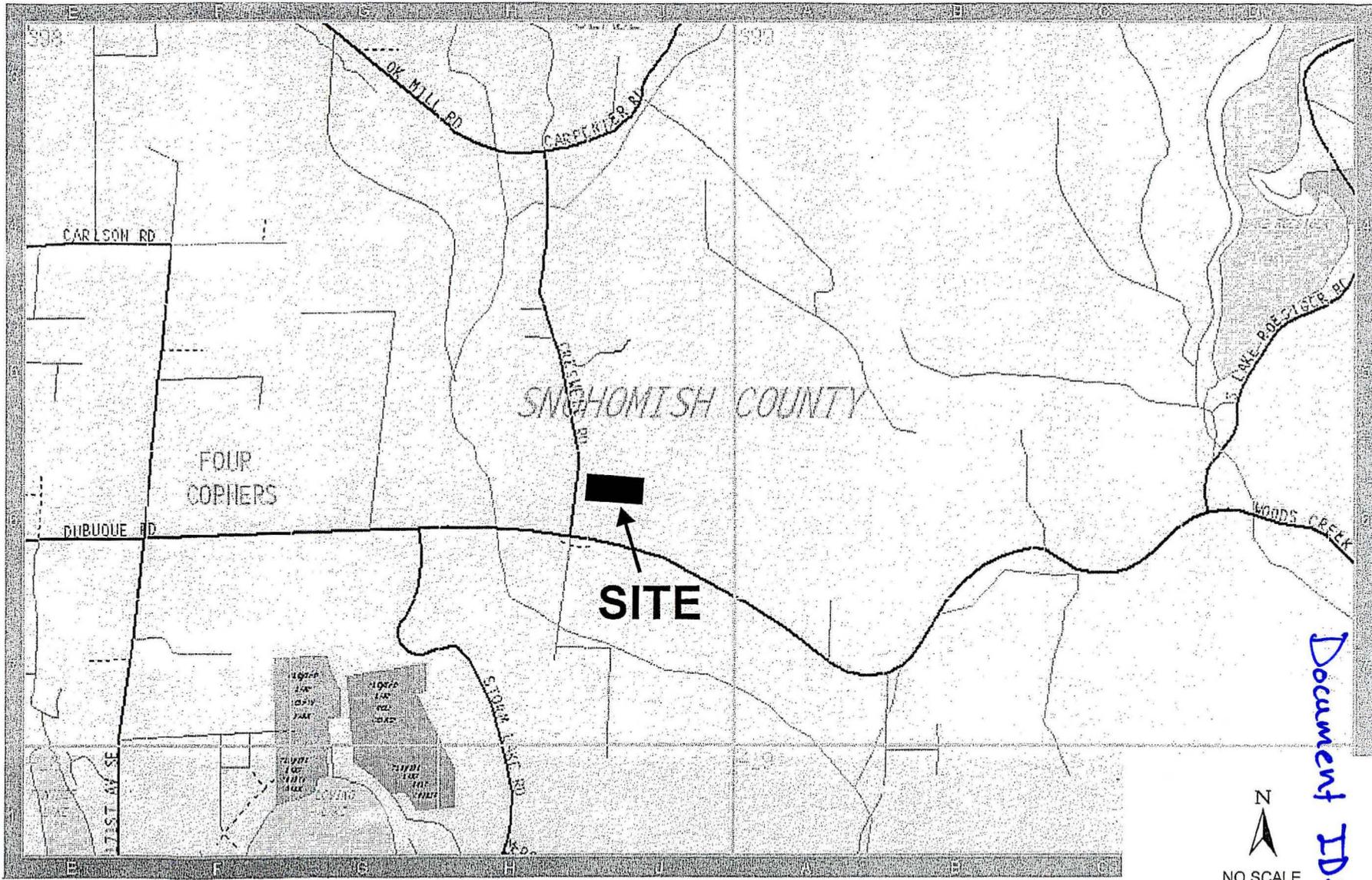


TP 61 - TP 62

EBS 2 - EBS

Document ID=6



05272_Waldrum 4-1-05\05272 Vicinity.cdr

Associated Earth Sciences, Inc.



