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EXHIBIT 11
PAGE 1 OF 90

Geotechnical Engineering Report

60 Percent Draft
NE Woodinville-Duvall Road Improvements
Woodinville, Washington
29 July 2010
Terracon Project No. 81095064

Prepared for:
Otak, Inc.
Kirkland, Washington

Prepared by:
Terracon Consultants, Inc.
Mountlake Terrace, Washington

EXHIBIT 11
PAGE 2 OF 90

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29 July 2010

Otak, Inc.
10230 NE Points Drive
Suite 400
Kirkland, Washington 98033

Attention: Mr. Nico Vanderhorst, PE

Subject: Geotechnical Engineering Report –**60 PERCENT DRAFT**
NE Woodinville-Duvall Road Improvements
Woodinville, Washington
Terracon Project No. 81095064

Dear Mr. Vanderhorst:

Terracon Consultants, Inc. (Terracon) is providing geotechnical engineering services for the above referenced project. These services are being performed in general accordance with our Subconsultant Agreement dated 4 August 2009. This **60 PERCENT DRAFT** report presents the results of the field exploration, laboratory testing, and geotechnical engineering analysis and provides geotechnical engineering conclusions and recommendations regarding the proposed road improvements.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

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James B. Thompson, PE
Senior Principal

David C. Williams, LEG
Senior Engineering Geologist

Distribution: Addressee (1 via email, 1 via mail)

EXHIBIT 11
PAGE 3 OF 96

TABLE OF CONTENTS DRAFT

DRAFT

	Exhibit No.
Appendix A – Field Exploration	
Site Location Plan	A1
Site and Exploration Plans	A2 to A5
Field Exploration Description	A6 & A7
General Notes	A8
Unified Soil Classification	A9
Boring Logs (B-1 through B-16)	
Test Pit Logs (TP-1 through TP-6)	
Appendix B – Laboratory Testing	
Laboratory testing description	B1 & B2
Grain size distribution plots	B3 to B11
California Bearing Ratio	B12

EXECUTIVE SUMMARY

A geotechnical engineering evaluation has been performed to support design efforts for the NE Woodinville-Duvall Road Improvements project in Woodinville, Washington. Terracon's geotechnical scope of services included a field exploration, laboratory testing, geotechnical engineering analysis, and preparation of this report.

Based on the information obtained from our exploration and analysis, implementation of the proposed improvements is feasible from the geotechnical perspective, in our opinion. The following geotechnical considerations were identified:

Subsurface conditions: The site is characterized by fill material of varied composition and density above native outwash deposits and glacial till. Groundwater was observed at seven of the boring and test pit locations on the date of exploration. Groundwater depths ranged from approximately 7.5 to 20 feet below grade.

Existing pavement conditions: The pavement section west of approximately Station 30+95 consists of asphalt concrete; we observed asphalt depths of approximately 9 to 19 inches at the two borings advanced in this area. The pavement between approximately Station 30+95 and Station 45+15 includes asphaltic concrete above Portland cement concrete. We observed asphalt thicknesses of approximately 3 to 9.25 inches and concrete thicknesses of 6 to 8 inches at the explorations completed along this interval. The existing pavement is considered to be in a serviceable condition and adequate for overlaying provided that conventional crack sealing and deficiency restoration is completed prior. We did not observe evidence of significant road section settlement.

Fill wall considerations: Construction of geogrid-reinforced fill embankments with concrete block facings is considered feasible from the geotechnical perspective. However, the presence of loose and/or organic soils of variable depth along some of the wall alignments will require wall subgrade improvements in order to reduce the likelihood of wall settlement and instability. Additional exploration is recommended as the project design proceeds.

Cut wall considerations: The construction of soldier pile walls at the cut locations is considered feasible from the geotechnical perspective, based upon the explorations completed to date. Additional exploration is recommended as the project design proceeds.

Structure foundations: It will be feasible to support the proposed surface water management structures above the native granular soils that are at least medium dense using conventional shallow spread footing foundations and concrete slabs. The presence of loose fill material at the location of the western storm water structures will require excavation of the fill and the

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placement of structural fill to provide adequate support for the structures. Alternatively, the structures could be supported on pin piling.

This geotechnical executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, the installation of drainage provisions, and other geotechnical conditions exposed during construction.

GEOTECHNICAL ENGINEERING REPORT
60 PERCENT DRAFT
NE WOODINVILLE-DUVALL ROAD IMPROVEMENTS
WOODINVILLE, WASHINGTON

Terracon Project No. 81095064
29 July 2010

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services for the NE Woodinville-Duvall Road Improvements project in Woodinville, Washington. Topics addressed in this report include:

- Surface and subsurface conditions
- Earthwork
- Retaining walls
- Traffic signal pole foundations
- Structure foundations
- Groundwater conditions
- Erosion control
- Surface and subsurface drainage
- Pavement support
- Recommendations for additional study

Our geotechnical engineering scope of services for this project included completing a reconnaissance of surface conditions, subsurface explorations, groundwater monitoring, laboratory testing, geotechnical engineering analysis, and preparation of this report. The project site is shown on the Site Location Plan, Exhibit A1. Approximate exploration locations are shown on the Site and Exploration Plans, Exhibits A2 through A5. Descriptive logs of the explorations are included in Appendix A of this report. Laboratory testing procedures and results are presented in Appendix B.

2.0 PROJECT INFORMATION

2.1 Project Description

The project site encompasses NE Woodinville-Duvall Road from 156th Avenue NE at the west to 168th Avenue NE at the east, a distance of approximately 4,000 feet. We understand that the project may be continued to the east of 168th Avenue NE, but our authorized scope of services does not include evaluating conditions to the east of 168th Avenue NE. The proposed improvements will provide three vehicular travel lanes along with a bike lane, landscaping strip, and sidewalk along the project length. Road widening will require the construction of both cut and fill retaining walls. The proposed finished grade is a few inches above existing grades.

New traffic signalization poles will be constructed at three intersections, and storm water system improvements will include below-grade structures near the west and east ends of the project and a new storm sewer extending along the south side of the eastbound lane.

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The project site comprises NE Woodinville-Duvall Road between 156th Avenue NE and 168th Avenue NE in Woodinville, Washington
Section, Township, Range	SE ¼ Section 2 & S ½ Section 1, T26N, R5E
Adjacent site features	Both developed residential and commercial properties
Current ground cover	Residential and commercial landscaping, mature trees
Existing topography	Elevations range from 438 feet at the west to 328 feet at the east

Note: Site features and ground surface elevations described in this report are based upon a topographic site plan, dated January 2010, provided by Otak, Inc.

3.0 SITE CONDITIONS

3.1 General Surface Conditions

The project alignment is a straight road segment with six major intersections (156th Avenue NE, Old NE Woodinville-Duvall Road, 160th Avenue NE, the future 162nd Avenue NE, 167th Avenue NE, and 168th Avenue NE. There are also multiple driveways intersecting the road. Developed commercial property borders the north side of the road from the western project limits to about Station 21+00. A surface water management pond is located to the north of the road between approximately Stations 21+50 and 23+00. A tall undeveloped cut slope with an inclination of approximately 1.5H:1V (Horizontal:Vertical) extends to the south of the road along this same interval. The balance of the alignment is bordered by residential properties.

The road grade descends from about elevation 436 feet to 374 feet between 156th Avenue NE at the west and 160th Avenue NE (Station 12+50 to Station 26+00), while the elevation drops approximately 50 feet over the remaining portion of the alignment. The road crosses a substantial fill embankment above Cold Creek between roughly Stations 21+50 and 25+50. The embankment is approximately 20 feet tall on the south side of the road, inclined at approximately 1.4H:1V to 1.6H:1V, and is mantled with nominal 12-inch angular rock.

With the exception of a low rising cut slope between approximately Stations 28+30 and 30+15, grades within the road prism generally descend toward the south to the adjacent properties. The grade transitions generally consist of slopes, although there is a segmental block retaining wall adjacent to the bus lane located just east of 160th Avenue NE. A second wall (large block gravity wall) is located a short distance west of 168th Avenue NE at the east end of the project. These

walls are in a serviceable condition and lack evidence of significant settlement or lateral displacement. The descending slopes lack evidence of significant surface water erosion or slope instability. A leg of Cold Creek flows in an easterly direction relatively close to the south side of the road between 167th Avenue NE and 168th Avenue NE. The creek then enters a culvert and flows to the east of 168th Avenue NE.

Grades to the north of the road vary, and include at-grade intervals, rising cut slopes that approach 10 feet in height, and descending slopes associated with filled drainages; these low areas are located in association with the existing storm drain at approximately Station 40+25, and a depression between approximately Stations 49+00 and 50+65. The cut slopes lack evidence of significant surface water erosion or slope instability. A low segmental block retaining wall is located along a cut slope between approximately Stations 26+65 and 26+95. The wall is in a serviceable condition and lacks evidence of significant settlement or lateral displacement.

3.1.1 Road Surface Conditions

The road surface consists of asphaltic concrete pavement. The road surface is in a serviceable condition from the west end of the project eastward to approximately Station 30+95, exhibiting very minor blemishes such as tarred and sealed joints.

From approximately Station 30+95 to 45+15, the roadway is in a serviceable condition but exhibits surface irregularities. We observed extensive transverse and linear reflection cracking of the road surface from underlying concrete panels. The extent of the reflection cracking appears to indicate that the concrete panels underlie the section of the roadway between the existing fog lines. We observed scattered potholes and rough surface conditions of the asphalt pavement that appear to be in association with apparent reflection cracking.

From approximately Station 45+15 to the east extent of the project at 168th Avenue NE, we observed pavement conditions similar to those noted at the west end of the alignment with the exception of a localized area of fatigue cracking observed in the westbound travel lane from approximately Station 45+25 to 45+85.

3.2 Site Geology

Published geologic maps indicate that the site uplands consist of Vashon advance outwash and Vashon lodgement glacial till while alluvial soils are present along drainages. The developed nature of the site also suggests the presence of fill material associated with construction of the roads and utility infrastructure. The subsurface explorations and our surface mapping confirmed the presence of the mapped soil units.

3.3 Subsurface Conditions

Subsurface conditions presented in this report are based on the subsurface conditions encountered at specific exploration locations and surface observations. Variations in

subsurface conditions may exist between the exploration locations and the nature and extent of variations between the explorations may not become evident until construction. If variations then appear, it may be necessary to reevaluate the recommendations of this report.

It should be noted that the subsurface conditions described below for proposed retaining wall locations may not be representative of conditions along the entire length of the walls. The explorations along the walls were generally spaced at relatively lengthy intervals and variations in subsurface conditions along the wall alignments may be disclosed by additional exploration or during construction.

Subsurface conditions as disclosed by specific explorations are summarized in the sections below. Please note that although we observed cobbles at only some of the exploration locations, and did not observe boulders at the exploration locations, it is not uncommon for cobbles and boulders to be present within the glacial deposits that underlie the site. Similarly, it should be noted that the composition and density of fill material may vary significantly over relatively short distances.

3.3.1 Signal Poles

Borings B-1, B-6, and B-16 were advanced for planned signal pole improvements located at the intersections of NE Woodinville-Duvall Road and 156th Avenue NE, 160th Avenue NE, and 168th Avenue NE, respectively. Borings B-1 and B-6 generally disclosed approximately 5 feet of loose to medium dense, silty sand to silty, gravelly sand (both fill and native soils). Below a depth of 5 feet, the soils graded to dense to very dense. Groundwater was observed at a depth of 11 feet at the boring B-1 location while drilling and at a depth of 14.8 feet in March 2010. Groundwater was not observed in the observation well installed at the boring B-6 location in March 2010.

Boring B-16 at 168th Avenue NE disclosed approximately 10 feet of loose to medium dense, silty sand (fill). Below approximately 10 feet, the soils graded to medium dense sand with gravel and trace silt and then graded to very dense conditions below 14 feet. Groundwater was not observed in boring B-16 at the time of drilling.

3.3.2 Roadway Borings

Borings B-2, B-7, B-8, B-10, and B-13 were advanced in order to evaluate existing roadway pavement sections and subgrade conditions. Borings B-8 and B-10 were drilled in areas where concrete roadway panels were anticipated based upon reflection cracking observed at the surface. These borings indicated 3.5 to 4 inches of asphalt pavement underlain by 7.5 to 8 inches of concrete. Loose silty, gravelly sand ranging in depth from approximately 2 to 5.5 feet was observed below the concrete; the loose material was fill. Underlying soils graded to medium dense to dense sand and silty gravelly sand to the maximum depth explored of 6.5 feet. Groundwater was not observed in these shallow borings at the time of drilling.

Borings B-2 and B-7 were advanced in the western half of the alignment where concrete panels were not believed to be located, based upon the lack of surficial reflection cracking. Asphalt thicknesses observed were 9 to 9.5 inches at boring B-2 and 19 inches at boring B-7. Dense to very dense gravelly sand with varying amounts of silt was observed below the asphalt pavement to the maximum depth explored of 6.5 feet. Groundwater was not observed in these shallow borings at the time of drilling.

Boring B-13 was advanced in the asphalt paved shoulder of the roadway adjacent to an area where concrete panels are anticipated to exist below the travel lanes; linear cracking along the travel lane edge suggests that the shoulders may not be underlain by concrete. Boring B-13 confirmed this, disclosing approximately 6 to 7 inches of asphalt pavement underlain by medium dense to dense silty, gravelly sand to the maximum depth of exploration at 6.5 feet. Groundwater was not observed in this shallow boring at the time of drilling.

3.3.3 Western Surface Water Management Pond

Boring B-3 was advanced to a depth of 21.5 feet on the northwest side of the existing pond located on the northeast corner of the intersection of NE Woodinville-Duvall Road and Old NE Woodinville-Duvall Road. Conditions observed in this boring indicate loose sand with silt and trace gravel (fill) from the surface to a depth of approximately 15 feet; the soils graded to medium dense sand from 15 to 17 feet. Medium dense, wet to saturated silty sand with trace gravel was observed to the maximum depth explored. Groundwater was observed at approximately 18 feet while drilling. The observation well installed at the boring B-3 location was dry when it was checked in March 2010.

3.3.4 Proposed Fill Wall STA 21+64 to STA 25+62 (south side)

We completed borings B-4 and B-5 in order to evaluate the condition of the existing roadway embankment in this area relative to the 2 to 3-foot high retaining wall proposed for this location. Boring B-4 was advanced to a depth of approximately 26.5 feet and disclosed approximately 24 feet of silty, gravelly sand in a very loose to loose condition interpreted as fill. Medium dense, silty sand with gravel was observed below a depth of 24 feet to the maximum depth explored. Groundwater was observed at a depth of approximately 20 feet at boring B-4 at the time of drilling. Boring B-5 was advanced to a depth of 11.5 feet and disclosed approximately 5 feet of loose, silty, gravelly sand interpreted as fill; this material was underlain by approximately 3 feet of additional fill in a medium dense condition. Below the fill, mottled tan-brown-gray, silty, gravelly sand in a medium dense condition interpreted as native material was observed to the maximum depth explored. Groundwater was not observed while advancing boring B-5.

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3.3.5 Proposed Cut Wall from STA 28+27 to STA 30+13 (south side)

Test pit TP-1 disclosed approximately 8 inches of loose organic-rich topsoil above medium dense silty gravelly sand to a depth of approximately 3 feet.

3.3.6 Proposed Cut Wall from STA 26+38 to STA 30+28 (north side)

Test pit TP-2 disclosed approximately 8 inches of loose organic-rich topsoil above medium dense silty gravelly sand to a depth of approximately 3 feet.

3.3.7 Proposed Fill Wall from STA 33+53 to STA 34+58 (south side)

Boring B-9 was advanced in order to evaluate subgrade conditions for a planned 2 to 4-foot tall fill wall on the south side of the road. Boring B-9 was advanced to a depth of 11.5 feet and disclosed medium dense grading to very loose silty sand with varying amounts of gravel and organics (fill) to a depth of approximately 7.5 feet. Loose to medium dense silty sand was encountered below the fill. Groundwater was observed at approximately 9 feet at the time of drilling.

3.3.8 Proposed Fill Wall from STA 35+53 to STA 36+33 (south side)

Test pit TP-3 disclosed 1.5 feet of loose to medium dense silty gravelly sand with small roots above medium dense gravelly silty sand that extended to a depth of approximately 3 feet below grade.

3.3.9 Proposed Fill Wall at STA 37+93 to STA 40+50 (south side)

Boring B-11 was advanced to a depth of 11.5 feet in the paved shoulder to evaluate subgrade conditions for the proposed 2.5 to 6 foot tall retaining wall. Boring B-11 disclosed approximately 3 inches of asphalt pavement over approximately 10 feet of very loose to loose silty sand with trace gravel (probable fill). We observed medium dense, saturated silty sand with trace gravel below 10 feet. Groundwater was observed at a depth of approximately 7.5 feet at the time of drilling.

3.3.10 Proposed Fill Wall at STA 39+88 to STA 40+64 (north side)

Boring B-12 was advanced to a depth of 11.5 feet to evaluate subgrade conditions for the proposed 4-foot tall retaining wall. The boring disclosed very loose silty sand with trace gravel and organics interpreted as fill to a depth of approximately 7.5 feet. Medium dense silty sand was observed below 7.5 feet. Groundwater was observed at a depth of approximately 8.5 feet at the time of drilling.

3.3.11 Proposed Cut Wall from STA 41+93 to STA 43+14 (north side)

Test pits TP-4 and TP-5 disclosed similar conditions along the proposed cut wall alignment: approximately 1.5 feet of loose to medium dense silty gravelly sand with small roots above medium dense silty gravelly sand.

3.3.12 Proposed Cut Wall from STA 44+23 to STA 45+14 (north side)

No explorations were completed along this proposed cut wall location.

3.3.13 Proposed Fill Wall at STA 45+14 to STA 47+70 (south side)

Boring B-14 was advanced to evaluate subgrade conditions for the proposed 2 to 5-foot tall retaining wall. Boring B-14 disclosed approximately 6 feet of medium dense grading to very loose sand with silt and silty sand fill. A probable relic topsoil horizon consisting of loose, silty sand with organics was observed at a depth of approximately 6 to 7 feet. Underlying the topsoil horizon from a depth of 7 to 12 feet, medium dense to very dense sand with gravel was observed. From a depth of 12 feet to the maximum depth explored of 15 feet, very dense gravelly sand with trace silt was observed. Groundwater was observed at a depth of approximately 9.5 feet at the time of drilling.

3.3.14 Proposed Fill Wall from STA 49+95 to STA 51+91 (south side)

Test pit TP-6 was completed to evaluate subgrade conditions at the toe of the existing ecology block wall on the south side of NE Woodinville-Duvall Road at the east end of the alignment. We observed approximately 2 feet of embedment of the lowest exposed ecology block. Soil conditions observed in this test pit included approximately 4 inches of forest duff over 14 inches of very loose to loose gravelly sand interpreted as fill. Medium dense gravelly sand fill extended to a depth of about 2.8 feet. Below 2.8 feet, silty sand to silty, gravelly sand in a loose to medium dense condition was observed to the maximum depth explored of 5.5 feet.

