbed samples were visually identified and described in the field, sealed to retain moisture, and returned to our laboratory for additional examination and testing.

SPT N-values can be significantly affected by several factors, including the efficiency of the hammer used. The same automatic hammer system was used for all borings performed at the site. Automatic hammers generally have higher energy transfer efficiencies than cathead-driven hammers. Based on information we received from Western States Soil Conservation, the energy efficiency of the hammer used at the site was 74.5 percent, as previously measured on March 17, 2013. All N-values presented in this report are in blows per foot, as counted in the field. No corrections of any kind have been applied.

An SPT was considered to have met refusal where more than 50 blows were required to drive the sampler 6 inches. If refusal was encountered in the first 6-inch interval (for example, 50 for 1.5”), the count is reported as 50/1st 1.5”. If refusal was encountered in the second 6-inch interval (for example, 48, 50 for 1.5”), the count is reported as 50/1.5”. If refusal was encountered in the last 6-inch interval (for example, 39, 48, 50 for 1.5”), the count is reported as 98/7.5”. N-values from samples acquired using a 3-inch O.D. sampler are not shown on the logs.

A.2.3 Borehole Abandonment

All borings were backfilled with bentonite cement grout or bentonite chips in accordance with Oregon Water Resource Department regulations. No wells or other instruments were installed in the boreholes.

A.3 MATERIAL DESCRIPTIONS

Soil samples were described and identified visually in the field in general accordance with ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The specific terminology used is defined in the Soil Description and Log Key, Figure A1. Consistency, color, relative moisture, degree of plasticity, peculiar odors, and other distinguishing characteristics of the samples were noted. Once transported to our laboratory, the samples were re-examined, various classification tests were performed, and the field descriptions and identifications were modified where necessary. We refined our visual-manual soil descriptions and identifications based on the results of the laboratory tests, using elements of the Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM D2487. However, ASTM D2487 was not followed in full because it requires that a suite of tests be performed to fully classify a single sample.

A.4 LOGS OF BORINGS AND HAND AUGERS

Summary logs of the borings and hand augers are presented in Figures A2 through A6. Soil descriptions and interfaces on the logs are interpretive, and actual changes may be gradual. The left-hand portion of the logs gives our description, identification, and geotechnical unit designation for the soils encountered in the exploration. The right-hand portion of the logs shows a graphic log, sample locations and designations, groundwater information, and a graphical representation of N-values, natural water contents, sample recovery, and fines content.

A.5 INFILTRATION TESTING

A Shannon & Wilson engineering geologist performed infiltration tests in or adjacent to the locations of borings. The tests were conducted through 4.25-inch inside diameter (I.D.) hollow-stem augers used in the geotechnical holes or set within 5 feet of the geotechnical hole locations. The tests were performed in general accordance with the Encased Falling Head Test method, described in the 2008 Portland Stormwater Management Manual, Appendix F2. At each test location, 4.25-inch I.D. hollow-stem auger was advanced to the test depth, and approximately 1 foot of water was added to pre-saturate soil. After the pre-saturation period, multiple tests were conducted by raising the head of water over the soil to approximately 1 foot and periodically measuring the depth to water from the top of the casing. Infiltration Test Results are presented in Table A1.

TABLE A1: INFILTRATION TEST RESULTS

Boring Designation	Depth[1] (feet)	Infiltration Rate[2]	Soil Type	Approximate Fines Content (percent by dry weight)	Geotechnical Unit[4]
B-8	5	0 in/hr	*Silt (ML)*	~70	Fill
B-8	10	<1 in/hr	*Silty Sand with Gravel to Silty Gravel with Sand(SM/GM)*	17[(3)]	CFD-GF
B-9	4.5	<0.5in/hr	*Sand (SP)*	~5	Fill
B-9	9	6 in/hr	*Silty Gravel with Sand (GM)*	14[(3)]	CFD-GF
B-10	4	3 to 5 in/hr	*Silty Gravel with Sand (GM)*	18 [(3)]	CFD-GF
B-11	3.5	0 in/hr	*Silt with Sand(ML)*	74[(3)]	Fill
B-11	12.5	>100 in/hr	*Silty Gravel with Sand (GM)*	~20	ASRD
B-12	4	11 in/hr	*Sand with Silt and Gravel (SP-SM)*	~10	CFD-SF

[1]Depth in feet below the ground surface at the time the explorations were performed
[2]Measured infiltration rates for head levels less than 1 foot; in = inches; hr = hour; gal = gallons; min = minute
[3]Value determined from laboratory testing
[4]CFD = Catastrophic Flood Deposits; FGF = Fine-grained Facies; SF = Sand Facies; GF = Gravel Facies; ASRD = Ancestral Sandy River Deposits

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT[2]	FINE-GRAINED SOILS (50% or more fines)[1]	COARSE-GRAINED SOILS (less than 50% fines)[1]
Major	***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3]	***Sand*** or ***Gravel***[4]
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4]	More than 12% fine-grained: ***Silty*** or ***Clayey***[3]
Minor Follows major constituent	15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4]	5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3]
	30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5]	15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5]

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor*.
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.

NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND	
Fine	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.)
Medium	#40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.)
Coarse	#10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL	
Fine	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.)
Coarse	3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS: N, SPT, BLOWS/FT.	RELATIVE DENSITY	COHESIVE SOILS: N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS

Bentonite Cement Grout	Surface Cement Seal
Bentonite Grout	Asphalt or Cap
Bentonite Chips	Slough
Silica Sand	Inclinometer or Non-perforated Casing
Perforated or Screened Casing	Vibrating Wire Piezometer

PERCENTAGES TERMS [1, 2]

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

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Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

SOIL DESCRIPTION AND LOG KEY

January 2014 24-1-03793-002

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FIG. A1
Sheet 1 of 3

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL		TYPICAL IDENTIFICATIONS
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Gravel *(less than 5% fines)*	GW		Well-Graded Gravel; Well-Graded Gravel with Sand
			GP		Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(more than 12% fines)*	GM		Silty Gravel; Silty Gravel with Sand
			GC		Clayey Gravel; Clayey Gravel with Sand
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Sand *(less than 5% fines)*	SW		Well-Graded Sand; Well-Graded Sand with Gravel
			SP		Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(more than 12% fines)*	SM		Silty Sand; Silty Sand with Gravel
			SC		Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML		Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL		Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH		Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH		Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT		Peat or other highly organic soils (see ASTM D4427)

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

SOIL DESCRIPTION AND LOG KEY

January 2014 — 24-1-03793-002

SHANNON & WILSON, INC.
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FIG. A1
Sheet 2 of 3

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS[1]

Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

PLASTICITY[2]

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASITICTY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20
High	It take considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS[1]

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

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[2]Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q_u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS[1]

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

SOIL DESCRIPTION AND LOG KEY

January 2014 24-1-03793-002

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FIG. A1
Sheet 3 of 3

Total Depth:	11.25 ft.	Northing:	~	Drilling Method:	Hollow Stem Auger	Hole Diam.: 7 in.
Top Elevation:	~	Easting:	~	Drilling Company:	Western States	Rod Type: AWJ
Vert. Datum:	NAVD88	Station:	~	Drill Rig Equipment:	Track WS45	Hammer Type: Automatic
Horiz. Datum:	NAD83	Offset:	~	Other Comments:	Hammer Efficiency = 74.5%	

SOIL DESCRIPTION

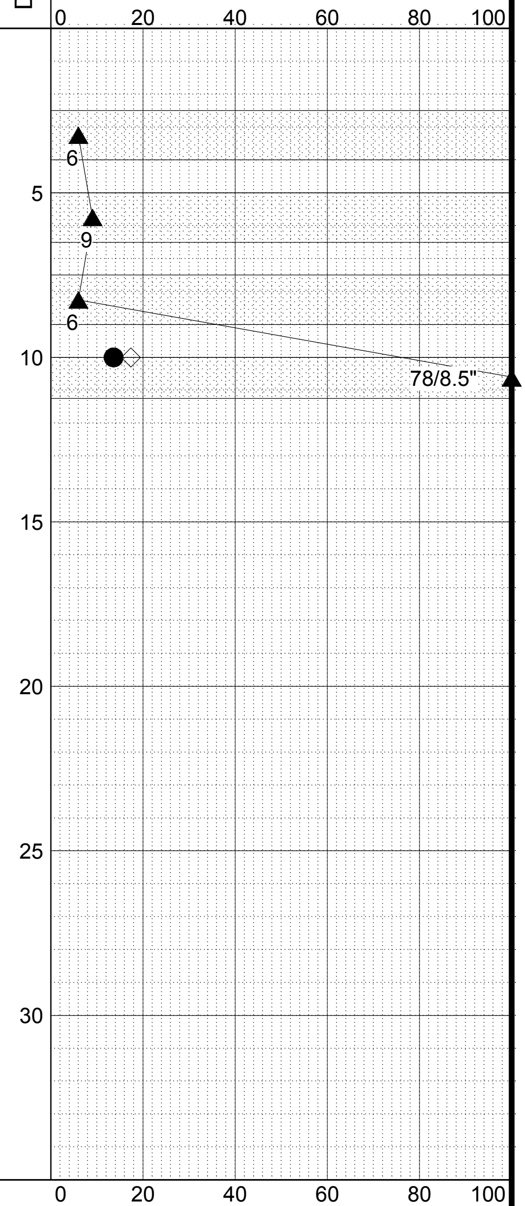
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

