Addendum 1

DRAFT Supplemental Geotechnical Investigation Geotechnical Data Report – Snohomish Force Main

October 25, 2011

Introduction

Presented herein are results from the supplemental geotechnical field investigation conducted by CH2M HILL for the City of Snohomish Force Main project in Snohomish, Washington. This field work supplements the data reported in the *Snohomish Force Main Draft Geotechnical Data Report (GDR).* The investigation was completed for the following objectives:

- Determine the depth of gravels at the proposed horizontal directional drilling (HDD) in the marshland area.
- Refine the soil profile at the proposed pump station for geotechnical design and to determine the thickness of the soft cohesive layer encountered in previous explorations performed by others.
- Define the fill material of the access road embankment at the existing lagoon
- Define the soil type and groundwater elevation near the City of Everett connection point.
- Perform laboratory testing to assist in developing soil properties for geotechnical design.

Subsurface Exploration Program

Borings for the supplemental geotechnical investigation were performed by subcontractors under the oversight of CH2M HILL geotechnical engineering staff. The exploration locations were determined in the field based on proposed reservoir and pipeline locations, equipment access, utility interference, and topographical features. The subsurface exploration program is summarized in Figure 1. Boring logs are found in Appendix A.

Borings for this project were drilled from October 3, 2011 to October 6, 2011 at the locations shown in Figure 1. Geotechnical drilling services for the Project were provided by Gregory Drilling, of Redmond, WA under the oversight of CH2M HILL geotechnical staff.

Soil drilling was accomplished using a combination of 6-inch, outside-diameter, hollow-stem auger and mud rotary drilling systems with a track-mounted Central Mine Equipment (CME) 850 drill rig.

At each exploration location, the soil profile was visually classified in general accordance with ASTM D 2488 - *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. Details such as obstructions, identification of soil stratigraphy, and observation of groundwater seepage were also noted. Soil samples were collected from the explorations, visually logged, and stored in watertight sample bags for possible laboratory testing.

Copies of the exploration logs summarizing visual field classifications and laboratory results (pending) are included in Appendix A.

Four borings were drilled along the proposed pipeline alignment and one boring was drilled near the proposed pump station. Boring depths ranged from 16.5 feet to 96.5 feet. Piezometers were installed in borings B-7-11 and B-8-11.

One-call utility notification service was notified by CH2M HILL before work was conducted. At each boring location before drilling, utility marks were verified by the on-site CH2M HILL geotechnical staff. Right-of-Entry permissions were obtained before accessing each site.

Representative disturbed soil samples were obtained from the borings using Standard Penetration Test (SPT) methods. SPTs were generally conducted at 5-foot intervals with an automatic-trip hammer and were performed in general accordance with ASTM D1586 – *Standard Penetration Test Method for Penetration Test and Split Barrel Sampling of Soils*, except that sample liners were not used. Soil samples collected from the SPTs were visually logged and stored in watertight sample bags for laboratory testing.

Laboratory testing has been submitted to HWA Geosciences Inc. of Bothell, WA. Results of the tests are still pending. Boring logs and this addendum will be updated once lab test results are available.

Results of the Field Exploration

This section summarizes the subsurface conditions based on the results of the supplemental field exploration at the HDD marshland area, proposed pump station, access road next to the existing lagoon, and the City of Everett connection point. Subsurface conditions at other locations within the project are described in the GDR.

Boring locations are provided in Figure 1. The exploration logs are provided in Appendix A and document detailed descriptions of the soils encountered at each location.

Soils within the project area can generally be sub-divided into 2 soil units. The upper soils are a low-energy deposit consisting of soft to firm silt and elastic silt with varying amounts of sand typically containing organics and woody debris. Underlying the low-energy soils are a high-energy deposit consisting of medium dense poorly graded sand with silt. The high energy deposits contain occasional fine gravels but eventually transition into more frequent gravels and larger size gravels and cobbles. A more detailed description is found below at each location of the supplemental investigation.

HDD Marshland Area

Boring B-5-11 and B-6-11 were drilled with the specific purpose to identify the depth to gravel for the horizontal directional drilling (HDD) portion of the alignment. Boring B-2-11 was drilled

for this same purpose in April, 2011 as discussed in the GDR. Boring B-2-11 was drilled in a farmed field just north of the BNSF railroad tracks and west of the proposed HDD area. Boring B-5-11 was drilled in an undeveloped field on the west side of the canal and south of the BNSF railroad tracks. Boring B-6-11 was drilled in a marshland area south of the BNSF railroad track and just east of the railroad marshland trestle. The marshland area can typically only be accessed during the summer due to soft soils and muddy conditions. Borings B-2-11, B-5-11, and B-6-11 are spaced approximately 1,300 to 1,800 feet apart, respectively, moving southeast along the alignment beginning at B-2-11.