3.3.15 Proposed Surface Water Structure at STA 47+73 to STA 48+05

We completed boring B-15 approximately 140 feet east of the proposed location of a below-grade surface water structure. Boring B-15 was advanced in the existing roadway and disclosed approximately 9.25 inches of asphalt pavement underlain by 2.5 feet of very dense, silty, gravelly sand fill. A probable concrete panel, approximately 8 inches thick, was encountered at a depth of 3.3 feet. Below the concrete panel, approximately 2.5 feet of medium dense silty sand with trace gravel was observed. This material was underlain by very dense silty, gravelly sand extending to the maximum depth explored of 21.5 feet. Groundwater was not observed at the time of drilling.

Boring B-14 was advanced approximately 100 feet west of the proposed structure location. Boring B-14 disclosed approximately 6 feet of medium dense grading to very loose sand with silt and silty sand fill. A probable relic topsoil horizon consisting of loose, silty sand with organics was observed at a depth of approximately 6 to 7 feet. Underlying the topsoil horizon from a depth of 7 to 12 feet, medium dense to very dense sand with gravel was observed. From a depth of 12 feet to the maximum depth explored of 15 feet, very dense gravelly sand with trace silt was observed. Groundwater was observed at a depth of approximately 9.5 feet at the time of drilling.

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Conditions observed at the exploration locations are summarized in the table below.

Exploration	Location (Project station and offset in feet left or right of centerline)	Approx. ground surface elevation (feet)	Approx. fill depth (feet)	Approx. groundwater depth at time of drilling (feet)	Observed pavement thickness (inches) and type
B-1	STA 12+12, 40L	437	3.2	11	NE
B-2	STA 17+64, 12L	404	NE	NE	9 to 9.5 AC
B-3	STA 21+60, 98L	383	17	18	NE
B-4	STA 24+10, 27R	374	24	20	NE
B-5	STA 24+87, 27R	373	8	NE	NE
B-6	STA 25+85, 40R	371	5	NE	NE
B-7	STA 27+90, 2L	372	NE	NE	19 AC
B-8	STA 31+63, 8R	363	2	NE	3.5 to 4 AC 7.5 to 8 PCC
B-9	STA 34+04, 22R	352	7.5	9	NE
B-10	STA 37+21, 9R	348	5.5	NE	3.5 to 4 AC 7.5 to 8 PCC
B-11	STA 39+23, 17R	347	10	7.5	3 AC
B-12	STA 40+17, 23L	344	7.5	8.5	NE
B-13	STA 42+25, 15R	346	NE	NE	6 to 7 AC
B-14	STA 46+62, 18R	334	6	9.5	NE
B-15	STA 49+43, 3L	327	3.25	NE	9.25 AC 8 PCC at 3.25 feet
B-16	STA 51+48, 28L	326	10	NE	NE
TP-1	STA 29+42, 17R	373	NE	NE	NE
TP-2	STA 29+40, 26L	374	NE	NE	NE
TP-3	STA 36+13, 25R	353	NE	NE	NE
TP-4	STA 42+14, 25L	350	NE	NE	NE
TP-5	STA 42+85, 25L	351	NE	NE	NE
TP-6	STA 51+41, 34R	321	2.8	NE	NE

AC: Asphaltic Concrete pavement
PCC: Portland Cement Concrete pavement
NE: Not encountered

EXHIBIT 11
PAGE 15 OF 90

3.4 Groundwater

Groundwater conditions observed at the boring and test pit explorations while drilling or excavating are summarized on the preceding table. It should be noted that groundwater conditions may fluctuate due to seasonal precipitation variations, site use, irrigation, and other factors. Groundwater observation wells were installed at the locations of borings B-1, B-3, B-4, and B-15. Groundwater measurements made while drilling and subsequent to installation of the wells are summarized in the table below.

Exploration	Approx. ground surface elevation (feet)	Approx. groundwater depth at time of drilling (feet)	Approx. groundwater depth (feet) /date
B-1	437	11	14.8 / 15 March 2010
B-3	383	18	NE (dry well) / 15 March 2010
B-4	374	20	19.3 / 15 March 2010
B-15	327	NE	NM

NE: Not Encountered, NM: Not Measured on referenced date

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on our subsurface exploration program and associated research, we conclude that the proposed roadway improvements are feasible from a geotechnical standpoint, contingent on proper design and construction practices. The undisturbed native granular soils that are at least medium dense will be adequate for support of pavements, below grade structures, utilities, and the proposed retaining walls. However, subgrade improvements appear warranted in several areas due to the presence of loose and/or organic soils.

Geotechnical engineering recommendations for foundation and retaining wall systems and other earthwork related phases of the project are outlined below. The recommendations contained in this report are based upon the results of the field exploration and laboratory testing (which are presented in Appendices A and B), engineering analyses, and our current understanding of the proposed project. ASTM and WSDOT Specification codes cited herein respectively refer to current manuals published by the American Society for Testing and Materials and the 2010 edition of the Washington State Department of Transportation *Standard Specifications for Road, Bridge, and Municipal Construction* (Publication M41-10), respectively.

4.2 Earthwork

This section presents recommendations for site preparation, subgrade preparation, and placement of structural fill. The recommendations presented later in this report for design and construction of foundations, walls, and other improvements are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by a qualified geotechnical engineer, or their representative. Evaluation of earthwork should include observation and testing of structural fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

As the first step in site preparation, temporary erosion and sediment control measures (TESC) should be installed in accordance with the approved plans. Following clearing and grubbing, any organic-rich topsoil will need to be stripped from pavement areas, wall and structure subgrades, and areas to receive structural fill. Surficial organic-rich topsoil on the order of up to 6 inches thick was observed at the exploration locations; this thickness should be expected to vary along the alignment. The topsoil should be removed and should not be used as structural fill. Localized areas of deeper organics, such as root systems, may be encountered within the project right-of-way and should likewise be removed. Any excavations that extend below finish grades should be backfilled with structural fill as outlined subsequently in this report.

4.2.2 Subgrade Preparation

The recommendations for subgrade preparation presented below are based upon observed subsurface conditions and the proposed improvements.

Fill Walls - General

Several fill walls are planned along the roadway alignment. As summarized in the table below, we observed varying depths of loose and/or organic subgrade materials at the fill wall locations.

Proposed fill wall location	Approximate proposed wall height (feet)	Approximate depth of loose and/or organic subgrade soil (feet)	Exploration at or near wall location
STA 21+64 to STA 25+62 (south side)	2 to 3	5.5 (B-5) to 24 (B-4)	B-4 and B-5
STA 33+53 to STA 34+58 (south side)	2 to 4	7.5	B-9
STA 35+53 to STA 36+33 (south side)	2 to 4	1.5	TP-3

Proposed fill wall location	Approximate proposed wall height (feet)	Approximate depth of loose and/or organic subgrade soil (feet)	Exploration at or near wall location
STA 37+93 to STA 40+50 (south side)	2.5 to 6	10	B-11
STA 39+88 to STA 40+64 (north side)	4	7.5	B-12
STA 45+14 to STA 47+70 (south side)	2 to 5	7	B-14
STA 49+95 to STA 51+91 (south side)	2 to 6	4.3	TP-6

It is our understanding that the fill walls will be constructed of pre-cast concrete blocks (Mesa, Keystone, or Alan wall systems are under consideration) and that Otak will design the walls. Geogrid reinforcement of the fill embankments will likely be incorporated into the taller wall sections. Current plans consider that the sidewalks will be constructed directly above the walls. Construction of the proposed fill walls above the existing loose and/or organic soils presents the potential for settlement. We recommend removing the loose and/or organic soils as part of subgrade preparation for the fill wall construction. The excavations should extend sufficiently deep to remove the unsuitable soils and to expose at least medium dense native soils. The excavations may then be backfilled with compacted structural fill placed in accordance with the recommendations presented in Section 4.2.3. We recommend extending the excavations laterally back into the road section a distance equal to the width of the walls, drainage systems, and geogrid-reinforced fill zones, as well as laterally in front and back of the wall a distance equal to the depth of excavation. **This will result in excavations that will extend beyond the current right-of-way.**

The proposed fill walls are located very close to the right-of-way limits and excavation of the unsuitable subgrade materials may present an unstable condition. If unstable conditions develop, we recommend backfilling the excavations with either lean mix concrete or quarry spalls that are tamped to a firm condition with an excavator bucket. These procedures would facilitate relatively rapid backfilling of the excavations.

Another alternative for wall subgrade improvement could include the installation of GeoPier rammed aggregate piers along the fill wall alignments where excavation of the unsuitable subgrade soils is not considered feasible. However, it should be noted that installation of the GeoPiers entails significant vibration and this may be problematic given the proximity of occupied residential dwellings adjacent to the road.

It may be necessary to provide temporary excavation shoring to support the cuts until they are backfilled. The selection of temporary shoring should be made the responsibility of the contractor. We recommend requiring the contractor to submit temporary shoring plans to the design team for review at least two weeks prior to scheduled use.

Fill Wall - Existing Embankment at Cold Creek Crossing

We observed the existing conditions of the large embankment at the crossing of Cold Creek near Station 24+00. We also understand that a 2 to 3 ft high fill wall is planned along the existing embankment from Station 21+64 to Station 25+62. Explorations performed in this area disclosed very loose to medium dense fill soils to a depth of approximately 24 feet.

We completed a stability analysis of the south side embankment based on conditions disclosed by boring B-4. We analyzed the slope to assess the potential for shallow failure of the outer portion of the fill embankment as well as a deeper failure, under the static condition and also under seismic loading. We derived a factor of safety of 1.4 for a deep failure condition in the static condition. The WSDOT Geotechnical Design Manual (GDM) recommends a factor of safety of 1.25. We calculated a factor of safety of 1.1 for the shallow failure case in the static condition. The GDM recommends a factor of safety of 1.25; the shallow failure case does not meet the GDM factor of safety recommendation. The GDM recommends a factor of safety of 1.1 for the seismic loading condition. We calculated a factor of safety of less than 1 for both the shallow and deep failure conditions. Please note that the existing soil conditions may also lead to soil liquefaction under seismic loading conditions.

The slope stability analysis indicates that under static conditions the fill embankment meets the GDM stability recommendation for the deep failure condition, but does not meet the GDM recommendations for the shallow failure condition. It will be necessary to implement ground improvement in order to improve the factor of safety and reduce the potential for settlement of the proposed fill wall above the embankment. It is our understanding that the project may include replacement of the existing Cold Creek culvert below the embankment. This may present an opportunity to regrade the embankment and improve stability and reduce the potential for settlement of the fill wall.

Pavement Subgrade Preparation

We understand that construction of the travel surface will likely include grinding the existing pavement and placing a Hot Mix Asphalt (HMA) overlay. However, some new pavement will be required along the sides of the road where the new travel lanes will extend beyond the existing pavement. We recommend preparing the widened road sections per the applicable requirements of the WSDOT *Standard Specifications*. Please note that portions of the site are characterized by loose fill material at elevations consistent with the future pavement section subgrade elevation. Improvement or replacement of the existing loose fill material may require subgrade preparation measures that are more extensive than those described in the WSDOT *Standard Specifications*, depending upon the requirements of the pavement design.

EXHIBIT 11
PAGE 20 OF 90

Terracon

DRAFT

4.2.3 Structural Fill

All structural fill should be placed in accordance with the recommendations presented herein. Structural fill includes any material placed below foundations and pavement sections, within utility trenches, and behind retaining walls. Prior to the placement of structural fill, all surfaces to receive fill should be prepared as previously recommended in the *Site Preparation* and *Subgrade Preparation* sections of this report.

Based on our review of the current grading plans, we anticipate a small quantity of soils generated from proposed cuts will be available for reuse as structural fill. However, we expect a majority of fill required for the roadway alignment and retaining walls will be imported.

The suitability of soil for use as structural fill will depend on the time of year, the moisture content of the soil, and the fines content (that portion passing the US No. 200 sieve) of the soil. As the amount of fines increases, the soil becomes increasingly sensitive to small changes in moisture content. Soils containing more than about 5 percent fines cannot be consistently compacted to the appropriate levels when the moisture content is more than approximately 2 percent above or below the optimum moisture content (per ASTM D1557). Optimum moisture content is that moisture content which results in the greatest compacted dry density when using a specified compactive effort.

It is our opinion that the native non-organic soils encountered on the site are suitable for reuse as structural fill from a compositional standpoint. However, depending on the time of year that earthwork is completed, drying or wetting of these soils may be required prior to compaction. Topsoil derived from stripping activities should only be used in landscaping areas or wasted from the site.

We recommend that imported structural fill for raising site grades meet the requirements of Section 9-03.14(1) *Gravel Borrow* of the WSDOT Standard Specifications. During wet weather, higher quality structural fill might be required, as *Gravel Borrow* may contain sufficient fines to be somewhat moisture sensitive. Imported structural fill used during wet weather should meet the requirements of *Gravel Borrow* as referenced above but the fines content should be limited to 5 percent based on the soil fraction passing the ¾ inch sieve.

4.2.4 Fill Placement and Compaction Recommendations

We recommend that structural fill compaction comply with Method C as described as described in WSDOT Specification 2-03.3(14)C *Compacting Earth Embankments*. We recommend that a geotechnical engineering representative be present during grading so that an adequate number of density tests may be conducted as structural fill placement occurs. In this way, the adequacy of the earthwork may be evaluated as it proceeds.

4.2.5 Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the improvements. Infiltration of water into utility trenches or foundation excavations should be prevented during construction.

4.2.6 Construction Considerations

It should be noted that the effort required for successful placement of structural fill is weather-dependent and delays due to inclement weather are common even when using relatively clean granular fill material. Excess soils may require stockpiling for extended periods of time before they can be used. We recommend protecting stockpiled soils intended for use as structural fill with anchored polyethylene sheet plastic strong enough to withstand local wind conditions.

4.3 Temporary and Permanent Slopes

Temporary excavation slope stability is a function of many factors, including:

- The presence and abundance of groundwater;
- The type and density of the various soil strata;
- The depth of cut;
- Surcharge loadings adjacent to the excavation; and
- The length of time the excavation remains open.

The maintenance of safe slopes and worker safety should remain the responsibility of the contractor, who is present at the site, able to observe changes in the soil conditions, and monitor the performance of the excavation.

Based on Chapter 296-155 of the Washington Administrative Code (WAC), it is our opinion the loose to medium dense granular soils encountered at the exploration locations would be classified as Type C soils. Temporary slopes in Type C soils should be constructed at angles no greater than 1½H:1V according to the WAC. However, it has been our experience that temporary cuts in loose granular soils may need to be flatter than 1½H:1V.

It is our opinion that the dense to very dense granular soils are consistent with the Type A soil characterization described in Chapter 296-155 of the WAC. The side slopes of unsupported excavations in Type A soils which are 20 feet or less in depth may be inclined no steeper than 3/4H:1V according to the WAC. Unsupported vertical sided excavations in Type A soils may not exceed 3.5 feet in height according to the WAC.

We generally recommend configuring permanent cut and fill slopes no steeper than 2H: 1V as a means of reducing the erosion potential. Permanent cut and fill slopes should be seeded or otherwise vegetated to reduce the erosion potential. We recommend covering bare soil exposures with mulch or compost in the event that the slopes are planted with individual plants rather than hydroseeded.

4.4 Seismic Considerations

Our recommendations for seismic aspects of design are summarized below:

- Site Classification per the 2006 International Building Code (IBC): C. Please note that the 2006 International Building Code requires a site soil profile determination extending a depth of 100 feet for seismic site classification. Our authorized scope of services does not include the required 100 foot soil profile determination. Borings for the roadway improvements extended to a maximum depth of approximately 26.5 feet and this seismic site class definition considers that very dense native silty gravelly sand exists below the maximum depth of the subsurface exploration. Additional exploration to greater depths could be considered to confirm the conditions below the maximum depth of exploration. Alternatively, a geophysical exploration could be utilized in order to better define the seismic site class.

- S_s Spectral Acceleration for a Short Period: 1.244 g

- S_1 Spectral Acceleration for a 1-Second Period: 0.411 g

4.5 Retaining Walls

At the time this report was prepared, the preliminary design considered the use of four soldier pile walls for cut conditions and concrete block retaining walls for the fill wall applications; the taller concrete block walls will likely be combined with Mechanically Stabilized Earth (MSE) embankments. Preliminary design and construction recommendations for these wall types are presented below. We understand that Otak, Inc. will design the walls.

4.5.1 Soldier Pile Walls

We understand that four permanent cantilever soldier pile retaining walls are proposed. Approximate soldier pile wall locations and heights are summarized in the table below.

Proposed cut wall location	Approximate proposed wall height (feet)	Exploration at or near wall location
STA 26+38 to STA 30+28(north side)	5.5	TP-2

EXHIBIT 11
PAGE 23 OF 90

Terracon DRAFT

Proposed cut wall location	Approximate proposed wall height (feet)	Exploration at or near wall location
STA 28+27 to STA 30+13 (south side)	5	TP-1
STA 41+93 to STA 43+14 (north side)	7.5	TP-4, TP-5
STA 44+23 to STA 45+14 (north side)	5.5	None in vicinity

The available subsurface information along the wall alignments is very limited and it does not appear that the information is sufficient to provide geotechnical recommendations for final soldier pile wall design. It is currently expected that additional field exploration and laboratory testing will be required. Preliminary geotechnical recommendations for the soldier pile walls are provided in the following sections.

Active Earth Pressures

The lateral earth pressures acting on retaining walls are a function of the ability of the wall to deflect during loading. We have assumed that the top of the soldier pile retaining walls will be free to move laterally an amount equal to at least 0.1 percent of the wall height during loading, and consequently "active" earth pressures should be used for wall design.

We understand that the soldier pile walls will be constructed in close proximity to the limits of the right-of-way and that portions of the retained soils located beyond the right-of-way may be sloped. Active earth pressures for level and inclined back slopes are provided in the table below.

ACTIVE EARTH PRESSURES		
Back Slope Inclination	Active Earth Pressure [1] (pcf)	Seismic Surcharge [2] (psf)
Level	37	7 H
5H:1V	42	9 H
4H:1V	44	10 H
3H:1V	47	13 H

1. The active earth pressure is presented as an equivalent fluid density (triangular distribution) in pounds per cubic foot. The active earth pressure should be assumed to act over the pile spacing from the top of the wall to finished grade at the wall face, and over one pile diameter from finished grade at the wall face to the pile tip.
2. The seismic surcharge is presented in pounds per square foot (rectangular distribution) where H is the height of the wall in feet. The seismic surcharge should be assumed to act over the pile spacing from the top of the wall to finished grade at the wall face.

The above active earth pressure values do not include the effects of surcharge loads, which should be accounted for as appropriate. In addition, these pressures assume that adequate drainage is provided behind the wall to prevent the buildup of hydrostatic (groundwater) pressures.