Soil Description	Elev. Depth (ft.)	Samples
Poorly Graded Gravel (GP) **FILL**	1.0	
Medium stiff, red-brown, *Silt (ML)*; moist; approx. 10% fine sand; nonplastic to low plasticity.	4.5	S-1
Stiff, red-brown, *Silt (ML)*; moist; approx. 5% fine sand; medium plasticity.	7.0	S-2
Medium stiff, red-brown, *Silt (ML)*; approx. 5% fine, subrounded gravel; approx. 5% fine sand; low plasticity.	9.5	S-3
Very dense, brown, *Silty Sand with Gravel* to *Silty Gravel with Sand (SM/GM)*; moist to wet; fine to coarse, subangular gravel; fine to coarse, subangular sand; low plasticity fines. *Sample collected immediately after performing infiltration test in the augers at 10.0 feet below ground surface.* **CATASTROPHIC FLOOD DEPOSITS GRAVEL FACIES**	11.3	S-4

Completed - November 22, 2013

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: lbs / inches



<u>LEGEND</u>

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Recovery (%)

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├──┤ Liquid Limit

<u>NOTES</u>

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. Group symbol is based on visual-manual identification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

LOG OF BORING B-8

January 2014 24-1-03793-002

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FIG. A2

REV 3

Total Depth:	11.25 ft.	Northing:	~	Drilling Method:	Hollow Stem Auger	Hole Diam.:	7 in.
Top Elevation:	~	Easting:	~	Drilling Company:	Western States	Rod Type:	AWJ
Vert. Datum:	NAVD88	Station:	~	Drill Rig Equipment:	Track WS45	Hammer Type:	Automatic
Horiz. Datum:	NAD83	Offset:	~	Other Comments:	Hammer Efficiency = 74.5%		

SOIL DESCRIPTION

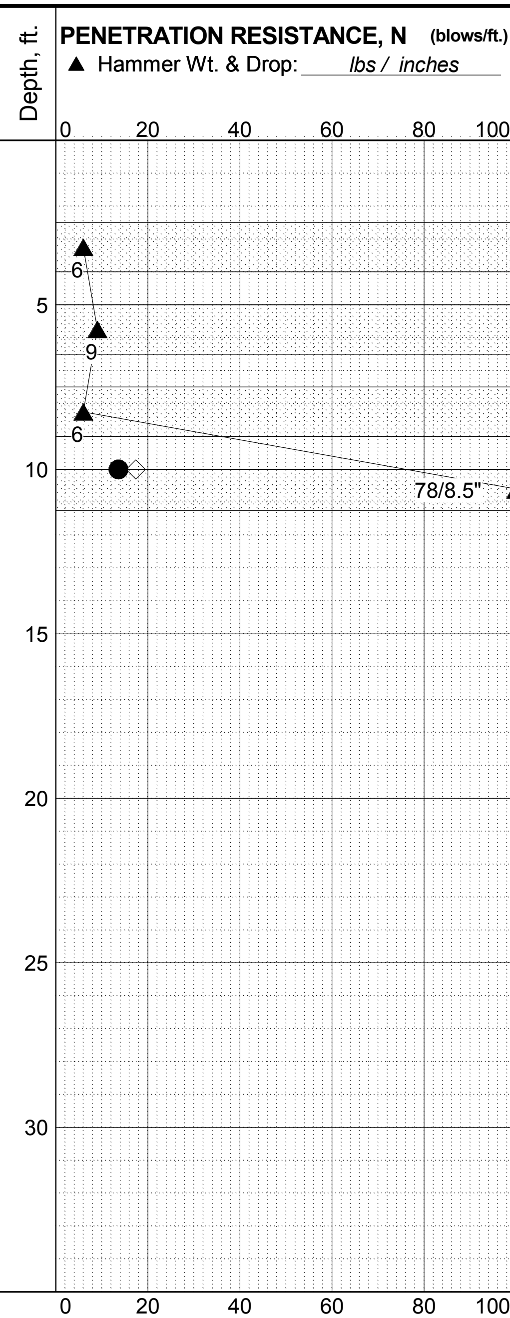
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