As found in the GDR, boring B-2-11 encountered very soft elastic silt with significant amounts of organics top 75 feet below ground surface (bgs). The high energy deposits were encountered from 75 feet to 95 feet at which point significant gravels were encountered.

Boring B-5-11 encountered very soft elastic silt with varying amounts of organics up to a depth of approximately 59 feet below ground surface (bgs). N-values in this layer were typically 0. At 59 feet bgs, the drilling indicated a layer break to the high energy deposits consisting of poorly graded sand up to a depth of 78.5 feet. N-values in this layer ranged from 23 to 45. Gravels were encountered from 78.5 feet bgs to boring termination at 86.5 feet. Soil classification from 78.5 feet to 86.5 feet was dense to very dense poorly graded sand with silt and gravel. Gravels were described as fine to coarse with an angularity of subangular to angular and N-values from 34 to 50. The gravels from 78.5 to 86.5 feet were estimated as being 15 to 25 percent of the weight of the sample; however, rig chatter was observed throughout the layer.

Boring B-6-11 encountered very soft elastic silt with varying amounts of organics up to a depth of approximately 45 feet bgs. N-values in this layer were typically 0. A transition zone from the low energy deposit to the high energy deposit occurred from 45 to 55 feet bgs. N-values in this transition layer were 3 and 10 and the soil description changed from silt with sand at 45 feet to silty sand at 50 feet. At 55 feet bgs the drilling showed a layer break to the high energy deposits consisting of poorly graded sand. Estimated gravel content in this layer ranged from 10 to 20 percent. Drill rig chatter indicated gravels at this depth. The gravels were described as fine and subrounded. At a depth of 70 feet bgs significant amounts of fine to coarse gravels were encountered. N-values from depths of 55 feet to 75 feet ranged from 24 to 38. From 75 to 92 feet bgs, drilling indicated sand and thin intermittent layers of gravel. N-values within this depth ranged varied from 10 to 27. At 92 feet bgs, significant gravels were encountered and the drilling indicated hard drilling. The N-value at 95 feet (boring termination) was 71. Gravels were the primary soil type in the sample and were subangular. The gravels were fractured indicating possible cobble-size material at this depth.

Pump Station

Boring B-7-11 was drilled at the proposed pump station to confirm subsurface information shown in borings drilled in 1993 by Lorilla Engineering Inc. Similar conditions were encountered in boring B-7-11 as was found in the Lorilla borings and described in the GDR. The boring was drilled in the existing lagoon and the subsurface conditions are described below.

Surficial soils at the pump station consisted of soft brown biosolids from approximately the surface to 2.5 feet bgs. Underlying the biosolids from 2.5 to approximately 10 feet is a very soft to very loose sandy silt to silty sand layer. At 10 feet the subsurface transitions to loose silty sand to poorly graded sand with N-values ranging from 2 to 8. This layer changes to a mixture

of poorly graded sand, poorly graded gravel, and sandy silt at a depth of approximately 27 feet up to 42.5 feet. N-values in this layer ranged from 6 to 22. Gravels were first encountered within this layer at 33 feet and the drilling indicated gravels up to a depth of 40 feet. Gravels in this zone were fractured indicating a possibility of cobble-size material. Underlying the sand and gravel layer at 42.5 feet is a soft to firm lean clay layer from 42.5 feet to 55 feet. From 55 to 62.5 feet is medium dense silty sand to poorly graded sand with silt layer. At 62.5 feet, a gravel layer was encountered up to the boring termination depth of 76.5 feet. Gravels in the sample were fractured indicating a possibility of cobble-size material.

Access Road at Existing Lagoon

Boring B-9-11 was drilled through the access road at the existing lagoon to determine the fill soils of the access road embankment. The boring encountered 1 to 2 inches of silty sand material overlying stiff brown silt up to a depth of approximately 12.5 feet. N-values in the access road embankment ranged from 10 to 13. Native soils were encountered below 12.5 feet consisting of soft to firm silt to sandy silt.

City of Everett Connection

Boring B-8-11 was drilled to determine the soils at the location where the proposed force main connects with the City of Everett pipeline. The upper 10 feet consisted of silty sand to silty sand with gravel. Gravels were described as fine to coarse (up to 2 inch diameter). N-values ranged from 10 to 24. Drill cuttings revealed brick from 7.5 to 9 feet within this layer. At approximately 10 feet bgs the soils changed to an elastic silt to silt layer with N-values ranging from 0 to 6. This layer was encountered up to the boring termination depth at 16.5 feet.