Passive Earth Pressures

The depth of embedment of the soldier piles must be adequate to provide resistance against "kick-out" from lateral earth pressures. Passive earth pressures acting on the soldier pile retaining walls may be computed using an ultimate equivalent fluid density of 375 pounds per cubic foot (triangular distribution) acting over 2 pile diameters or the pile spacing, whichever is less.

Lagging

Permanent lagging should be installed between the soldier piles. We recommend that the lagging extend a minimum of 2 feet below the design finished grade at the wall face. Lagging could consist of treated lumber, concrete fascia panels, or other approved lagging type as specified by the structural engineer. Due to soil arching, lagging may be designed to resist 50 percent of the active earth pressure.

4.5.2 Concrete Block Retaining Walls

The concrete block walls will consist of a wall facing, and in cases where the wall height exceeds about 3 to 4 feet, a reinforced soil mass. Soil reinforcement in MSE wall systems typically consists of a horizontal element such as geogrids or metallic strips that extend back from the face. MSE walls resist soil pressures through the weight of the reinforced soil mass. MSE walls are well suited for fill and limited height cut applications where adequate space is available for installation of the soil reinforcement. In cut applications, MSE walls require temporary excavations that extend the full height of the supported cut. MSE walls are generally competitive economically for fill wall applications. MSE walls may be constructed with vertical or slightly stepped faces. We expect the MSE walls for the project to consist of dry-stacked segmental concrete block units with geogrid-reinforced fill for the taller applications.

The available subsurface information along the fill wall alignments is very limited. Several of the explorations disclosed loose and/or organic soils which would be inadequate for support of the walls, in our opinion. It is currently expected that additional field exploration would be required in terms of better defining wall subgrade conditions and the need for subgrade improvement. Preliminary geotechnical recommendations for the SRWs are provided in the following sections.

The parameters provided in the table below should be used for design of MSE walls. We recommend a peak ground acceleration value of 0.33g; this value is based on an event with a seismic event with a 10 percent probability of exceedance in 50 years.

Design Component	Reinforced Backfill	Retained Soil	Foundation Soil
Unit Weight (pcf)	135	125	115
Friction Angle (deg)	36	32	30
Cohesion (psf)	0	0	0

Wall Embedment

With a level foreslope and adequate soil bearing conditions, the walls need only be embedded a minimum of 8 inches. In locations where the foreslopes extend down below the walls, we recommend at least 2 feet of embedment below finished grade at the toe. We recommend overexcavation and replacement of loose and/or organic soils to provide adequate bearing conditions.

Construction Considerations

Subgrade preparation, backfill placement, and backfill compaction for SRWs should be completed in accordance with corresponding recommendations provided in the *Subgrade Preparation*, *Structural Fill*, and *Fill Placement and Compaction* sections of this report.

It should be noted that adequate performance of the SRWs will depend on proper installation of the geogrid reinforcement. The geogrids should be placed on a level surface and staked taught during placement and compaction of the structural fill placed above each geogrid layer; the geogrids should not be installed loosely.

4.5.3 Cast-In-Place (CIP) Cantilever Concrete

We understand that segments of low CIP walls may be used in conjunction with the soldier pile walls proposed for the cut applications. We also understand that horizontal space available for wall construction is limited. In this case, it may be worthwhile to consider a reverse cantilever CIP wall. It is our opinion that the use of CIP walls is feasible from the geotechnical perspective. We can provide design recommendations for this wall type if so requested.

4.6 Traffic Signalization

New traffic signal poles are proposed for the intersections at 156th Avenue NE, 160th Avenue NE, and 168th Avenue NE. Subsurface conditions disclosed by borings B-1, B-6, and B-16 are generally favorable for construction of conventional signal pole foundations. Our recommended lateral bearing pressures for the three signal pole intersections are summarized below.

4.6.1 Lateral Bearing Pressures

Location	Recommended lateral bearing pressure (psf) / referenced depth interval below existing grade (feet)
156th Avenue NE and 160th Avenue NE intersections	900 / 0 to 5 4,500 / below 5
168th Avenue NE intersection	1,000 / 0 to 10 3,100 / below 4 feet 4,500 / below 10 feet

Recommended lateral bearing pressures from Table 17.2 in Section 17.2.1 of the WSDOT *Geotechnical Design Manual*

4.6.2 Construction Considerations

Given the soil conditions encountered at the exploratory boring locations, we anticipate that some degree of sidewall caving within the shallow soils overlying the denser soils at depth may occur. Depending upon the time of year that the signal poles are constructed, groundwater seepage may be encountered as well. We recommend that the contractor be prepared to utilize full-depth casing in the event that seepage and sidewall sloughing occurs when the shafts are drilled for the signal pole foundations. Consequently, we recommend that the project specifications include a requirement for the contractor to have sufficient casing on site to reach the anticipated drilled depth.

The drilling contractor should be prepared to clean out the bottom of the shafts if loose soil is observed or suspected. We recommend that the drilling contractor have a cleanout bucket on site to remove loose soils and/or mud from the bottom of the boring. Although the drilling and sampling process employed while advancing the exploratory borings did not suggest the presence of cobbles or boulders at the signal pole boring locations, these materials may be present and the contractor should also be prepared to deal with the presence of cobbles and boulders over the drilled depth interval.

We recommend specifying that the contractor tremie from the bottom of the hole to displace water to reduce the risk of contaminating or segregating the concrete mix should any accumulate in the drilled shafts. The *Drilled Shaft Manual* published by the Federal Highway Administration recommends that concrete be placed by tremie methods if more than 3 inches of water has accumulated in the excavation.

4.7 Pavement Section Design Considerations

Otak will be completing pavement design for the project. We completed a California Bearing Ratio (CBR) test on one composite sample of shallow soils collected from explorations completed along the alignment. The silty sand with gravel was determined to have a CBR value

EXHIBIT 11
PAGE 21 OF 90
Terracon

DRAFT

of 25 when compacted to 95 percent of the modified Proctor maximum dry density (ASTM D 1557). We recommend that the pavement section design consider the potential variability in subgrade soil along the alignment and pavement section subgrade preparation procedures that may yield soil conditions that have a lesser effective CBR value.

4.8 Utility Trenching and Backfilling

We recommend that utility trenching, installation, and backfilling conform to all applicable Federal, State, and local regulations such as WISHA and OSHA regulations for open excavations.

In order to maintain the function of any existing utilities, we recommend that temporary excavations not encroach upon the bearing splay of existing utilities. Likewise, utility excavations should not encroach upon the bearing splay of footings or slabs. If, due to space constraints, an open excavation cannot be completed without encroaching on a utility, foundation, or slab, we recommend shoring the new utility excavation with a slip box or other suitable means that provide for protection of workers and that maintain excavation sidewall integrity to the depth of the excavation.

We recommend that utility subgrades be firm, unyielding and free of all soils that are loose, disturbed, or pumping. Such soils should be removed and replaced with compacted structural fill or crushed rock foundation material.

Backfilling of the trenches could be completed with on-site soils if they can be compacted as per WSDOT standards. If native soil moisture conditions cannot be adequately maintained in a range that allows their compaction to the required density it will be necessary to import soil at a moisture content that allows compaction meeting project requirements.

4.9 Water Quality Structures

Three below-grade water quality structures are currently proposed for construction at the west end of the alignment and one is proposed for the east end. The structures may be either pre-cast concrete or cast-in-place concrete. The structure locations and dimensions are summarized below, along with geotechnical explorations that were located near the proposed structures.

Structure	Approximate location	Approximate depth (feet)	Explorations
Sand filter	STA 22+30, 50 feet left of centerline (at location of existing detention pond)	9.5	B-3 (30 feet to northwest)

Structure	Approximate location	Approximate depth (feet)	Explorations
Combined detention vault / settling tank	STA 21+80, 60 feet left of centerline (at location of existing detention pond)	14	B-3 (30 feet to northwest)
East structure	STA 47+73 to 48+05 (structure will be built inside median)	9 to 10	B-14 (100 feet to west) B-15 (140 feet to east)

4.9.1 Structure Foundation Recommendations

It has been our experience that below grade structures of the types proposed may employ a simple concrete slab without a foundation, or a perimeter foundation with separate floor slab. **Foundation and slab design recommendations for the below-grade concrete structures are summarized below. These recommendations should be considered preliminary given the uncertain nature of the structure configurations.**

Eastern Structure

Borings B-14 and B-15 disclosed approximately 7 feet and 4 feet, respectively, of fill and underlying native organic relic topsoil above medium dense grading to very dense sand, silty sand, and gravelly sand. The glacially consolidated soils were observed to the termination depth of each boring (16.5 feet in the case of boring B-14 and 21.5 feet in the case of boring B-15). The glacially consolidated soils will be adequate for support of the proposed below-grade structure which is expected to have a depth that may approach 9 to 10 feet.

It would be feasible to use a conventional shallow foundation for the eastern structure. Foundation design recommendations are summarized in the table below. The recommended values assume that the foundations have at least 18 inches of embedment and a minimum width of 18 inches.

DESCRIPTION	VALUE
Net allowable bearing pressure	4,000 psf
Allowable passive pressure	325 psf
Allowable coefficient of sliding friction	0.35

Sand Filter and Combined Detention Vault and Settling Tank

Boring B-3 was advance at the northwest corner of the existing detention pond in the general vicinity of where the sand filter and combined settling tank and detention vault are proposed for construction. Boring B-3 disclosed loose fill material to a depth of approximately 15 feet

(elevation 368 feet), and medium dense fill to approximately 17 feet (elevation 366 feet). Medium dense native silty sand with trace gravel extended to the 21.5 foot termination depth. Although groundwater was observed at a depth of approximately 18 feet below grade while advancing boring B-3, subsequent sounding of the observation well installed at the boring location disclosed no water in the well. Groundwater conditions should be expected to fluctuate seasonally, and construction dewatering may be necessary depending upon the time of year that construction takes place and the depth of excavation.

The anticipated 14 foot depth of the combined detention vault and settling tank would require an excavation that would remove almost all of the fill material disclosed by boring B-3. We recommend founding the structure so that it bears on the medium dense native soils (encountered at approximately elevation 366 feet in boring B-3) or upon structural fill placed above the medium dense soils and compacted to 95 percent of the modified Proctor maximum dry density (ASTM D 1557). We recommend constructing the shallower sand filter on structural fill placed as described above, rather than constructing it on the existing loose fill material as this would likely result in unacceptable settlement.

Preliminary foundation recommendations for the sand filter and combined detention vault and setting tank are presented in the table below. The recommended values assume that the foundations have at least 18 inches of embedment and a minimum width of 18 inches.

DESCRIPTION	Value
Net allowable bearing pressure [1]	3,000 psf
Allowable passive pressure [3]	225 psf
Allowable coefficient of sliding friction	0.35

It would also be feasible to reduce the excavation depth for the structures by supporting them on driven pin piling that extend through the fill material and derive bearing from deeper and denser native soils. We can provide design recommendation for this alternative if so requested.

Concrete Slab-on-Grade Support Criteria

The floor slabs or pre-cast slabs for the eastern and western below-grade structures should be founded on medium dense to very dense undisturbed native granular soils, or structural fill placed above these native soils and compacted to at least 95 percent density (ASTM D 1557).

Construction Considerations

Based upon our review of the preliminary plans, it appears likely that temporary excavation shoring will be required to complete the excavations necessary to construct the below-grade structures. We recommend that the design of a temporary excavation shoring system be made the responsibility of the contractor. We recommend requiring the contractor to submit plans for

EXHIBIT 11
PAGE 30 OF 90

DRAFT

the temporary shoring to the City at least two weeks prior to installation so that they can be reviewed prior to installation.

4.10 Erosion Control

For erosion control planning purposes, much of the shallow soils are consistent with the sandy loam and silt loam characterizations per the USDA textural soil description terminology. We recommend that the contractor take the following steps as a minimum to reduce the likelihood of erosion and off-site sediment transport:

- Cover soil stockpiles with anchored plastic sheeting during wet weather;
- Install geotextile inlet protection in catch basins;
- Install and maintain siltation control fencing or other approved perimeter controls such as compost filter socks or wattles;
- Sweep adjacent pavement as needed;
- Regularly inspect and maintain the erosion control BMPs as necessary.

We anticipate that the use of shallow ditches and sumps with pumps would be adequate for surface water control during wet weather and site conditions. The locations of these features would best be determined during construction.

4.11 Recommendations for Additional Study

Certain aspects of the design were in the preliminary stage at the time this draft report was prepared, and the extent of some of the proposed improvements had not been considered at the time of the field exploration. We recommend completing additional geotechnical exploration along the proposed retaining wall alignments once the locations have been finalized. The additional explorations along the cut wall alignments will provide needed subsurface information necessary to complete final design analysis. Additional explorations along the fill wall alignments will allow better characterization of wall subgrade conditions in regard to necessary subgrade improvement.

We also recommend completing additional explorations at the location of the proposed below-grade storm system structures proposed for construction in the vicinity of the existing detention pond at the western end of the alignment. Given the significant depth of loose fill material that was disclosed by boring B-3, which was advanced to the northwest of the proposed structures, it is our opinion that additional exploration within the footprint of the proposed structures would be valuable.

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5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during site grading.

The analysis and recommendations presented in this report are based upon the data obtained from the explorations performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between explorations, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

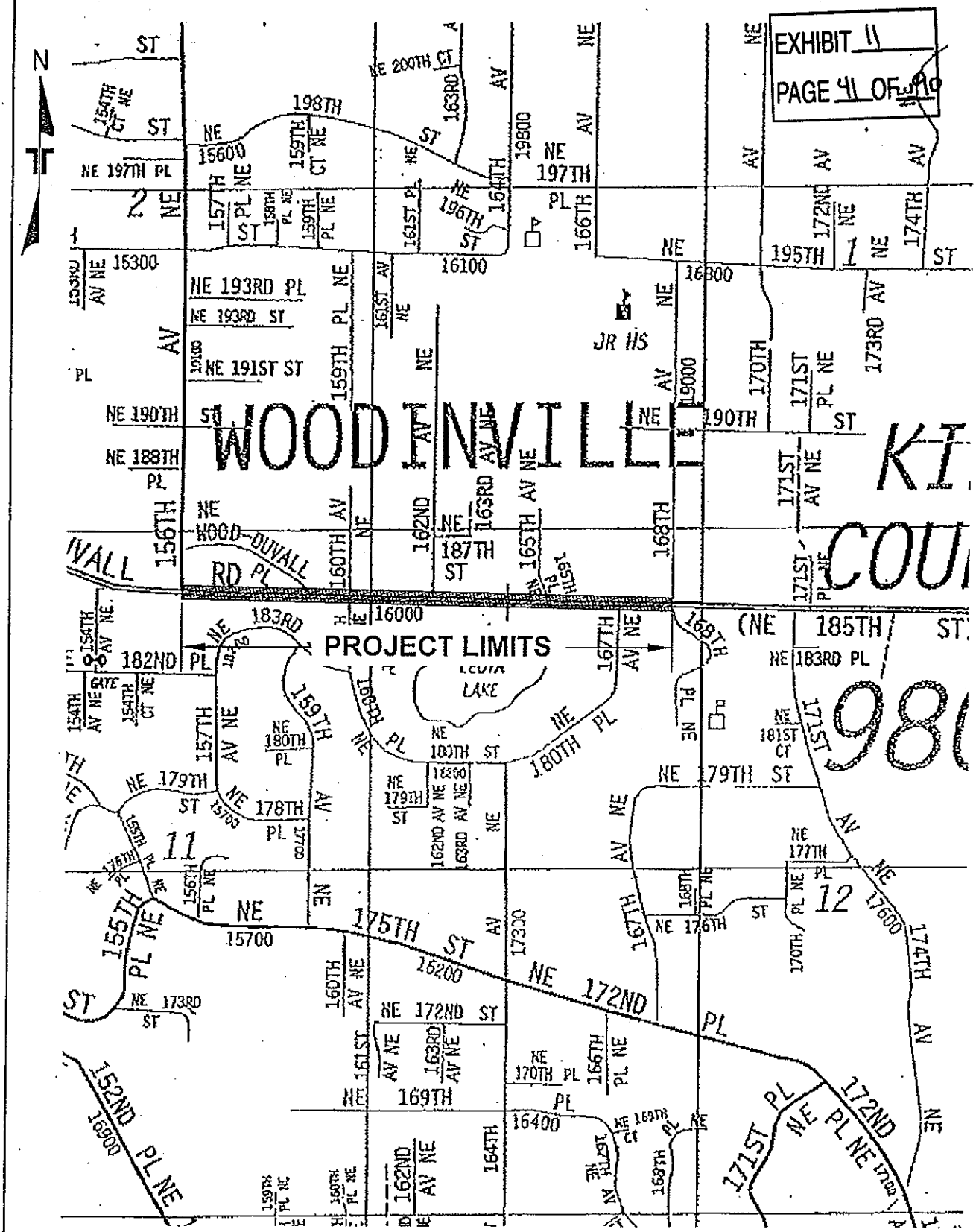
The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the Otak, Inc. or the City of Woodinville are concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of Otak, Inc. and the City of Woodinville for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety and excavation support are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION

EXHIBIT 11
PAGE 41 OF 110



Project Mngr: DCW	Project No. 81095084	Terracon Consulting Engineers and Scientists	SITE LOCATION PLAN	Exhibit
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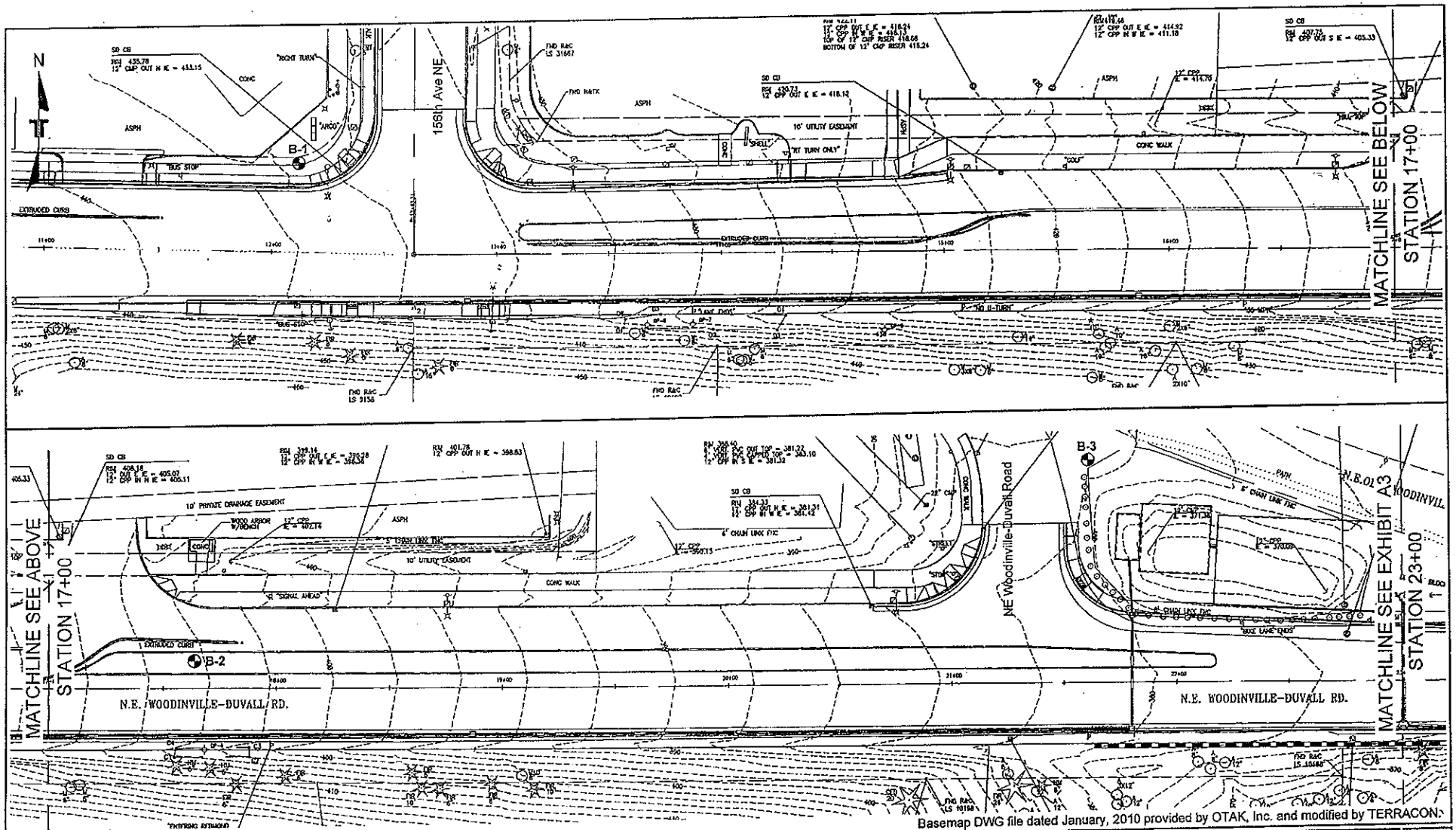
Checked By: DCW	File No. ExA1.dwg	PH. (425) 771-3304 FAX. (425) 771-3549	Woodinville, Washington	
Approved By: DCW	Date: July 2010		Prepared for: Otak, Inc. and the City of Woodinville	



Basemap DWG file dated January, 2010 provided by OTAK, Inc. and modified by TERRACON.