Soil Description	Elev. Depth (ft.)	Samples
Poorly Graded Gravel (GP) **FILL**	1.0	
Medium stiff, red-brown, *Silt (ML)*; moist; approx. 10% fine sand; nonplastic to low plasticity.	4.5	S-1
Stiff, red-brown, *Silt (ML)*; moist; approx. 5% fine sand; medium plasticity.	7.0	S-2
Medium stiff, red-brown, *Silt (ML)*; approx. 5% fine, subrounded gravel; approx. 5% fine sand; low plasticity.	9.5	S-3
Very dense, brown, *Silty Sand with Gravel* to *Silty Gravel with Sand (SM/GM)*; moist to wet; fine to coarse, subangular gravel; fine to coarse, subangular sand; low plasticity fines. *Sample collected immediately after performing infiltration test in the augers at 10.0 feet below ground surface.* **CATASTROPHIC FLOOD DEPOSITS GRAVEL FACIES**	11.3	S-4

Completed - November 22, 2013

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: lbs / inches



LEGEND

* Sample Not Recovered

⌶ 2.0" O.D. Split Spoon Sample

Recovery (%)

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├──┤ Liquid Limit

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. Group symbol is based on visual-manual identification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

LOG OF BORING B-8

January 2014 24-1-03793-002

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FIG. A2

REV 3

MASTER_LOG_E_PDX 24-1-03793.GPJ 2013SEALIBRARY.GLB SHAN_WIL.GDT 1/27/14 Log: EJOF Rev: Typ: ATH

Total Depth:	31.5 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	7 in.
Top Elevation:	~	Easting:	~	Drilling Company:	Western States	Rod Type:	AWJ
Vert. Datum:	NAVD88	Station:	~	Drill Rig Equipment:	Track WS45	Hammer Type:	Automatic
Horiz. Datum:	NAD83	Offset:	~	Other Comments:	Hammer Efficiency = 74.5%		

SOIL DESCRIPTION

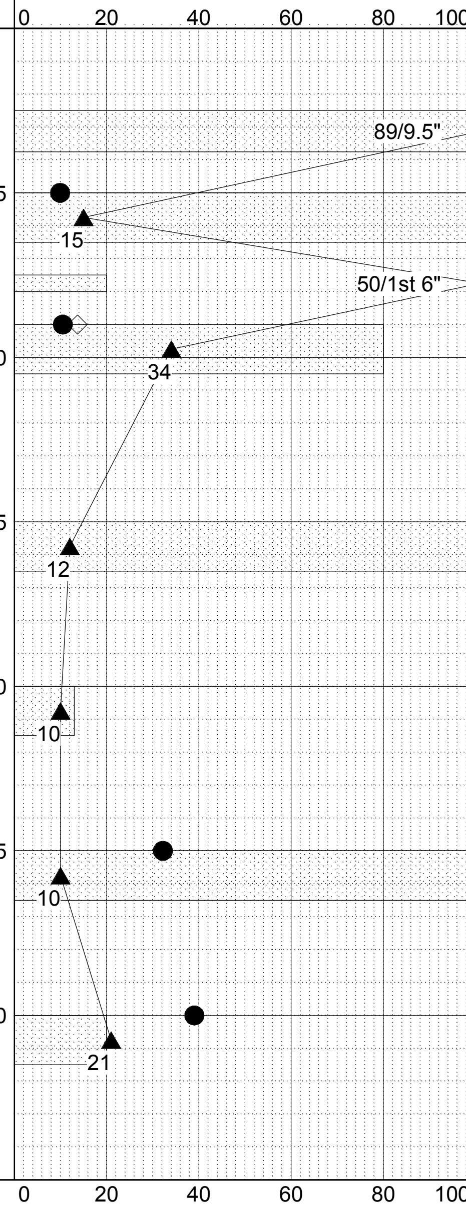
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

Soil Description	Elev. Depth (ft.)	Samples
Hard, brown, *Silt with Sand (ML)*; approx. 15% fine, rounded to subrounded gravel; medium to coarse, subangular sand; low plasticity. **FILL**	4.5	S-1
Medium dense, brown, *Poorly Graded Sand (SP)*; moist; approx. 5% fine, rounded to subrounded gravel; medium to coarse, subangular sand; few nonplastic fines.	8.0	S-2, S-3
Boulders or cobbles.	9.0	
Dense, brown, *Silty Gravel with Sand (GM)*; moist; subrounded to subangular gravel; fine to coarse, subangular sand; low plasticity fines. **CATASTROPHIC FLOOD DEPOSITS GRAVEL FACIES**	12.0	S-4
Medium dense, brown, *Sandy Silt (ML)*; moist to wet; approx. 10% coarse, subrounded gravel; fine to medium, subangular sand; nonplastic to low plasticity. **ANCESTRAL SANDY RIVER DEPOSITS**	18.0	S-5
Stiff, red-brown, *Sandy Silt (ML)*; wet; fine to medium, subangular sand; medium plasticity.	23.0	S-6
Stiff, light gray-brown with red mottling, *Elastic Silt (MH)*; moist; medium plasticity.	28.0	S-7
Very stiff, brown, *Sandy Silt with Gravel (ML)*; wet; fine to coarse, subangular gravel; fine to medium, subangular sand; low to medium plasticity.	31.5	S-8