Groundwater Conditions

Piezometers were installed in borings B-7-11 and B-8-11 for monitoring groundwater levels. At the current writing of this report groundwater measurements have not been reported. Once obtained, this report will be updated with groundwater readings at these locations. Drilling was performed before the rainy season and therefore groundwater depths will most likely become shallower during the winter, spring, and early summer. Groundwater was encountered at the following depths during drilling:

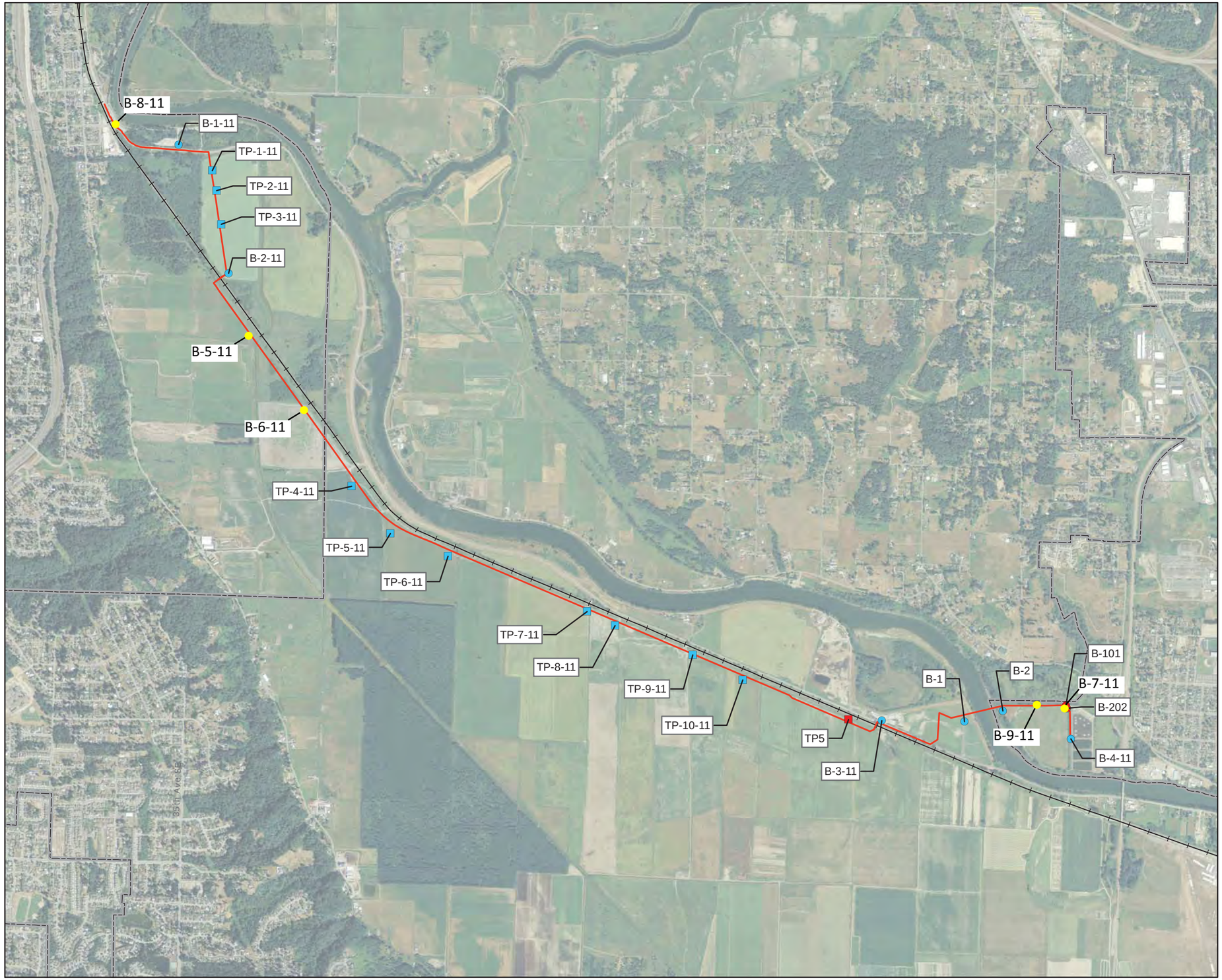
- B-5-11 – Not measured but expected near the ground surface.
- B-6-11 – Not measured but expected near the ground surface.
- B-7-11 – Less than 5 feet bgs.
- B-8-11 – Approximately 12.5 feet bgs.
- B-9-11 – Approximately 15 feet bgs.

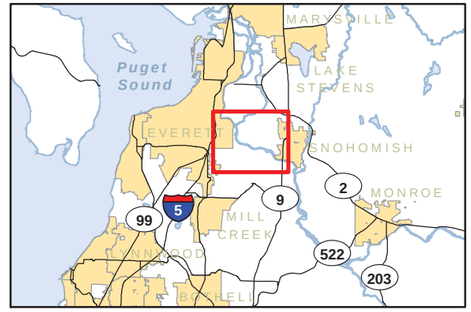
Limitations

This addendum has been prepared for the exclusive use of the CH2M HILL design team and the City of Snohomish for specific application to the Snohomish Force Main Project, in accordance with generally accepted geotechnical engineering practice. No other warranty, express or implied, is made.

Any information contained in this addendum is based on collected data, geologic reports, and subsurface explorations conducted for this project. The boring logs and related information depict subsurface conditions only at the specific locations and times indicated and only to the depths penetrated. Subsurface conditions and water levels at other locations may differ from conditions occurring at these indicated locations. They do not necessarily reflect strata variations that may exist between such locations. The passage of time may result in a change in the conditions at these locations. If variations in subsurface condition from those described and presented are noted during construction, recommendations in this report must be re-evaluated.

In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this addendum modified or verified in writing by CH2M HILL. CH2M HILL is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analyses without the express written authorization of CH2M HILL.





- Boring
- Test Pit
- Existing Boring
- Existing Test Pit
- Force Main
- City Limits
- Supplemental Boring

Source: Color Aerial; National Agriculture Imagery Program (NAIP), 2009, Force Main (2011) CH2M HILL.

N

0 1,000 2,000 4,000 Feet

FIGURE 1
Exploration Map
Addendum 1 Supplemental Geotechnical Investigation
Snohomish Force Main Project

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Appendix A

Boring Logs

Laboratory Test Results (pending)

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PROJECT NUMBER:	BORING NUMBER:	SHEET
391193.A3.GE.01	B-5-11	1 OF 3

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: City of Everett Owned Field

ELEVATION: ~2 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Hollow Stem Auger and Mud Rotary drilling

WATER LEVELS: Not Measured START: 10/13/2011 END: 10/13/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0					Surface is grass and brown silt.	Begin drilling with hollow stem auger.
5	5					
	6.5	0	SS-1	PUSH	**NO RECOVERY**.	Switch to mud rotary drilling.
10	10					
	11.5	4"	SS-2	PUSH	**LEAN CLAY (CL)**, gray and brown, wet, very soft, low to medium plasticity, significant wood organics.	
15	15					
	16.5	18"	SS-3	PUSH	**ELASTIC SILT WITH ORGANICS/PEAT (MH/PT),** dark brown, wet, very soft, medium plasticity, high amounts of organics.	
20	20					
	21.5	18"	SS-4	PUSH	**ELASTIC SILT WITH ORGANICS (MH)**, dark gray, wet, very soft, medium to high plasticity, significant organics in upper 6", some organics in bottom 1".	
25	25					
	26.5	18"	SS-5	PUSH	**ELASTIC SILT (MH)**, dark gray, wet, very soft, medium to high plasticity, some organics throughout.	
30						

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CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	SHEET
391193.A3.GE.01	B-5-11	2 OF 3

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: City of Everett Owned Field

ELEVATION: ~2 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Hollow Stem Auger and Mud Rotary drilling

WATER LEVELS: Not Measured START: 10/13/2011 END: 10/13/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
30	30	18"	SS-6	PUSH	**ELASTIC SILT (MH)**, same as above.	
	31.5					
35	35	18"	SS-7	PUSH	**ELASTIC SILT (MH)**, same as above.	
	36.5					
40	40	18"	SS-8	PUSH	**ELASTIC SILT (MH)**, similar to above except trace organics.	
	41.5					
45	45	18"	SS-9	PUSH	**ELASTIC SILT (MH)**, same as above.	
	46.5					
50	50	6"	SS-10	PUSH	**ELASTIC SILT (MH)**, same as above.	
	51.5					
55	55	15"	SS-11	0-0-4 (4)	**SILT WITH SAND (ML)**, dark brownish gray, wet, soft, low plasticity, estimated 15-25% very fine sand.	
	56.5					
60						Driller reports: harder @ 59;.

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PROJECT NUMBER:	BORING NUMBER:	SHEET
391193.A3.GE.01	B-5-11	3 OF 3

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: City of Everett Owned Field

ELEVATION: ~2 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Hollow Stem Auger and Mud Rotary drilling

WATER LEVELS: Not Measured START: 10/13/2011 END: 10/13/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
60	60	8"	SS-12	6-10-13 (23)	**SILTY SAND (SM)**, dark gray, wet, medium dense, fine sand, estimated 15-20% non-plastic fines.	
	61.5					
65	65					
	66.5	13"	SS-13	11-10-17 (27)	**POORLY GRADED SAND (SP)**, dark gray, wet, medium dense, fine to medium sand, trace non-plastic fines, 0.5" wood lens at 65.7'.	
70	70					
	71.5	10"	SS-14	8-11-12 (23)	**POORLY GRADED SAND (SP)**, dark gray, wet, medium dense, fine to medium sand, estimated 0-5% non-plastic fines, one fine subangular gravel, in shoe, 0.5" lens at 70.5".	
75	75					
	76.5	12"	SS-15	17-19-26 (45)	**POORLY GRADED SAND (SP)**, similar to above except dense, one coarse subrounded gravel.	
80	80					Driller reports: gravels at 78.5'.
	81.5	12"	SS-16	16-24-26 (50)	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**, dark gray, wet, dense, fine to coarse sand, predominantly fine to medium sand, estimated 5-10% non-plastic fines, estimated 15-25% fine to coarse subangular to angular gravel.	Rig chatter from 80-85'.
85	85					
	86.5	10"	SS-17	12-11-23 (34)	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**, same as above.	
90					Bottom of hole at 86.5'.	Abandoned hole with bentonite grout.

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PROJECT NUMBER:	BORING NUMBER:	SHEET
391193.A3.GE.01	B-6-11	1 OF 4

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project

LOCATION: 100' east of BNSF marshland trestle east abutment

ELEVATION: ~0 ft

DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Mud Rotary drilling

WATER LEVELS: Not measured

START: 10/4/2011

END: 10/4/2011

LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0					Surface is grass and sandy silt.	Begin drilling with mud rotary.
5	5					
	6.5	18"	SS-1	PUSH	**ELASTIC SILT WITH ORGANICS (MH)**, dark brown and gray, wet, very soft, medium plasticity, trace fine sand, significant organics from 5-6', trace organics from 6-6.5'.	
10	10					
	11.5	16"	SS-2	PUSH	**ELASTIC SILT WITH ORGANICS/PEAT (MH/PT)**, 10-10.5' is gray, 10.5-11.5' is dark dark brown, wet, very soft, medium plasticity, significant organics throughout.	
15	15					
	16.5	18"	SS-3	PUSH	**ELASTIC SILT WITH ORGANICS (MH),** 15-15.5' is gray, 15.5-16.5' is dark brown, wet, very soft, medium plasticity, significant organics from 15.5-16.5'.	
20	20					
	21.5	18"	SS-4	PUSH	**ELASTIC SILT WITH ORGANICS (MH)**, gray, wet, very soft, medium plasticity, woody organics throughout.	
25	25					
	26.5	18"	SS-5	PUSH	**ELASTIC SILT WITH ORGANICS (MH)**, same as above.	Weight of rods without hammer for first 1'.
30						

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PROJECT NUMBER:	BORING NUMBER:	SHEET
391193.A3.GE.01	B-6-11	2 OF 4

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: 100' east of BNSF marshland trestle abutment

ELEVATION: ~0 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Mud Rotary drilling

WATER LEVELS: Not measured START: 10/4/2011 END: 10/4/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
30	30	18"	SS-6	PUSH	**ELASTIC SILT WITH ORGANICS (MH)**, same as above.	
	31.5					
35	35					
	36.5	18"	SS-7	PUSH	**ELASTIC SILT (MH)**, similar to above except trace organics.	
40	40					
	41.5	18"	SS-8	PUSH	**ELASTIC SILT (MH)**, same as above.	
45	45					
	46.5	18"	SS-9	0-0-3 (3)	**45-45.6': ELASTIC SILT (MH)**, same as above. **45.6-46.5': SILT WITH SAND (ML)**, tan, moist to wet, soft, low plasticity, estimated 15-25% very fine sand.	
50	50					
	51.5	18"	SS-10	0-4-6 (10)	**50-50.8': ELASTIC SILT (MH)**, dark gray, wet, stiff, low plasticity, estimated 10-15% very fine sand, trace organics (SS-10A). **50.8-51.5': SILTY SAND (SM)**, dark gray, wet, loose, fine sand, estimated 20-30% non-plastic fines.	
55	55					
	56.5	16"	SS-11	7-12-12 (24)	**POORLY GRADED SAND (SP)**, dark gray, wet, medium dense, fine to medium sand, estimated 10-15% fine subrounded gravel, estimated 5% non-plastic fines.	Driller reports: gravels at 55'. Rig chatter from 55-60'.
60						

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PROJECT NUMBER:	BORING NUMBER:	SHEET
391193.A3.GE.01	B-6-11	3 OF 4

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: 100' east of BNSF marshland trestle abutment

ELEVATION: ~0 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Mud Rotary drilling

WATER LEVELS: Not measured START: 10/4/2011 END: 10/4/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
60	60	11"	SS-12	12-15-22 (37)	**POORLY GRADED SAND WITH GRAVEL (SP)**, gray, wet, dense, fine to coarse sand, estimated 15-20% fine subrounded to subangular gravel, estimated 5% non-plastic fines.	
	61.5					
65	65					
	66.5	12"	SS-13	18-20-18 (38)	**POORLY GRADED SAND WITH GRAVEL (SP)**, same as above.	
70	70					
	71.5	6"	SS-14	13-14-16 (30)	**POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, dark brown, wet, medium dense, fine to coarse subrounded to subangular gravel, estimated 25-35% fine to coarse sand, estimated 5-15% non-plastic fines.	
75	75					
	76.5	2"	SS-15	5-4-6 (10)	POOR RECOVERY **ELASTIC SILT (MH)**, bluish gray, wet, stiff, medium plasticity, trace fine sand, one 1.5" subangular gravel.	1.5" diameter gravel lodged in shoe. Occasional rig chatter from 75-80'.
80	80					
	81.5	14"	SS-16	8-10-10 (20)	**POORLY GRADED SAND (SP)**, dark gray, wet, fine to medium sand, trace non-plastic fines.	
85	85					
	86.5	10"	SS-17	9-11-15 (26)	**POORLY GRADED SAND (SP)**, similar to above except medium sand.	Heavy rig chatter from 87-88'.
90						

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PROJECT NUMBER:	BORING NUMBER:	SHEET
391193.A3.GE.01	B-6-11	4 OF 4

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: 100' east of BNSF marshland trestle abutment

ELEVATION: ~0 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Mud Rotary drilling

WATER LEVELS: Not measured START: 10/4/2011 END: 10/4/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
90	90 91.5	10"	SS-18	14-12-15 (27)	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**, dark gray, wet, medium dense, medium to coarse sand, estimated 15-25% fine to coarse subrounded to subangular gravel, estimated 5-15% non-plastic fines.	Some gravels appear fractured indicating a possibility of cobble-size material. Driller reports: really hard at 92'.
95	95 96.5	14"	SS-19	30-33-38 (71)	**WELL-GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, dark gray, wet, very dense, fine to coarse subrounded to subangular gravel, estimated 35-45% fine to coarse sand, estimated 5-15% non-plastic fines.	
					Bottom of hole at 96.5'.	Abandoned hole with bentonite grout.

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PROJECT NUMBER: 391193.A3.GE.01	BORING NUMBER: B-7-11	SHEET 1 OF 3

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: Snohomish Pump Station

ELEVATION: ~13 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Hollow Stem Auger and Mud Rotary drilling

WATER LEVELS: < 5' bgs at time of drilling START: 10/5/2011 END: 10/5/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0					Surface is grass and brown silt.	Begin drilling with hollow stem auger.
						Driller reports: very soft at 2.5'. Blind drill hole B-7A-11 for shelby tube ST-1 from 2.5-4.5' and 23" recovery.
5	5				**SILT WITH SAND (ML)**, dark gray, wet, soft, slightly plastic, estimated 15-25% fine sand.	
	6.5	7"	SS-1	PUSH	**SANDY SILT (ML)**, bluish gray, wet, very soft, slightly plastic, estimated 25-35% fine sand.	
	7.5					
	9.5	20"	ST-2	PUSH	**Top: SILT (ML)**, dark brown, wet, soft, low plasticity. **Bottom: SILTY SAND (SM)**, dark gray, wet, loose, fine sand, estimated 15-20% non-plastic fines.	Pushed at 50 psi.
10	11	18"	SS-3	PUSH	**SANDY SILT (ML) TRANSITIONS TO SILTY SAND (SM)**, dark gray, wet, very soft to very loose, fine sand, estimated 40-60% non-plastic fines.	Switch to mud rotary drilling.
15	15					
	16.5	5"	SS-4	1-1-1 (2)	**SILTY SAND (SM),** dark gray, wet, very loose, fine sand, estimated 15-25% non-plastic fines.	
20	20					
	21.5	14"	SS-5	2-1-3 (3)	**POORLY GRADED SAND WITH SILT (SP-SM)**, dark gray, wet, very loose, fine to medium sand, estimated 5-15% non-plastic fines.	
25	25					
	26.5	8"	SS-6	3-4-4 (8)	**POORLY GRADED SAND (SP)**, similar to above except trace non-plastic fines.	
						Driller reports: 6" thick wood at 27.5'. Harder after wood.
30						

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CH2MHILL

PROJECT NUMBER: 391193.A3.GE.01	BORING NUMBER: B-7-11	SHEET 2 OF 3

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: Snohomish Pump Station

ELEVATION: ~13 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Hollow Stem Auger and Mud Rotary drilling

WATER LEVELS: < 5' bgs at time of drilling START: 10/5/2011 END: 10/5/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
30	30	6"	SS-7	6-8-10 (18)	**POORLY GRADED SAND (SP)**, similar to above except medium dense, trace fine subrounded gravel.	
	31.5					
						Rig chatter at 33' indicating gravels.
35	35					
	36.5	6"	SS-8	4-10-12 (22)	**POORLY GRADED GRAVEL WITH SILT AND GRAVEL (GP-GM)**, dark gray, wet, medium dense, fine to coarse subangular gravel, estimated 20-30% fine to coarse sand, estimated 5-15% non-plastic fines.	Fractured gravels indicating possible cobble-size material.
40	40					
	41.5	12"	SS-9	3-3-3 (6)	**SANDY SILT (ML)**, dark brown, wet, firm, slightly plastic, estimated 40-50% fine sand, woods organics throughout, trace fine subangular gravel.	Rig chatter at 40' indicating gravels.
						Driller reports: clay/silt at 42.5'.
45	45					
	47	0	ST-10	PUSH	POOR RECOVERY **LEAN CLAY (CL)**, dark gray, wet, soft, medium plasticity, estimated 5-15% fine to medium sand.	Pushed 1' then got very hard. Possible gravel. Sample fell out when drillers pulled up tube. 4" of recovery with gravel slough in top.
	48.5	6"	SS-11	0-1-2 (3)	**LEAN CLAY (CL)**, dark gray, wet, soft, medium plasticity, trace fine sand, one fine subrounded gravel, organics throughout.	
50	50					
	52	20"	ST-12	PUSH	**LEAN CLAY (CL)**, dark brown, wet, soft, medium plasticity, estimated 10-15% fine to medium sand.	Pushed through alternating layers of harder then softer material.
	53.5	12"	SS-13	0-0-5 (5)	**LEAN CLAY (CL)**, alternating dark brown and gray, wet, firm, medium plasticity, estimated 5-10% very fine sand, some organic lenses.	
55	55					
	56.5	15"	SS-14	6-8-10 (18)	**SILTY SAND (SM)**, dark gray, wet, medium dense, fine sand, estimated 30-40% non-plastic to low plasticity fines, sandy silt in bottom 2".	
60						

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CH2MHILL

PROJECT NUMBER: 391193.A3.GE.01	BORING NUMBER: B-7-11	SHEET 3 OF 3

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: Snohomish Pump Station

ELEVATION: ~13 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Hollow Stem Auger and Mud Rotary drilling

WATER LEVELS: < 5' bgs at time of drilling START: 10/5/2011 END: 10/5/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
60	60	12"	SS-15	10-5-11 (16)	**POORLY GRADED SAND WITH SILT (SP-SM)**, dark gray, wet, medium dense, fine to medium sand, estimated 5-15% non-plastic fines, som organics.	Gravels at 62.5'.
	61.5					
65	65	2"	SS-16	50/5"	POOR RECOVERY **WELL-GRADED GRAVEL (GW) - washed**, gray, wet, very dense, fine to coarse subrounded to angular gravel, coarse sand, fines washed out.	Gravels are fractured indicating cobble-size material. Heavy rig chatter from 65-70'.
	65.4					
70	70	4"	SS-17	18-31-32 (63)	**WELL-GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, dark gray, wet, very dense, fine to coarse subangular to subrounded gravel, estimated 20-30% fine to coarse sand, estimated 5-15% non-plastic fines.	Driller reports: cobbles and gravels from 70-75'.
	71.5					
75	75	12"	SS-18	16-16-17 (33)	**WELL-GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, similar to above except dense, estimated 15-25% fine to coarse sand.	Gravels are fractured indicating cobbles.
	76.5				Bottom of hole at 76.5'	Well Information Well Tag No: BBT 148 1" PVC Schedule 40 0 to 2': Monument 2 to 8', 20-75': Bentonite 8 to 20': Sand 10 to 20': Screen
80						
85						
90						

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CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	SHEET
391193.A3.GE.01	B-8-11	1 OF 1

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project

LOCATION: West side of Snohomish River Trail Parking Lot

ELEVATION: ~20 ft

DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Hollow Stem Auger drilling

WATER LEVELS: ~12.5' bgs at time of drilling

START: 10/4/2011

END: 10/4/2011

LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS (6"-6"-6"-6")	SOIL DESCRIPTION (SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY)	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION)
0					Surface is grass.Silty sand in upper 2' with 2" diameter	Begin drilling with hollow stem auger.
	2.5					
	4	5"	SS-1	4-6-4 (10)	**SILTY SAND (SM)**, dark brown, dry, loose, fine sand, estimated 30-40% non-plastic fines, estimated 5-10% fine subrounded gravel, some wood organics.	
5	5				**SILTY SAND WITH GRAVEL (SM)**, dark gray, dry, medium dense, fine to medium sand, estimated 35-40% fine to coarse subrounded to angular gravel, estimated 15-20% non-plastic fines, some wood.	
	6.5	8"	SS-2	3-12-12 (24)		
	7.5				**7.5-8.1': SILTY SAND WITH GRAVEL (SM)**, dark brown, dry, loose, fine to medium sand, estimated 15-20% non-plastic fines, estimated 30-40% fine to coarse subrounded gravel up to 1.5".	Brick in cuttings from 7.5-9'.
	9	15"	SS-3	10-6-4 (10)		
10	10				**8.1-8.8': SILTY SAND (SM)**, bluish gray, moist to wet, loose fine to medium sand, estimated 30-40% no to slightly plastic fines, estimated 5-10% fine subangular gravel.	
	11.5	0	SS-4	0-2-4 (6)	**NO RECOVERY.**	
	12.5					
	14	18"	SS-5	1-2-3 (5)	**ELASTIC SILT (MH)**, dark brown and gray, wet, firm, medium plasticity, trace fine sand, wood and roots throughout.	
15	15					
	16.5	18"	SS-6	PUSH	**SILT WITH SAND (ML),** dark gray, wet, very soft, no to low plasticity, estimated 15-25% very fine sand.	
					Bottom of hole at 16.5'	Well Information Well Tag No: BBT 147 1" PVC Schedule 40 0 to 2': Monument 2 to 3': Bentonite chips 3 to 15': Sand 5 to 15': Screen
20						
25						
30						

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CH2MHILL

PROJECT NUMBER: 391193.A3.GE.01	BORING NUMBER: B-9-11	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Snohomish - Everett Conveyance Project LOCATION: Existing lagoon access road

ELEVATION: ~22 ft DRILLING CONTRACTOR: Gregory Drilling Inc., Redmond, Washington

DRILLING METHOD AND EQUIPMENT: CME 850 track-mounted rig, 140-lb auto-hammer with 30-inch drop, Hollow Stem Auger drilling

WATER LEVELS: ~15' bgs at time of drilling START: 10/4/2011 END: 10/4/2011 LOGGER: T. Valentine

DEPTH BELOW SURFACE (ft)	INTERVAL (ft)	RECOVERY (in)	NUMBER AND TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0	2.5				Surface is 1 to 2" of fine to coarse sand (SM). Below is brown silt.	Begin drilling with hollow stem auger.
	4	13"	SS-1	4-5-8 (13)	**SILT (ML)**, 2.5-2.7' is brown, 2.7-3.6' is gray, dry, stiff, slightly plastic, trace fine sand, some iron oxide staining (Fill).	
5	5					
	6.5	15"	SS-2	6-8-5 (13)	**SILT (ML)**, 5-5.3' is brown, 5.3- 6.2' is gray, dry, stiff, slightly plastic, very fine to fine sand ranging from estimated 15-25% from 5-5.3' to 10-15% from 5.3-6.2' (Fill).	
	7.5					
	9	18"	SS-3	4-7-5 (12)	**SANDY SILT (ML)**, dark gray, dry, stiff, slightly plastic, estimated 25-35% very fine sand, interbedded (Fill).	
10	10					
	11.5	18"	SS-4	3-6-4 (10)	**SILT (ML)**, dark gray, dry, stiff, slightly plastic, estimated 10-15% very fine sand (Fill).	
	12.5					
	14	18"	SS-5	0-3-3 (6)	**SILT (ML)**, dark gray, moist, firm, low plasticity, estimated 5-10% very fine sand (Native).	
15	15					
	16.5	18"	SS-6	0-2-1 (3)	**SANDY SILT / SILTY SAND (ML/SM),** dark gray, wet, soft to very loose, estimated 40-60% fine sand, estimated 40-60% low plasticity fines (Native).	
20					Bottom of hole at 16.5'	Abandoned hole with bentonite chips.
25						
30						