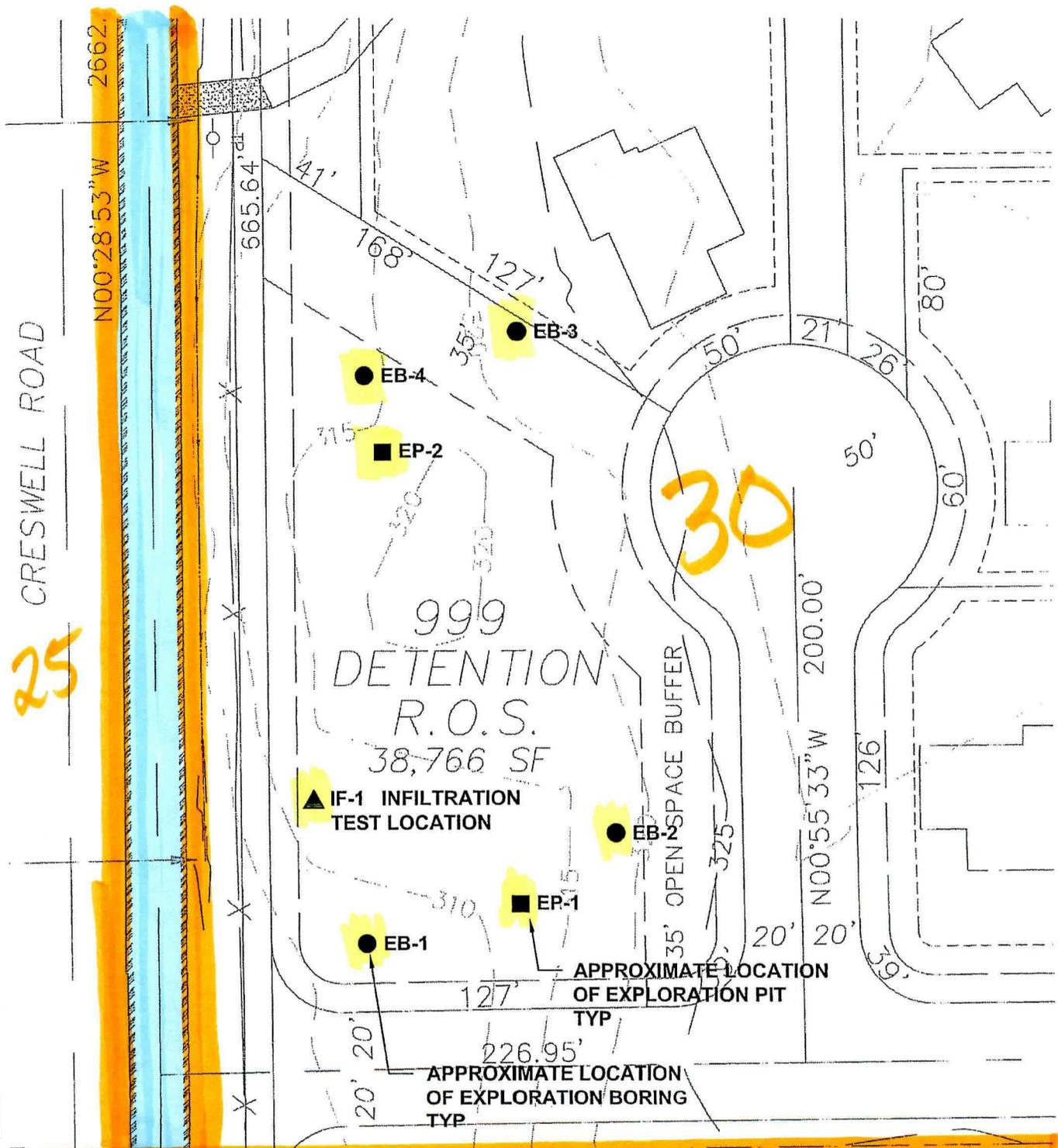
VICINITY MAP
 WARDRUM WOODS
 SNOHOMISH COUNTY, WASHINGTON

FIGURE 1

DATE 12/05

PROJ. NO. KE05272A

05272 Waldrum 4-14-05 \ 05272 Site and Explr.dwg Layout: AESI-Site & Explr 12-05



Reference: Land Resolutions



SITE AND EXPLORATION PLAN
 WARDRUM WOODS
 SNOHOMISH COUNTY, WASHINGTON

FIGURE 2
 DATE 12/05
 PROJECT NO. KE05272A

2.5% = 25% → 25% → 40%

feet to slightly over 320 feet. Consequently, the bottom of the pond will range from approximately 9 to 24 feet below the existing site grades. The purpose of this study is to evaluate a suitable design infiltration rate for infiltration of storm water.