Completed - November 22, 2013

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

Recovery (%)

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├──┤ Liquid Limit

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. Group symbol is based on visual-manual identification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

LOG OF BORING B-9

January 2014 24-1-03793-002

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FIG. A3

REV 3

Total Depth:	*11.5 ft.*	Northing:	~	Drilling Method:	*Hollow Stem Auger*
Top Elevation:	~	Easting:	~	Drilling Company:	*Western States*
Vert. Datum:	*NAVD88*	Station:	~	Drill Rig Equipment:	*Track WS45*
Horiz. Datum:	*NAD83*	Offset:	~	Other Comments:	*Hammer Efficiency = 74.5%*

Hole Diam.:	*7 in.*
Rod Type:	*AWJ*
Hammer Type:	*Automatic*

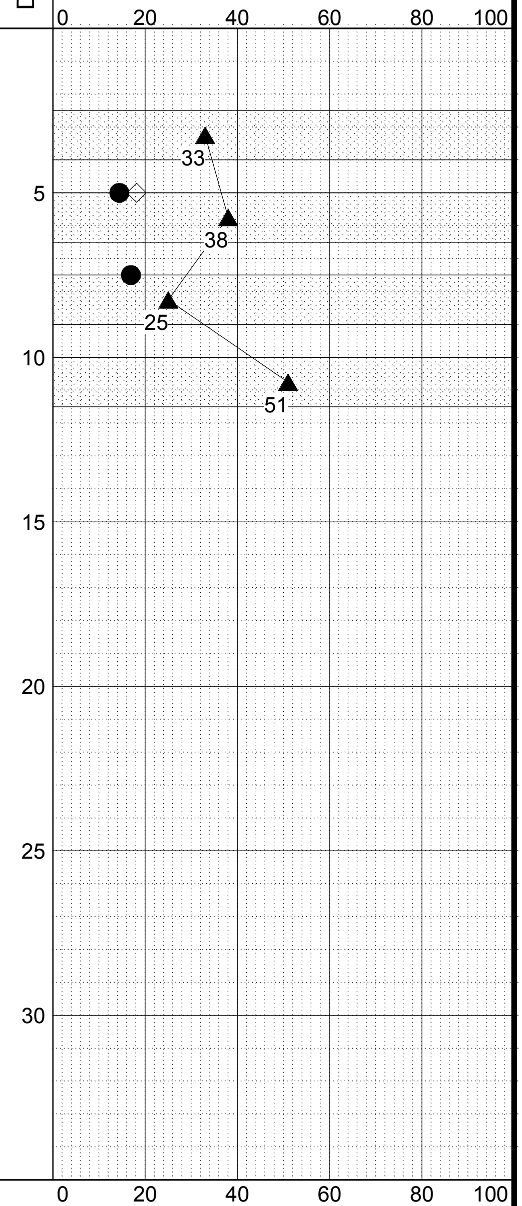
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

Soil Description	Elev. Depth (ft.)	Samples
Dense, brown, *Silty Gravel with Sand (GM)*; moist; coarse, subrounded to subangular gravel; fine to coarse, sand; low plasticity fines. **CATASTROPHIC FLOOD DEPOSITS GRAVEL FACIES**		S-1, S-2
Cobbles	6.5	
Medium dense to very dense, brown, *Silty Gravel with Sand (GM)*; moist; coarse, subrounded to subangular gravel; fine to coarse, subangular sand; low plasticity fines.	7.5	S-3, S-4
Completed - November 21, 2013	11.5	

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



□ Recovery (%)

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├──┤ Liquid Limit

LEGEND

* Sample Not Recovered

Ɪ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. Group symbol is based on visual-manual identification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