LEGEND:

- B-1 BORING NUMBER AND APPROXIMATE LOCATION
- TP-1 TEST PIT NUMBER AND APPROXIMATE LOCATION

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SCALE IN FEET

Project Mngr:	DCW
Drawn By:	RMS
Checked By:	DCW
Approved By:	DCW
Project No.	81095064
Scale:	AS-SHOWN
File No.	EXHIBITS2-5.dwg
Date:	APRIL 2010

Terracon
Consulting Engineers and Scientists
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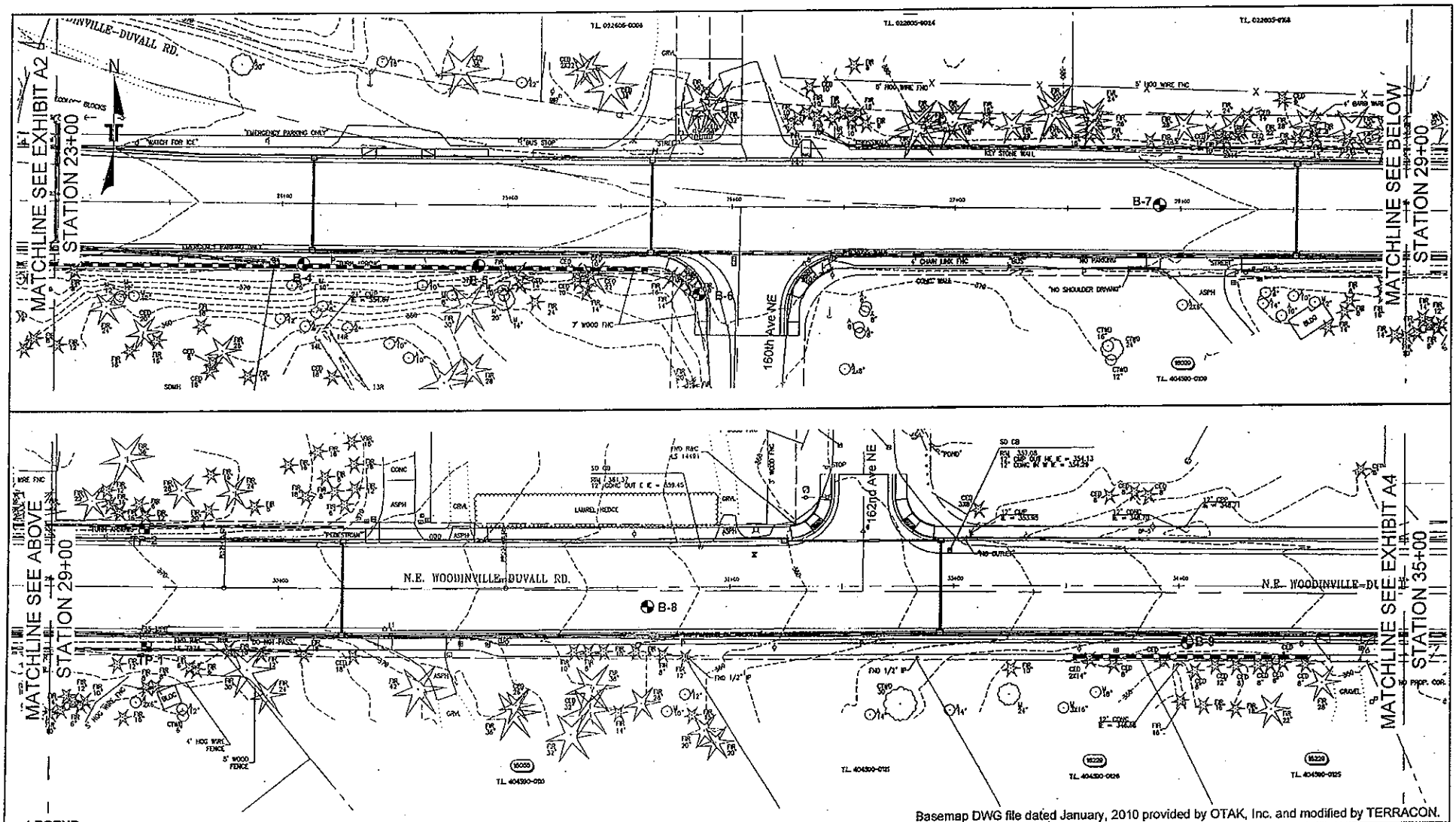
SITE AND EXPLORATION PLAN

NE WOODINVILLE-DUVALL ROAD IMPROVEMENTS
Woodinville, Washington
Prepared for: Otak, Inc. and the City of Woodinville

EXHIBIT A2

EXHIBIT 11
PAGE 42 OF 40



Basemap DWG file dated January, 2010 provided by OTAK, Inc. and modified by TERRACON.

LEGEND:

- B-1 BORING NUMBER AND APPROXIMATE LOCATION
- TP-1 TEST PIT NUMBER AND APPROXIMATE LOCATION

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Project Mngr:	DCW
Drawn By:	RMS
Checked By:	DCW
Approved By:	DCW
Project No.	81095064
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File No.	EXHIBIT S2-5.dwg
Date:	APRIL 2010

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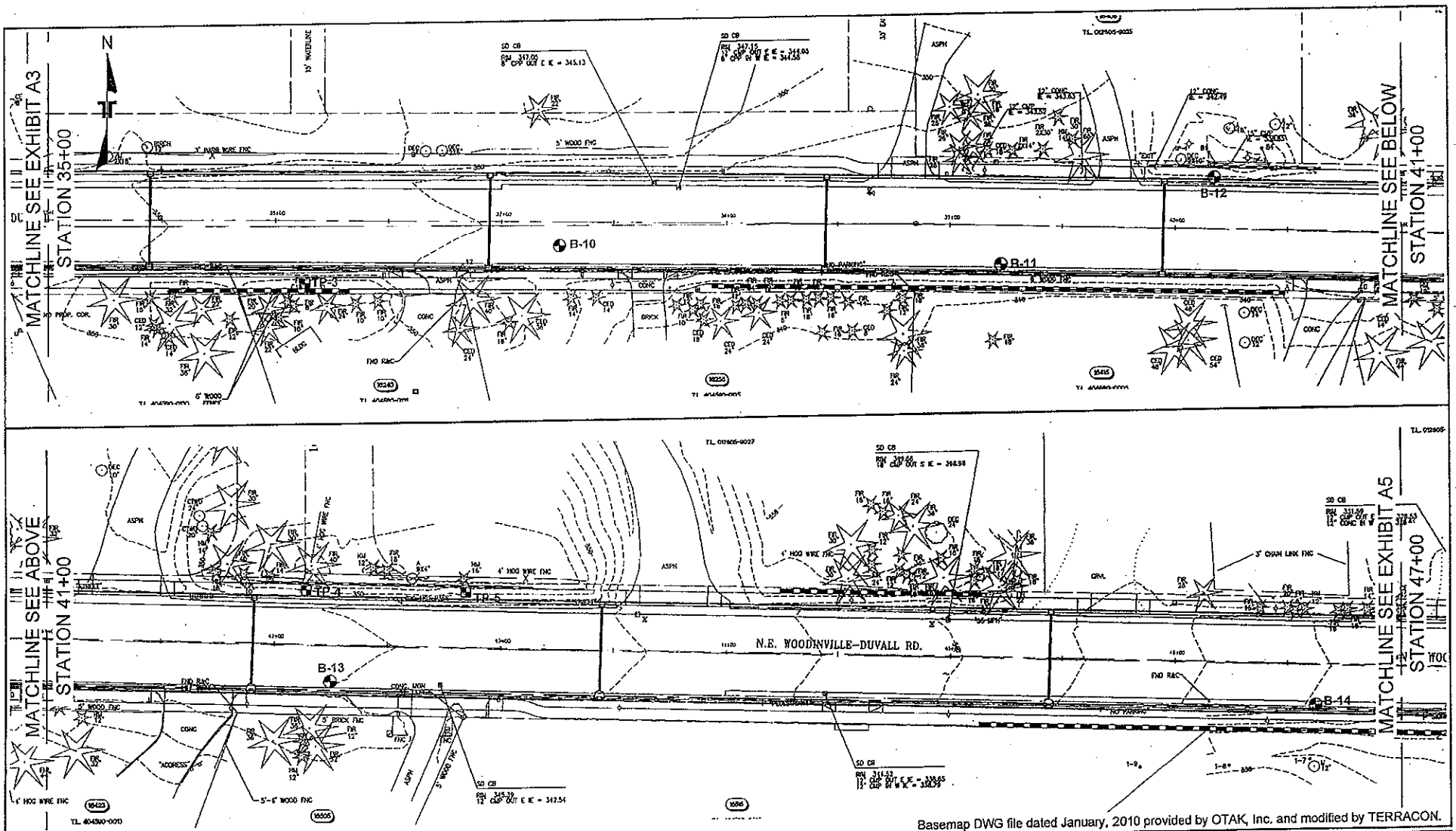
SITE AND EXPLORATION PLAN
NE WOODINVILLE-DUVALL ROAD IMPROVEMENTS
Woodinville, Washington
Prepared for: Otak, Inc. and the City of Woodinville

EXHIBIT A3

EXHIBIT 11
PAGE 12 OF 90



Basemap DWG file dated January, 2010 provided by OTAK, Inc. and modified by TERRACON.

LEGEND:

- B-1 BORING NUMBER AND APPROXIMATE LOCATION
- TP-1 TEST PIT NUMBER AND APPROXIMATE LOCATION

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SCALE IN FEET

Project Mngr:	DCW
Drawn By:	RMB
Checked By:	DCW
Approved By:	DCW
Project No.	81095064
Scale:	AS SHOWN
File No.	EXHIBITS2-S.dwg
Date:	APRIL 2010

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SITE AND EXPLORATION PLAN

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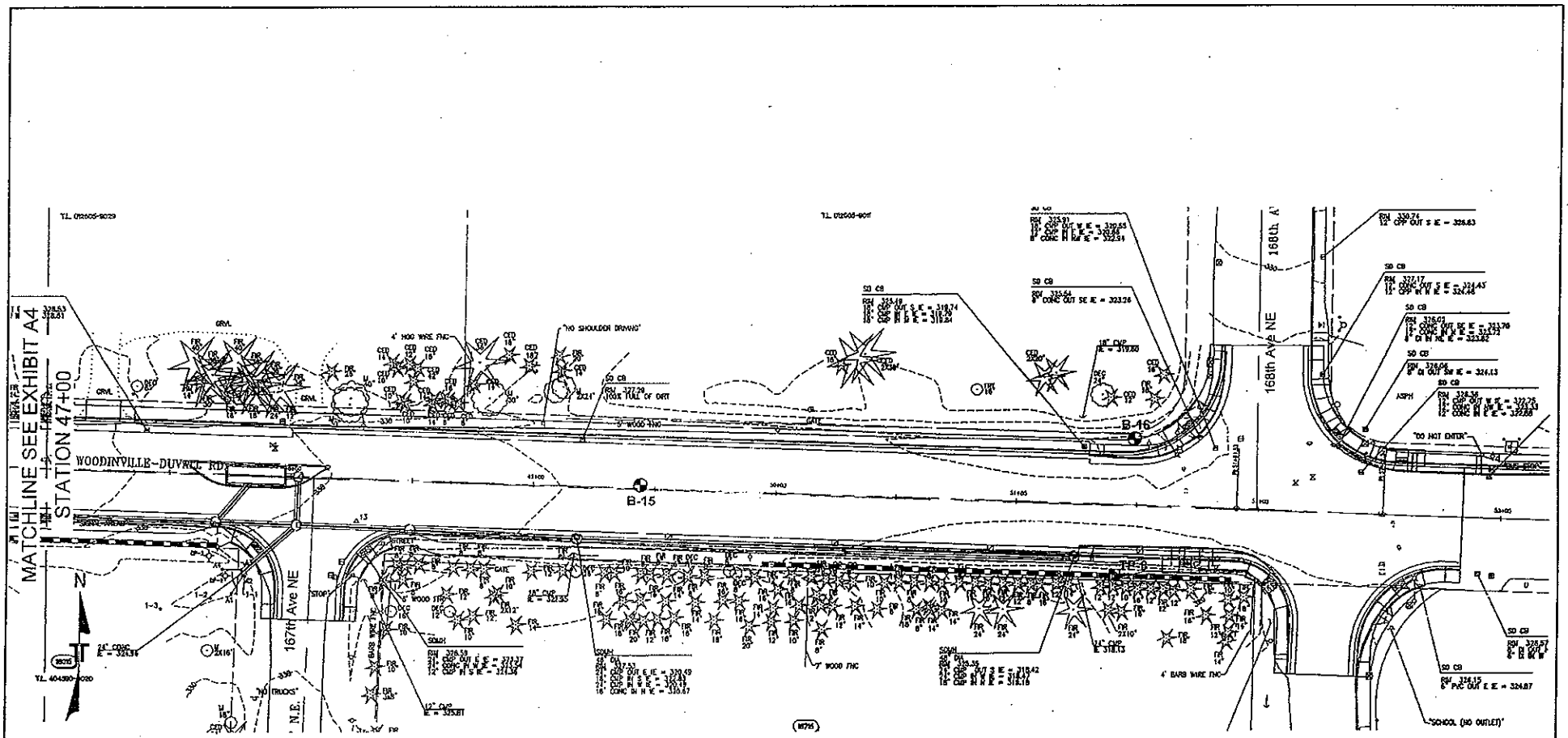
EXHIBIT A4

EXHIBIT 11
PAGE 44 OF 49



LEGEND:

- B-1 — BORING NUMBER AND APPROXIMATE LOCATION
- TP-1 — TEST PIT NUMBER AND APPROXIMATE LOCATION

40 0 10 20 40
SCALE IN FEET

Basemap DWG file dated January, 2010 provided by OTAK, Inc. and modified by TERRACON.

Project Mngr:	DCW
Drawn By:	RMS
Checked By:	DCW
Approved By:	DCW
Project No.	81095064
Scale:	AS-SHOWN
File No.	EXHIBIT62-5.dwg
Date:	APRIL 2010

Terracon
Consulting Engineers and Scientists
21905 64th Avenue W, Ste 100 Mountlake Terrace, WA 98043
PH. (425) 771-3304 FAX. (425) 771-3549

SITE AND EXPLORATION PLAN — EXHIBIT A5

NE WOODINVILLE-DUVALL ROAD IMPROVEMENT
Woodinville, Washington
Prepared for: Otak, Inc. and the City of Woodinville

EXHIBIT 11
PAGE 45 OF 90

Field Exploration Description

The field exploration included completing a reconnaissance of surface conditions, advancing 16 exploratory borings (B-1 through B-16), and completing 6 hand-excavated test pits (TP-1 through TP-6) at the approximate locations shown on the Site and Exploration Plans, Exhibits A2 through A5. The locations of the explorations were determined by measuring distances with steel and fiberglass tapes relative to fixed features shown on a site survey prepared by Otak (dated January 2010). As such, the exploration locations should be considered accurate to the degree implied by the measurement method; **the exploration locations were not surveyed.** The approximate ground surface elevation at each exploration location was determined by interpolating ground surface elevation contours shown on the drawings provided by Otak. The following sections describe our procedures associated with the exploration. Descriptive logs of the explorations are enclosed in this appendix.

Exploratory Boring Procedures

Borings B-1 through B-16 were advanced via hollow stem auger methods using both track-mounted and trailer-mounted drill rigs operated by a local independent drilling firm working under subcontract to our firm. Engineering geologists and a geotechnical engineer from our firm continuously observed the borings, logged the subsurface conditions encountered, and obtained representative soil samples. All samples were stored in moisture-tight containers and transported to our laboratory for further visual classification and testing.

Throughout the drilling operation, soil samples were obtained at 2.5-foot to 5-foot depth intervals by means of the Standard Penetration Test (ASTM D-1586). This testing and sampling procedure consists of driving a standard 2-inch outside diameter steel split spoon sampler 18 inches into the soil with a 140-pound hammer free falling 30 inches. The number of blows required to drive the sampler through each 6-inch interval is recorded, and the total number of blows struck during the final 12 inches is recorded as the Standard Penetration Resistance, or "blow count" (N value). If a total of 50 blows is struck within any 6-inch interval, the driving is stopped and the blow count is recorded as 50 blows for the actual penetration distance. The resulting Standard Penetration Resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

Test Pit Procedures

The test pits were advanced by a geotechnical engineer from our office utilizing a shovel, a post-hole digger, and a 3-inch diameter hand auger. Soils retrieved as cuttings were continuously observed and classified as they were removed from the explorations. Representative portions of the soils were placed in moisture tight containers and returned to our laboratory for further visual classification.