SUBSURFACE CONDITIONS

Exploration pits EP-1 and EP-2 were excavated in the infiltration pond area to depths of approximately 18 and 14 feet during our initial geotechnical engineering study in April 2005. These pits were located at approximately ground surface elevation 312 and 316 feet, respectively. Consequently, exploration pit EP-1 was excavated to a depth approximately 2 feet below the proposed bottom of the pond, and EP-2 was excavated to a depth approximately 7 feet above the proposed pond bottom. In order to further evaluate subsurface conditions below the planned infiltration depth, four exploration borings were drilled in the proposed pond area to depths of approximately 26.5 to 41.5 feet. Exploration boring EB-1, located in the southwestern portion of the pond, was completed as a 2-inch-diameter monitoring well. Conditions encountered in the explorations were observed and logged by a geologist from our firm. The approximate locations of the explorations are depicted on the Site and Exploration Plan, Figure 2.

Stratigraphy

Sediments encountered in the explorations are described below in order of shallowest (youngest) to deepest (oldest) sediment types.

Forest Duff/Topsoil

A surficial forest duff/organic topsoil layer was encountered at each of the exploration locations except exploration boring EB-1. The ground surface in the area of EB-1 appeared to have been disturbed slightly during excavation of exploration pit EP-1, and no topsoil or forest duff remained at the time of drilling. The surficial forest duff/topsoil layer was approximately 4 to 12 inches thick.

Vashon Recessional Outwash

Sediments encountered below the surficial duff/topsoil layer generally consisted of medium dense, brown to gray sand and gravel with minor quantities of silt. We interpret these sediments to be representative of Vashon recessional outwash. The Vashon recessional outwash was deposited by meltwater streams that emanated from the retreating glacial ice during the latter portion of the Vashon Stage of the Fraser Glaciation ending approximately 12,500 years ago. At the locations of explorations EP-1, EP-2, IF-1, and EB-1, the upper portion of the outwash was observed to be reddish brown and contained moderate to high

Table 1
Summary of Ground Water Elevations

Boring	Date	Ground Surface Elevation (feet)	Depth to Ground Water (feet)	Ground Water Elevation (feet)
EB-1	12/7/05	305.75	12.81	292.94
EB-1	12/9/05	305.75	12.81	292.94
EB-2	12/5/05 - ATD	313.7	25	289
EB-3	12/7/05 - ATD	320.0	28	292
EB-4	12/7/05 - ATD	310.8	18	293

ATD - At Time of Drilling

The ground surface elevation shown for EB-1 is actually the top of the well casing elevation; the top of the well casing is positioned 0.23 feet below the ground surface as measured at the monument rim.

The ground water elevation measured in monitoring well EB-1 on December 9, 2005 was measured approximately 10 minutes before completion of the infiltration test, as discussed below. No measurable change in ground water level from the December 7, 2005 gauging event was detected in the well at this time. It should be noted that the depth to ground water seepage may vary due to such factors as changes in season, amount of precipitation, and site use.

INFILTRATION TESTING

Infiltration test IF-1 was conducted in the western portion of the proposed infiltration pond area approximately where shown on Figure 2. The infiltration test was conducted using a method generally corresponding to the procedure described for the Pilot Infiltration Test (PIT) in the 1992 Washington State Department of Ecology (Ecology) *Stormwater Manual for the Puget Sound Basin* (Ecology Manual). This test is conducted by discharging water into a flat-bottomed pit of known dimensions for a "soaking period" to allow the receptor soils in the immediate vicinity of the pit to become saturated. Typically the soaking period is at least 4 hours. The test is continued until the discharge rate required to maintain a constant head in the pit remains fairly consistent over a period of 1 hour.