LOG OF BORING B-10

January 2014 24-1-03793-002

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FIG. A4

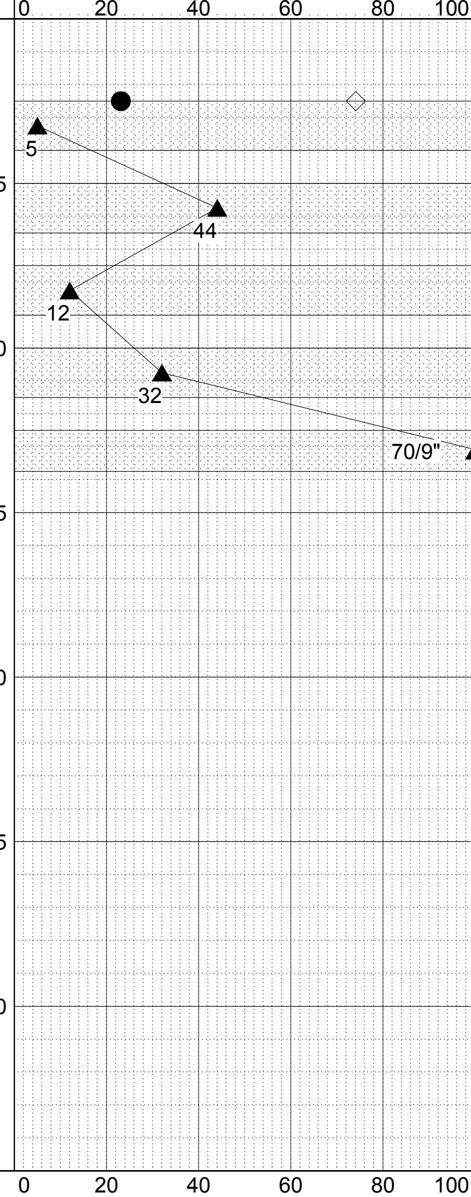
REV 3

Total Depth:	*13.75 ft.*	Northing:	~	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*7 in.*
Top Elevation:	~	Easting:	~	Drilling Company:	*Western States*	Rod Type:	*AWJ*
Vert. Datum:	*NAVD88*	Station:	~	Drill Rig Equipment:	*Track WS45*	Hammer Type:	*Automatic*
Horiz. Datum:	*NAD83*	Offset:	~	Other Comments:	*Hammer Efficiency = 74.5%*		

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	*Elev.* Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.
Soft to medium stiff, red-brown, *Silt with Sand (ML)*; moist; low plasticity fines. **FILL**			S-1		
Dense, brown to red-brown, *Silty Gravel with Sand (GM)*; moist; coarse, rounded to subrounded gravel; fine to coarse, subangular sand; nonplastic fines. **CATASTROPHIC FLOOD DEPOSITS GRAVEL FACIES**	4.5		S-2		5
	7.0		S-3		
Stiff, yellow-brown, *Elastic Silt (MH)*; moist; fine, rounded gravel; medium to high plasticity fines.	10.0		S-4		10
Dense, red-brown, *Silty Gravel with Sand (GM)*; moist; fine to coarse, subrounded gravel; fine to coarse, subrounded to subangular sand; low plasticity fines.	12.5		S-5		
Very dense, red-brown to gray, *Silty Gravel (GM)*; fine to coarse, subrounded to subangular gravel; approx. 10% fine to coarse, subrounded to subangular sand; low plasticity fines. **ANCESTRAL SANDY RIVER DEPOSITS**	13.8				15
Completed - November 20, 2013					20
					25
					30

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



Recovery (%)

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit |——| Liquid Limit

LEGEND

* Sample Not Recovered

⌶ 2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. Group symbol is based on visual-manual identification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

LOG OF BORING B-11

January 2014 24-1-03793-002

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FIG. A5

REV 3

MASTER_LOG_E_PDX 24-1-03793.GPJ 2013SEALIBRARY.GLB SHAN_WIL.GDT 1/27/14 *Log: EJOF Rev: Typ: ATH*

Total Depth:	11.5 ft.	Northing:	~	Drilling Method:	Hollow Stem Auger
Top Elevation:	~	Easting:	~	Drilling Company:	Western States
Vert. Datum:	NAVD88	Station:	~	Drill Rig Equipment:	Track WS45
Horiz. Datum:	NAD83	Offset:	~	Other Comments:	Hammer Efficiency = 74.5%