The exploration logs describe the vertical sequence of soils encountered at the exploration locations, based primarily upon our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradational, our logs indicate the average contact depth. Where a soil type changed between sample intervals, we inferred the contact depth. The logs also indicate the sample number and approximate depth of each soil sample obtained from the explorations. If groundwater was encountered in an exploration, either at the time of exploration or measured in an observation well following the exploration, the approximate observed groundwater depth is described on the log.

EXHIBIT 11
PAGE 48 OF 90

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted	PA:	Power Auger (Solid Stem)
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	BCR:	Before Casing Removal
WCI:	Wet Cave in	WD:	While Drilling	ACR:	After Casing Removal
DCI:	Dry Cave in	AB:	After Boring	N/E:	Not Encountered

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 - 15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 50	Dense
> 50	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	≥ 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

EXHIBIT 11
PAGE 49 OF 90

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]

					Soil Classification	
					Group Symbol	Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI plots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.

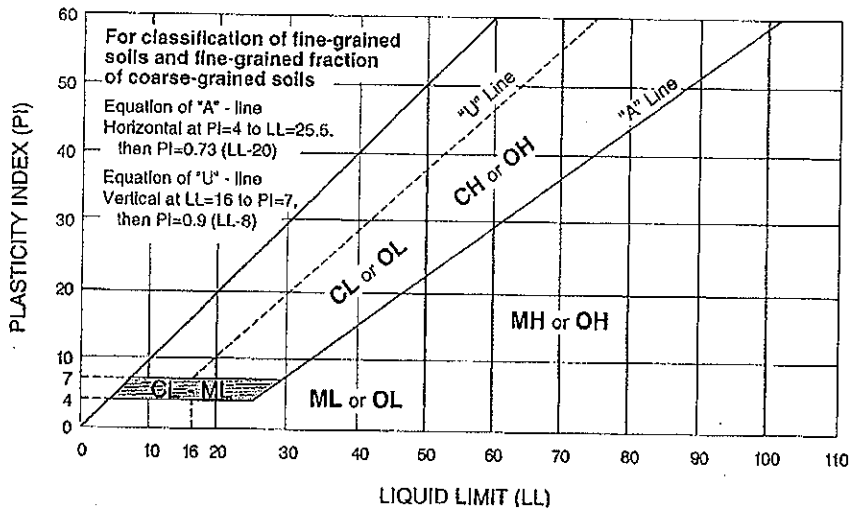


EXHIBIT 11
PAGE 90 OF 90

LOG OF BORING NO. B-1

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 12+12, 40 feet left of CL

BOREHOLE DIA.: 4 in
WELL DIA.: 1 in
GROUND SURFACE ELEV.: 437 ft

GRAPHIC LOG	DESCRIPTION		WELL DETAIL	DEPTH, ft	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS OTHER LABORATORY TESTS
	0.5 Landscape Bark	436.5										
	SILTY SAND, trace organics, brick and metal, brown, medium dense, moist (FILL)				SM	S-1	SS	12	13	13		
	3.2	433.8										
	SILTY SAND, gray, dense to dense, moist				SM	S-2	SS	16	34	13		
	5	432		5								
	SILTY SAND, brown, dense, moist				SM	S-3	SS	12	38	11		
	7.5	429.5										
	SILTY SAND, brown, very dense, moist				SM	S-4	SS	14	77	10		GSA
	10	427		10								
	SILTY SAND with 1/2" sandy SILT interbeds, brown, dense, wet ▽				SM	S-5	SS	14	47	19		
	14.5	422.5										
	SILTY SAND with gravel, brown, very dense, moist ▼			15	SM	S-6	SS	14	83	6		
	20	417		20								
	Continued Next Page											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 11	WD	▼ 14.8 3/15/10
WL	▽		▼
WL			

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED			3-1-10
BORING COMPLETED			3-1-10
RIG	Track	CO.	Geologic
LOGGED	CRT	JOB #	81095064

TC_WELL 81095064 WOOD DUVALL B-1 TO B-16.GPJ TERRACON.GDT 7/29/10

EXHIBIT 11
PAGE 51 OF 90

LOG OF BORING NO. B-1

CLIENT Otak, Inc.

SITE NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT NE Woodinville - Duvall Road Improvements

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS OTHER LABORATORY TESTS
	GRAVELLY SAND trace silt, brown-gray, very dense, moist			SP	S-7	SS	12	67	6		
				SP	S-8	SS	6	100/6"			
	23.5 grades to with silt 413.5										
	Boring completed at 23.5 feet. Department of Ecology Well Tag No. BBL276.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 11	WD	▼ 14.8 3/15/10
WL	▽		▼
WL			

Terracon
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Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED			3-1-10
BORING COMPLETED			3-1-10
RIG	Track	CO.	Geologic
LOGGED	CRT	JOB #	81095064

EXHIBIT 11
PAGE 52 OF 90

LOG OF BORING NO. B-2

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 17+64, 12 feet left of CL

Approx. Surface Elev.: 404 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	0.67 9 - 9.5 inches asphalt 403.3										
	GRAVELLY SAND trace silt, gray, very dense, moist		SP	S-1	SS	8	75	3			
	4 400		SP	S-2	SS	18	61	7			
	SILTY, GRAVELLY SAND, gray, very dense, moist	5	SM	S-3	SS	18	86	8			
	6.5 397.5										
	Boring completed at 6.5 feet. No groundwater observed.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▽
WL		

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BORING STARTED			3-1-10
BORING COMPLETED			3-1-10
RIG	XL	CO.	Geologic
LOGGED	RWS	JOB #	81095064

TC BOREHOLE 81095064 WOOD DUVALL B-1 TO B-16.GPJ TERRACON.GDT 7/29/10

EXHIBIT 11
PAGE 52 OF 90

LOG OF BORING NO. B-3

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 21+60, 98 feet left of CL

BOREHOLE DIA.: 4 in
WELL DIA.: 1 in
GROUND SURFACE ELEV.: 383 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS OTHER LABORATORY TESTS
SAND with silt and trace gravel, brown, medium dense grading to loose, moist (Fill)		SP SM	S-1	SS	10	12	8		
		SP SM	S-2	SS	4	5			
	5	SP SM	S-3	SS	3	4	8		GSA
		SP SM	S-4	SS	1	4			
	10	SP SM	S-5	SS	10	5	9		
15 368									
SAND with silt and trace gravel, brown, medium dense, moist (Fill) (1 to 2 inch gravel observed in cuttings from approximately 16 feet)	15	SP SM	S-6	SS	3	12			
17 366									
SILTY SAND trace gravel, tan-grey, medium dense, wet to saturated ▽	20								

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 18	WD	▽ Dry 3/15/2010
WL	▽		▽
WL			

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BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	Track	CO.	Geologic
LOGGED	CDF	JOB #	81095064

EXHIBIT 11
PAGE 54 OF 90

LOG OF BORING NO. B-3

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS OTHER LABORATORY TESTS
	SILTY SAND trace gravel, tan-grey, medium dense, wet to saturated			SM	S-7	SS	10	20	19		GSA
	21.5 361.5										
	Boring completed at 21.5 feet. Department of Ecology Well Tag No. BBL279.										

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 18	WD	▼ Dry 3/15/2010
WL	▽		▼
WL			

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Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	Track	CO.	Geologic
LOGGED	CDF	JOB #	81095064

EXHIBIT 11
PAGE 52 OF 90

LOG OF BORING NO. B-4

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 24+10, 27 feet right of CL

BOREHOLE DIA.: 4 in
WELL DIA.: 1 in
GROUND SURFACE ELEV.: 374 ft

GRAPHIC LOG	DESCRIPTION	ELEV.	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS OTHER LABORATORY TESTS
	0.5 Topsoil	373.5			SM	S-1	SS	12	8	10		
	SILTY, GRAVELLY SAND, trace organics, brown, loose, moist (FILL)											
	2.5	371.5			SM	S-2	SS	12	5	10		
	SILTY SAND with gravel, trace organics, brown, loose, moist (FILL)			5	SM	S-3	SS	14	4	6		
	7.5	366.5			SM	S-4	SS	14	13	10		
	SILTY, GRAVELLY SAND, brown-gray, loose to medium dense, moist (FILL)											
	10	364		10	SM	S-5	SS	14	9	9		
	SILTY GRAVELLY SAND, gray, loose, moist (FILL)											
	15.5	358.5		15	SM	S-6	SS	18	3	17		
	SILTY GRAVELLY SAND, with organics, brown-gray, very loose, moist (FILL)											
	20	354		20								

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 20	WD	▼ 19.3	3/15/10
WL	▼		▼	
WL				

Terracon
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Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED			3-1-10
BORING COMPLETED			3-1-10
RIG	Track	CO.	Geologic
LOGGED	CRT	JOB #	81095064

EXHIBIT 11
PAGE 56 OF 94

LOG OF BORING NO. B-4

CLIENT Otak, Inc.

SITE NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT NE Woodinville - Duvall Road Improvements

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS OTHER LABORATORY TESTS
	SILTY GRAVELLY SAND, with organics, brown-gray, loose, wet (FILL)			SM	S-7	SS	12	7	20		GSA
	24 350										
	SILTY SAND with gravel, mottled brown-gray, medium dense, wet		25	SM	S-8	SS	12	24	16		
	26.5 347.5										
	Boring completed at 26.5 feet. Department of Ecology Well Tag No. BBL-277.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 20	WD	▼ 19.3 3/15/10
WL	▽		▼
WL			

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Mountlake Terrace, WA 98043
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BORING STARTED	3-1-10		
BORING COMPLETED	3-1-10		
RIG	Track	CO.	Geologic
LOGGED	CRT	JOB #	81095064

EXHIBIT 11
PAGE 51 OF 90

LOG OF BORING NO. B-5

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 24+87, 27 feet right of CL

Approx. Surface Elev.: 373 ft

DEPTH, ft.	GRAPHIC LOG	DESCRIPTION	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
		SILTY, GRAVELLY SAND, trace organics, brown, loose, moist (FILL)	SM	S-1	SS	6	8	8			
			SM	S-2	SS	14	4	9			
5			SM	S-3	SS	12	21	8			
5.5		367.5									
		SILTY, GRAVELLY SAND, trace organics, brown, medium dense, moist (FILL)	SM	S-4	SS	14	28	9			
8		365									
		SILTY, GRAVELLY SAND, mottled tan-brown-gray, medium dense, moist									
10			SM	S-5	SS	14	13	12			
11.5		361.5									
		Boring completed at 11.5 feet. No groundwater observed.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▼	▽
WL		

Terracon
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Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED	3-1-10		
BORING COMPLETED	3-1-10		
RIG	Track	CO.	Geologic
LOGGED	CRT	JOB #	81095064

EXHIBIT 11
PAGE 58 OF 90

LOG OF BORING NO. B-6

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 25+85, 40 feet right of CL

Approx. Surface Elev.: 371 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	0.5 Topsoil 370.5		SM	S-1	SS	12	12	9			
	SILTY, GRAVELLY SAND, with trace organics, brown-gray, loose to medium dense, moist (Fill)										
	2.5 368.5		SM	S-2	SS	12	4	18			
	SILTY SAND with gravel, tan-brown-gray, loose, moist (Fill)										
	5 366	5	SM	S-3	SS	14	41	12			GSA
	SILTY SAND with gravel, brown-gray, dense, moist (Glacial Till)										
			SM	S-4	SS	14	53	11			
	SILTY SAND with gravel, brown-gray, very dense, moist (Glacial Till)										
	10 361	10	SM	S-5	SS	14	60	11			
	SILTY SAND with gravel, brown-gray, very dense, moist (Glacial Till)										
		15	SM	S-6	SS	12	50/3"	10			
		20									

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED			3-1-10
BORING COMPLETED			3-1-10
RIG	Track	CO.	Geologic
LOGGED	CRT	JOB #	81095064

EXHIBIT 11
PAGE 59 OF 90

LOG OF BORING NO. B-6

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT-N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, tsf	TESTS: OTHER LABORATORY TESTS
	20.5 **SILTY SAND** with gravel, brown-gray, very dense, moist (Glacial Till) 350.5		SM	S-7	SS	6	100/5.5"	9			
	Boring completed at 20.5 feet. No groundwater observed.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED			3-1-10
BORING COMPLETED			3-1-10
RIG	Track	CO.	Geologic
LOGGED	CRT	JOB #	81095064

EXHIBIT 11
PAGE 60 OF 99

LOG OF BORING NO. B-7

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 27+90, 2 feet left of CL

Approx. Surface Elev.: 372 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	ASPHALT - approximately 19 inches in thickness										
	1.6 — 370.4										
	GRAVELLY SAND with silt, gray, dense, moist		SP SM	S-1	SS	16	48	7			
	3 — 369										
	SILTY, GRAVELLY SAND, mottled dark gray-brown, very dense, moist		SM	S-2	SS	16	62	8			
	5 — 367	5									
	SILTY, GRAVELLY SAND, gray, medium dense, moist		SM	S-3	SS	14	25	12			
	6.5 — 365.5										
	Boring completed at 6.5 feet. No groundwater observed.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED			3-1-10
BORING COMPLETED			3-1-10
RIG	XL	CO.	Geologic
LOGGED	RWS	JOB #	81095064

TC_BOREHOLE 81095064 WOOD DUVALL B-1 TO B-16.GPJ TERRACON.GDT 7/29/10

EXHIBIT 11
PAGE 61 OF 90

LOG OF BORING NO. B-8

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 31+63, 8 feet right of CL

Approx. Surface Elev.: 363 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	0.33 ASPHALT - 3.5 to 4 inches in thickness 362.7										
	1 CONCRETE - 7.5 to 8 inches in thickness (concrete panel) 362										
	2 SILTY, GRAVELLY SAND, gray, loose, moist (Fill) 361		SM	S-1	SS	6	8	8			
	SILTY, GRAVELLY SAND, red-brown, medium dense to dense, moist to wet		SM	S-2	SS	6	32	10			
	4 359										
	SILTY, GRAVELLY SAND, gray, dense, moist to wet	5	SM	S-3	SS	18	40	12			
	6.5 356.5										

Boring completed at 6.5 feet.
No groundwater observed.

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▽
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED			3-1-10
BORING COMPLETED			3-1-10
RIG	XL	CO.	Geologic
LOGGED	RWS	JOB #	81095064

TC_BOREHOLE 81095064 WOOD DUVALL B-1 TO B-16.GPJ TERRACON.GDT 7/29/10

EXHIBIT 11
PAGE 62 OF 90

LOG OF BORING NO. B-9

CLIENT Otak, Inc.

SITE NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 34+04, 22 feet right of CL

Approx. Surface Elev.: 352 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	SILTY, GRAVELLY SAND, brown, medium dense, wet (Fill)		SM	S-1	SS	8	11	9			
	2.5 — 349.5										
	SILTY SAND, trace gravel, with organics, brown, medium dense, wet (Fill)		SM	S-2	SS	6	12	22			
	5 — 347	5									
	SILTY SAND with organics, brown, very loose, wet (Fill)		SM	S-3	SS	10	2	38			
	7.5 — 344.5										
	SILTY SAND, trace gravel and organics, brown, medium dense, wet to saturated ▽		SM	S-4	SS	4	13	19			
	10 — 342	10									
	SILTY SAND, trace gravel, brown-gray, loose, saturated		SM	S-5	SS	10	7				
	11.5 — 340.5										
	Boring completed at 11.5 feet.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 9	WD	▽
WL	▽		▽
WL			

Terracon
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T: 425-771-3304 F: 425-771-3549

BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	Track	CO.	Geologic
LOGGED	CDF	JOB #	81095064

TC_BOREHOLE 81095064 WOOD DUVALL B-1 TO B-16.GPJ TERRACON.GDT 7/29/10

EXHIBIT 11
PAGE 63 OF 90

LOG OF BORING NO. B-10

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 37+21, 9 feet right of CL

Approx. Surface Elev.: 348 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT-N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, tsf	TESTS: OTHER LABORATORY TESTS
	0.33 ASPHALT - 3.5 to 4 inches in thickness 347.7										
	1 CONCRETE - 7.5 to 8 inches in thickness 347										
	SILTY, GRAVELLY SAND, trace cinders, brown, loose, moist to wet (Fill)		SM	S-1	SS	6	7	19			
			SM	S-2	SS	18	4	23			
	5.5 342.5	5	SP	S-3	SS	18	50	13			
	6.5 SAND, trace to with silt, gray, dense to very dense, moist 341.5										
	Boring completed at 6.5 feet. No groundwater observed.										

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▽
WL		

Terracon
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Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	XL	CO.	Geologic
LOGGED	RWS	JOB #	81095064

TC_BOREHOLE 81095064 WOOD DUVALL B-1 TO B-16.GPJ TERRACON.GDT 7/29/10

EXHIBIT 11
PAGE 64 OF 90

LOG OF BORING NO. B-11

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 39+23, 17 feet right of CL

Approx. Surface Elev.: 347 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	0.25 ASPHALT - 3 inches in thickness — 346.7										
	SAND with gravel and trace silt, brownish gray, loose, wet (Fill)		SP	S-1	SS	4	6				
	1.5 — 345.5										
	SILTY SAND, trace gravel, brownish gray, very loose, moist to wet (Fill)		SM	S-2	SS	1	2				
	5 — 342	5									
	SILTY SAND, trace gravel, brownish gray, loose, wet (Fill)		SM	S-3	SS	18	3				
	7.5 ▽ 339.5										
	SILTY SAND, trace gravel, trace organics, brownish gray, very loose, saturated (Fill)		SM	S-4	SS	12	3				
	10 — 337	10									
	SILTY SAND, trace gravel, brownish gray, medium dense, saturated		SM	S-5	SS	12	26				
	11.5 — 335.5										
	Boring completed at 11.5 feet.										