The water source used for the test consisted of a water truck with a capacity of approximately 3,500 gallons. Water was discharged into the pit through a fabric diffuser to minimize turbulence and scouring in the pit bottom. An electronic flow meter/totalizer was used to monitor the water discharge rate and total flow. A staff gauge with 0.01-foot divisions was installed in the pit to monitor the depth of water during testing. According to the Ecology Manual, a head of 3 to 4 feet above the bottom of the pit should be maintained for the

quantities of silt and abundant roots to depths of approximately 2 to 4 feet. This reddish brown color and increased silt content is due to weathering. At the locations of exploration borings EB-2 through EB-4, the thickness of the weathered soil horizon was indeterminate due to poor cuttings return. The Vashon recessional outwash extended to depths of approximately 36 to 40.5 feet at the locations of exploration borings EB-1 through EB-3, and beyond the maximum depths explored of approximately 14 to 26.5 feet at the remaining exploration locations.

Vashon Advance Outwash

Sediments encountered in exploration borings EB-1 through EB-3 below depths of 36 to 40.5 feet generally consisted of medium dense to very dense, tan to gray silty sand with variable gravel content. We interpret these sediments to be representative of Vashon advance outwash. The Vashon advance outwash was deposited by meltwater streams that emanated from the advancing glacial ice during Vashon time. The high relative density characteristic of the advance outwash is due to its consolidation by the massive weight of the glacial ice that overrode these sediments subsequent to their deposition. Where encountered, the Vashon advance outwash extended beyond the maximum depth explored of approximately 41.5 feet.

Review of the regional geologic map titled *Surficial Geologic Map of the Skykomish and Snoqualmie Rivers Area, Snohomish and King Counties, Washington* by Derek Booth (1990) indicates that the project area is underlain by Vashon recessional outwash. Our interpretation of the sediments encountered in our explorations is in general agreement with the regional geologic map.

Hydrology

Ground water seepage was encountered in exploration borings EB-1 through EB-4 at depths ranging from approximately 13 to 28 feet. The ground water seepage originated from the recessional outwash sediments and appeared to be perched atop the underlying, lower permeability advance outwash sediments. Ground surface elevations at each of the boring locations were measured using an autolevel relative to the hub marking the centerline stake for Station 0+20 for the new road proposed south of the infiltration pond. We understand that the surveyed elevation of this hub is 300.83 feet. Ground water elevations measured at each of the boring locations are summarized below in Table 1. It should be noted that the ground water elevations shown for exploration boring EB-1 are based on ground water levels measured on the dates indicated in the monitoring well installed in this boring. The depths to ground water shown for the other three borings are based on ground water levels observed at the time of drilling and should be considered approximate.

LOG OF EXPLORATION PIT NO. EP-1

TP 61

Depth (ft)	<p>This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p>	
	DESCRIPTION	
	Forest Duff/Topsoil	
1	Weathered Vashon Recessional Outwash*	
2	Loose to medium dense, moist, reddish brown, silty SAND with gravel (SM).	
3		
	Vashon Recessional Outwash	
4	Medium dense, moist, tan SAND with gravel, trace silt, scattered cobbles (SW); contains lenses of well graded gravel; also contains lenses of increased silt content (few silt).	
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19	Bottom of exploration pit at depth 18 feet No seepage. No caving. *Weathered zone extends to a depth of approximately 5 1/2' at north end of hole.	
20		

K:\TP3 05272A.GPJ December 15, 2005

Wardrum Woods Snohomish County, WA

Associated Earth Sciences, Inc.



Logged by: TJP

Approved by:

Project No. KE05272A

4/15/05

LOG OF EXPLORATION PIT NO. EP-2

TJPA 62

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.
DESCRIPTION	
1	<p style="text-align: center;">Forest Duff/Topsoil</p> <p style="text-align: center;">Weathered Vashon Recessional Outwash</p> <p>Loose to medium dense, moist, reddish tan to tan, SAND with gravel, little silt (SM); abundant roots.</p>
2	
3	<p style="text-align: center;">Vashon Recessional Outwash</p> <p>Loose to medium dense, moist, tan, SAND with gravel, scattered cobbles, trace to few silt (SW); contains lenses of gravel with sand (GW).</p>
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	<p>Bottom of exploration pit at depth 14 feet Exploration terminated due to caving. No seepage. Moderately severe to severe caving.</p>
16	
17	
18	
19	
20	

KCTP3 05272A.GPJ December 15, 2005

**Wardrum Woods
Snohomish County, WA**

Associated Earth Sciences, Inc.



Logged by: TJP
 Approved by:

Project No. KE05272A

4/15/05

~~SECRET~~

LOG OF EXPLORATION PIT NO. IF-1

Depth (ft)	<p>This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p>
DESCRIPTION	
	Topsoil
	Weathered Vashon Recessional Outwash
1	Loose, moist, reddish brown, silty SAND with gravel (SM); abundant roots.
2	Vashon Recessional Outwash
3	Loose to medium dense, moist, grayish tan, SAND with gravel, trace to few silt (SW); contains gravel lenses; becomes medium dense and gray with coarse to medium SAND below 10'.
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	Bottom of exploration pit at depth 16 feet No seepage. Minor caving during excavation.
18	
19	
20	

KCTP3 05272A (IF),GPJ December 12, 2005

Wardrum Woods Snohomish County, WA

Associated Earth Sciences, Inc.



Logged by: TJP
Approved by: *TJP*

Project No. KE05272A

December 2005

BH 2

Associated Earth Sciences, Inc. **Geologic & Monitoring Well Construction Log**

Project Number KE05272A	Well Number EB-1	Sheet 1 of 2
Project Name Wardrum Woods	Location Snohomish County, WA	
Elevation (Top of Well Casing) 305.75'	Surface Elevation (ft) 305.98'	
Water Level Elevation 292.94'	Date Start/Finish 12/5/05, 12/5/05	
Drilling/Equipment Holocene/4" I.D. HSA	Hole Diameter (in) 8"	
Hammer Weight/Drop 140# / 30"		

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6"	Graphic Symbol	DESCRIPTION
		Flush monument, threaded cap Concrete			Weathered Vashon Recessional Outwash
			1 1 1		Very moist, reddish brown, silty SAND with gravel (SM).
5		Bentonite chips	4 4 3		Vashon Recessional Outwash (increased gravel content at approximately 4') Moist, brown, GRAVEL with sand, few silt (GW); moderate organics (roots).
10		Cuttings	13 10 8		Moist, grayish brown, SAND with gravel, trace silt (SW).
15		#10/20 silica sand	4 6 7		Becomes wet. Little gravel.
20			6 6 16		Sand becomes tan and fine grained with little silt and no gravel below 21'; contains silty lenses.
25		2" I.D. Schedule 40 PVC well screen 0.010" machine cut slots	7 13 21		(2' of heave in auger at 25'; driller flushed out prior to sampling) Wet, gray, GRAVEL with sand, trace silt (GW).
30		Threaded end cap	15 23 28		Wet, gray, SAND, few gravel, trace silt (SW).
35		Caved	50/6"		(No heave; approximately 6" sample recovery at 35') Sand becomes medium to coarse grained, few pebble gravel.

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	No Recovery	M - Moisture	Logged by: TJP
3" OD Split Spoon Sampler (D & M)	Ring Sample	Water Level (12/7/05)	Approved by: <i>TJP</i>
Grab Sample	Shelby Tube Sample	Water Level at time of drilling (ATD)	

NWELL 05272A.GPJ BORING.GDT 12/15/05

BH2

Associated Earth Sciences, Inc. 	Geologic & Monitoring Well Construction Log		
Project Number KE05272A	Well Number EB-1	Sheet 2 of 2	

Project Name Wardrum Woods	Location Snohomish County, WA
Elevation (Top of Well Casing) 305.75'	Surface Elevation (ft) 305.98'
Water Level Elevation 292.94'	Date Start/Finish 12/5/05, 12/5/05
Drilling/Equipment Holocene/4" I.D. HSA	Hole Diameter (in) 8"
Hammer Weight/Drop 140# / 30"	

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				6 8 17		Vashon Advance Outwash Very moist, gray, silty SAND, little gravel (SM). Boring terminated at 41.5 feet on 12/5/05 <div style="float: right; font-family: cursive; font-size: 2em; margin-top: 10px;">Agar</div>
45						
50						
55						
60						
65						
70						
75						

NWELL_05272A.GPJ BORING.GDT 12/15/05

Sampler Type (ST):			<input type="checkbox"/> No Recovery	<input type="checkbox"/> M - Moisture	Logged by: TJP
<input type="checkbox"/> 2" OD Split Spoon Sampler (SPT)	<input type="checkbox"/> Ring Sample	<input type="checkbox"/> Water Level (12/7/05)	Approved by: <i>TJP</i>		
<input type="checkbox"/> 3" OD Split Spoon Sampler (D & M)	<input type="checkbox"/> Shelby Tube Sample	<input type="checkbox"/> Water Level at time of drilling (ATD)			
<input type="checkbox"/> Grab Sample					

BA 3

Project Name: <u>Wardrum Woods</u> Location: <u>Snohomish County, WA</u> Driller/Equipment: <u>Holocene/4" I.D. HSA</u> Hammer Weight/Drop: <u>140# / 30"</u>	Ground Surface Elevation (ft): <u>313.7'</u> Datum: <u>NAVD88</u> Date Start/Finish: <u>12/5/05, 12/5/05</u> Hole Diameter (in): <u>8"</u>
--	---

Depth (ft)	S T	Samples Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6'				Other Tests
						10	20	30	40	
			Topsoil Vashon Recessional Outwash (Note: thickness of weathered soil horizon undetermined due to poor cuttings return)							
5		S-1	Moist, brown, GRAVEL with sand, trace silt (GW); contains thin, silty lenses.		22 14 12		▲25			
10		S-2			10 9 11		▲20			
15		S-3	Moist, grayish brown, SAND with gravel, little silt (SM).		11 15 18		▲33			
20		S-4	Few silt (SW).		9 10 12		▲22			
25		S-5	Becomes wet and gray with trace silt.	▼	6 10 9		▲19			
30		S-6	(approximately 18" of heave in auger at 30'; driller attempted to flush out unsuccessfully; approximately 1' of heave in auger when sampling) Contains thin, silty lenses. (blow count likely overstated due to heave)		10 17 45		▲62			
35		S-7	(approximately 6" of heave in auger at 35'; driller out of water and unable to flush out prior to sampling) (blow count likely overstated due to heave) (approximately 6" of heave in auger at 40'; driller out of water and unable to flush out prior to sampling)		12 18 24		▲42			

Q50g

AESIBOR 05272A.GPJ December 8, 2005

Sampler Type (ST):

<input type="checkbox"/> 2" OD Split Spoon Sampler (SPT)	<input type="checkbox"/> No Recovery	M - Moisture
<input type="checkbox"/> 3" OD Split Spoon Sampler (D & M)	<input type="checkbox"/> Ring Sample	▽ Water Level ()
<input checked="" type="checkbox"/> Grab Sample	<input type="checkbox"/> Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: TJP
 Approved by: 

BH 1

Associated Earth Sciences, Inc.		Exploration Log	
Project Number KE05272A	Exploration Number EB-3	Sheet 1 of 2	
Project Name <u>Wardrum Woods</u>		Ground Surface Elevation (ft) <u>320.0'</u>	
Location <u>Snohomish County, WA</u>		Datum <u>NAVD88</u>	
Driller/Equipment <u>Holocene/4" I.D. HSA</u>		Date Start/Finish <u>12/7/05, 12/7/05</u>	
Hammer Weight/Drop <u>140# / 30"</u>		Hole Diameter (in) <u>8"</u>	

Depth (ft)	S T	Samples Graphic Symbol	DESCRIPTION	Well Completion Water Level Blows/6"	Blows/Foot				Other Tests
					10	20	30	40	
			Topsoil Vashon Recessional Outwash (Note: thickness of weathered soil horizon undetermined due to poor cuttings return)						
5		S-1	Very moist, brown, silty GRAVEL with sand (GM).	5 5 4	▲9				
10		S-2	Very moist, brown, SAND with gravel, few silt (SW).	35 6 9	▲15				
15		S-3	Very moist, brown GRAVEL with sand, few silt (GW).	23 12 15	▲27				
20		S-4	Very moist, brown, SAND, little gravel, few silt (SW).	50/6"					▲50/6"
25		S-5	No recovery.	10 17 19					▲36
		S-6	Wet, brown, GRAVEL, little sand, trace silt (GW).	8 10 11	▲21				
30		S-7	Wet, grayish brown, SAND with gravel, trace silt (SW).	4 7 9	▲15				
35		S-8	Becomes brownish gray, fine to medium grained with no gravel (SP).	5 8 18	▲26				
			Vashon Advance Outwash Very moist, tan, silty fine SAND, few pebble gravel (SM).						

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AESIBOR 05272A.GPJ, December 8, 2005

Sampler Type (ST):

<input type="checkbox"/> 2" OD Split Spoon Sampler (SPT)	<input type="checkbox"/> No Recovery	M - Moisture
<input type="checkbox"/> 3" OD Split Spoon Sampler (D & M)	<input type="checkbox"/> Ring Sample	▽ Water Level ()
<input type="checkbox"/> Grab Sample	<input type="checkbox"/> Shelby Tube Sample	▽ Water Level at time of drilling (ATD)

Logged by: TJP
Approved by: *TOP*

B44

Associated Earth Sciences, Inc.		Exploration Log		
		Project Number KE05272A	Exploration Number EB-3	Sheet 2 of 2
Project Name		Wardrum Woods		Ground Surface Elevation (ft)
Location		Snohomish County, WA		Datum
Driller/Equipment		Holocene/4" I.D. HSA		Date Start/Finish
Hammer Weight/Drop		140# / 30"		Hole Diameter (in)
				320.0'
				NAVD88
				12/7/05, 12/7/05
				8"

Depth (ft)	S T	Samples Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests	
							10	20	30	40		
		S-9	Becomes very moist to wet and grayish tan with no gravel.			12						
			Bottom of exploration boring at 41.5 feet			28						
						42						
45												
50												
55												
60												
65												
70												
75												

AESIBOR_05272A.GPJ December 8, 2005

Sampler Type (ST):

<input type="checkbox"/> 2" OD Split Spoon Sampler (SPT)	<input type="checkbox"/> No Recovery	M - Moisture	Logged by: TJP
<input type="checkbox"/> 3" OD Split Spoon Sampler (D & M)	<input type="checkbox"/> Ring Sample	▽ Water Level ()	Approved by: <i>TJP</i>
<input type="checkbox"/> Grab Sample	<input type="checkbox"/> Shelby Tube Sampler	▼ Water Level at time of drilling (ATD)	

BH 5

Associated Earth Sciences, Inc.		Exploration Log		
Project Number KE05272A	Exploration Number EB-4	Sheet 1 of 1		

Project Name <u>Wardrum Woods</u>	Ground Surface Elevation (ft) <u>310.8'</u>
Location <u>Snohomish County, WA</u>	Datum <u>NAVD88</u>
Driller/Equipment <u>Holocene/4" I.D. HSA</u>	Date Start/Finish <u>12/7/05, 12/7/05</u>
Hammer Weight/Drop <u>140# / 30"</u>	Hole Diameter (in) <u>8"</u>

Depth (ft)	S T	Samples Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/Foot				Other Tests
						10	20	30	40	
			Topsoil Vashon Recessional Outwash							
5		S-1	Moist, brown, GRAVEL with sand, few silt (GW). (blow count likely overstated due to gravel content)		16 20 19				▲39	
10		S-2	Becomes very moist and grayish brown. (blow count likely overstated due to gravel content)		12 18 23				▲41	
15		S-3	Moist, grayish brown, medium to coarse SAND with gravel, trace silt (SP).		8 9 15				▲24	
		S-4	Becomes wet at approximately 18'.		▼ 7 7 10				▲7	
20		S-5	Becomes well graded.		6 7 8				▲15	
25		S-6			10 13 14				▲27	
30			Bottom of exploration boring at 26.5 feet Exploration terminated due to drill rig break down.							

Q_{sg}

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AESIBOR 05272A.GPJ December 8, 2005

Sampler Type (ST):

<input type="checkbox"/> 2" OD Split Spoon Sampler (SPT)	<input type="checkbox"/> No Recovery	M - Moisture
<input type="checkbox"/> 3" OD Split Spoon Sampler (D & M)	<input type="checkbox"/> Ring Sample	▼ Water Level ()
<input checked="" type="checkbox"/> Grab Sample	<input checked="" type="checkbox"/> Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: TJP
Approved by: *TJP*