Hole Diam.: 7 in.
Rod Type: AWJ
Hammer Type: Automatic

SOIL DESCRIPTION

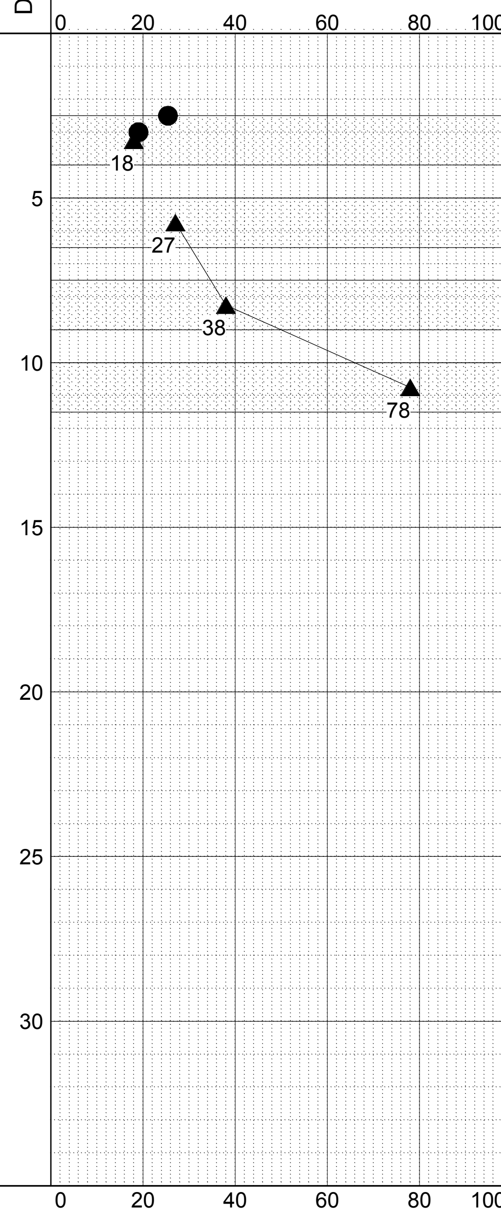
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

Soil Description	Elev. Depth (ft.)	Samples
Soft, brown, *Silt (ML)*; moist; <5% sand; low to medium plasticity. **FILL**	3.0	S-1a
Medium dense, brown, *Silty Gravel (GM)*; moist; fine to coarse, rounded gravel; low to medium plasticity fines.	4.5	S-1b
Medium dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist; coarse, subangular gravel; fine to coarse sand; nonplastic fines. **CATASTROPHIC FLOOD DEPOSITS SAND FACIES**	7.0	S-2, S-3
Dense, brown, *Poorly Graded Sand with Gravel (SP)*; moist; coarse, subrounded gravel; fine sand; trace to few nonplastic fines.	10.5	S-4
Very dense, brown, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; moist; fine, rounded to subrounded gravel; fine sand; nonplastic fines. **CATASTROPHIC FLOOD DEPOSITS GRAVEL FACIES**	11.5	

Completed - November 20, 2013

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



Recovery (%)

● % Water Content

Plastic Limit ├──┤ Liquid Limit

LEGEND

* Sample Not Recovered

2.0" O.D. Split Spoon Sample

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. Group symbol is based on visual-manual identification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

LOG OF BORING B-12

January 2014 24-1-03793-002

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FIG. A6

REV 3

APPENDIX B

LABORATORY TESTING

TABLE OF CONTENTS

FIGURES

APPENDIX B

LABORATORY TESTING

B.1 GENERAL

The soil samples obtained during the field explorations were described and identified in the field in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM D2488. The specific terminology used is presented in Appendix A, Figure A1. The samples were reviewed in the laboratory. The physical characteristics of the samples were noted, and the field descriptions and identifications were modified where necessary in accordance with terminology presented in Appendix A, Figure A1. Representative samples were selected for various laboratory tests. We refined our visual-manual soil descriptions and identifications based on the results of the laboratory tests, using elements of the Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM D2487. The refined descriptions and identifications were then incorporated into the Logs of Borings, presented in Appendix A. Note that ASTM D2487 was not followed in full because it requires that a suite of tests be performed to fully classify a single sample.

The soil testing program included moisture content analyses and particle-size analyses. The testing procedures from our laboratory program are summarized in the following paragraphs. All test procedures were performed by Shannon & Wilson, Inc., in accordance with applicable ASTM International (ASTM) standards.