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 7.5	WD	▽
WL	▽		▽
WL			

Terracon
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Mountlake Terrace, WA 98043
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BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	Track	CO.	Geologic
LOGGED	CDF	JOB #	81095064

EXHIBIT 11
PAGE 65 OF 90

LOG OF BORING NO. B-12

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 40+17, 23 feet left of CL

Approx. Surface Elev.: 344 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	0.25 Topsoil — 343.7		SP	S-1	SS	12	3	9			
	1.5 SAND, trace gravel and silt, tan, loose, moist (FILL) — 342.5										
	SILTY SAND, trace gravel and organics, some oxide staining, brownish gray, very loose, moist (FILL)		SM	S-2	SS	2	2	16			
	5 — 339	5	SM	S-3	SS	16	2	22			
	SILTY SAND, trace gravel, reddish brown, very loose, moist (FILL)										
	7.5 — 336.5		SM	S-4	SS	18	17	15			
	SILTY SAND, gray, medium dense, wet to saturated ▽	10	SM	S-5	SS	18	18				
	11.5 — 332.5										
	Boring completed at 11.5 feet.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 8.5	WD	▽
WL	▽		▽
WL			

Terracon
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Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	Track	CO.	Geologic
LOGGED	CDF	JOB #	81095064

EXHIBIT 11
PAGE 166 OF 90

LOG OF BORING NO. B-13

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 42+25, 15 feet right of CL

Approx. Surface Elev.: 346 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	0.6 ASPHALT - 6 to 7 inches in thickness 345.4										
	SILTY, GRAVELLY SAND, gray, medium dense to dense, moist		SM	S-1	SS	18	29	8			
	3 343										
	SILTY, GRAVELLY SAND, gray, dense, moist		SM	S-2	SS	18	48	9			
		5	SM	S-3	SS	18	31	10			
	6.5 339.5										
	Boring completed at 6.5 feet. No groundwater observed.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED			3-1-10
BORING COMPLETED			3-1-10
RIG	XL	CO.	Geologic
LOGGED	RWS	JOB #	81095064

EXHIBIT 11
PAGE 67 OF 90

LOG OF BORING NO. B-14

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 46+62, 18 feet right of CL

Approx. Surface Elev.: 334 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	SAND with silt and trace gravel, brown, medium dense, wet (FILL)		SP SM	S-1	SS	8	14	13			
	1.5 — 332.5										
	SILTY SAND, trace gravel and organics, gray, very loose, wet (FILL)		SM	S-2	SS	10	3	14			GSA
		5	SM	S-3	SS	12	3	13			
	6 — 328										
	SILTY SAND with organics, dark brown, loose, wet (Relic Topsoil)							35			
	7 — 327										
	SAND with gravel and trace organics, orangish brown with iron staining, medium dense, wet ▽		SP	S-4	SS	16	24	13			
	10.5 — 323.5	10	SP	S-5	SS	16	53				
	SAND with gravel and trace organics, orangish brown with iron staining, very dense, saturated										
	12 — 322										
	GRAVELLY SAND with trace silt, gray, very dense, saturated	15	SP	S-6	SS	14	70				
	16.5 — 317.5										
	Boring completed at 16.5 feet.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 9.5	WD	▽
WL	▽		▽
WL			

Terracon
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Mountlake Terrace, WA 98043
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BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	Track	CO.	Geologic
LOGGED	CDF	JOB #	81095064

EXHIBIT 11
PAGE 168 OF 910

LOG OF BORING NO. B-15

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 49+43, 3 feet left of CL

BOREHOLE DIA.: 6 In
WELL DIA.: 1 In
GROUND SURFACE ELEV.: 327 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	RECOVERY, in.	SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS OTHER LABORATORY TESTS
ASPHALT - 9.25 inches in thickness (0.75 / 326.2)									
SILTY, GRAVELLY SAND, gray - brown, very dense, moist (Fill)		SM	S-1	SS	18	60	7		
(3.25 / 323.7)		SM	S-2	SS	12	50/3"	8		
CONCRETE - approximately 8 inches in thickness (Probable concrete panel) (4 / 323)									
SILTY SAND, trace gravel, dark brown, medium dense, moist	5	SM	S-3	SS	18	29	6		
(6.5 / 320.5)									
SILTY, GRAVELLY SAND, gray - brown, very dense, moist		SM	S-4	SS	18	67	5		GSA
	10	SM	S-5	SS	12	50/5"	6		
(15 / 312)									
SILTY, GRAVELLY SAND, with interbedded coarse sand and silt layers, gray - brown, very dense, wet	15	SM	S-6	SS	18	79	12		
(20 / 307)	20								

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▽
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	XL	CO.	Geologic
LOGGED	RWS	JOB #	81095064

TC_WELL 81095064 WOOD DUVALL B-1 TO B-16.GPJ TERRACON.GDT 7/29/10

EXHIBIT 11
PAGE 6 OF 90

LOG OF BORING NO. B-15

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS OTHER LABORATORY TESTS
	SILTY, GRAVELLY SAND, gray, very dense, moist			SM	S-7	SS	18	81	4		
	21.5 305.5										
	Boring completed at 21.5 feet. No groundwater observed. Department of Ecology Well Tag No. BBL278										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
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Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	XL	CO.	Geologic
LOGGED	RWS	JOB #	81095064

EXHIBIT 11
PAGE 10 OF 90

LOG OF BORING NO. B-16

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Boring Location: STA 51+48, 28 feet left of CL

Approx. Surface Elev.: 326 ft

DESCRIPTION	Depth, ft	USCS Symbol	Sample Number	Sample Type	Recovery, in.	SPT-N Blows / ft.	Water Content, %	Dry Unit Wt pcf	Unconfined Strength, tsf	Other Laboratory Tests
SAND with gravel and silt, brown-gray, loose, moist (FILL)		SP SM	S-1	SS	5	9	4			
2.5 / 323.5										
SAND with gravel and silt, gray, medium dense, moist (FILL)		SP SM	S-2	SS	8	13	6			
4 / 322										
SILTY SAND, trace gravel, dark brown, loose, moist (FILL)	5	SM	S-3	SS	6	5	12			
7 / 319										
SILTY SAND, trace gravel, orangish brown, loose, moist (FILL)		SM	S-4	SS	16	6	15			GSA
10 / 316	10									
SAND with gravel and trace silt, orangish-brown, medium dense, moist		SP SM	S-5	SS	18	18	9			
14 / 312										
SANDY GRAVEL, trace silt, brown-gray, dense, wet	15	GP	S-6	SS	16	85	10			
	20									

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▼	▽
WL		

Terracon
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BORING STARTED	3-2-10		
BORING COMPLETED	3-2-10		
RIG	Track	CO.	Geologic
LOGGED	CDF	JOB #	81095064

EXHIBIT 11
PAGE 71 OF 90

LOG OF BORING NO. B-16

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT-N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf	TESTS OTHER LABORATORY TESTS
	SANDY GRAVEL, trace silt, brown-gray, dense, wet		GP	S-7	SS	16	71	8			
	21.5 304.5										
	Boring completed at 21.5 feet. No groundwater observed.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

BORING STARTED			3-2-10
BORING COMPLETED			3-2-10
RIG	Track	CO.	Geologic
LOGGED	CDF	JOB #	81095064

EXHIBIT 11
PAGE 12 OF 90

LOG OF TEST PIT NO. TP-1

CLIENT Otak, Inc.

SITE NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT NE Woodinville - Duvall Road Improvements

Approx. Test Pit Location: STA 29+42, 17 feet right of CL

Approx. Surface Elev.: 373 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES DCP BLOWS / 1.75 in.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf
	SILTY SAND with organics, brown, loose, moist (Topsoil)		SM							
0.67	372.3									
	SILTY, GRAVELLY SAND, gray, medium dense, moist		SM	S-1	GR	6				
		2.5								
3	370									
	Test pit completed at 3 feet. No groundwater seepage or caving observed.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

TEST PIT STARTED	1-22-10		
TEST PIT COMPLETED	1-22-10		
RIG		CO.	
LOGGED	RWS	JOB #	81095064

EXHIBIT 11
PAGE 13 OF 90

LOG OF TEST PIT NO. TP-2

CLIENT Otak, Inc.

SITE NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT NE Woodinville - Duvall Road Improvements

Approx. Test Pit Location: STA 29+40, 26 feet left of CL

Approx. Surface Elev.: 374 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES DCP BLOWS / 1.75 in.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf
	SILTY SAND with organics, brown, loose, moist (Topsoil)									
0.67	373.3									
	SILTY, GRAVELLY SAND, gray, medium dense, moist		SM							
			SM							
		2.5								
3	371									
	Test pit completed at 3 feet. No groundwater seepage or caving observed.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

TEST PIT STARTED	1-22-10		
TEST PIT COMPLETED	1-22-10		
RIG		CO.	
LOGGED	RWS	JOB #	81095064

EXHIBIT 11
PAGE 74 OF 90

LOG OF TEST PIT NO. TP-3

CLIENT Otak, Inc.

SITE NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT NE Woodinville - Duvall Road Improvements

Approx. Test Pit Location: STA 36+13, 25 feet right of center line

Approx. Surface Elev.: 353 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES DCP BLOWS / 1.75 in.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf
	SILTY, GRAVELLY SAND, with small roots, brown, loose to medium dense, moist		SM	S-1	GR	6				
	1.5 — 351.5									
	SILTY, GRAVELLY SAND, gray, medium dense, moist	2.5	SM							
	3 — 350									
	Test pit completed at 3 feet. No groundwater seepage or caving observed.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▼	▽
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

TEST PIT STARTED			1-22-10
TEST PIT COMPLETED			1-22-10
RIG		CO.	
LOGGED	RWS	JOB #	81095064

EXHIBIT 11
PAGE 75 OF 90

LOG OF TEST PIT NO. TP-4

CLIENT Otak, Inc.

SITE NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT NE Woodinville - Duvall Road Improvements

Approx. Test Pit Location: STA 42+14, 25 feet left of center line

Approx. Surface Elev.: 350 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES DCP BLOWS / 1.75 in.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf
	SILTY, GRAVELLY SAND, with small roots, brown, loose to medium dense, moist		SM							
	1.5 — 348.5									
	SILTY, GRAVELLY SAND, gray, medium dense, moist		SM							
		2.5								
	3 — 347									
	Test pit completed at 3 feet. No groundwater seepage or caving observed.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

TEST PIT STARTED			1-22-10
TEST PIT COMPLETED			1-22-10
RIG		CO.	
LOGGED	RWS	JOB #	81095064

TC_HANDAUGER 81095064 WOOD DUVALL TP-1 TO TP-6.GPJ TERRACON.GDT 7/23/10

EXHIBIT 11
PAGE 76 OF 90

LOG OF TEST PIT NO. TP-5

CLIENT Otak, Inc.

SITE NE Woodinville - Duvall Road
Woodinville, Washington

PROJECT NE Woodinville - Duvall Road Improvements

Approx. Test Pit Location: STA 42+85, 25 feet left of center line

Approx. Surface Elev.: 351 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES DCP BLOWS / 1.75 in.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf
	SILTY, GRAVELLY SAND, with small roots, brown, loose to medium dense, moist		SM							
	1.5 — 349.5									
	SILTY, GRAVELLY SAND, gray, medium dense, moist		SM							
		2.5								
	3 — 348									
	Test pit completed at 3 feet. No groundwater seepage or caving observed.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

TEST PIT STARTED			1-22-10
TEST PIT COMPLETED			1-22-10
RIG		CO.	
LOGGED	RWS	JOB #	81095064

EXHIBIT 11
PAGE 71 OF 90

LOG OF TEST PIT NO. TP-6

CLIENT: Otak, Inc.

SITE: NE Woodinville - Duvall Road, Woodinville, Washington

PROJECT: NE Woodinville - Duvall Road Improvements

Approx. Test Pit Location: STA 51+41, 34 feet right of center line

Approx. Surface Elev.: 321 ft

GRAPHIC LOG	DESCRIPTION		DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES DCP BLOWS / 1.75 in.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, tsf
	Forest Duff	320.7									
	0.3										
	GRAVELLY SAND with silt, brown, very loose grading to loose, wet (FILL)										
	grades to loose to medium dense			SP	S-1	GR	6				
	2.8	318.2	2.5								
	SILTY SAND with gravel, dark brown, loose to medium dense, moist to wet			SM	S-2	GR	6				
	4.3	316.7									
	SILTY, GRAVELLY SAND, brown, medium dense, moist		5.0	SM	S-3	GR	6				
	5.5	315.5									
	Test pit completed at 5.5 feet. No groundwater observed.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon
21905 64th Avenue West, Ste. 100
Mountlake Terrace, WA 98043
T: 425-771-3304 F: 425-771-3549

TEST PIT STARTED	3-15-10		
TEST PIT COMPLETED	3-15-10		
RIG		CO.	
LOGGED	RWS	JOB #	81095064

EXHIBIT 11
PAGE 78 OF 90

APPENDIX B

LABORATORY TESTING

Laboratory Testing

A series of laboratory tests were performed during the course of this study to evaluate the index and geotechnical engineering properties of the subsurface soil samples recovered from the exploratory borings. Descriptions of the types of tests performed are given below.

Visual Classification

Samples recovered from the exploration locations were visually classified in the field during the exploration program. Representative portions of the samples were carefully packaged in moisture tight containers and transported to our laboratory where the field classifications were verified or modified as required. Visual classification was generally done in accordance with the Unified Soil Classification system. Visual soil classification includes evaluation of color, relative moisture content, soil type based upon grain size, and accessory soil types included in the sample. Soil classifications are presented on the exploration logs in Appendix A.

Moisture Content Determinations

Moisture content determinations were performed on representative samples obtained from the explorations in order to aid in identification and correlation of soil types. The determinations were made in general accordance with the test procedures described in ASTM D 2216. The results are shown on the exploration logs in Appendix A and on the grain size curves in this Appendix.

Grain Size Analysis

A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses were performed on representative samples in general accordance with ASTM D 422. The results of the grain size determinations for the samples were used in classification of the soils, and are presented in this appendix.

Fines Content Determination

Fines content determinations were performed on representative samples in general accordance with ASTM D 1140. These analyses were conducted only to determine the fines content of samples - the dry weight percentage of soil passing the US No. 200 sieve (200 wash). The results of the fines content determinations for the samples are discussed in the report text.

California Bearing Ratio Test

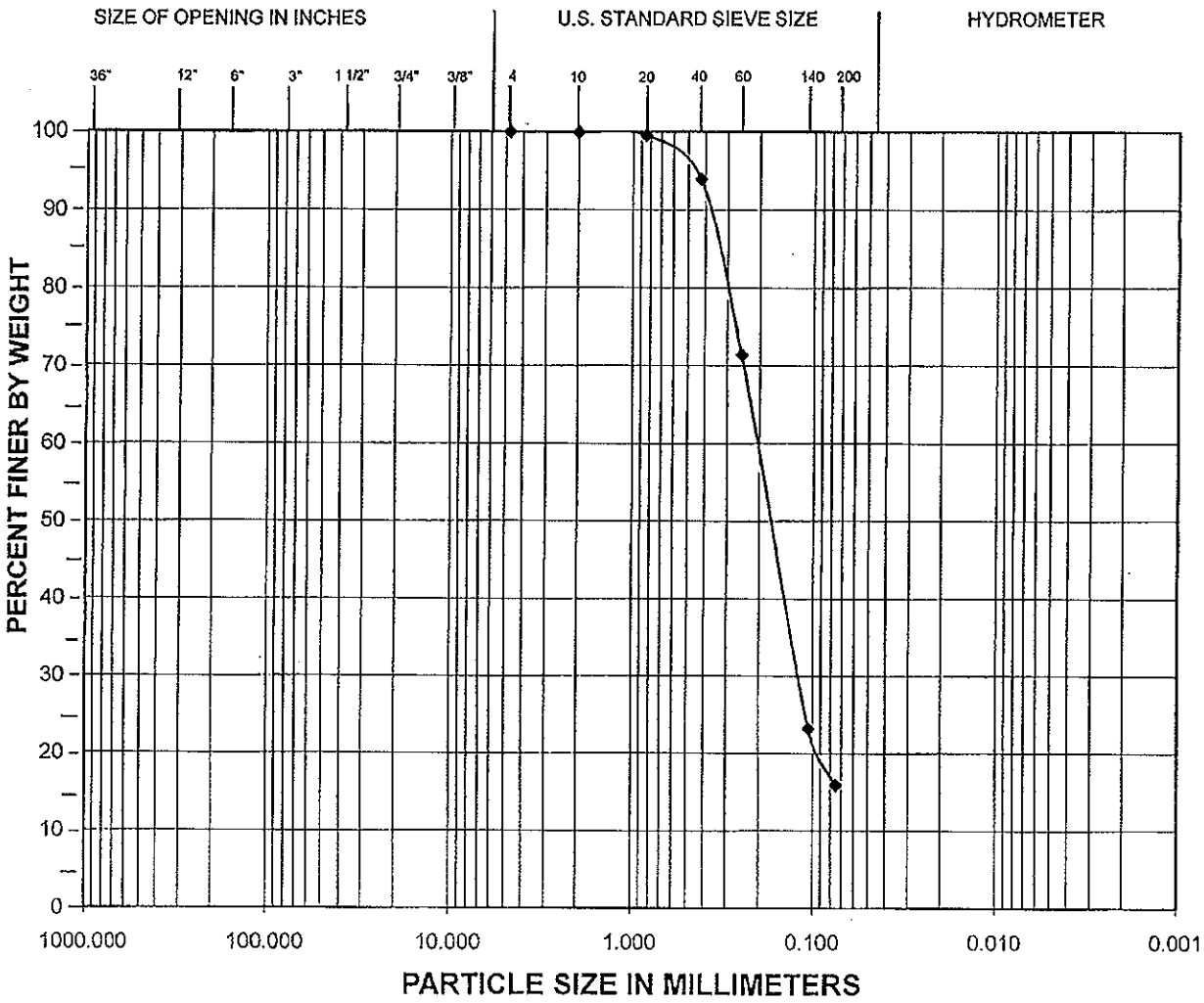
A California Bearing Ratio (CBR) test was performed on a representative sample in general accordance with ASTM D-1883-73 to provide an evaluation of the relative quality and support characteristics of subgrade soils. CBR test results and moisture-density relationships plotted in terms of percent water content versus percent corrected CBR and dry density, respectively, are presented in this appendix.

EXHIBIT 11
PAGE 81 OF 90

GRAIN SIZE ANALYSIS

Test Results Summary

ASTM D 422



		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
BOULDERS	COBBLES	GRAVEL		SAND			FINE GRAINED	

Comments:

Exploration	Sample	Depth (feet)	Moisture (%)	Fines (%)	Description
B-1	S-4	7.5-9	10	15.9	Silty sand

Terracon
Geotechnical and Environmental Consulting

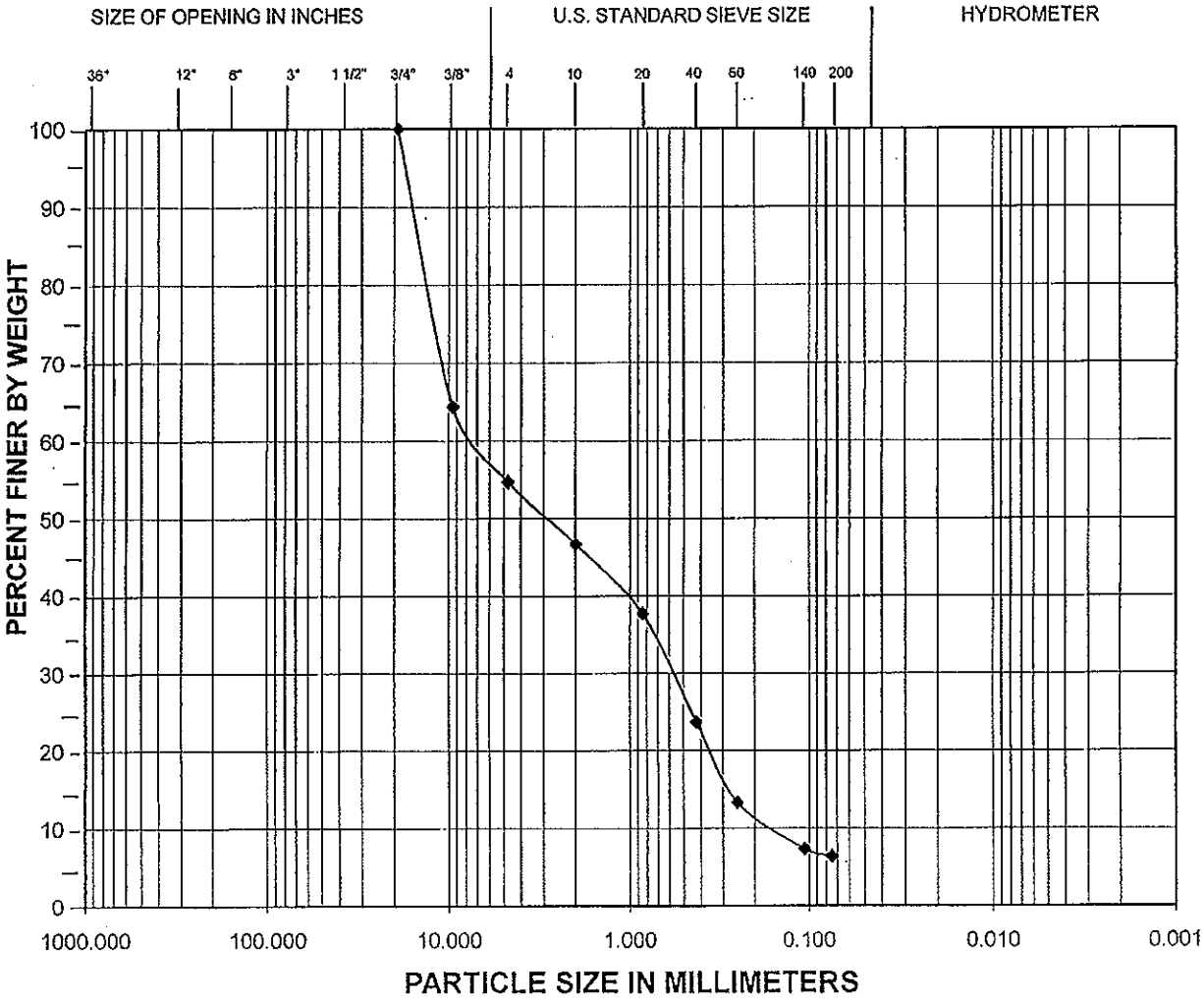
JOB NO: 81095064
DATE OF TESTING: 3/9/2010

PROJECT NAME:
NE Woodinville-Duvall Road Exhibit B3

EXHIBIT 11
PAGE 82 OF 90

GRAIN SIZE ANALYSIS

Test Results Summary ASTM D 422



BOULDERS	COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
		GRAVEL		SAND			FINE GRAINED	

Comments:

Exploration	Sample	Depth (feet)	Moisture (%)	Fines (%)	Description
B-3	S-3	5-6.5	8	6.4	Sand with silt and gravel

Terracon
Geotechnical and Environmental Consulting

JOB NO: 81095064
DATE OF TESTING: 3/9/2010

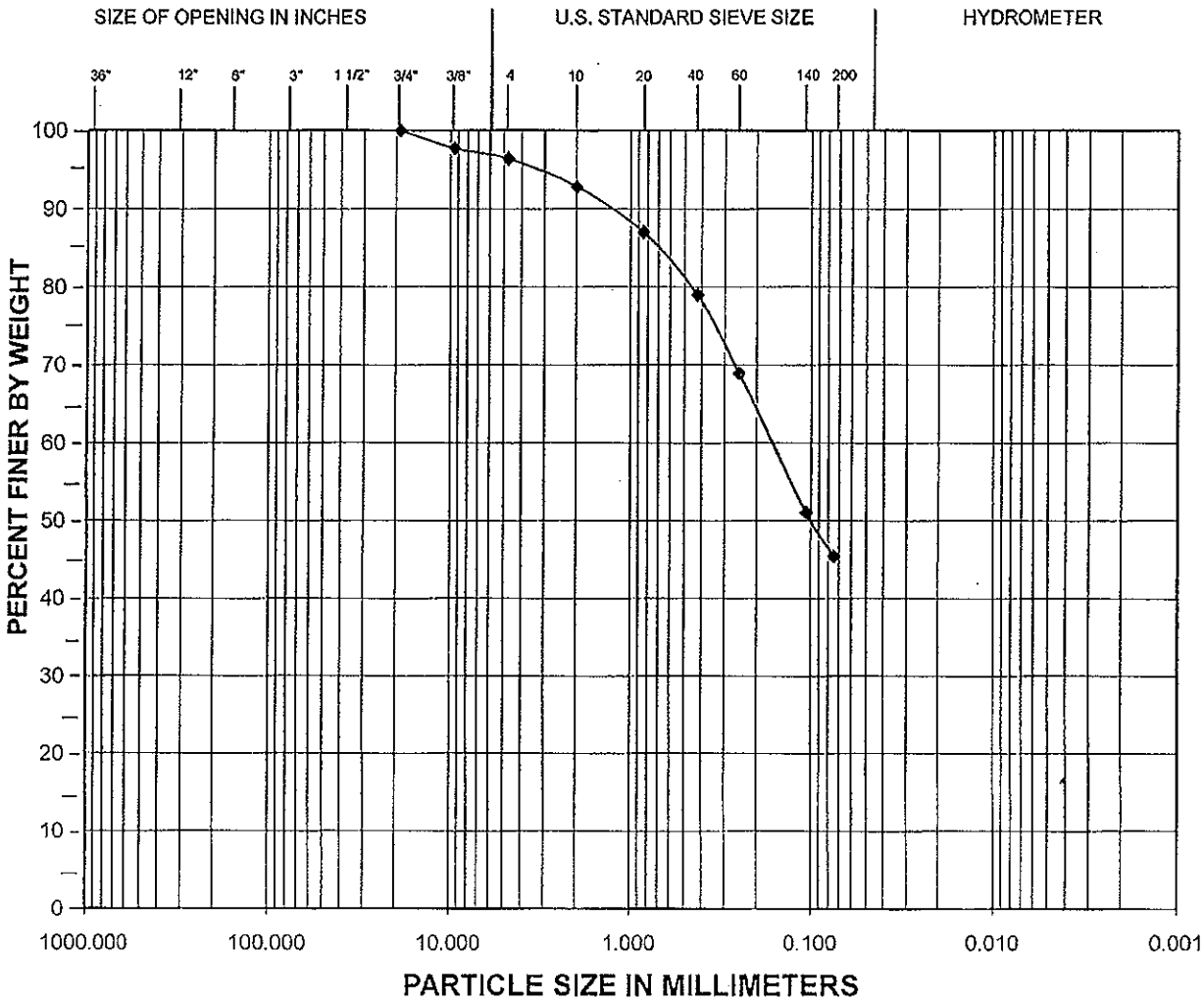
PROJECT NAME: NE Woodinville-Duvall Road Exhibit B4

EXHIBIT 11
PAGE 83 OF 90

GRAIN SIZE ANALYSIS

Test Results Summary

ASTM D 422



		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
BOULDERS	COBBLES	GRAVEL		SAND			FINE GRAINED	

Comments:

Exploration	Sample	Depth (feet)	Moisture (%)	Fines (%)	Description
B-3	S-7	20-21.5	19	45.5	Sandy silt, trace gravel

Terracon
Geotechnical and Environmental Consulting

JOB NO: 81095064
DATE OF TESTING: 3/9/2010

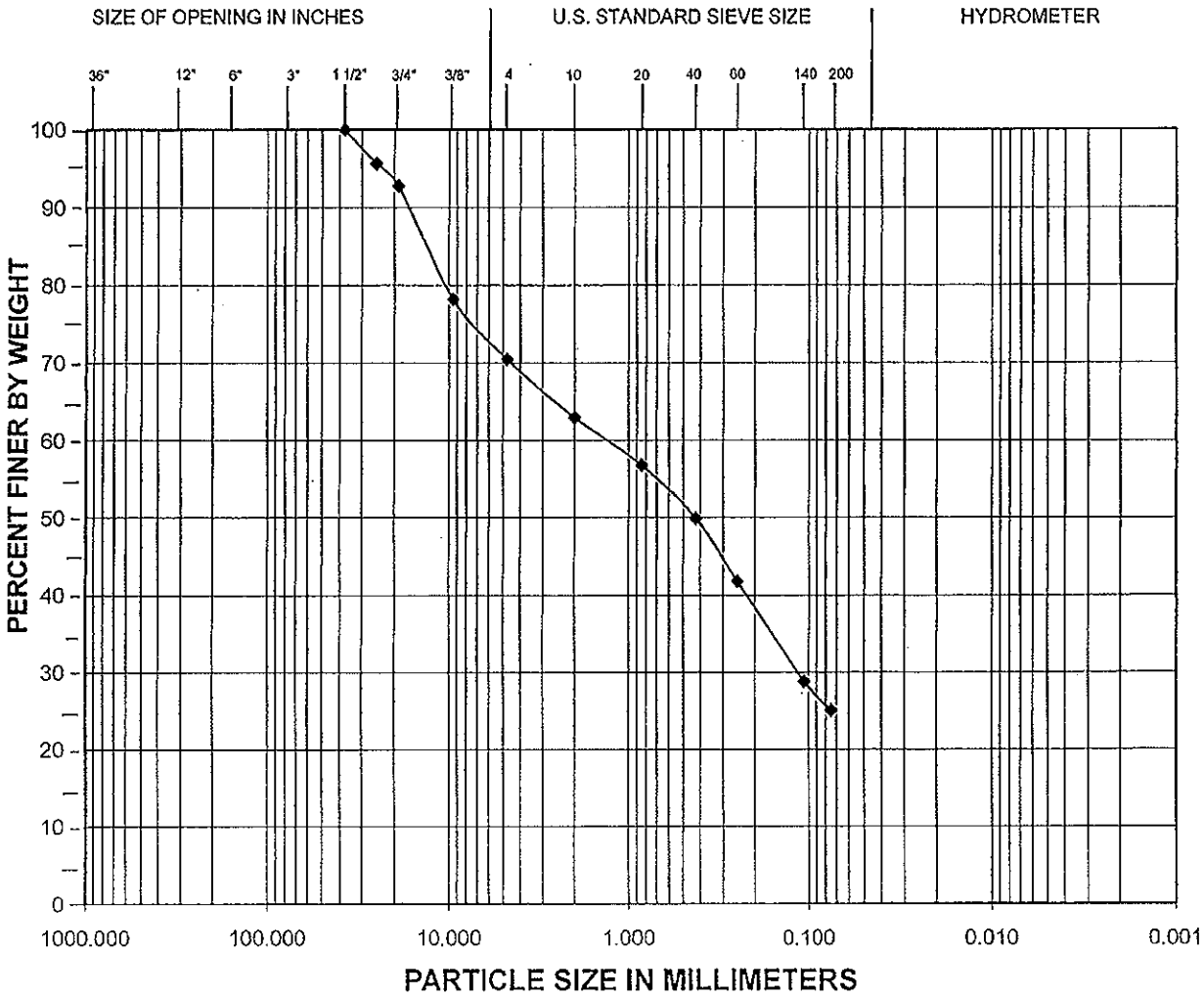
PROJECT NAME: NE Woodinville-Duvall Road Exhibit B5

EXHIBIT 11
PAGE 84 OF 90

GRAIN SIZE ANALYSIS

Test Results Summary

ASTM D 422



BOULDERS	COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
		GRAVEL		SAND			FINE GRAINED	

Comments:

Exploration	Sample	Depth (feet)	Moisture (%)	Fines (%)	Description
B-4	S-7	20-21.5	20	25.1	Silty sand with gravel

Terracon
Geotechnical and Environmental Consulting

JOB NO: 81095064
DATE OF TESTING: 3/9/2010

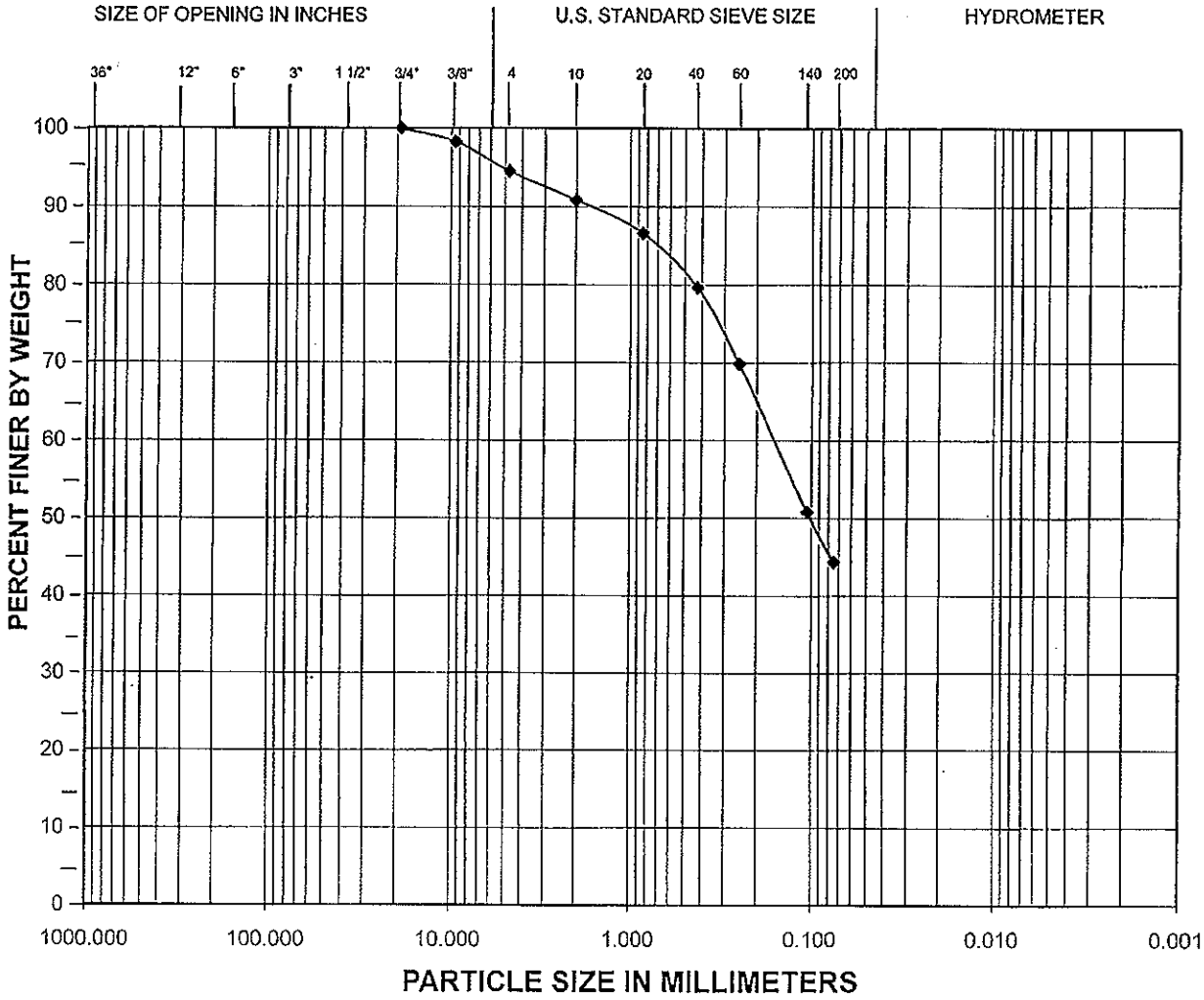
PROJECT NAME: NE Woodinville-Duvall Road Exhibit B6

EXHIBIT 11
PAGE 85 OF 90

GRAIN SIZE ANALYSIS

Test Results Summary

ASTM D 422



		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
BOULDERS	COBBLES	GRAVEL		SAND			FINE GRAINED	

Comments:

Exploration	Sample	Depth (feet)	Moisture (%)	Fines (%)	Description
B-6	S-3	5-6.5	12	44.4	Silty sand

Terracon
Geotechnical and Environmental Consulting

JOB NO: 81095064
DATE OF TESTING: 3/9/2010

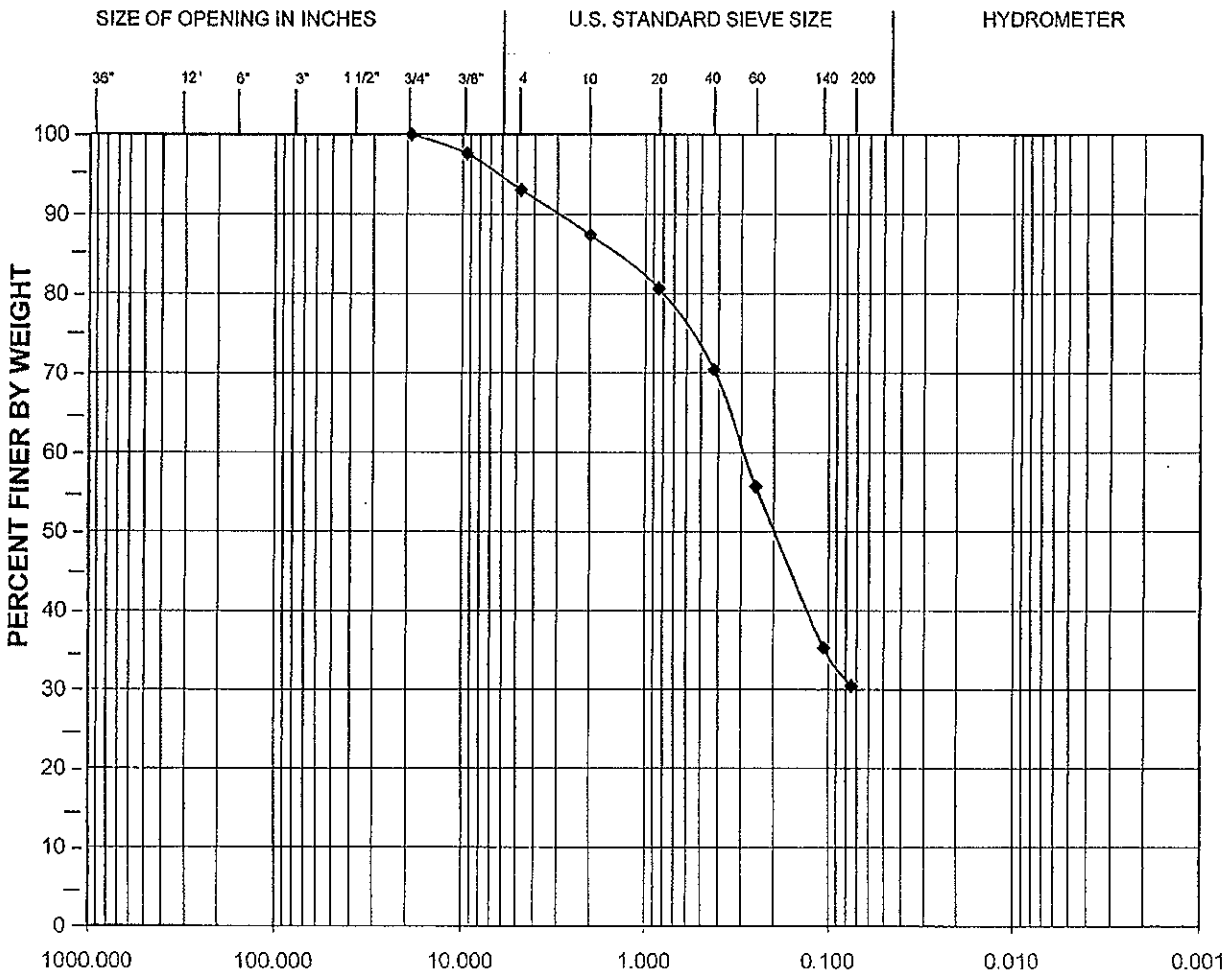
PROJECT NAME: NE Woodinville-Duvall Road Exhibit B7

EXHIBIT 11
PAGE 86 OF 90

GRAIN SIZE ANALYSIS

Test Results Summary

ASTM D 422



		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
BOULDERS	COBBLES	GRAVEL		SAND			FINE GRAINED	

Comments:

Exploration	Sample	Depth (feet)	Moisture (%)	Fines (%)	Description
B-11	S-3	5-6.5	15	30.5	Silty sand

Terracon
Geotechnical and Environmental Consulting

JOB NO: 81095064
DATE OF TESTING: 3/9/2010

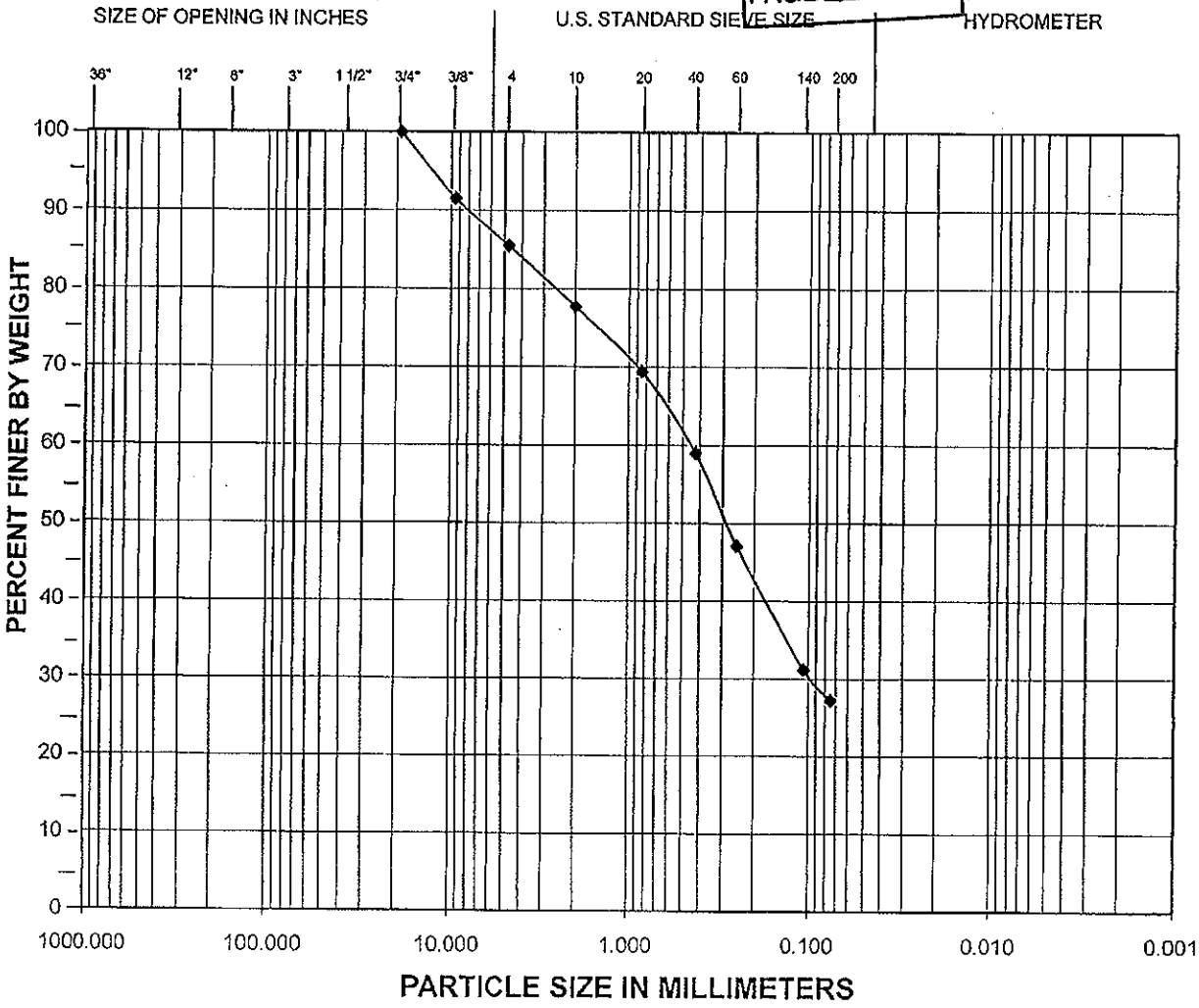
PROJECT NAME: NE Woodinville-Duvall Road Exhibit B8

GRAIN SIZE ANALYSIS

Test Results Summary

ASTM D 422

EXHIBIT 11
PAGE 10 OF 99



BOULDERS	COBBLES	GRAVEL		SAND			FINE GRAINED	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

Comments:

Exploration	Sample	Depth (feet)	Moisture (%)	Fines (%)	Description
B-14	S-2	2.5-4	14	27.2	Silty sand

Terracon
Geotechnical and Environmental Consulting

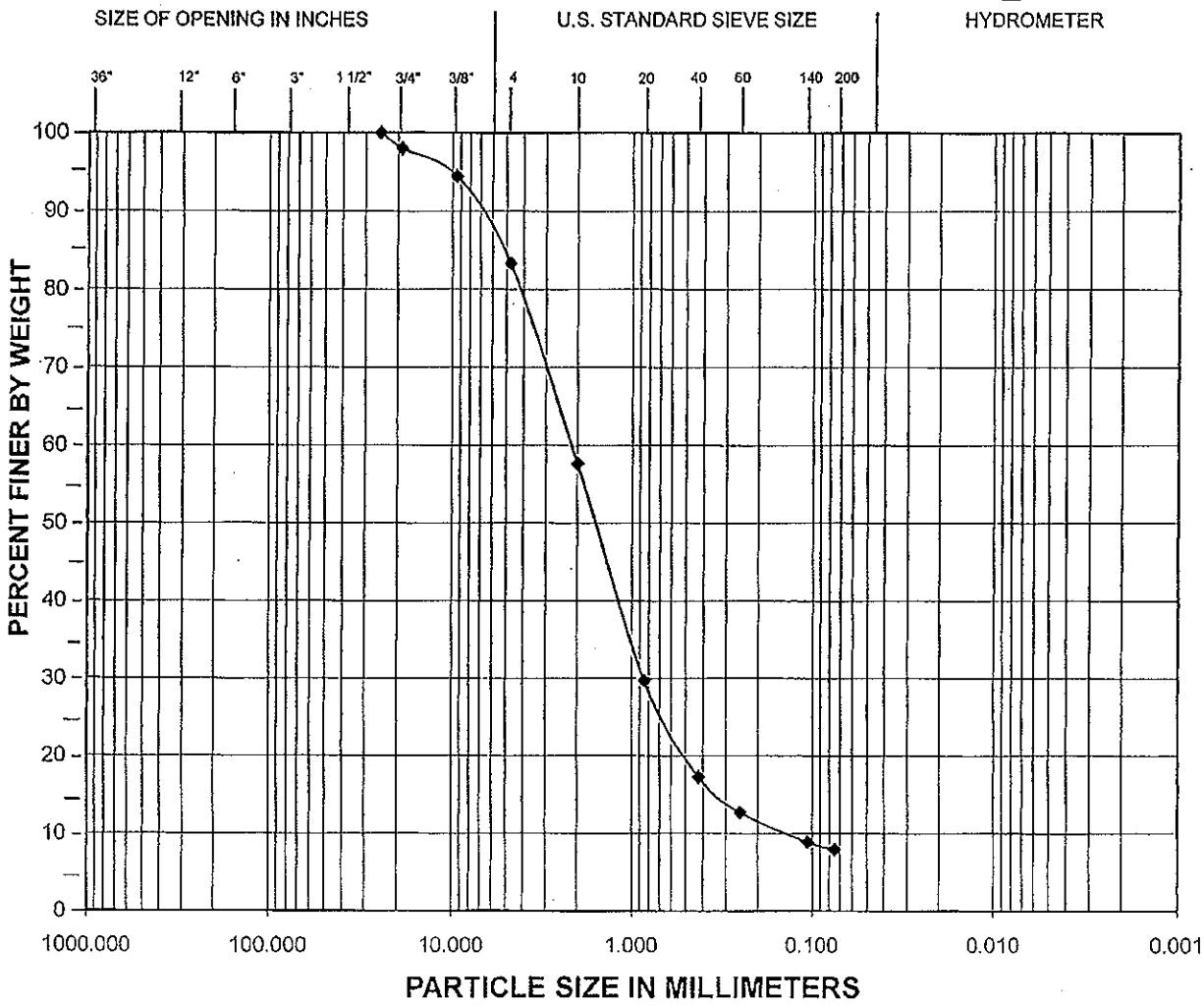
JOB NO: 81095064
DATE OF TESTING: 3/9/2010

PROJECT NAME: NE Woodinville-Duvall Road Exhibit B9

EXHIBIT 11
PAGE 89 OF 90

GRAIN SIZE ANALYSIS

Test Results Summary ASTM D 422



		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
BOULDERS	COBBLES	GRAVEL		SAND			FINE GRAINED	

Comments:

Exploration	Sample	Depth (feet)	Moisture (%)	Fines (%)	Description
B-15	S-4	7.5-9	5	7.9	SAND with silt, trace gravel

Terracon
Geotechnical and Environmental Consulting

JOB NO: 81095064
DATE OF TESTING: 3/9/2010

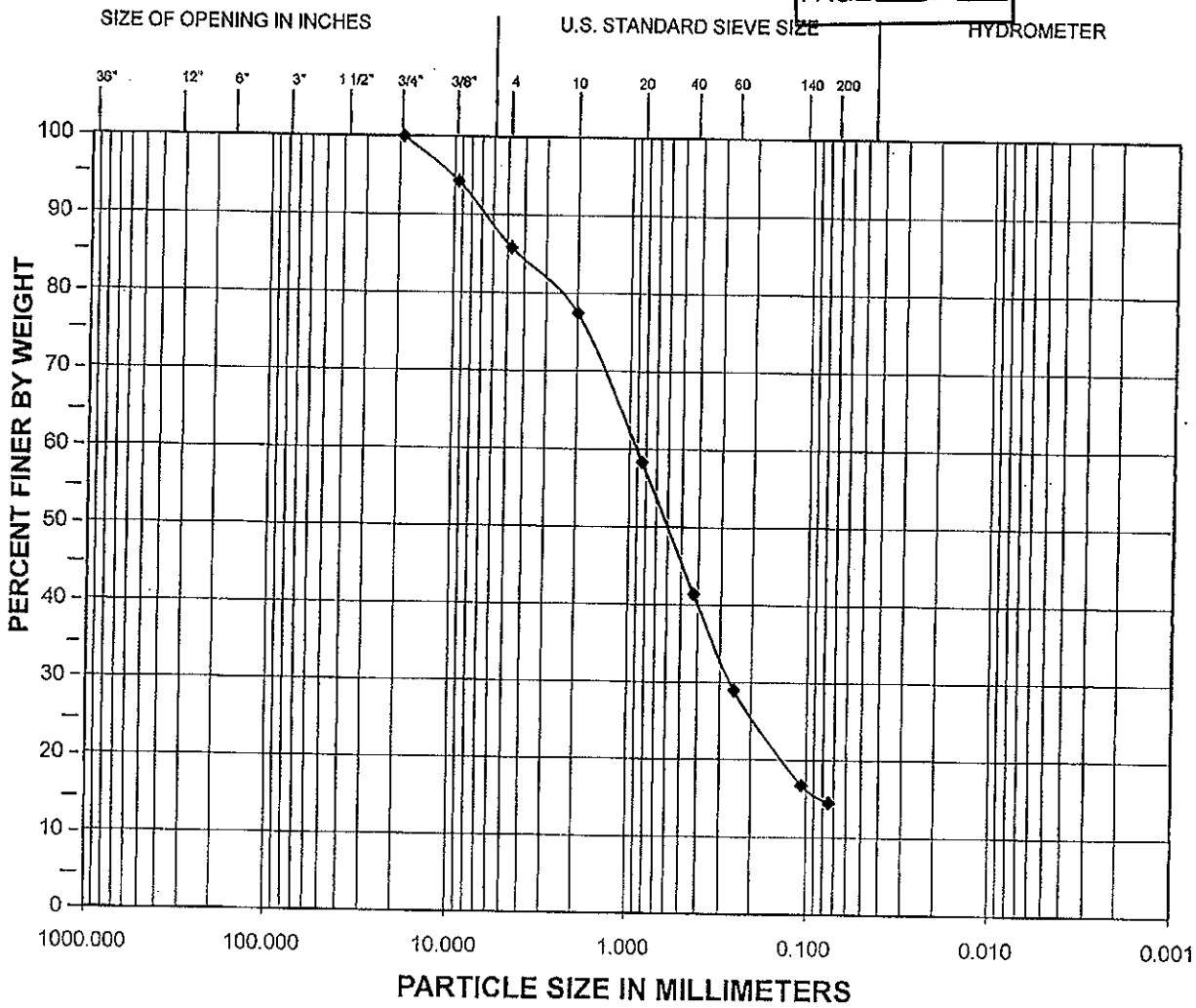
PROJECT NAME: NE Woodinville-Duvall Road Exhibit B10

GRAIN SIZE ANALYSIS

Test Results Summary

EXHIBIT 11
PAGE 89 OF 90

ASTM D 422



BOULDERS	COBBLES	GRAVEL		SAND			FINE GRAINED	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

Comments:

Exploration	Sample	Depth (feet)	Moisture (%)	Fines (%)	Description
B-16	S-4	7.5-9	15	14.5	Sand with silt and gravel

Terracon
Geotechnical and Environmental Consulting

JOB NO: 81095064
DATE OF TESTING: 3/9/2010

PROJECT NAME: NE Woodinville-Duvall Road Exhibit B11

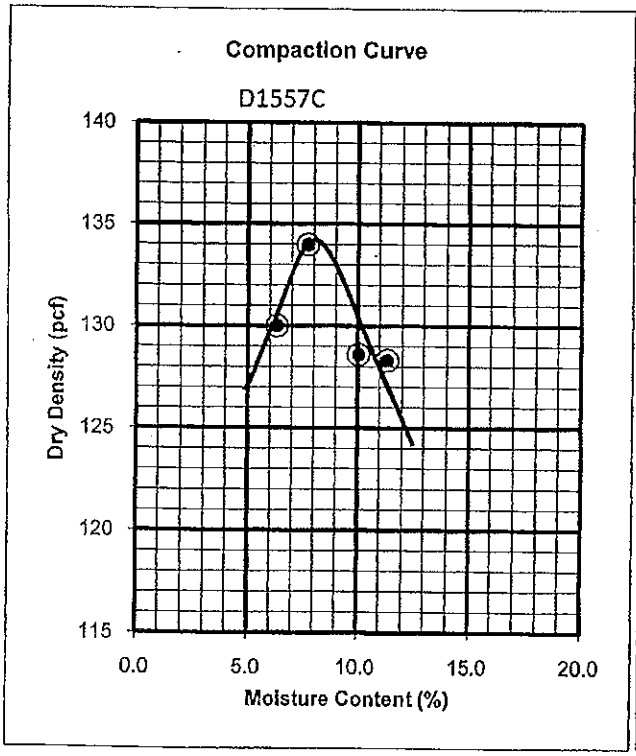
EXHIBIT 11
PAGE 90 OF 90

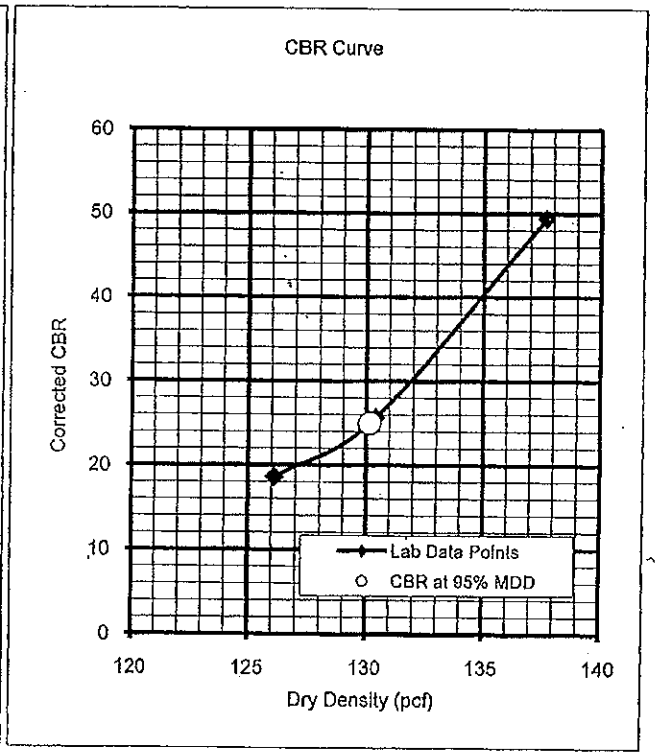
CALIFORNIA BEARING RATIO ASTM D 1883

Soil Description: Brown SILTY SAND with gravel

Sample No.: CBR-Composite
Depth: 0.5 - 1.5 feet

	10 Blows/Lift		25 Blows/Lift		56 Blows/Lift	
Condition of Sample:	soaked		soaked		soaked	
Dry Density Before Soaking:	126	pcf	130	pcf	138	pcf
Dry Density After Soaking:	131	pcf	134	pcf	139	pcf
Moisture Content:						
Before Compaction:	7.2	%	7.9	%	7.1	%
After Compaction:	7.9	%	7.1	%	7.1	%
Top 1-in Layer After Soaking:	10.0	%	8.7	%	7.6	%
Average After Soaking:	8.7	%				
Swell:	0.6	%	0.0	%	0.0	%
Surcharge Amount:	64.8	psf	64.8	psf	64.8	psf





Max. Dry Density (MDD)* = 137 pcf
Optimum Moisture* = 7.4 %
*Rock Corrected Values

95% of MDD = 130.2 pcf
CBR at 95% of MDD = 25

Terracon Geotechnical and Environmental Consulting	PROJECT NO: 81095064	PROJECT NAME: NE Woodinville-Duvall Road Exhibit B12