B.2 SOIL TESTING

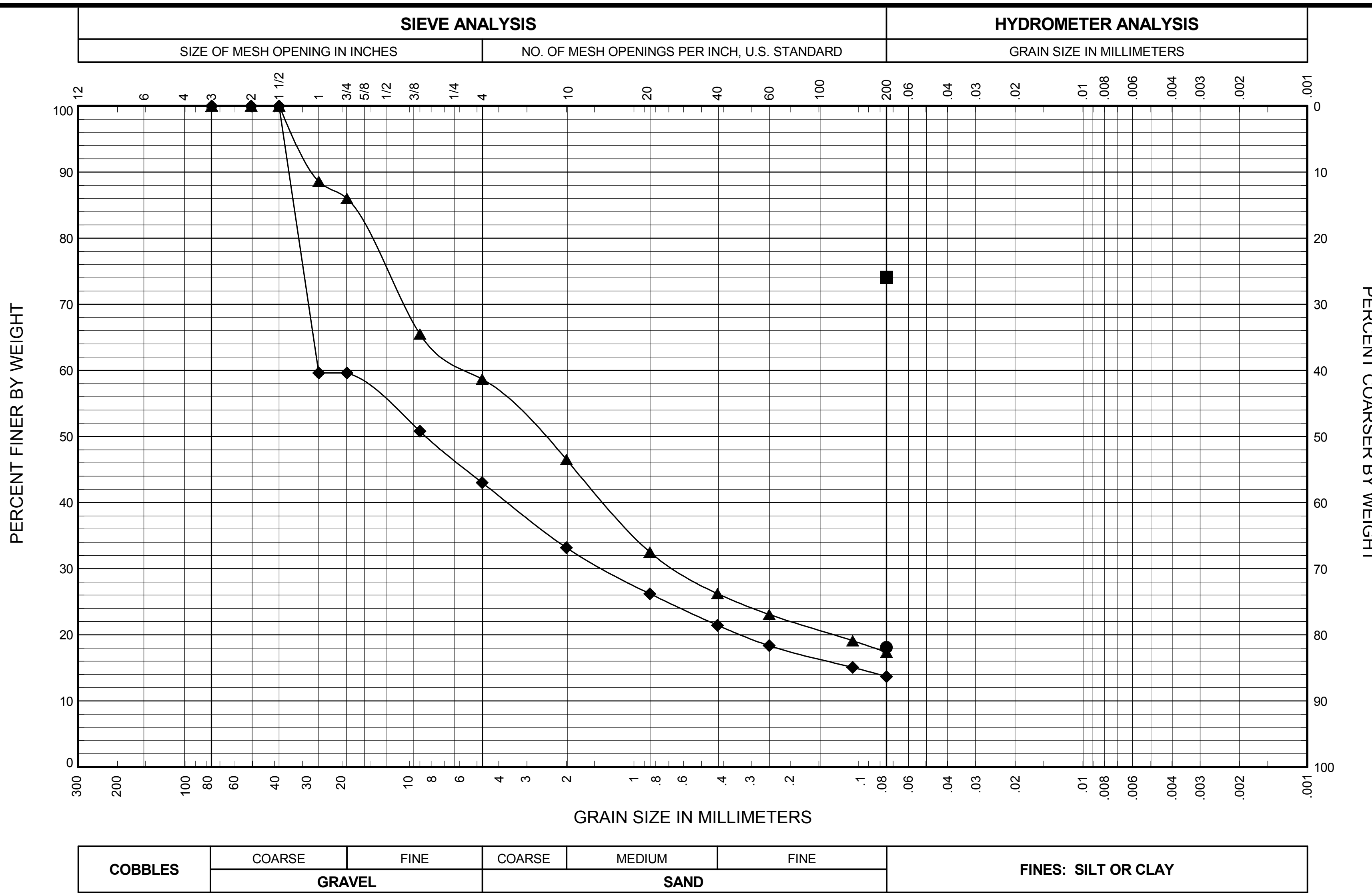
B.2.1 Moisture (Natural Water) Content

Natural moisture content determinations were performed in accordance with ASTM D2216 on selected soil samples. The natural moisture content is a measure of the amount of moisture in the soil at the time the explorations are performed, and is defined as the ratio of the weight of water to the dry weight of the soil, expressed as a percentage. The results of the moisture content determinations are presented graphically in the Logs of Borings in Appendix A.

B.2.2 Particle-Size Analyses

Particle-size analyses were conducted on selected samples to determine their grain-size distributions. Grain-size distributions were determined by sieve analysis in accordance with

ASTM D422. A wet sieve analysis was performed to determine a percentage (by weight) of the sample passing the No. 200 (0.075 mm) sieve. For several samples, the material retained on the No. 200 sieve was shaken through a series of sieves to determine the distribution of the plus No. 200 fraction. For some samples, only the percentage of the sample passing the No. 200 (0.075mm) sieve was determined. Results of the particle-size analyses are presented on Figure B2, Grain Size Distribution. For all particle-size analyses, the percentage of material passing the No. 200 sieve is also shown graphically in the Logs of Borings in Appendix A.



BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-10, S-2	5.0	*GM*	*Silty Gravel with Sand*	-	-	18	14	
■ B-11, S-1	2.5	*ML*	*Silt with Sand*	-	-	74	23	
▲ B-8, S-4	10.0	*SM*	*Silty Sand with Gravel*	41	41	17	14	
◆ B-9, S-4	9.0	*GM*	*Silty Gravel with Sand*	57	29	14	11	

Gresham Vista Business Park - Lots 1-5
Gresham, Oregon

GRAIN SIZE DISTRIBUTION

January 2014 24-1-03793-002

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FIG. B1

NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913 and sieve with hydrometer analyses were performed in general accordance with ASTM D422 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

GSA MAIN PDX 24-1-03793.GPJ SHAN WIL.GDT 1/27/14

FIG. B1

APPENDIX C

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland