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MEMORANDUM

To: Sean Sheldrake, EPA
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Date: January 20, 2011

From: John Edwards, Anchor QEA
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Project: 000029-02.26

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Re: Segment 2 Capture Zone Test, Data Summary Memorandum

The attachments to this memorandum provide the key data, boring logs, and geologic cross sections prepared from the field work completed under the Gasco Capture Zone Field Test Plan (Anchor QEA 2009), as amended. A technical memorandum providing the complete analyses from these data will be provided in appendices to both the Sediment Report and uplands Source Control Final Design Report. Table 1 lists the new pilot extraction wells that were constructed in Segment 2, the pump test periods, and the well discharge rates.

Table 1
Segment 2 Pump Test Summary

Test Duration and Rate	Start Pump Test	End Pump Test	Pumping Wells			
			PW-7-93	PW-8-39	PW-8-68	PW-9-92
2-hour Pump Test - 15 GPM	4/19/2010, 8:45	4/19/2010, 10:45	X		X	X
2-hour Pump Test - 25 GPM	4/20/2010, 9:30	4/20/2010, 11:30	X		X	X
2-hour Pump Test - 35 GPM	4/21/2010, 10:42	4/21/2010, 12:42	X		X	X
72-hour Pump Test - 25 GPM	4/26/2010, 16:57	4/30/2010, 8:38	X		X	X
72-hour Pump Test - 35 GPM	5/4/2010, 8:37	5/7/2010, 16:29	X		X	X
72-hour Pump Test - 2 GPM	9/9/2010, 10:28	9/12/2010, 10:28		X		
72-hour Pump Test - 25 GPM	11/8/2010, 12:00	11/11/2010, 12:45	X	X	X	X

Note: GPM = gallons per minute

Initial testing of new pilot extraction wells PW-7-93, -8-68, and -9-92 was completed in April and May 2010. Based on the initial findings from those tests, an additional pilot extraction well, PW-8-39, was installed and tested in September and November 2010. The Oregon Department of Environmental Quality (DEQ) requested that an interim data package be submitted within 30 days of completion of field testing, and the data are provided in CD format as an attachment to this memorandum. Anchor QEA has not completed a quality assurance/quality control evaluation of this information, so this information is considered preliminary and subject to minor change upon further review. A brief summary of the contents of the CD attachment is provided below:

1. Table 2
2. Boring Logs. The DVD contains the geologic and well construction logs for the new pilot extraction wells, monitoring wells, and piezometers completed for the Segment 2 capture zone tests.
3. Transducer Data. There are three sets of Excel files. All three file sets contain the water level and temperature data recorded by the transducers. One file contains the transducer data and plots for the November 72-hour test of all wells. A second file contains the transducer data and plots for the April and May 2-hour and 72-hour tests. The third file contains the transducer data and plots for the September 72-hour test of well PW-8-39.
4. Geologic Cross Sections. This file contains a map showing the locations of the cross sections, and five sections: A-A', B-B', F-F', G-G', and H-H'.

Anchor QEA is currently in the process of evaluating the data obtained during the field tests. The laboratory reports for the groundwater samples obtained during the pump tests are currently being validated. The aquifer test hydrology data are currently being evaluated to determine aquifer properties, such as transmissivity and storage coefficient.

We have completed a preliminary analysis of the degree of hydraulic head reduction that was measured in the offshore piezometers during the tests. As described in the Segment 2 Capture Zone Field Test Plan (Anchor QEA 2009), Anchor QEA calculated the average groundwater elevation at each of the upland wells and offshore piezometers during pre-test ambient conditions and during the pump tests using the Serfes method (1991). The average groundwater elevations compared to the river elevations during the same period are shown on Table 2. These results show that the groundwater elevation was maintained below the river elevation in the offshore piezometers that are screened in the lower alluvium above the aquitard. This seepage control was measured from the water level data in the following offshore wells and piezometers screened in the upper alluvium: PZ1-50, PZ2-43, PZ2-77, PZ4-41, PZ5-55, and PZ5-85.

These data will be checked and refined as Anchor QEA moves forward with the following assessments:

- Developing the Engineering Evaluation/Cost Analysis and Data Report
- Refining the aquifer parameters used in the upland MODFlow groundwater flow model
- Developing the final source control design

Attachments

Table 2 – Pump Test Results

Boring Logs

Site Map and Cross Sections

Data CD

TABLE

Table 2
Pump Test Results
Groundwater Elevations
Gasco Segment 2 Capture Zone Analysis

	Ambient Pre-Test 4/21 18:00 - 4/24 18:00		Ambient Pre-test 4/23 0:00 - 4/26 0:00		72 hour Pump Test - 25 GPM 4/27 0:00 - 4/30 0:00 25 GPM		72 hour Pump Test - 35 GPM 5/4 12:00 - 5/7 12:00		Pre Test Ambient 11/5 12:00 - 11/8 11:00		72 hour Pump Test - 25 GPM 11/8 12:47 - 11/11 12:47		Post Test Ambient 11/12 8:40 - 11/15 8:40	
	72 hour Moving Average	Δ H from River	72 hour Moving Average	Δ H from River	72 hour Moving Average	Δ H from River	72 hour Moving Average	Δ H from River	72 hour Moving Average	Δ H from River	72 hour Moving Average	Δ H from River	72 hour Moving Average	Δ H from River
MW-2-32	13.13	5.60	13.11	4.97	13.27	3.92	13.08	5.21	10.14	2.61	10.22	2.76	9.79	4.08
MW-2-61	7.63	0.11	8.24	0.10	9.12	(0.23)	7.57	(0.30)	7.65	0.12	7.27	(0.19)	5.91	0.19
MW-2-104	7.64	0.11	8.25	0.11	9.11	(0.24)	7.54	(0.33)	7.69	0.16	7.30	(0.16)	5.96	0.24
MW-3-26	13.78	6.26	13.65	5.51	14.31	4.96	13.82	5.94	13.97	6.44	14.44	6.98	14.37	8.66
MW-3-56	7.76	0.24	8.33	0.19	9.34	(0.01)	7.96	0.09	7.77	0.25	7.54	0.08	6.14	0.43
MW-16-65	7.76	0.24	8.33	0.19	9.37	0.02	8.00	0.13	9.22	1.69	9.02	1.56	7.58	1.87
MW-18-125									6.22	(1.31)	5.98	(1.48)	4.48	(1.24)
MW-18-180	7.74	0.22	8.35	0.21	9.51	0.16	8.06	0.19	7.78	0.25	7.68	0.22	6.03	0.32
MW-21-12	12.73	5.20	12.72	4.58	13.16	3.81	12.85	4.98	12.23	4.70	12.48	5.02	12.34	6.62
MW-21-75	7.67	0.15	8.28	0.14	9.12	(0.23)	7.56	(0.32)	7.73	0.20	7.32	(0.14)	6.01	0.29
MW-21-115	7.73	0.20	8.33	0.19	9.23	(0.12)	7.65	(0.22)	7.78	0.25	7.40	(0.06)	6.02	0.31
MW-21-166	7.84	0.32	8.45	0.31	9.60	0.25	8.14	0.26	7.88	0.35	7.76	0.30	6.12	0.41
MW-22-80	7.53	0.00	8.14	(0.00)	9.09	(0.26)	7.63	(0.25)	7.64	0.11	7.32	(0.14)	5.88	0.17
MW-23-27	9.51	1.99	9.59	1.45	10.10	0.75	9.89	2.01	9.01	1.48	9.16	1.70	8.86	3.15
MW-23-75	7.58	0.06	8.20	0.06	9.05	(0.30)	7.51	(0.37)	7.65	0.12	7.27	(0.19)	5.89	0.18
MW-23-123	7.59	0.07	8.20	0.06	9.19	(0.16)	7.69	(0.18)	7.69	0.16	7.37	(0.09)	5.93	0.22
MW-24-70	7.73	0.21	8.30	0.16	9.32	(0.03)	7.93	0.05	7.78	0.25	7.55	0.09	6.14	0.42
MW-24-130	7.66	0.14	8.27	0.13	9.28	(0.07)	7.78	(0.09)	7.70	0.17	7.44	(0.02)	5.95	0.24
OW-7-17	11.72	4.19	11.71	3.57	12.28	2.93	11.78	3.91	11.91	4.38	12.18	4.72	11.88	6.17
OW-8-15	12.02	4.50	12.04	3.90	12.49	3.14	12.15	4.28	11.42	3.89	11.54	4.08	11.34	5.62
OW-8-28									9.24	1.71	8.21	0.75	8.38	2.66
OW-9-25	9.83	2.31	9.88	1.74	10.29	0.94	9.93	2.05	9.31	1.78	9.40	1.93	9.17	3.45
PW-7-93	7.87	0.35	8.48	0.34	3.59	(5.76)	-1.14	(9.02)	7.83	0.30	1.73	(5.73)	6.09	0.37
PW-8-39									8.24	0.71	-7.88	(15.34)	6.72	1.00
PW-8-68	7.81	0.29	8.42	0.28	6.38	(2.97)	3.60	(4.27)	7.84	0.31	4.51	(2.95)	6.09	0.37
PW-9-92	7.78	0.25	8.39	0.25	-2.83	(12.18)	-10.60	(18.47)	7.69	0.16	-4.41	(11.87)	5.94	0.22
PZ1-5	7.87	0.34	8.35	0.21	9.63	0.28	8.38	0.51	8.33	0.80	8.29	0.83	7.08	1.37
PZ1-20	7.86	0.34	8.41	0.27	9.47	0.12	8.14	0.27	7.67	0.14	7.50	0.04	5.97	0.25
PZ1-50	7.63	0.10	8.24	0.10	9.17	(0.18)	7.64	(0.23)	7.66	0.13	7.32	(0.14)	5.91	0.20
PZ2-5	7.68	0.15	8.29	0.15	9.31	(0.04)	7.80	(0.08)	7.63	0.10	7.57	0.11	5.83	0.12
PZ2-20	7.70	0.18	8.30	0.16	9.39	0.04	7.97	0.10	7.67	0.14	7.50	0.04	5.97	0.25
PZ2-43	7.60	0.08	8.21	0.07	9.30	(0.05)	7.83	(0.05)	7.65	0.12	7.46	(0.00)	5.90	0.19
PZ2-77	7.68	0.15	8.29	0.15	9.31	(0.04)	7.80	(0.08)	7.70	0.17	7.45	(0.02)	5.94	0.23
PZ4-12	7.55	0.03	8.13	(0.01)	9.28	(0.07)	7.90	0.02	7.60	0.07	7.49	0.03	5.91	0.19
PZ4-41	7.59	0.06	8.19	0.05	9.34	(0.01)	7.89	0.01	7.63	0.10	7.50	0.04	5.87	0.16
PZ5-5	9.52	2.00	9.69	1.55	10.35	1.00	9.69	1.81	9.61	2.08	9.60	2.14	9.12	3.41
PZ5-20	8.58	1.05	8.98	0.84	9.92	0.57	8.88	1.00	8.61	1.08	8.51	1.05	7.55	1.83
PZ5-55	7.69	0.17	8.30	0.16	9.21	(0.14)	7.67	(0.21)	7.71	0.18	7.35	(0.11)	5.96	0.25
PZ5-85	7.70	0.18	8.31	0.17	9.24	(0.11)	7.70	(0.17)	7.71	0.18	7.35	(0.11)	5.96	0.24
Willamette River	7.52	0.00	8.14	0.00	9.35	0.00	7.87	0.00	7.53	0.00	7.46	0.00	5.71	0.00

Notes:

Values represent average water level elevation in feet, City of Portland datum. Average values calculated using a 72 hour moving average method (Serfes, 1991).

Values in red with parentheses represent negative values (average water level in River higher than average water level in well).

BORING LOGS

MW-22-80

MW-23-27

MW-23-75

MW-23-123

MW-24-70

MW-24-130

OW-7-17

OW-8-15

OW-8-28

OW-9-25

PW-7-93

PW-8-39

PW-8-68

PW-9-92

PZ1-50

PZ2-43

PZ2-77

PZ3-33

PZ4-12

PZ5-5

PZ5-20

PZ5-55

PZ5-85

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-22-80
LOCATION	Portland, Oregon	PAGE	1 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	80.9 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	1/28/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009301
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102834

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
Hand Dug	0.8	0	None	NA			0 to 1.0 foot: GRAVEL (GW), dark gray, angular. (FILL)	100	0	0	
CB	0.7	0	None	2/8.5			1.0 to 10.0 feet: GRAVELLY SILT (ML), dark brown, firm, moist, abundant rootlets, non plastic. @ 1.5 feet: abundant lampblack, gravel-sized pieces, small brick pieces, fibrous material, broken glass, electrical wires. (FILL)	20	0	80	
	NA	NA	NA		5						
CB	2.4	2	None	3/5	10		10.0 to 15.0 feet: GRAVEL WITH SAND AND SILT (GW-GM), black, moist, large chunks of brick and gravel, electrical wires, metal fragments, slight hydrocarbon-like odor, lampblack, concrete chunks, well graded. (FILL)	80	10	10	
	NA	NA	NA								
CB	0.9	1	None	4.5/5	15		15.0 to 22.0 feet: SILTY SANDY GRAVEL (GW-GM), black, dry, loose, abundant lampblack, brick, electrical wire, concrete chunks, well graded. (FILL)	50	30	20	
	1.7	1	None		20		@ 18.5 feet: wet.				

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-22-80
LOCATION	Portland, Oregon	PAGE	2 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	80.9 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	1/28/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009301
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102834

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %	
CB	0	0	None	2/2				15.0 to 22.0 feet: SILTY SANDY GRAVEL (GW-GM) , continued.	50	30	20	
CB	0.3	0	None	10/10				22.0 to 23.0 feet: SAND (SP) , dark reddish brown, loose, moist, poorly graded, medium grained, homogenous. (FILL)	0	100	0	
	0.2	0	None					23.0 to 26.6 feet: SILTY SAND (SM) , gray, wet, with intermittent, thin silt layers. @ 24.5 to 26.6 feet: red and gray mottling. (FILL)	0	60	40	
	0.5	0	None			-25			26.6 to 40.0 feet: SILT WITH SAND (MH) , gray, wet, firm, highly plastic with thin sand layers (~1-2 mm). (ALLUVIUM)	0	10	90
	0.5	0	None			-30			@ 30.5 to 31.5 feet: SILTY SAND layer (SM), dark gray, fine to medium sand.	0	80	20
	0.3	0	None			-35			@ 31.5 to 40.0 feet: no recovery.			
CB	NA	NA	NA	0/8								

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-22-80
LOCATION	Portland, Oregon	PAGE	3 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	80.9 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	1/28/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009301
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102834

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.1	0	None	3.8/5	45	50	55	40.0 to 45.0 feet: SANDY SILT (MH) , dark brownish gray, very soft, wet, medium plasticity, fine sand. (ALLUVIUM)	0	20-30	70-80
	0.0	0	None					@ 41.8 to 42.5 feet: silty sand layer, fine sand. (ALLUVIUM)	0	90	10
CB	0.3	0	None	5/5	50	55	60	45.0 to 45.9 feet: SAND (SP) , dark gray, loose, wet, fine sand, <5 percent fines, poorly graded, homogenous. (ALLUVIUM)	0	95-100	0-5
	1.0	0	None					45.9 to 49.3 feet: SANDY SILT (MH) , dark brownish gray, soft, moist, medium plasticity, intermittent thin (~1-2 mm) sand layers. (ALLUVIUM) @ 46.4 to 46.6 feet: sand layer. @ 47.1 to 47.2 feet: sand layer. @ 48.0 to 48.2 feet: sand layer.	0	20-30	70-80
CB	0.4	0	None	10/10	55	60	65	49.3 to 52.4 feet: SAND (SP) , dark gray, loose, wet, fine to medium grained, poorly graded sand, occasional silt blebs (<5 percent fines). (ALLUVIUM)	0	95-100	0-5
	0.4	0	None					52.4 to 56.6 feet: SANDY SILT (MH) , dark brownish gray, soft, wet, medium plasticity, intermittent thin (~1-2 mm) sand layers. (ALLUVIUM) @ 53.8 to 54.0 feet: sand layer.	0	20-30	70-80
	0.8	0	None					@ 55.4 to 55.6 feet: sand layer.			
	0.4	0	None					56.6 to 59.0 feet: SAND (SP) , dark gray, loose, wet, fine to medium grained, poorly graded sand, occasional silt blebs. (ALLUVIUM) @ 57.4 to 58.0 feet: silt layer.	0	95-100	0-5
								59.0 to 60.0 feet: SILTY SAND (SM) , dark gray, loose, wet, fine to medium grained,	0	70-80	20-30

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-22-80
LOCATION	Portland, Oregon	PAGE	4 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	80.9 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	1/28/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009301
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102834

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.7	0	None	7.4/10	65			poorly graded sand, occasional silt blebs. (ALLUVIUM)	0	100	0
	0.7	0	None					60.0 to 60.6 feet: SAND (SP) , variegated sand grain color, dark gray, loose, wet, medium grained, poorly graded. (ALLUVIUM)	0	15	85
	0.4	0	None					60.6 to 69.5 feet: SILT (MH) , dark brownish gray, soft, moist, medium plasticity silt intermixed with medium grained sand. (ALLUVIUM)			
	0.3	0	None					@ 61.0 to 61.2 feet: medium grained sand layer. @ 66.1 to 66.4 feet: SAND (SP) , medium grained.			
CB	1.1	0	None	5/5	70			69.5 to 80.0 feet: SAND (SP) , dark gray, wet, loose, medium grained, poorly graded, variegated grain colors (mostly black with gray, white, red, tan). (ALLUVIUM)	0	100	0
	1.0	0	None								
CB	0.8	3	None	3.5/5	75						
	1.3	1	None								
					80						

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-22-80
LOCATION	Portland, Oregon	PAGE	5 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	80.9 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	1/28/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009301
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102834

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					<div style="display: flex; align-items: center;"> <div style="border-right: 1px solid black; height: 100%; position: relative;"> 100 -95 -90 -85 </div> <div style="width: 10px; height: 100%; background-color: black; margin-left: 5px;"></div> </div>		<p>Total depth = 80.9 feet.</p> <p>WELL COMPLETION DETAILS</p> <p>0 to 69.9 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.</p> <p>69.9 to 79.9 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>79.9 to 80.9 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 5.0 feet: Concrete.</p> <p>5.0 to 64.8 feet: Bentonite grout.</p> <p>64.8 to 67.8 feet: 20-40 Colorado silica sand.</p> <p>67.8 to 80.9 feet: 10-20 Colorado silica sand.</p>				

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-123
LOCATION	Portland, Oregon	PAGE	1 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	131.5 ft.
LOGGED BY	Matt Wilson/John Renda	DATE COMPLETED	2/5/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009310
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102839

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	1.1	0	None	3/3				0 to 2.2 feet: GRAVELLY SILT (MH) , brown moist, soft, sticky, fine to cobble sized, angular gravel, highly plastic silt. (FILL)	40	0	60
CB	0.6	0	None	2/4	5			2.2 to 9.0 feet: GRAVELLY SILT (ML) , black and dark olive gray mixed, dry, hard, concrete pieces at 3.8 to 4.0 feet, gravel is well rounded, fine to cobble sized, low plasticity silt. (FILL)	40-50	0	50-60
	0.6	0	None								
CB	1.8	0	None	0.8/2							
	0.9	0	None								
CB	NA	NA	None	2.5/5	10			9.0 to 14.5 feet: SILTY GRAVEL (GW) , gray and black mixed, dry, very hard, large cobble from 9.0 to 10.0 feet, gravel is angular, fine to cobble sized, well graded, nonplastic silt, very soft silt. (FILL) @ 10.0 feet: wet, black, sticky, concrete and lampblack (fine grained soot-like material present).	60-70	0	30-40
	1.1	0	None								
CB	10.2	0	None	4/4	15			@ 14.4 feet: chunk of concrete.	30	0	70
	25.9	0	None								
	9.0	0	None	2.5/3	20			@ 17.9 feet: hard, dry, gray concrete. @ 18.6 feet: hard, dry, gray concrete.			

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-123
LOCATION	Portland, Oregon	PAGE	2 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	131.5 ft.
LOGGED BY	Matt Wilson/John Renda	DATE COMPLETED	2/5/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009310
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102839

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
								14.5 to 21.0 feet: GRAVELLY SILT (ML) , continued.	30	0	70
CB	5.4	0	None	2/2				21.0 to 22.5 feet: SANDY SILT (ML) , dark gray to black, medium to high plasticity fines, fine to coarse sand, angular, fine gravel, naphthalene odor, moist to wet. (FILL)	5	25-30	70-75
CB								22.5 to 24.0 feet: GRAVELLY SILT (MH) , greenish gray, medium to high plasticity fines, fine to coarse gravel, angular to subrounded, moist. (FILL)	40	5	60
					25			24.0 to 24.5 feet: SAND (SP) , light brown, fine to medium, dry. (FILL)	0	0	100
								24.5 to 25.0 feet: SANDY SILT (MH) , dark gray to black, dense, brittle. (FILL)	0	0	100
CB	3.9	2	None	1/1				25.0 to 26.0 feet: SAND (SP) , light brown, fine to medium, dry. (FILL)	0	100	0
CB	0.9	0	None	3/3				26.0 to 27.5 feet: SILTY SAND (SM) , mottled dark gray to brown, fine to medium sand, medium to high plasticity fines, trace angular gravel, wood pieces at 27.5 feet (anthropogenic). (FILL)	Trace	40	60
					30			27.5 to 32.0 feet: SANDY SILT (MH) , light gray, medium to high plasticity fines, fine sand. (ALLUVIUM)	0	0-20	80-100
								@ 31.0 to 31.5 feet: fine sand lens.			
CB	0.9	0	None	3/3				32.0 to 59.0 feet: SAND (SP) , light gray, fine sand, trace root hairs and fine wood chips. (ALLUVIUM)	0	80-100	0-30
								@ 34.0 feet: 0.2-foot silt lens.			
					35			@ 35.0 feet: 0.2-foot silt lens.			
CB	0.9	0	None	2/2				@ 36.0 feet: 0.3-foot silt lens.			
								@ 37.5 feet: 0.2-foot silt lens.			
CB	0.6	0	None	3/3				@ 38.5 to 39.5 feet: silt lens.			
					40						

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-123
LOCATION	Portland, Oregon	PAGE	3 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	131.5 ft.
LOGGED BY	Matt Wilson/John Renda	DATE COMPLETED	2/5/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009310
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102839

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					32.0			32.0 to 59.0 feet: SAND (SP), (ALLUVIUM), continued.			
CB	1.2	0	None	2/2				@ 40.5 to 41.0 feet: silt lens.			
CB	1.2	0	None	3/3	45			@ 42.0 feet: 0.2-foot silt lens.			
CB	1.6	0	None	1/1				@ 46.5 to 47.0 feet: silt lens.			
CB	1.3	0	None	4/4	50			@ 49.5 feet: 0.3-foot silt lens.			
CB	1.0	0	None	3/3				@ 50.3 to 50.8 feet: silt lens.			
CB	1.3	0	None	3/3	55			@ 51.0 feet: 0.3-foot silt lens.			
CB	0.9	0	None	2/2				@ 52.0 feet: 0.5-foot silt lens.			
CB	1.0	0	None	3/3				@ 53.0 to 54.0 feet: silt with organic laminations.			
					60			@ 58.5 to 59.0 feet: silt lens, trace organics.			
								59.0 to 91.0 feet: SAND (SP), as on following page.	0	95-100	0-5

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-123
LOCATION	Portland, Oregon	PAGE	4 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	131.5 ft.
LOGGED BY	Matt Wilson/John Renda	DATE COMPLETED	2/5/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009310
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102839

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					65			<p>59.0 to 91.0 feet: SAND (SP), gray, medium grained, poorly graded, less than 5 percent fines, individual grains gray, red, white, clear. (ALLUVIUM)</p> <p>@ 68.0 feet: 0.1-foot silt lens, brown.</p> <p>@ 69.0 feet: 0.1-foot silt lens.</p> <p>@ 70.0 to 70.5 feet: silt lens, trace organics, medium plasticity.</p> <p>@ 72.0 feet: 0.1-foot silt lens.</p> <p>@ 74.7 feet: 0.2-foot silt lens.</p> <p>@ 76.0 to 81.0 feet: no recovery/drillers pushed past without sampling.</p>	0	95-100	0-5
CB	1.5	0	None								
CB				5/5							
CB	1.8	0	None								
CB				5/5							
CB	0.3	0	None		70						
CB				5/5							
CB	0.1	0	None								
CB				5/5							
CB	0.2	1	None		75						
CB				5/5							
CB	0.2	0	None								
CB				5/5							
CB	NA	NA	None	0/0							
CB				0/0							
CB	NA	NA	None		80						

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-123
LOCATION	Portland, Oregon	PAGE	5 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	131.5 ft.
LOGGED BY	Matt Wilson/John Renda	DATE COMPLETED	2/5/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009310
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102839

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
	NA	NA	None					59.0 to 91.0 feet: SAND (SP) , as on previous page, medium grained, poorly graded. (ALLUVIUM)			
CB	0.5	3	None	5/5	85						
	0.0	0	None								
CB	0.4	3	None	4/5	90			@ 88.0 feet: 10 to 15 percent fines (increase in fines), soupy, loose, wet.	0	85-90	10-15
	0.5	9	None								
CB	0.4	8	None	5/5	95			91.0 to 97.0 feet: SILTY SAND (SM) , gray, fine to medium sand, low to medium plasticity fines, firm, dense, single piece of gravel at 92.0 feet, flat 1-inch diameter. (ALLUVIUM)	0	80-85	15-20
	0.8	12	None								
NA	NA	NA	None	0/0				@ 96.0 to 97.0 feet: no recovery, driller over drilled casing.			
CB	0.6	1	None	4/4	100			97.0 to 131.5 feet: SAND (SP) , dark gray, loose, wet, poorly graded, medium grained, <5 percent fines, homogenous, variegated grain colors (mostly black with gray, white, red, tan, clear). (ALLUVIUM)	0	95-100	0-5

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-123
LOCATION	Portland, Oregon	PAGE	6 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	131.5 ft.
LOGGED BY	Matt Wilson/John Renda	DATE COMPLETED	2/5/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009310
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102839

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	1.0	0	None	3.6/5	97.0			97.0 to 131.5 feet: SAND (SP), as on previous page, medium grained, poorly graded. (ALLUVIUM)	0	95-100	0-5
	1.4	0	None		105				0	95-100	0-5
CB	1.4	0	None		110			@ 114.9 to 115.3 feet: SANDY SILT (ML), dark grayish brown, dry, stiff, low plasticity, friable, medium grained sand.			
	1.1	0	None	10/10	115						
	1.4	2	None								
	1.5	7	None								
CB	1.8	8	None	15/15	120						
	0.9	1	None								

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-123
LOCATION	Portland, Oregon	PAGE	7 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	131.5 ft.
LOGGED BY	Matt Wilson/John Renda	DATE COMPLETED	2/5/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009310
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102839

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
	2.8	8	None		125	125	125	<p>97.0 to 131.5 feet: SAND (SP), as on previous page, medium grained, poorly graded. (ALLUVIUM)</p> <p>@ 123.0 feet: grain size change to fine grained.</p> <p>@ 123.5 to 124.0 feet: silt layer (MH).</p> <p>@ 124.2 to 124.5 feet: silt layer (MH).</p> <p>@ 125.4 to 125.5 feet: silt layer (MH).</p> <p>@ 125.7 to 126.6 feet: silt layer (MH).</p> <p>@ 126.7 to 126.9 feet: silt layer.</p> <p>@ 128.1 to 128.5 feet: silt layer.</p> <p>@ 129.3 feet: color change to mixed dark gray and brown, dark gray is fine grained sand, brown is medium grained sand.</p> <p>@ 130.7 to 131.0 feet: sandy silt layer.</p>	0	95-100	0-5
	1.4	2	None		130	130	130	<p>Total depth = 131.5 feet.</p> <p>WELL COMPLETION DETAILS</p> <p>0 to 113.3 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.</p> <p>113.3 to 123.3 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>123.3 to 124.3 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 5.0 feet: Concrete.</p> <p>5.0 to 108.7.0 feet: Bentonite grout.</p> <p>108.7 to 111.4 feet: 20-40 Colorado silica sand.</p> <p>111.4 to 124.2 feet: 10-20 Colorado silica sand.</p> <p>124.2 to 131.5 feet: Bentonite chips.</p>			
	2.0	2	None		135	135	135				
	1.4	4	None		140	140	140				

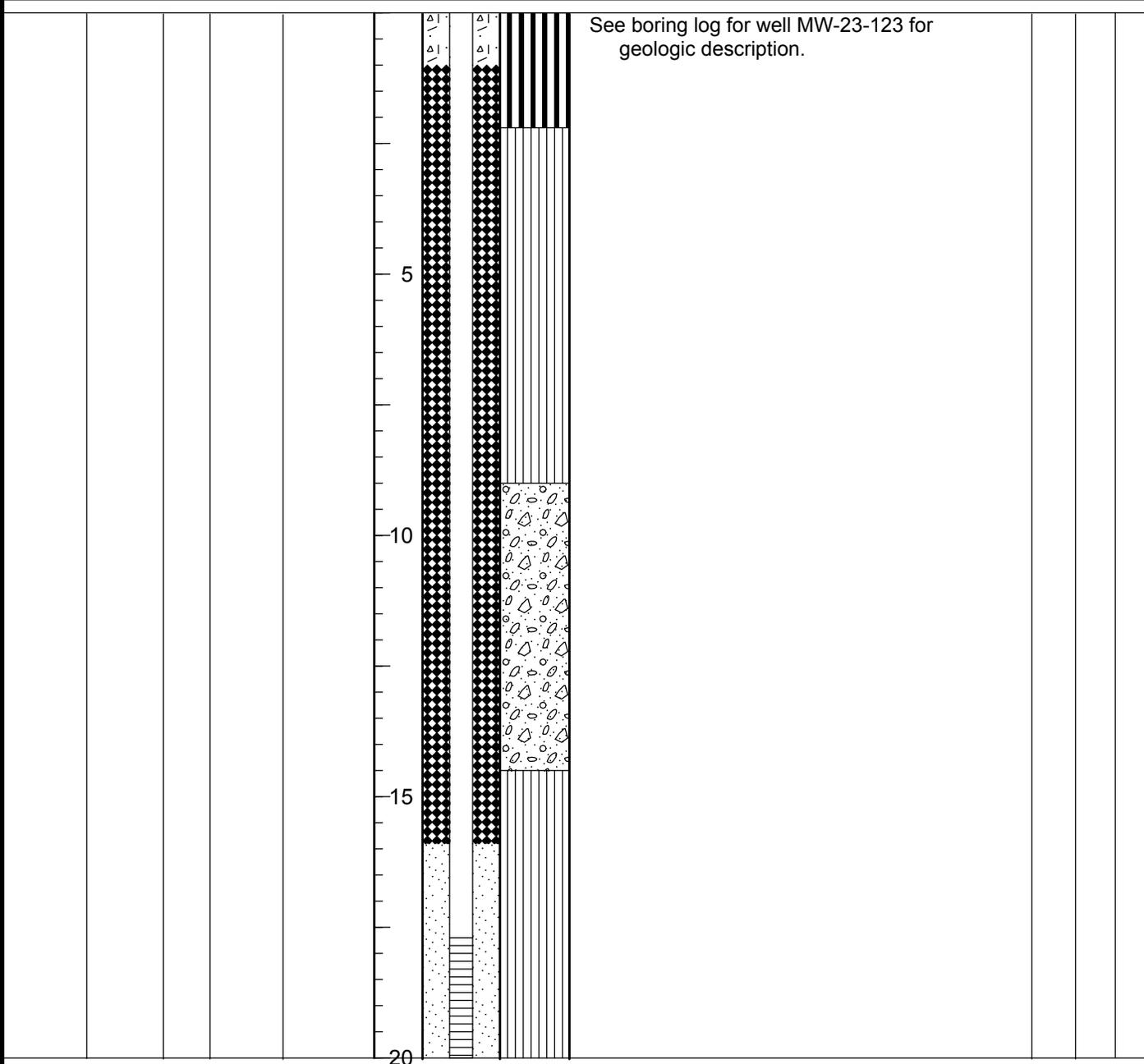
REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-27
LOCATION	Portland, Oregon	PAGE	1 of 2
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.8 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	30.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/16/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009312
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102841

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
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REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-27
LOCATION	Portland, Oregon	PAGE	2 of 2
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.8 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	30.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/16/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009312
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102841

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					25		30	See boring log for well MW-23-123 for geologic description.			
					35		40	<p>Total depth = 30.0 feet.</p> <p>WELL COMPLETION DETAILS</p> <p>0 to 17.7 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.</p> <p>17.7 to 27.7 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>27.7 to 28.0 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 1.0 foot: Concrete.</p> <p>1.0 to 15.9 feet: 3/8-inch bentonite chips.</p> <p>15.9 to 28.0 feet: 10-20 Colorado silica sand.</p> <p>28.0 to 30.0 feet: 3/8-inch bentonite chips.</p>			

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-75
LOCATION	Portland, Oregon	PAGE	2 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	75.7 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/16/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009311
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102840

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					25			See boring log for well MW-23-123 for geologic description.			
					30						
					35						
					40						

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-75
LOCATION	Portland, Oregon	PAGE	3 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	75.7 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/16/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009311
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102840

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					45	50	55				
					60						

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-23-75
LOCATION	Portland, Oregon	PAGE	4 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	32.9 ft msl
DRILL METHOD	Rotosonic - AMS I7-C Compact Sonic	TOTAL DEPTH	75.7 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/16/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009311
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102840

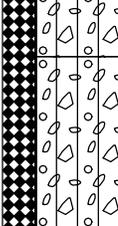
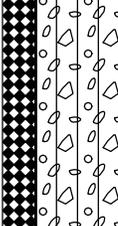
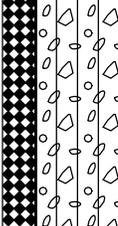
SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					65	70	75	<p>See boring log for well MW-23-123 for geologic description.</p> <p>WELL COMPLETION DETAILS 0 to 64.7 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe. 64.7 to 74.7 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots. 74.7 to 75.7 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 2.0 feet: Concrete. 2.0 to 59.7 feet: Bentonite grout. 59.7 to 62.7 feet: 20-40 Colorado silica sand. 62.7 to 75.7 feet: 10-20 Colorado silica sand. Total depth = 75.7 feet.</p>			
					80						

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-24-130
LOCATION	Portland, Oregon	PAGE	1 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	31.3 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	131.1 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/2/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009302
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102832

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.7	0	None	6/6	5			0 to 6.0 feet: SILTY GRAVEL (GM) , dark brown, wet, fine to coarse gravel, nonplastic silt. (FILL) @ 1.6 feet: color change to light reddish brown, hard, dry. @ 4.5 feet: mixed black and light reddish brown color.	70	0	30
	0.4	0	None								
	0.5	0	None								
CB	0.1	0	None	4/4	10			6.0 to 14.1 feet: SILTY GRAVEL (GM) , dark brown, moist, soft, fine to cobble size angular gravel, highly plastic sticky silt. (FILL)	60	0	40
	1.0	0	None								
CB	0.6	3	None	4/5	15			14.1 to 25.0 feet: SILTY SANDY GRAVEL (GW-GM) , mixed dark gray and black, loose, dry, fine to cobble, well rounded angular gravel, nonplastic silt, well graded. (FILL)	60	20	20
	0.6	1	None								
	1.1	0	None								
CB	0.6	1	None	2.5/5	20			@ 18.2 feet: color change to black, wet, oily, strong hydrocarbon-like odor, spotty sheen at 19.0 to 20.0 feet.			
	14.1	0	Yes ¹								

REMARKS

¹ Dull orange swirls and specks of fluorescence, green fluorescent smearing on plastic sample bag. ² Trace orange fluorescence.



LOG OF EXPLORATORY BORING

PROJECT NAME: NW Natural Gasco Site
 LOCATION: Portland, Oregon
 DRILLED BY: Cascade Drilling, Inc.
 DRILL METHOD: Rotosonic - Speedstar 15K
 LOGGED BY: Matt Wilson
 SAMPLING METHOD: 4-in. by 10-ft. core barrel (CB)
 BOREHOLE DIAMETER: 6-inches

BORING NO.: MW-24-130
 PAGE: 2 of 7
 GROUND SURFACE ELEVATION: 31.3 ft msl
 TOTAL DEPTH: 131.1 ft.
 DATE COMPLETED: 2/2/10
 PERMIT/STARTCARD NO.: 1009302
 WATER RESOURCES WELL ID: L102832

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	10.9	0	Yes ¹	5/5	25			14.1 to 25.0 feet: SILTY SANDY GRAVEL (GW-GM) , as on previous page.	60	20	20
	16.1	0	Yes ¹					@ 21.0 to 24.6 feet: heavy sheen, oily, strong hydrocarbon-like odor. @ 22.2 to 22.4 feet: tar. @ 23.0 feet: lampblack and charcoal-like material. @ 24.0 feet: wood chips. @ 24.2 to 24.6 feet: gravelly sand layer, heavily saturated with oil.			
CB	29.6	0	Yes ¹	5/5	25			@ 24.6 to 25.0 feet: SILT WITH GRAVEL , dark olive gray with black banding, highly plastic, sticky, heavy sheen. (FILL)	0	20	80
	4.2	0	Yes ¹					25.0 to 29.4 feet: SANDY SILT (MH) , dark gray with red mottling, soft, moist, highly plastic, fine sand, spotty sheen, rootlets, hydrocarbon-like odor. (ALLUVIUM) @ 25.8 feet: increased sand content. @ 29.4 feet: heavy sheen, trace oil.			
CB	4.8	0	Yes ¹	8.9/10	30			29.4 to 65.5 feet: SAND (SP) , gray, wet, loose, poorly graded, fine to medium grained, occasional silt blebs, slight hydrocarbon-like odor. (ALLUVIUM) @ 29.4 to 30.0 feet: heavy sheen, trace oil. @ 30.0 to 34.0 feet: slough from upper units.	0	100	0
	2.2	0	Yes ¹					@ 34.0 feet: no sheen.			
	1.0	0	Yes ²					@ 35.6 feet: color change to brown. @ 35.6 to 36.2 feet: rust colored banding.			
	1.4	2	None								

REMARKS

¹ Dull orange swirls and specks of fluorescence, green fluorescent smearing on plastic sample bag. ² Trace orange fluorescence.



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-24-130
LOCATION	Portland, Oregon	PAGE	3 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	31.3 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	131.1 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/2/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009302
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102832

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.9	0	None	9.3/10	45			29.4 to 65.5 feet: SAND (SP), (ALLUVIUM), same as previous page. @ 40.0 feet: color change to dark gray. @ 40.0 to 50.0 feet: slight hydrocarbon-like odor. @ 42.2 to 42.5 feet: silt layer, highly plastic.	0	100	0
	1.4	0	None								
CB	1.8	0	None	5/10	50			@ 45.8 to 46.2 feet: highly plastic silt layer.	5	85	10
	1.9	0	None					@ 47.0 to 47.3 feet: silt layer. @ 48.6 to 49.2 feet: silt layer.			
CB	0.2	0	None	5/10	55			@ 57.6 feet: grain size change to fine to medium sand.	0	100	0
	0.7	0	None								

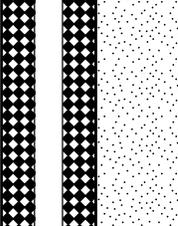
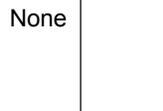
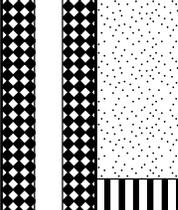
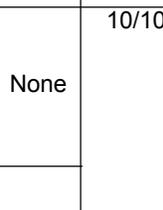
REMARKS

¹ Dull orange swirls and specks of fluorescence, green fluorescent smearing on plastic sample bag. ² Trace orange fluorescence.



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-24-130
LOCATION	Portland, Oregon	PAGE	5 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	31.3 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	131.1 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/2/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009302
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102832

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %					
CB	0.7	0	None	3.2/10	85			80.0 to 130.0 feet: SAND (SP), dark gray, loose, wet, poorly graded, medium grained, homogenous, strong "dirty gym sock" odor, variegated grain colors (mostly black, with gray, white, red and tan). (ALLUVIUM) @ 80.3 to 80.8 feet: highly plastic, dark grayish brown silt layer.								
	0.3	1	None													
CB	0.7	2	None	10/10	90			@ 90.0 to 92.7 feet: occasional silt blebs.								
	0.6	1	None					@ 92.7 to 94.2 feet: highly plastic, dark grayish brown, firm silt layer.				0	0	100		
	1.0	1	None													
	1.2	2	None													
					95											
					100											

REMARKS

¹ Dull orange swirls and specks of fluorescence, green fluorescent smearing on plastic sample bag. ² Trace orange fluorescence.



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-24-130
LOCATION	Portland, Oregon	PAGE	6 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	31.3 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	131.1 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/2/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009302
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102832

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %			
CB	13.1	0	None	10/10	105	110	115	80.0 to 130.0 feet: SAND (SP), as on previous page, medium grained. (ALLUVIUM)	0	100	0			
	6.3	0	None											
	10.4	0	None											
	1.4	1	None											
CB	3.1	5	None	10/10	120	115	120	@ 114.8 to 117.0 feet: trace silt (~5 percent). @ 117.0 feet: wood fragments and silt laminations. @ 117.3 to 120.0 feet: occasional silt blebs, hard, light brown.	0	95	5			
	3.1	8	None									0	95	5
	2.6	7	None											
	1.2	1	None											

REMARKS

¹ Dull orange swirls and specks of fluorescence, green fluorescent smearing on plastic sample bag. ² Trace orange fluorescence.



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-24-130
LOCATION	Portland, Oregon	PAGE	7 of 7
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	31.3 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	131.1 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/2/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009302
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102832

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.9	4	None	10/10	125			80.0 to 130.0 feet: SAND (SP), as on previous page, medium grained. (ALLUVIUM)	0	100	0
	1.0	3	None		125			@ 123.1 to 124.0 feet: very wet, very soft, soupy, sandy silt layer, low plasticity.	0	30	70
	0.7	2	None		130			@ 128.1 to 129.4 feet: trace silt, medium dense.	0	95	5
	0.6	1	None		130			Total depth = 130.0 feet. Sampling stopped at 130.0 feet. Well materials to 131.1 feet during well installation.	0	0	0
					135		WELL COMPLETION DETAILS 0 to 120.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe. 120.1 to 130.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots. 130.1 to 131.1 feet: 2-inch-diameter threaded end cap. 0 to 5.0 feet: Concrete. 5.0 to 115.0 feet: Bentonite grout with 10 percent organoclay by volume. 115.0 to 117.5 feet: 20-40 Colorado silica sand. 117.5 to 131.1 feet: 10-20 Colorado silica sand.				
					140						

REMARKS

¹ Dull orange swirls and specks of fluorescence, green fluorescent smearing on plastic sample bag. ² Trace orange fluorescence.



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-24-70
LOCATION	Portland, Oregon	PAGE	1 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	31.4 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	71.1 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/3/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009303
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102833

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					5 10 15 20			<p>See boring log for well MW-24-130 for geologic description.</p>			

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-24-70
LOCATION	Portland, Oregon	PAGE	2 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	31.4 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	71.1 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/3/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009303
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102833

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					25			See boring log for well MW-24-130 for geologic description.			
					30						
					35						
					40						

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-24-70
LOCATION	Portland, Oregon	PAGE	3 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	31.4 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	71.1 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/3/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009303
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102833

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					45			See boring log for well MW-24-130 for geologic description.			
					50						
					55						
					60						

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	MW-24-70
LOCATION	Portland, Oregon	PAGE	4 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	31.4 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	71.1 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/3/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009303
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102833

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					65	70	75	80			
								See boring log for well MW-24-130 for geologic description.			
								Total depth = 71.1 feet.			
								<p>WELL COMPLETION DETAILS</p> <p>0 to 60.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.</p> <p>60.1 to 70.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>70.1 to 71.1 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 5.0 feet: Concrete.</p> <p>5.0 to 54.8 feet: Bentonite grout with 10 percent organoclay by volume.</p> <p>54.8 to 57.7 feet: 20-40 Colorado silica sand.</p> <p>57.7 to 71.1 feet: 10-20 Colorado silica sand.</p>			

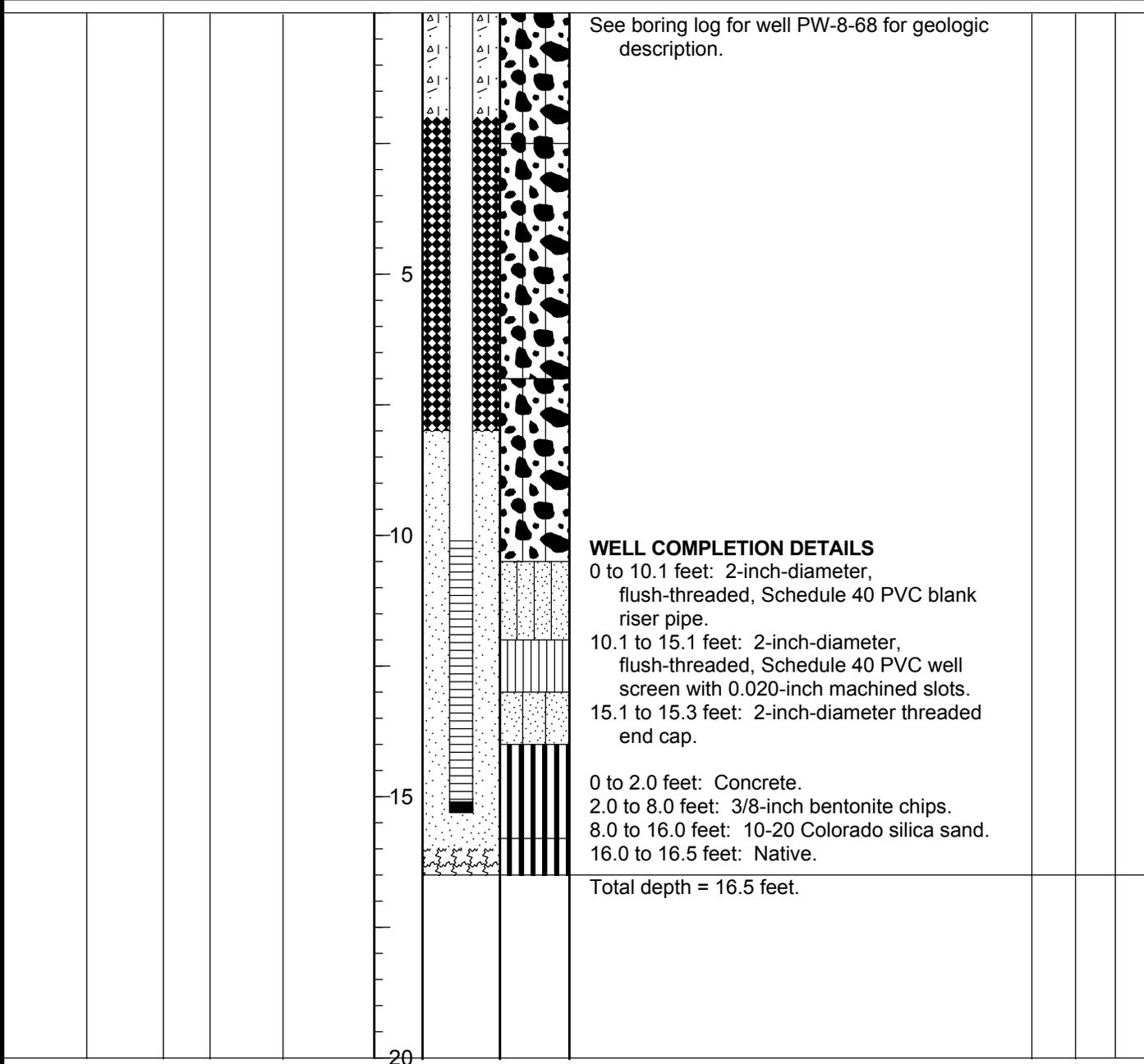
REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	OW-8-15
LOCATION	Portland, Oregon	PAGE	1 of 1
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	16.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/12/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009304
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102835

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
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REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	OW-8-28
LOCATION	Portland, Oregon	PAGE	1 of 2
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	23.79 ² feet
DRILL METHOD	Hollow-stem Augers	TOTAL DEPTH	29.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	8/13/10
SAMPLING METHOD	2-foot split-spoon (SS)	PERMIT/STARTCARD NO.	1010937
BOREHOLE DIAMETER	8-inches	WATER RESOURCES WELL ID	L103383

SAMPLING METHOD	HYDROGEN CYANIDE HEADSPACE (ppm)	VOC HEADSPACE (ppm)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
SS	1	0.3	No	1.3/2.0				0 to 10.9 feet: GRAVELLY SILT (ML) , dark brown to black, dry, hard, friable, nonplastic silt, angular, fine to coarse gravel. (FILL)	30	0	70
SS	1	0.0	No	1.0/2.0							
SS	NA	NA	NA	0.0/2.0		5		@ 4.0 to 6.0 feet: no recovery (gravel blocked sampler).			
SS	0	0.0	No	1.0/2.0				@ 6.0 feet: moist, trace yellow brown patches, low plasticity.			
SS	0	0.0	No	1.2/2.0				@ 8.4 to 9.0 feet: lampblack. @ 9.0 feet: color change to black.			
SS	0	0.0	No	1.4/2.0		10		10.9 to 17.2 feet: SAND (SP) , dark reddish brown, dry, loose, fine grained, poorly graded. (FILL) @ 12.0 to 14.0 feet: trace gravel.	0	100	0
SS	1	0.0	No	0.8/2.0				@ 14.0 feet: wet.			
SS	0	0.1	No	1.0/2.0		15		@ 16.5 to 17.2 feet: sheen visible on sample.			
SS	1	0.3	¹	1.5/2.0				17.2 to 19.5 feet: SILT (MH) , dark grayish brown, medium plasticity, firm, wet, trace fine sand, trace rootlets. (ALLUVIUM)	0	5	95
SS	0	0.1	¹	1.5/2.0		20		@ 19.5 feet: silty sand. 19.5 to 25.0 feet: SILTY SAND AND SILT			

REMARKS

¹ Faint dull yellow fluorescence in soil. ² City of Portland Datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	OW-8-28
LOCATION	Portland, Oregon	PAGE	2 of 2
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	23.79 ² feet
DRILL METHOD	Hollow-stem Augers	TOTAL DEPTH	29.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	8/13/10
SAMPLING METHOD	2-foot split-spoon (SS)	PERMIT/STARTCARD NO.	1010937
BOREHOLE DIAMETER	8-inches	WATER RESOURCES WELL ID	L103383

SAMPLING METHOD	HYDROGEN CYANIDE HEADSPACE (ppm)	VOC HEADSPACE (ppm)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
SS	1	1.6	No	1.7/2.0				19.5 to 25.0 feet: SILTY SAND AND SILT (SM-MH) intermixed, dark brownish gray, soft, wet, slight hydrocarbon-like odor.	0	50-55	45-50
SS	0	0.4	No	1.0/2.0			@ 23.0 to 23.7 feet: silt layer.	0	0	100	
SS	0	0.9	No	1.0/2.0	25		@ 23.7 to 24.4 feet: silty fine sand.	0	80	20	
SS	0	0.4	No	0.4/2.0			@ 24.4 to 25.0 feet: silt.	0	0	100	
SS	0	0.3	No	0.8/1.0			25.0 to 29.0 feet: SILTY SAND (SM) , dark brownish gray, wet, medium dense, fine-grained sand.	0	80	20	
					30			Total depth = 29.0 feet.			
					35		WELL COMPLETION DETAILS 0 to 23.1 feet: 2-inch-diameter Schedule 40 PVC blank riser pipe. 23.1 to 28.1 feet: 2-inch-diameter slotted PVC screen with 0.020-inch slots. 28.1 to 28.7 feet: 2-inch-diameter Schedule 40 PVC end cap. 0 to 2.0 feet: Concrete. 2.0 to 20.6 feet: Bentonite chips. 20.6 to 29.0 feet: 10-20 Colorado Silica Sand.				
					40						

REMARKS

¹ Faint dull yellow fluorescence in soil. ² City of Portland Datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	OW-9-25
LOCATION	Portland, Oregon	PAGE	2 of 2
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.1 ft msl
DRILL METHOD	Rotosonic - AMS 17-C Compact Sonic	TOTAL DEPTH	25.3 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	3/8/10
SAMPLING METHOD	4-in. by 5-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009309
BOREHOLE DIAMETER	6-inches	WATER RESOURCES WELL ID	L102843

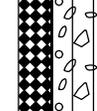
SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					25	30	35	40			
								See boring log for well PW-9-92 for geologic description.			
								Total depth = 25.3 feet.			
								<p>WELL COMPLETION DETAILS</p> <p>0 to 20.0 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.</p> <p>20.0 to 25.0 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>25.0 to 25.3 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 2.0 feet: Concrete.</p> <p>2.0 to 17.7 feet: Granular bentonite.</p> <p>17.7 to 25.3 feet: 10-20 Colorado silica sand.</p>			

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-7-93
LOCATION	Portland, Oregon	PAGE	1 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.2 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	96.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/22/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009306
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102837

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.4	0	None	2.8/5	5			0 to 0.9 foot: GRAVEL WITH SILT (GW) , dark gray, loose, wet, angular, well graded. (FILL)	90	0	10
	0.0	0	None					0.9 to 6.0 feet: GRAVELLY SILT (ML) , black with reddish brown patches, stiff, moist, low plasticity, grass fibers at 1.0 foot, gravel is coarse to cobble size, angular, trace red brick pieces. (FILL)	30	0	70
CB	0.1	0	None	2.7/5	10			6.0 to 9.8 feet: SILTY GRAVEL (GM) , light gray, dry, loose, dusty, concrete pieces, gravel is well graded, fine to cobble size, angular. (FILL)	80	0	20
	0.2	0	None					9.8 to 17.5 feet: SILTY GRAVEL WITH SAND (GM) , dark reddish brown, soft, moist, well graded, fine to cobble sized, angular gravel, low plasticity silt, fine to medium sand. (FILL) @ 11.2 feet: wet. @ 11.6 to 15.0 feet: very wet, light sheen on water, brown oil spots observed on plastic sampling bag.	50	20	30
CB	0.3	0	None	4/5	15			@ 16.5 to 17.0 feet: sand layer, dark gray, loose, wet, poorly graded, fine to medium, no sheen.	0	100	0
	0.0	0	None					17.5 to 23.2 feet: SILT (MH) , dark olive gray, wet, very soft, medium to high plasticity, trace fine sand, no sheen, slight hydrocarbon-like odor. (ALLUVIUM)	0	0-5	95-100

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-7-93
LOCATION	Portland, Oregon	PAGE	2 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.2 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	96.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/22/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009306
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102837

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.2	0	None	4/10	25	30	17.5 to 23.2 feet: SILT (MH), (ALLUVIUM), same as on previous page.	0	0-5	95-100	
	0.4	0	None				23.2 to 43.6 feet: SAND (SP), dark olive gray, loose, wet, poorly graded, fine to medium grained, <5 percent fines, slight hydrocarbon-like odor. (ALLUVIUM)	0	95-100	0-5	
	0.5	0	None				@ 28.0 to 28.2 feet: silt layer. @ 28.2 feet: grain size change to fine.				
	0.5	0	None								
CB	0.3	0	None	7.2/10	35	40	@ 33.2 to 33.3 feet: sheen observed, moderate hydrocarbon-like odor.				
	0.7	0	None				@ 36.0 to 36.3 feet: silt layer.				
	1.0	0	None				@ 37.9 to 38.2 feet: silt layer. @ 38.6 to 39.4 feet: silt layer.				
	0.9	0	None								

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-7-93
LOCATION	Portland, Oregon	PAGE	3 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.2 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	96.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/22/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009306
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102837

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %		
CB	0.6	0	None	8.1/10	45	45		23.2 to 43.6 feet: SAND (SP) , as on previous page, fine to medium grained. (ALLUVIUM)	0	95-100	0-5		
	0.6	0	None					43.6 to 47.2 feet: SILT (MH) , dark grayish brown, moist, soft, highly plastic, <5 percent fine sand. (ALLUVIUM) @ 44.2 to 44.6 feet: sand layer.	0	0-5	95-100		
	0.9	0	None										
	0.5	0	None							47.2 to 55.4 feet: SAND (SP) , dark gray, loose, wet, poorly graded, fine to medium grained, occasional silt blebs (up to cobble size). (ALLUVIUM)	0	95-100	0-5
CB	1.5	0	None	6.7/10	50	50		@ 49.5 to 50.0 feet: silt content increases, sand with silt, fine grained sand. @ 50.0 to 53.1 feet: medium grained, poorly graded sand, slight "dirty gym sock"/"onion" odor.	0	85-90	10-15		
	0.4	0	None					@ 53.1 to 53.7 feet: silt with sand banding in 1-inch-thick bands, fine grained sand. @ 53.7 to 55.4 feet: fine grained sand with silt.	0	10	90		
	0.4	0	None								0	90	10
	0.5	0	None							55.4 to 59.4 feet: SILT (MH) , dark grayish brown, moist, soft, highly plastic, trace very thin sand partings (<1 mm). (ALLUVIUM)	0	0-5	95-100
					55	55		59.4 to 64.9 feet: SAND (SP) , next page.	0	95-100	0-5		
					60	60							

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-7-93
LOCATION	Portland, Oregon	PAGE	4 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.2 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	96.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/22/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009306
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102837

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.3	0	None	4.1/10	65			59.4 to 64.9 feet: SAND (SP) , dark gray, loose, wet, fine grained, poorly graded, trace fines. (ALLUVIUM) @ 60.0 to 63.4 feet: very loose, very wet, fine grained.	0	95-100	0-5
	0.9	4	None					@ 63.4 to 64.9 feet: SAND WITH SILT layer (SP-SM), fine grained, slightly cohesive, wet, ~5 to 10 percent fines, occasional silt blebs.	0	90-95	5-10
	0.7	0	None					64.9 to 69.0 feet: SILT (MH) , dark gray-brown, moist, soft, highly plastic, trace organic debris and shell fragments. (ALLUVIUM)	0	0	100
	1.1	0	None					@ 67.6 to 68.1 feet: sand layer.			
CB	1.8	1	None	8.7/10	70			69.0 to 69.5 feet: SAND (SP) , dark gray, slightly cohesive and compact, medium dense, wet, fine to medium grained, poorly graded. (ALLUVIUM)	0	95-100	0-5
								69.5 to 72.4 feet: SAND (SP) , dark gray, loose, wet, poorly graded, fine to medium grained, trace fines. (ALLUVIUM)	0	95-100	0-5
	1.7	0	None					72.4 to 86.6 feet: SAND (SP) , dark gray, loose, wet, poorly graded, medium grained, little to no fines, slight "dirty gym sock/onion" odor, variegated grain colors (black, gray, white, tan, red). (ALLUVIUM)	0	100	0
	1.9	0	None					@ 77.7 to 78.6 feet: abundant silt blebs.			
					75						
					80						

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-7-93
LOCATION	Portland, Oregon	PAGE	5 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.2 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	96.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/22/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009306
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102837

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %				
CB	0.5	1	None	8.9/10	85			72.4 to 80.6 feet: SAND (SP) , as on previous page, medium grained. (ALLUVIUM)	0	100	0				
	0.8	3	None					86.6 to 90.0 feet: SAND WITH SILT (SW-SM) , gray, dense, wet, well graded, fine to coarse, trace gravel, slight "gym sock/onion" odor. (ALLUVIUM)	5	85	10				
	1.4	12	None					3/5	90			90.0 to 95.0 feet: SAND (SP) , dark gray, loose, wet, well graded, medium grained, little to no fines, variegated grain colors (black, gray, white, tan, red, clear), slight "gym sock/onion" odor. (ALLUVIUM)	0	100	0
	1.3	6	None									Sampling terminated at 95.0 feet bgs. Borehole advanced to 96.5 feet because of washout from circulating water.			
CB	1.4	2	None	3/5	95			90.0 to 95.0 feet: SAND (SP) , dark gray, loose, wet, well graded, medium grained, little to no fines, variegated grain colors (black, gray, white, tan, red, clear), slight "gym sock/onion" odor. (ALLUVIUM)	0	100	0				
	1.9	6	None					Sampling terminated at 95.0 feet bgs. Borehole advanced to 96.5 feet because of washout from circulating water.							
					100			Sampling terminated at 95.0 feet bgs. Borehole advanced to 96.5 feet because of washout from circulating water.							
<p>WELL COMPLETION DETAILS 0 to 73.5 feet: 8-inch-diameter, flush-threaded, Schedule 40 carbon steel blank riser pipe. 73.5 to 93.5 feet: 8-inch-diameter, flush-threaded, stainless steel continuous wire-wrapped screen with 0.035-inch slots.</p>															

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-7-93
LOCATION	Portland, Oregon	PAGE	6 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.2 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	96.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/22/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009306
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102837

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					105			93.5 to 95.5 feet: 8-inch-diameter stainless steel sump.			
					110			0 to 1.5 feet: Concrete.			
					115			1.5 to 69.5 feet: Bentonite grout with 10 percent organoclay by volume.			
					120			69.5 to 72.0 feet: 20-40 Colorado silica sand.			
								72.0 to 96.5 feet: 10-20 Colorado silica sand.			

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PW-8-39
LOCATION	Portland, Oregon	PAGE	1 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	23.22 ³ feet
DRILL METHOD	Rotosonic and Hollow-stem Augers ²	TOTAL DEPTH	50.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	8/13/10
SAMPLING METHOD	10-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1010439
BOREHOLE DIAMETER	15-inches	WATER RESOURCES WELL ID	L103390

SAMPLING METHOD	HCN (ppm)	FID/PID (ppm)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	1	0.1	None	2.8/5	0			0 to 10.0 feet: SILT (ML) ; dark reddish brown with black patches, dry, gravelly silt, hard, no plasticity, trace concrete pieces, well-rounded gravel, fine to cobble size. (FILL)	25	0	75
	1	0.2	None								
CB	1	0.3	None	5/5	5			@ 5.0 feet: color change to black with patches of reddish brown, slightly moist, low plasticity, trace red brick and pink concrete.			
	0	0.2	None								
CB	1	0.4	None	4.8/5	10			10.0 to 14.4 feet: SAND (SP) ; dark brownish red, wet, fine to medium, poorly graded, loose, homogeneous.	0	100	0
	1	0.5	None								
CB	1	1.2	Yes ¹	5/5	15			14.4 to 16.1 feet: SAND (SP) ; gray to brown, wet, loose, fine to medium grained, poorly graded, sheen from 15.7 to 16.1 feet, slight petroleum hydrocarbon-like odor.	0	100	0
	2	1.4									
	1	0.8	Yes ¹	16.1 to 19.7 feet: SILT (MH) ; dark gray, moist, high plasticity, soft, trace fine sand, trace spotty sheen from 16.1 to 17.5 feet, trace petroleum hydrocarbon-like odor, trace rootlets and black organic material residue and small plant debris. @ 19.7 feet: increased sand content, sandy silt.				0	5	95	

REMARKS

¹ Yellow and dull orange fluorescence. ² Boring was originally drilled and sampled with Rotosonic methods to 50.0 feet. Boring was then overdrilled with hollow-stem augers to 42.0 feet and well was installed. ³ City of Portland datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PW-8-39
LOCATION	Portland, Oregon	PAGE	2 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	23.22 ³ feet
DRILL METHOD	Rotosonic and Hollow-stem Augers ²	TOTAL DEPTH	50.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	8/13/10
SAMPLING METHOD	10-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1010439
BOREHOLE DIAMETER	15-inches	WATER RESOURCES WELL ID	L103390

SAMPLING METHOD	HCN (ppm)	FID/PID (ppm)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	1	0.4	None	7.5/10	25	30	35	19.7 to 31.4 feet: SILTY SAND AND SILT (SM-MH); dark gray, wet, fine sand, moderately plastic silt, soft, trace hydrocarbon-like odor, trace gravel, sand and silt are intermixed, some thin sand layers can be discerned but there appears to be no stratification. @ 28.8 to 30.0 feet: silt layer.	0	50-60	40-50
	1	0.4	None								
	1	0.4	None								
	1	0.2	None								
CB	1	0.5	None	8/10	30	35	40	31.4 to 37.5 feet: SILTY SAND (SM); dark brownish gray, wet, very soft, fine sand and high plasticity silt, abundant silt blebs.	0	60	40
	1	0.4	None								
	1	0.6	None								
	1	0.6	None								

REMARKS

¹ Yellow and dull orange fluorescence. ² Boring was originally drilled and sampled with Rotosonic methods to 50.0 feet. Boring was then overdrilled with hollow-stem augers to 42.0 feet and well was installed. ³ City of Portland datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PW-8-39
LOCATION	Portland, Oregon	PAGE	3 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	23.22 ³ feet
DRILL METHOD	Rotosonic and Hollow-stem Augers ²	TOTAL DEPTH	50.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	8/13/10
SAMPLING METHOD	10-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1010439
BOREHOLE DIAMETER	15-inches	WATER RESOURCES WELL ID	L103390

SAMPLING METHOD	HCN (ppm)	FID/PID (ppm)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	1	0.4	None	7.5/10				37.5 to 43.0 feet: SAND (SP), as on previous page.	0	70	30
	1	0.0	None		45			43.0 to 50.0 feet: SAND (SP); dark gray with variegated sand grains color (mostly black with red, gray, white, clear, tan), loose, poorly graded, medium grained, wet.	0	100	0
	1	0.2	None					@ 49.0 to 50.0 feet: large silt bleb, sand with silt.	0	90	10
	1	0.2	None		50			Total depth = 50.0 feet.			
					55			WELL COMPLETION DETAILS 0 to 24.2 feet: 6-inch-diameter, flush-threaded, Schedule 40 low-carbon steel blank riser pipe. 24.2 to 39.2 feet: 6-inch-diameter, stainless steel, continuous wire-wrapped well screen with 0.035-inch slots. 39.2 to 42.2 feet: 6-inch-diameter stainless steel sump. 0 to 2.0 feet: Concrete. 2.0 to 23.0 feet: Bentonite chips. 23.0 to 42.2 feet: 10-20 Colorado Silica Sand. 42.2 to 50.0 feet: Bentonite.			
					60						

REMARKS

¹ Yellow and dull orange fluorescence. ² Boring was originally drilled and sampled with Rotosonic methods to 50.0 feet. Boring was then overdrilled with hollow-stem augers to 42.0 feet and well was installed. ³ City of Portland datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-8-68
LOCATION	Portland, Oregon	PAGE	1 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	70.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/11/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009305
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102836

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.2	0	None	2.9/5	0			0 to 2.5 feet: GRAVEL WITH SILT (GW-GM) , dark grayish brown, loose, moist, fine to cobble, angular gravel. (FILL)	90	0	10
	0.2	0	None					2.5 to 7.0 feet: GRAVEL WITH SILT (GW-GM) , light gray, loose, dry, dusty, fine to cobble-sized angular gravel. (FILL)	90	0	10
CB	0.2	0	None	2/2	5			@ 5.0 feet: dark gray, brick and concrete rubble.			
CB	0.3	0	None	0.7/3				7.0 to 10.5 feet: GRAVEL WITH SILT (GW-GM) , mottled dark reddish brown and black, sticky, moist, well graded, fine to cobble-sized gravel, high plasticity silt, trace brick pieces. (FILL)	80	0	20
CB	0.4	1	None	5/5	10			10.5 to 12.0 feet: SILTY SAND (SM) , brown, loose, moist to wet, fine to medium sand, trace brick pieces. (FILL)	0	80	20
	2.0	1	None					12.0 to 13.0 feet: SANDY SILT (ML) , mottled reddish brown and gray, wet, firm (1.0 kg/cm ²), low plasticity, fine sand. (FILL)	0	40-50	50-60
								13.0 to 14.0 feet: SAND WITH SILT (SP-SM) , reddish brown, very loose, wet, medium grained, poorly graded. (FILL)	0	90	10
CB	5.9	1	None	1.2/5	15			14.0 to 15.8 feet: SAND (SP) , dark gray, very loose, wet, poorly graded, fine to medium grained, slight hydrocarbon-like odor, variegated grain colors (black, gray, white, clear, red). (FILL)	0	100	0
								@ 15.0 feet: moderate hydrocarbon-like odor, trace oil, sheen present, crude oil odor.			
								15.8 to 20.0 feet: SILT (MH) , dark grayish brown, high plasticity, very soft, wet. (ALLUVIUM)	0	0	100
					20						

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-8-68
LOCATION	Portland, Oregon	PAGE	2 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	70.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/11/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009305
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102836

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %			
CB	0.4	1	None	10/10	25			20.0 to 27.5 feet: SANDY SILT (ML) ; dark grayish brown, low plasticity, fine sand, no sheen, very soft, wet. (ALLUVIUM)	0	30	70			
	0.4	1	None											
	0.6	1	None								@ 26.0 to 27.5 feet: increasing sand content with depth.			
	0.3	0	None								27.5 to 30.0 feet: SAND WITH SILT (SP-SM) , dark gray, loose, wet, fine to medium grained, poorly graded, no sheen. (ALLUVIUM)	0	90	10
CB	0.8	1	None	8/10	30			30.0 to 35.1 feet: SAND (SP) , dark gray, very loose, very wet, fine to medium grained, poorly graded, no sheen. (ALLUVIUM)	0	100	0			
	0.4	0	None											
	0.6	1	None								35.1 to 38.9 feet: SILT (MH) , dark grayish brown, highly plastic, wet. (ALLUVIUM) @ 35.1 to 35.6 feet: sheen, moderate hydrocarbon-like odor. @ 35.6 to 35.8 feet: sand layer. @ 37.1 to 37.5 feet: sand layer. @ 37.9 to 38.0 feet: sand layer.	0	0	100
	0.4	0	None								38.9 to 46.0 feet: SAND (SP) , as on following page.	0	95-100	0-5
					40									

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-8-68
LOCATION	Portland, Oregon	PAGE	3 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	70.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/11/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009305
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102836

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %						
CB	0.6	0	None	8/10	45	[Well Diagram]	[Lithologic Column]	38.9 to 46.0 feet: SAND (SP) , dark gray, very loose, very wet, fine to medium grained, poorly graded, no sheen, moderate hydrocarbon-like odor. (ALLUVIUM)	0	95-100	0-5						
	0.4	0	None					46	[Well Diagram]	[Lithologic Column]	46.0 to 46.9 feet: SILT (MH) , dark grayish brown, highly plastic, wet with organic debris laminations. (ALLUVIUM)	0	0	100			
	0.3	0	None								47	[Well Diagram]	[Lithologic Column]	46.9 to 70.0 feet: SAND (SP) , dark gray, very loose, wet, poorly graded, medium grained, <5 percent fines, variegated grain color (black with gray, white, red, clear). (ALLUVIUM)	0	100	0
	0.2	0	None											48	[Well Diagram]	[Lithologic Column]	@ 49.0 to 49.3 feet: highly plastic silt layer.
CB	0.2	1	None	9/10	50	[Well Diagram]	[Lithologic Column]	@ 55.2 feet: no silt.									
	0.4	1	None					55	[Well Diagram]	[Lithologic Column]	@ 57.3 to 57.8 feet: highly plastic silt layer.						
	0.2	0	None								58	[Well Diagram]	[Lithologic Column]	@ 58.7 to 59.1 feet: highly plastic silt layer.			
	0.3	0	None											60	[Well Diagram]	[Lithologic Column]	@ 59.5 to 60.0 feet: abundant silt blebs with organic debris.

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-8-68
LOCATION	Portland, Oregon	PAGE	4 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	24.6 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	70.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	2/11/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009305
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102836

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.9	2	None	7.5/10	65			46.9 to 70.0 feet: SAND (SP), (ALLUVIUM), continued.	0	100	0
	0.7	3	None								
	1.0	1	None								
	0.6	1	None		70						
					75			Total depth = 70.0 feet. WELL COMPLETION DETAILS 0 to 48.0 feet: 8-inch-diameter, flush-threaded, Schedule 40 carbon steel riser pipe. 48.0 to 68.0 feet: 8-inch-diameter, flush-threaded, Schedule 40 stainless steel continuous wire-wrapped screen with 0.035-inch slots. 68.0 to 70.0 feet: 8-inch-diameter stainless steel sump. 0 to 4.0 feet: Concrete. 4.0 to 43.0 feet: Bentonite grout with 10 percent organoclay by volume. 43.0 to 45.7 feet: 20-40 Colorado silica sand. 45.7 to 70.0 feet: 10-20 Colorado silica sand.			
					80						

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-9-92
LOCATION	Portland, Oregon	PAGE	1 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.0 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	95.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	3/1/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009308
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102842

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
Hand Dug	NA	NA	None	NA				0 to 2.0 feet: SILTY GRAVEL (GW-GM) , dark brown, moist to wet, well graded, angular gravel, low plasticity silt. (FILL)	80	0	20
CB	0.2	0	None	3/3				2.0 to 15.8 feet: GRAVELLY SILT (ML) , dark gray to black, moist, sticky, low plasticity, well graded angular gravel, slight hydrocarbon-like odor, trace red brick pieces, fine to cobble size gravel. (FILL)	45-50	0	50-55
CB	0.3	0	None	2.9/5	5			@ 7.4 feet: color change to brown.			
	0.4	0	None								
CB	0.3	0	None	3.5/5	10						
	0.3	0	None								
CB	0.9	0	None	1.8/5	15			15.8 to 22.0 feet: GRAVELLY SAND WITH SILT (SW) , black, moist, abundant cobble size pieces of concrete, sooty (lampblack), well graded, fine to coarse sand, no sheen, moderate hydrocarbon-like odor (naphthalene) (core blockage, poor recovery). (FILL)	40	50	10
	0.7	0	None					@ 18.0 feet: wet; large chunks of lampblack, brick, and concrete.			

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-9-92
LOCATION	Portland, Oregon	PAGE	2 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.0 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	95.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	3/1/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009308
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102842

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	1.1	0	None	4/5	25	[Patterned]	[Patterned]	15.8 to 22.0 feet: GRAVELLY SAND WITH SILT (SP) , (ALLUVIUM), continued.	40	50	10
	0	100	0				[Patterned]	22.0 to 25.0 feet: SAND (SP) , brownish red, wet, loose, poorly graded, fine to medium sand. (ALLUVIUM) @ 22.2 to 22.3 feet: silt layer.	0	100	0
CB	0.5	0	None	5/5	25	[Patterned]	[Patterned]	26.3 to 27.6 feet: SANDY SILT (MH) , dark olive gray, soft, wet, fine sand, highly plastic silt with intermittent sand layers. (ALLUVIUM)	0	45-50	50-55
	0.5	0	None				[Patterned]	27.6 to 29.1 feet: SILT (MH) , dark olive gray, soft, wet, highly plastic silt, trace fine sand, trace brown organic debris. (ALLUVIUM) @ 28.7 to 29.1 feet: sand layer.	0	0-5	95-100
CB	0.5	0	None	6.6/10	30	[Patterned]	[Patterned]	29.1 to 37.7 feet: SILTY SAND (SM) , dark olive gray, soft, wet, interbedded thin fine sand and high plasticity silt layers (0.1 to 0.2-feet thick), slightly cohesive. (ALLUVIUM)	0	50-55	45-50
	0.9	0	None				[Patterned]				
	0.7	0	None				[Patterned]	35			
	0.5	0	None				[Patterned]	40			
	0.5	0	None			[Patterned]	37.7 to 40.0 feet: SILTY SAND (SM) , dark olive gray, loose, very wet, fine sand, poorly graded. (ALLUVIUM)	0	70-80	20-30	

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-9-92
LOCATION	Portland, Oregon	PAGE	3 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.0 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	95.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	3/1/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009308
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102842

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %		
CB	0.7	0	None	4.6/10	45	45	45	40.0 to 46.3 feet: SILT WITH SAND (ML) , dark grayish brown, very soft, very wet, low plasticity, fine sand, interspersed interbedded thin sand layers. (ALLUVIUM)	0	10	90		
	0.7	0	None										
	0.3	0	None										
	0.4	0	None										
CB	1.3	0	None	9/10	55	55	55	46.3 to 50.0 feet: SILTY SAND (SM) , dark brownish gray, medium dense, wet, cohesive, fine sand, low plasticity silt. (ALLUVIUM)	0	60	40		
	0.9	0	None										
	1.1	0	None										
	0.6	0	None										
CB	1.3	0	None	9/10	60	60	60	50.0 to 57.7 feet: SAND (SP) , dark brownish gray, very loose, very wet, poorly graded fine to medium grained sand, <5 percent fines, slight "dirty gym sock/onion" odor. (ALLUVIUM)	0	95-100	0-5		
	0.6	0	None										
								57.7 to 64.0 feet: SILTY SAND (SM) , dark grayish brown, medium dense, wet, fine sand. (ALLUVIUM)	0	80	20		

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-9-92
LOCATION	Portland, Oregon	PAGE	4 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.0 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	95.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	3/1/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009308
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102842

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	NA	NA	None	2.3/10	65	70	75	57.7 to 64.0 feet: SILTY SAND (SM) , (ALLUVIUM), continued. (@ 60.0 to 67.7 feet: no recovery.)	0	80	20
	NA	NA	None					64.0 to 70.0 feet: SAND (SW) , dark brownish gray, loose, wet, well graded, fine to coarse, coarse sand occurs in thin intermittent layers, majority of sand is fine grained, occasional silt blebs. (ALLUVIUM)	0	95-100	0-5
	NA	NA	None								
	1.2	5	None								
CB	1.3	3	None	5.5/10	75	80	85	70.0 to 95.0 feet: SAND (SP) , dark gray, loose, wet, poorly graded, medium grained, homogenous, variegated grain colors (black, gray, white, clear, red, brown). (ALLUVIUM) @ 70.0 to 71.5 feet: trace fines.	0	95-100	0-5
	0.2	2	None								
	0.2	1	None								
	0.2	0	None								

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-9-92
LOCATION	Portland, Oregon	PAGE	5 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.0 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	95.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	3/1/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009308
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102842

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	NA	NA	None	3.8/10	85			0 to 95.0 feet: SAND (SP), (ALLUVIUM), continued. (@ 80.0 to 86.2 feet: no recovery.)	0	95-100	0-5
	NA	NA	None								
	0.3	3	None								
	0.7	42	None								
CB	0.3	13	None	5/5	90			@ 89.5 to 90.0 feet: medium dense, grayish brown compacted silty sand layer.			
	0.3	5	None								
					95			Total depth of boring at 95.0 feet.			
					100			WELL COMPLETION DETAILS 0 to 72.6 feet: 8-inch-diameter, flush-threaded, Schedule 40 carbon steel blank riser pipe. 72.6 to 92.6 feet: 8-inch-diameter, flush-threaded, Schedule 40 stainless steel continuous wire-wrapped screen with 0.035-inchs slots. 92.6 to 94.6 feet: 8-inch-diameter stainless			

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	NW Natural Gasco Site	BORING NO.	PW-9-92
LOCATION	Portland, Oregon	PAGE	6 of 6
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	33.0 ft msl
DRILL METHOD	Rotosonic - Speedstar 15K	TOTAL DEPTH	95.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	3/1/10
SAMPLING METHOD	4-in. by 10-ft. core barrel (CB)	PERMIT/STARTCARD NO.	1009308
BOREHOLE DIAMETER	12-inches	WATER RESOURCES WELL ID	L102842

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					105			steel sump.			
					110			0 to 1.0 foot: Concrete.			
					115			1.0 to 68.3 feet: Bentonite grout with 10 percent organclay by volume.			
					120			68.3 to 70.8 feet: 20-40 Colorado silica sand.			
								70.8 to 94.6 feet: 10-20 Colorado silica sand.			
								94.6 to 95.0 feet: Native.			

REMARKS



LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ1-50
LOCATION	Portland, Oregon	PAGE	1 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.2 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	50.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/23/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008694
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99079

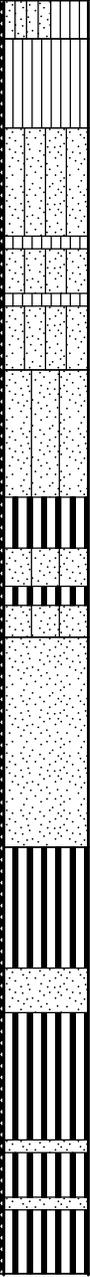
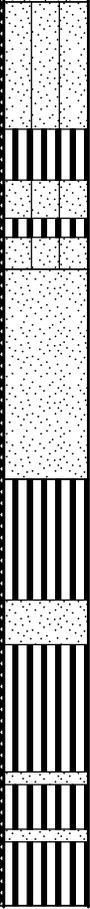
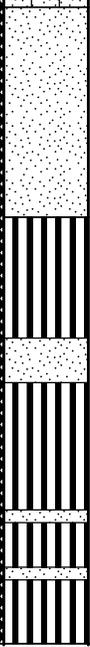
SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.2	0	No	5/5	5			0 to 1.0 foot: SANDY GRAVEL (GW) , dark reddish-brown, very loose, moist, fine to cobble sized, medium graded, angular to rounded gravel, medium sand. (FILL)	60	40	0
	0.2	0	No	1.0 to 2.8 feet: SAND (SP) , dark reddish brown, loose, moist at 1.0 to 2.0 feet, wet at 2.0 feet, medium graded, poorly graded, no sheen. (FILL)				0	100	0	
CB	0.2	1	Yes ¹	1.5/1.5			2.8 to 6.5 feet: SAND (SP) , dark brownish red, loose, wet, poorly graded, fine to medium graded, no sheen. (FILL) @ 3.1 to 3.2 feet: 0.1 foot silt layer. @ 4.5 feet: 0.1 foot silt layer, no sheen.	0	95-100	0-5	
CB	0.5	0	Yes ¹	2.7/3.5			6.5 to 12.9 feet: SILTY SAND (SM) , dark gray, soft, wet, slight hydrocarbon-like odor, no sheen. (ALLUVIUM)	0	50-55	45-50	
CB	0.2	0	No	5/5	10			@ 10.6 feet: increased sand content.	0	70	30
	0.6	0	No	@ 12.3 feet: 0.1 foot sandy silt layer.				0	20	80	
	0.5	0	No	5/5	15			12.9 to 13.4 feet: SANDY SILT (MH) , medium plasticity, grayish-brown, soft, moist. (ALLUVIUM)	0	30	70
	0.6	0	No	13.4 to 17.3 feet: SANDY SILT (ML/SM) , dark gray, soft, wet, low plasticity, no sheen, numerous intermittent interbedded thin silty sand layers. (ALLUVIUM)				0	60-70	30-40	
					20			17.3 to 20.6 feet: SILTY SAND (SM/ML) , dark gray, soft, wet, with sandy silt interbeds, no sheen. (ALLUVIUM)	0	60-70	30-40

REMARKS

¹ Mildly fluorescent in silt nodules.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ1-50
LOCATION	Portland, Oregon	PAGE	2 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.2 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	50.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/23/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008694
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99079

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.4	0	No	5/5	25			17.3 to 20.6 feet: SILTY SAND (SM/ML) , continued.	0	20	80
	0.5	0	No	5/5				20.6 to 22.0 feet: SANDY SILT (ML) , with silty sand interbeds, dark gray, firm, wet, no sheen. (ALLUVIUM) @ 21.5 to 21.7 feet: sandy silt layer. 22.0 to 25.8 feet: SILTY SAND (SM) , dark gray, firm, wet, no sheen. (ALLUVIUM) @ 23.7 to 23.9 feet: silt layer, fine to medium sand. @ 24.6 to 24.8 feet: silt layer.	0	70	30
CB	0.5	0	No	5/5	30			25.8 to 30.0 feet: SAND WITH SILT (SP-SM) , dark gray, loose, wet, fine to medium sand, no sheen, poorly graded. (ALLUVIUM) @ 27.8 to 28.6 feet: silt layer, high plasticity.	0	80-90	10-20
	0.3	0	No	3.3/5				30.0 to 33.3 feet: SAND (SP) , dark gray, very loose, wet, soupy, poorly graded, no sheen, <5 percent fines. (ALLUVIUM)	0	95-100	0-5
CB	0.2	0	No	3.3/5	35			33.3 to 40.0 feet: SILT WITH SAND (MH) , dark grayish-brown, highly plastic, no sheen, firm. (ALLUVIUM) @ 35.2 to 35.9 feet: sand layer, poorly graded, fine to medium grained, dark gray.	0	10	90
	0.1	0	No	4.3/5				@ 37.9 to 38.1 feet: sand layer. @ 38.8 to 39.0 feet: sand layer.			

REMARKS

¹ Mildly fluorescent in silt nodules.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ1-50
LOCATION	Portland, Oregon	PAGE	3 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.2 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	50.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/23/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008694
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99079

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.3	0	No	4.6/5				40.0 to 43.7 feet: SAND (SP) , dark gray, loose, wet, poorly graded, fine to medium sand, no sheen, <5 percent fines. (ALLUVIUM) @ 41.5 to 41.9 feet: highly plastic silt layer.	0	95-100	0-5
	0.5	0	No					43.7 to 50.5 feet: SAND (SP) , dark gray, loose, wet, poorly graded, medium grained sand with red, white, brown grains, <5 percent fines. (ALLUVIUM) @ 44.0 to 44.6 feet: highly plastic silt layer.	0	95-100	0-5
CB	0.5	0	No	4.1/5	45			@ 48.1 to 48.2 feet: silt layer. @ 48.4 to 48.5 feet: silt layer.			
	0.7	2	No		50			@ 49.7 to 49.8 feet: silt layer.			
					55			Total depth = 50.5 feet below mudline. WELL COMPLETION DETAILS +27.5 to 45.3 feet: 2-inch-diameter, flush-threaded, Schedule 40 steel blank riser pipe. 45.3 to 50.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots. 50.1 to 50.4 feet: 2-inch-diameter threaded end cap. 0 to 40.4 feet: Bentonite grout. 40.4 to 43.3 feet: 20-40 Colorado Silica Sand. 43.3 to 50.4 feet: 10-20 Colorado Silica Sand. 50.4 to 50.5 feet: Native.			
					60						

REMARKS

¹ Mildly fluorescent in silt nodules.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ2-43
LOCATION	Portland, Oregon	PAGE	1 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	3.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	43.8 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	12/3/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008697
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99082

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					5 10 15 20			See boring log PZ2-77 for lithologic description.			

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ2-43
LOCATION	Portland, Oregon	PAGE	2 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	3.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	43.8 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	12/3/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008697
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99082

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					25						
					30						
					35						
					40						

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ2-43
LOCATION	Portland, Oregon	PAGE	3 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	3.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	43.8 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	12/3/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008697
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99082

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					45	45	45	<p>Total depth = 43.8 feet below mudline.</p> <p>WELL COMPLETION DETAILS</p> <p>+34.2 to 38.5 feet: 2-inch-diameter, flush-threaded, Schedule 40 steel blank riser pipe.</p> <p>38.5 to 43.3 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>43.3 to 43.6 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 33.5 feet: Bentonite grout with 10% organoclay.</p> <p>33.5 to 36.5 feet: 20-40 Colorado Silica Sand.</p> <p>36.5 to 43.6 feet: 10-20 Colorado Silica Sand.</p> <p>43.6 to 43.8 feet: Native.</p>			
					50	50	50				
					55	55	55				
					60	60	60				

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ2-77
LOCATION	Portland, Oregon	PAGE	1 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	3.1 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	80.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	12/2/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008698
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99083

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	1.2	1	No	2/3	5	5	5	<p>0 to 9.1 feet: SILTY SAND WITH WOOD CHIPS (SM), black, loose, wet, poorly graded, fine to medium grained with abundant small wood chips and wood fragments (approximately 75 percent of sample), strong hydrocarbon-like odor, spotty sheen with rainbow iridescence, oily from 0.7 to 3.0 feet, strong hydrocarbon-like odor.</p> <p>@ 5.0 feet: light spotty sheen.</p>	0	80	20
CB	1.4	0	No	2/2							
CB	13.6	0	Yes ²	2/5 ¹							
CB	16.5	7	Yes ²	3/3							
CB	4.1	1	No	5/5							
CB	6.1	1	Yes ²	5/5							
CB	1.1	1	Yes ²								
CB	0.8	0	No	5/5	10	10	<p>9.1 to 11.3 feet: SILT WITH WOOD CHIPS (ML), black, very soft, wet, low plasticity, with abundant small to large wood chips and fragments (approximately 35 to 50 percent of sample), heavy sheen, strong hydrocarbon-like odor, strong hydrogen sulfide-like odor.</p>	0	0	100	
CB	0.5	1	No				<p>11.3 to 14.5 feet: SILT (MH), gray-brown, soft, moist, highly plastic, occasional wood fragments and twig pieces, moderate hydrocarbon-like odor, moderate hydrogen sulfide-like odor, trace sand, no noticeable sheen. (ALLUVIUM)</p>	0	0-5	95-100	
CB	0.5	1	No	5/5	15	15	15	<p>14.5 to 21.9 feet: SAND (SP), dark gray, loose, wet, poorly graded, fine to medium sand, moderate hydrocarbon-like odor, moderate hydrogen sulfide-like odor. (ALLUVIUM)</p>	0	100	0
CB								<p>@ 17.5 to 17.6 feet: silt layer.</p>			

REMARKS

¹ Wood chips plugged catcher in shoe. ² Yellow fluorescence consistent with wood chips.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ2-77
LOCATION	Portland, Oregon	PAGE	2 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	3.1 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	80.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	12/2/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008698
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99083

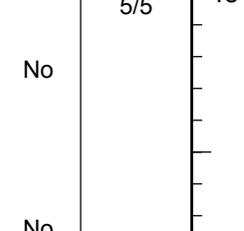
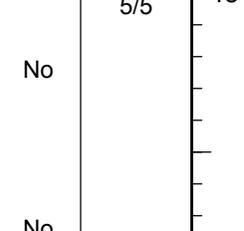
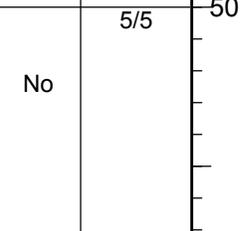
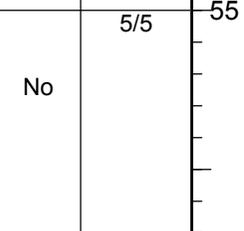
SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.4	0	No	5/5				14.5 to 21.9 feet: SAND (SP) , continued.	0	100	0
	0.5	0	No					21.9 to 23.5 feet: SILT (MH) , dark gray-brown, soft, moist, high plasticity, trace organic debris, no sheen. (ALLUVIUM)	0	0	100
								23.5 to 33.5 feet: SAND (SP) , dark gray, loose, wet, poorly graded, fine to medium grained, slight hydrocarbon-like odor, no sheen. (ALLUVIUM)	0	100	0
CB	1.0	0	No	5/5	25						
	0.9	0	No								
CB	1.0	2	No	5/5	30						
	0.4	0	No					33.5 to 35.0 feet: SANDY SILT (ML) , dark gray-brown, wet, fine to medium sand, low plasticity, no sheen. (ALLUVIUM)	0	20	80
CB	0.9	5	No	5/5	35						
	0.6	3	No					35.0 to 40.7 feet: SAND (SP) , dark gray, loose, wet, poorly graded, medium grained, variegated grain colors (red, brown, gray, black, white, tan), <5 percent fines, no sheen. (ALLUVIUM)	0	95-100	0-5
					40			@ 39.8 feet: silt blebs.			

REMARKS

¹ Wood chips plugged catcher in shoe. ² Yellow fluorescence consistent with wood chips.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ2-77
LOCATION	Portland, Oregon	PAGE	3 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	3.1 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	80.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	12/2/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008698
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99083

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.5	3	No	5/5	45			35.0 to 40.7 feet: SAND (SP), continued.			
								40.7 to 41.5 feet: SILT (MH), gray-brown, soft, wet, highly plastic, no sheen. (ALLUVIUM)	0	0	100
								41.5 to 43.5 feet: SAND (SP), dark gray, loose, wet, medium grained, poorly graded, no sheen. (ALLUVIUM)	0	100	0
								43.5 to 44.9 feet: SILT (MH), gray-brown, soft, moist, high plasticity, no sheen. (ALLUVIUM)	0	0	100
CB	0.6	1	No	5/5	45			44.9 to 80.0 feet: SAND (SP), dark gray, loose, wet, poorly graded, medium grained, variegated grain colors, <5 percent fines, no sheen. (ALLUVIUM)	0	95-100	0-5
								@ 47.9 to 48.8 feet: SILT (MH), high plasticity silt layer.	0	0	100
CB	0.3	1	No	5/5	50						
								0.7	2	No	
CB	0.5	1	No	5/5	55			@ 55.0 to 80.0 feet: slight "dirty gym sock" odor.			
								0.5	0	No	

REMARKS

¹ Wood chips plugged catcher in shoe. ² Yellow fluorescence consistent with wood chips.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ2-77
LOCATION	Portland, Oregon	PAGE	4 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	3.1 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	80.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	12/2/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008698
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99083

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.4	2	No	5/5				44.9 to 80.0 feet: SAND (SP), continued.	0	95-100	0-5
CB	0.6	9	No	5/5	65			@ 68.0 feet: trace silt blebs.			
CB	0.5	6	No	5/5							
CB	0.5	8	No	5/5	70			@ 74.5 to 75.0 feet: dark gray-brown silty sand layer.			
CB	0.5	5	No	5/5							
CB	0.5	4	No	5/5	75						
CB	0.5	7	No	5/5							
CB	0.5	5	No	5/5	80						

REMARKS

¹ Wood chips plugged catcher in shoe. ² Yellow fluorescence consistent with wood chips.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ2-77
LOCATION	Portland, Oregon	PAGE	5 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	3.1 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	80.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	12/2/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008698
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99083

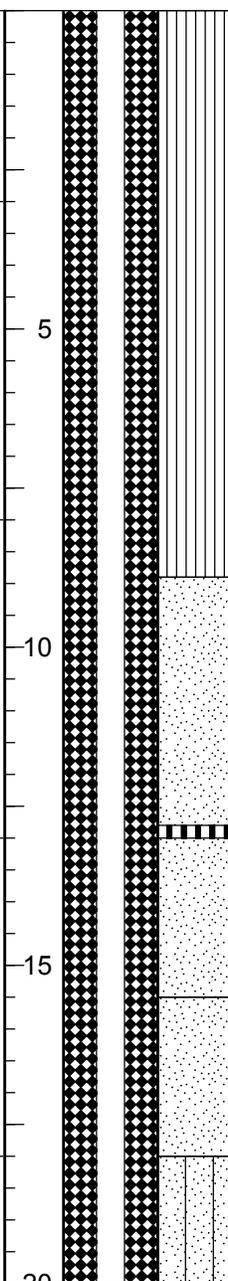
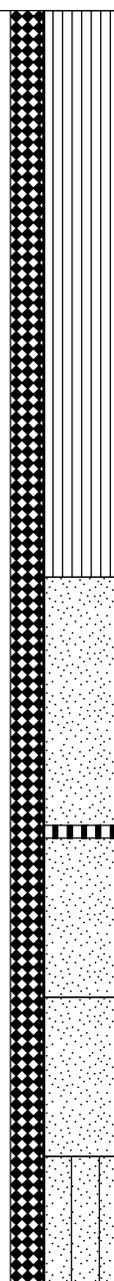
SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					85			Total depth = 80.0 feet below mudline. WELL COMPLETION DETAILS +35.6 to 72.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 steel blank riser pipe. 72.1 to 76.9 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots. 76.9 to 77.2 feet: 2-inch-diameter threaded end cap. 0 to 66.8 feet: Bentonite grout (with 10% organoclay from 0 to 30.0 feet). 66.8 to 69.8 feet: 20-40 Colorado Silica Sand. 69.8 to 77.2 feet: 10-20 Colorado Silica Sand. 77.2 to 80.0 feet: Native.			
					90						
					95						
					100						

REMARKS

¹ Wood chips plugged catcher in shoe. ² Yellow fluorescence consistent with wood chips.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ3-33
LOCATION	Portland, Oregon	PAGE	1 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	-15.5 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	36.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/25/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008696
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99081

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %		
CB	7.7	0	Yes ¹	2.7/3				0 to 8.9 feet: SILT (ML) , dark grayish-brown with black staining, very soft, wet, low plasticity, abundant rootlets, strong hydrocarbon-like odor (naphthalene), strong sheen with rainbow iridescence. (ALLUVIUM) @ 1.0 to 1.5 feet: black sticky oil like substance. Much anthropogenic material: wood fragments, a magnet, cardboard. @ 4.0 to 4.1 feet: heavy sheen and oil. @ 4.1 to 8.9 feet: no sheen. @ 7.0 to 7.1 feet: coarse sand layer. @ 7.5 feet: cardboard fragments, twigs.	0	0-5	95-100		
CB	5.3	0	Yes ¹	5/5									
CB	4.9	0	Yes ¹	5/5									
CB	2.0	0	Yes ²	5/5									
CB	1.5	0	No	5/5									
CB	1.4	0	Yes ²	5/5									
CB	0.6	0	No	4/5									
CB	0.7	1	No	4/5									
								8.9 to 15.5 feet: SAND (SP) , very dark gray, loose, wet, poorly graded, fine to medium grained, occasional silt blebs, trace spotty sheen. (ALLUVIUM) @ 12.8 to 13.0 feet: SILT layer, medium plasticity. 15.5 to 18.0 feet: SAND (SP) , very dark gray, loose, wet, poorly graded, medium grained, occasional silt blebs, no sheen. (ALLUVIUM) 18.0 to 23.8 feet: SAND WITH SILT (SP-SM) , dark grayish-brown, very loose, wet, soupy, occasional silt blebs, poorly graded fine sand, no sheen. (ALLUVIUM)	0	95-100	0-5		

REMARKS

¹ Specks of green, orange, and yellow fluorescence. ² Trace fluorescence.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ3-33
LOCATION	Portland, Oregon	PAGE	2 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	-15.5 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	36.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/25/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008696
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99081

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.6	0	No	4/5				18.0 to 23.8 feet: SAND WITH SILT (SP-SM) , continued.	0	85-90	10-15
CB	0.5	0	No	5/5				@ 23.5 to 23.7 feet: sandy silt layer.	0	20	80
	0.6	1	No		25			23.8 to 24.8 feet: SANDY SILT (MH) , grayish brown, soft, wet, medium plasticity silt, fine sand, no sheen. (ALLUVIUM)	0	100	0
CB	0.8	3	Yes ²	5/5				24.8 to 32.4 feet: SAND (SP) , very dark gray, loose, wet, poorly graded, medium grained, variegated grain colors from gray, white, black, red, and tan, no sheen. (ALLUVIUM)			
	0.6	1	No		30						
CB				3/3				32.4 to 33.4 feet: SANDY SILT (MH) , dark grayish-brown, soft, wet, highly plastic, no sheen, medium sand. (ALLUVIUM)	0	20	80
	0.6	2	No		35			33.4 to 36.0 feet: SAND (SP) , dark grayish brown, loose, wet, poorly graded, fine to medium sand, no sheen. (ALLUVIUM)	0	95-100	0-5
								@ 34.1 to 34.3 feet: silt layer.			
								@ 34.6 to 35.0 feet: silt layer.			
								Total depth = 36.0 feet below mudline.			
					40			See Page 3 for Well Completion Details.			

REMARKS

¹ Specks of green, orange, and yellow fluorescence. ² Trace fluorescence.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ3-33
LOCATION	Portland, Oregon	PAGE	3 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	-15.5 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	36.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/25/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008696
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99081

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					45			<p>WELL COMPLETION DETAILS</p> <p>+42.5 to 27.7 feet: 2-inch-diameter, flush-threaded, Schedule 40 steel blank riser pipe.</p> <p>27.7 to 32.5 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>32.5 to 32.8 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 23.5 feet: Bentonite grout.</p> <p>23.5 to 25.5 feet: 20-40 Colorado Silica Sand.</p> <p>25.5 to 32.8 feet: 10-20 Colorado Silica Sand.</p> <p>32.8 to 36.0 feet: Native.</p>			
					50						
					55						
					60						

REMARKS

¹ Specks of green, orange, and yellow fluorescence. ² Trace fluorescence.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ4-12
LOCATION	Portland, Oregon	PAGE	2 of 2
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	-8.6 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	16.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	12/4/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008699
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99084

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					25			<p>WELL COMPLETION DETAILS</p> <p>+43.3 to 6.9 feet: 2-inch-diameter, flush-threaded, Schedule 40 steel blank riser pipe.</p> <p>6.9 to 11.7 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>11.7 to 12.0 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 4.7 feet: Bentonite chips.</p> <p>4.7 to 13.0 feet: 10-20 Colorado Silica Sand.</p> <p>13.0 to 16.5 feet: Bentonite chips.</p>			
					30						
					35						
					40						

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ4-41
LOCATION	Portland, Oregon	PAGE	1 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	-8.3 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	42.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/24/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008695
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99080

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	1.1	0	Yes ¹	4/5	5			0 to 13.6 feet: SILT (ML) , grayish brown to dark gray, very soft, wet, low plasticity, trace sand and gravel (<5 percent), spotty sheen, slight hydrocarbon-like odor. (ALLUVIUM)	0-5	0-5	95-100
	1.0	0		@ 1.1 to 1.3 feet: black, tarry-like interval.							
	1.3	0	Yes ²	@ 3.5 to 3.6 feet: slightly tarry, trace rootlets.							
CB	0.5	0	Yes ²	5/5	10			@ 5.6 to 5.8 feet: black laminations.	0	100	0
	0.2	0	Yes ²	@ 6.6 to 6.8 feet: sand layer with spotty sheen.							
	0.4	0	Yes ²	@ 8.0 to 8.1 feet: sand layer, spotty sheen.							
CB				5/5	15			@ 8.9 to 9.4 feet: sand layer, spotty sheen (in PZ4-12 1.3 feet layer of sand).	0	0	100
	0.4	0	Yes ³	@ 11.4 to 11.5 feet: sand layer.							
CB	0.6	0	Yes ³	4.5/5	20			13.6 to 14.7 feet: SAND (SP) , dark gray, loose, wet, poorly graded, fine to medium grained, no sheen, gray, brown, white and red sand grains. (ALLUVIUM)	0	95-100	0-5
				14.7 to 16.6 feet: SILT (ML) , grayish-brown, soft, moist, low plasticity. (ALLUVIUM)							
	0.4	0	No	@ 15.8 feet: thin sand parting (<1 cm).							
								16.6 to 25.0 feet: SAND (SP) , dark gray, loose, wet, poorly graded, fine to medium grained with silt blebs. (ALLUVIUM)			
								@ 17.2 to 17.3 feet: silt layer.			

REMARKS

¹ Green, yellow, and orange fluorescent specks and droplets. ² Heavy green, yellow, and orange fluorescent droplets. ³ Trace fluorescent droplets. ² Trace fluorescent sheen.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ4-41
LOCATION	Portland, Oregon	PAGE	2 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	-8.3 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	42.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/24/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008695
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99080

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.3	0	No	4.5/5				16.6 to 25.0 feet: SAND (SP), continued. @ 20.8 feet: brown, hard, silt blebs. @ 21.3 feet: brown, hard, silt blebs. @ 22.2 to 22.5 feet: silt layer. @ 23.0 feet: increased silt content, sand with silt.	0	95-100	0-5
CB	0.6	0	No	4.9/5	25			25.0 to 33.5 feet: SAND (SP), very dark gray, loose, wet, poorly graded, medium grained, gray, black, white, brown and red grains, occasional silt blebs, no sheen. (ALLUVIUM)	0	95-100	0-5
CB	0.4	0	No	5/5	30						
	0.5	2	No					33.5 to 35.0 feet: INTERBEDDED SANDY SILT AND SILTY SAND (SM/ML), dark grayish-brown and dark gray, soft, wet, interbeds are approximately 1- to 2-inches thick, medium plasticity silt, fine to medium grained sand, no sheen. (ALLUVIUM)	0	60	40
CB	0.8	1	No	5/5	35			35.0 to 42.0 feet: SAND (SP), very dark gray, loose, wet, poorly graded, medium grained, gray, black, white, brown sand grains, no sheen, occasional silt blebs. (ALLUVIUM)	0	95-100	0-5
	0.4	1	No								
					40						

REMARKS

¹ Green, yellow, and orange fluorescent specks and droplets. ² Heavy green, yellow, and orange fluorescent droplets. ³ Trace fluorescent droplets. ² Trace fluorescent sheen.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ4-41
LOCATION	Portland, Oregon	PAGE	3 of 3
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	-8.3 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	42.0 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/24/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008695
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99080

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.2	0	Yes ⁴	2/2			<p>35.0 to 42.0 feet: SAND (SP), continued.</p>	0	95-100	0-5	
<p>Total depth = 42.0 feet below mudline.</p> <p>WELL COMPLETION DETAILS</p> <p>+41.4 to 36.3 feet: 2-inch-diameter, flush-threaded, Schedule 40 steel blank riser pipe.</p> <p>36.3 to 41.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>41.1 to 41.4 feet: 2-inch-diameter threaded end cap.</p> <p>0 to 32.3 feet: Bentonite grout.</p> <p>32.3 to 34.3 feet: 20-40 Colorado Silica Sand.</p> <p>34.3 to 41.4 feet: 10-20 Colorado Silica Sand.</p> <p>41.4 to 42.0 feet: Native.</p>											

REMARKS

¹ Green, yellow, and orange fluorescent specks and droplets. ² Heavy green, yellow, and orange fluorescent droplets. ³ Trace fluorescent droplets. ⁴ Trace fluorescent sheen.

LOG OF EXPLORATORY BORING

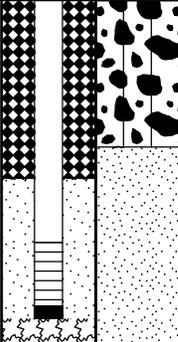
PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-20
LOCATION	Portland, Oregon	PAGE	2 of 2
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	20.3 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/20/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008692
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99034

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					25			Total depth = 20.3 feet. WELL COMPLETION DETAILS +5.5 to 15.2 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe. 15.2 to 20.0 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots. 20.0 to 20.3 feet: 2-inch-diameter threaded end cap. +0.3 to 1.0 foot: Cement. 1.0 to 12.9 feet: Bentonite chips. 12.9 to 20.3 feet: 10-20 Colorado Silica Sand.			
					30						
					35						
					40						

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-5
LOCATION	Portland, Oregon	PAGE	1 of 1
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.7 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	5.4 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/20/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008693
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99035

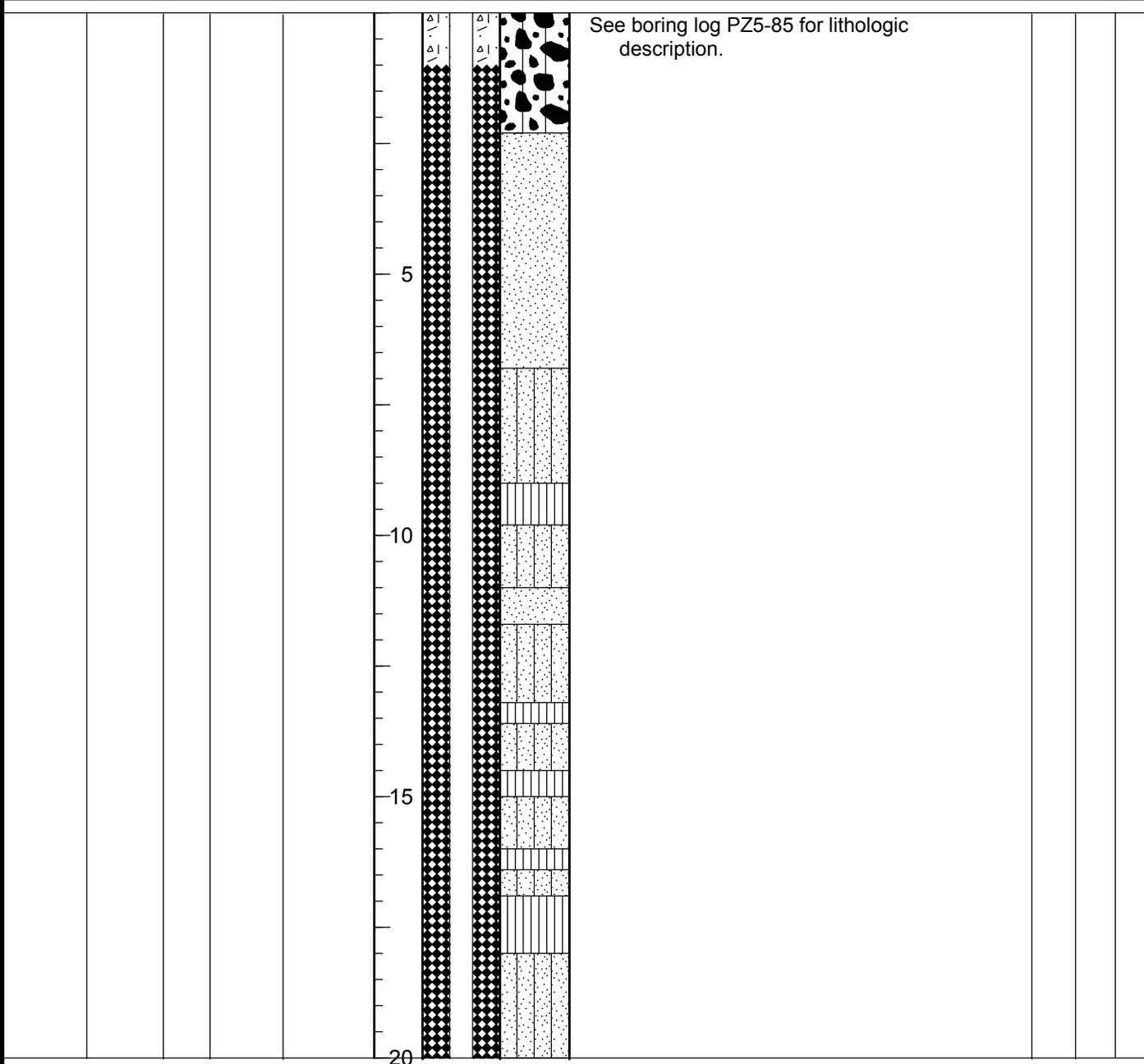
SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					5		<p>See boring log PZ5-85 for lithologic description.</p>				
					10		<p>Total depth = 5.4 feet.</p> <p>WELL COMPLETION DETAILS</p> <p>+5.5 to 3.8 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.</p> <p>3.8 to 4.8 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>4.8 to 5.0 feet: 2-inch-diameter threaded end cap.</p> <p>+0.5 to 0 feet: Concrete.</p> <p>0 to 2.8 feet: Bentonite chips.</p> <p>2.8 to 5.0 feet: 10-20 Colorado Silica Sand.</p> <p>5.0 to 5.4 feet: Native.</p>				
					15						
					20						

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-55
LOCATION	Portland, Oregon	PAGE	1 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	55.3 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/20/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008691
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99033

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
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REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-55
LOCATION	Portland, Oregon	PAGE	2 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	55.3 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/20/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008691
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99033

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					25	30	35				
					40						

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-55
LOCATION	Portland, Oregon	PAGE	3 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	55.3 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/20/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008691
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99033

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					45		50				
					55			Total depth = 55.3 feet.			
					60			See Page 4 for Well Completion Details.			

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-55
LOCATION	Portland, Oregon	PAGE	4 of 4
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	55.3 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/20/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008691
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99033

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
					65			<p>WELL COMPLETION DETAILS</p> <p>+5.5 to 50.2 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.</p> <p>50.2 to 55.0 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>55.0 to 55.3 feet: 2-inch-diameter threaded end cap.</p> <p>+0.3 to 1.0 foot: Concrete.</p> <p>1.0 to 6.0 feet: Bentonite chips.</p> <p>6.0 to 45.2 feet: Bentonite grout.</p> <p>45.2 to 48.0 feet: 100 Colorado Silica Sand.</p> <p>48.0 to 55.3 feet: 10-20 Colorado Silica Sand.</p>			
					70						
					75						
					80						

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-85
LOCATION	Portland, Oregon	PAGE	1 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	85.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/18/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008690
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99032

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.0	NA	No	1/1			0 to 2.3 feet: SANDY GRAVEL WITH SILT (GW-GM) , dark brown and dark gray, moist, loose, fine to coarse angular gravel, fine to medium sand, well graded. (FILL)	60	30	10	
CB	0.1	NA	No	1/4			@ 2.0 feet: wet, no sheen.				
	0.6	NA	No				2.3 to 6.8 feet: SAND (SP) , dark gray, loose, wet, poorly graded, light hydrocarbon-like odor. (FILL)	0	100	0	
							@ 4.0 feet: large chunks of wood and wood debris.	0	100	0	
CB				1/1	5						
CB	0.5	NA	No	4/4			@ 6.2 feet: light sheen observed.				
	0.3	NA	No				6.8 to 20.0 feet: INTERBEDDED SILTY SAND AND SANDY SILT (SM/ML) , dark gray, loose, wet, fine sand, poorly graded, sand mixed with two separate fractions (interbedded). (ALLUVIUM)	0	50-60	40-50	
	0.1	NA	No				@ 7.5 feet: light sheen (spotty), light hydrocarbon-like odor.				
CB				5/5	10						
	0.2	NA	No				@ 11.0 to 11.7 feet: poorly graded, fine to medium sand layer.				
							@ 13.2 to 13.6 feet: sandy silt layer.	0	20	80	
							@ 14.5 to 15.0 feet: sandy silt, trace rootlets and organic debris.	0	20	80	
CB	0.0	NA	No	5/5	15						
	0.6	NA	No				@ 16.0 to 16.4 feet: sandy silt layer.	0	20	80	
							@ 16.9 to 18.0 feet: sandy silt layer.				
							@ 18.0 feet: increased sand content.	0	80	20	

REMARKS

NA = Not Analyzed.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-85
LOCATION	Portland, Oregon	PAGE	2 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	85.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/18/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008690
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99032

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	NA	NA	NA	3.8/5				20.0 to 25.0 feet: SANDY SILT (ML) , dark gray, wet, very soft, low plasticity silt, fine sand, trace wood pieces, trace gravel (<5 percent), no sheen. (ALLUVIUM)	0-5	20	80
	0.1	NA	No								
	0.1	NA	No								
CB				5/5	25			25.0 to 31.4 feet: SILTY SAND (SM) , dark gray, very loose, wet, soupy, fine sand, low plasticity silt. (ALLUVIUM) @ 25.0 to 31.4 feet: no sheen.	0	55	45
	0.1	NA	No								
CB	0.0	NA	No	5/5	30			@ 30.0 to 31.4 feet: alternating layers of medium plasticity silt and medium grained sand.			
	0.1	NA	No					31.4 to 32.6 feet: SAND (SP) , dark gray, poorly graded, wet, loose, medium grained, >5 percent fines, no sheen. (ALLUVIUM)	0	95-100	0-5
	0.2	NA	No					32.6 to 35.2 feet: SANDY SILT (ML) , dark gray, very soft, wet, low plasticity, no sheen. (ALLUVIUM)	0	20	80
CB				5/5	35			35.2 to 37.0 feet: SAND (SP) , dark gray, loose, wet, poorly graded, fine to medium grained, no sheen. (ALLUVIUM)	0	95	5
	0.0	NA	No					37.0 to 40.8 feet: SILTY SAND (SM) , dark gray, very soft, wet, fine to medium grained sand, no sheen. (ALLUVIUM) @ 38.2 to 38.7 feet: medium plasticity sandy silt layer, no sheen.	0	60	40
					40						

REMARKS

NA = Not Analyzed.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-85
LOCATION	Portland, Oregon	PAGE	3 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	85.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/18/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008690
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99032

SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.1	NA	No	5/5	45			37.0 to 40.8 feet: SILTY SAND (SM) , continued.	0	60	40
								40.8 to 41.5 feet: SILT (MH) , dark gray, highly plastic, soft, wet, no sheen. (ALLUVIUM)	0	0	100
CB	0.3	NA	No	5/5	45			41.5 to 43.8 feet: SILTY SAND (SM) , dark gray, loose, wet, intermittent thin silt layers, fine to medium grained sand, no sheen. (ALLUVIUM)	0	70	30
								43.8 to 45.0 feet: SANDY SILT (MH) , dark gray, moist, very stiff, medium plasticity, medium grained sand, no sheen. (ALLUVIUM)	0	30	70
CB	0.2	NA	No	5/5	45			45.0 to 48.1 feet: SAND (SP) , dark gray, loose, wet, poorly graded, <5 percent fines, medium grained, no sheen. (ALLUVIUM)	0	95-100	0-5
								48.1 to 49.0 feet: SAND AND SILT (MH/SP) , dark gray, alternating lenses. (ALLUVIUM)	0	50	50
CB	0.1	NA	No	5/5	50			49.0 to 49.8 feet: SILT WITH SAND (MH) , dark gray, very soft, wet, highly plastic, no sheen. (ALLUVIUM)	0	10	90
								49.8 to 85.5 feet: SAND (SP) , dark gray, loose, wet, poorly graded, medium grained, no sheen. (ALLUVIUM)	0	95-100	0-5
CB	0.1	NA	No	5/5	55			@ 54.0 feet: two coarse-size (2-inches diameter) pieces of gravel.			
CB	0.0	NA	No	5/5	55						
CB	0.1	NA	No	5/5	60						

REMARKS
NA = Not Analyzed.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-85
LOCATION	Portland, Oregon	PAGE	4 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	85.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/18/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008690
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99032

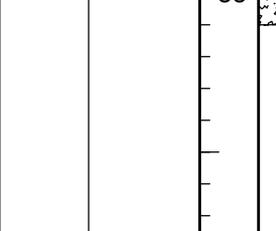
SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUOR-ESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.0	NA	No	5/5				49.8 to 85.5 feet: SAND (SP), continued.	0	95-100	0-5
	0.0	NA	No								
CB	0.1	NA	No	5/5	65						
	0.0	NA	No								
CB	0.0	NA	No	5/5	70			@ 70.0 to 85.5 feet: moderate "dirty gym sock" odor.			
	0.0	NA	No								
CB	0.0	NA	No	5/5	75						
	0.1	NA	No								
					80						

REMARKS

NA = Not Analyzed.

LOG OF EXPLORATORY BORING

PROJECT NAME	Gasco Seg 2 Capture Zone Test	BORING NO.	PZ5-85
LOCATION	Portland, Oregon	PAGE	5 of 5
DRILLED BY	Cascade Drilling, Inc.	GROUND SURFACE ELEVATION	10.8 ft msl
DRILL METHOD	Rotosonic - AMS C-17 Rig	TOTAL DEPTH	85.5 ft.
LOGGED BY	Matt Wilson	DATE COMPLETED	11/18/09
SAMPLING METHOD	5-foot by 4-inch core barrel (CB)	PERMIT/STARTCARD NO.	1008690
BOREHOLE DIAMETER	6-inch	WATER RESOURCES WELL ID	L99032

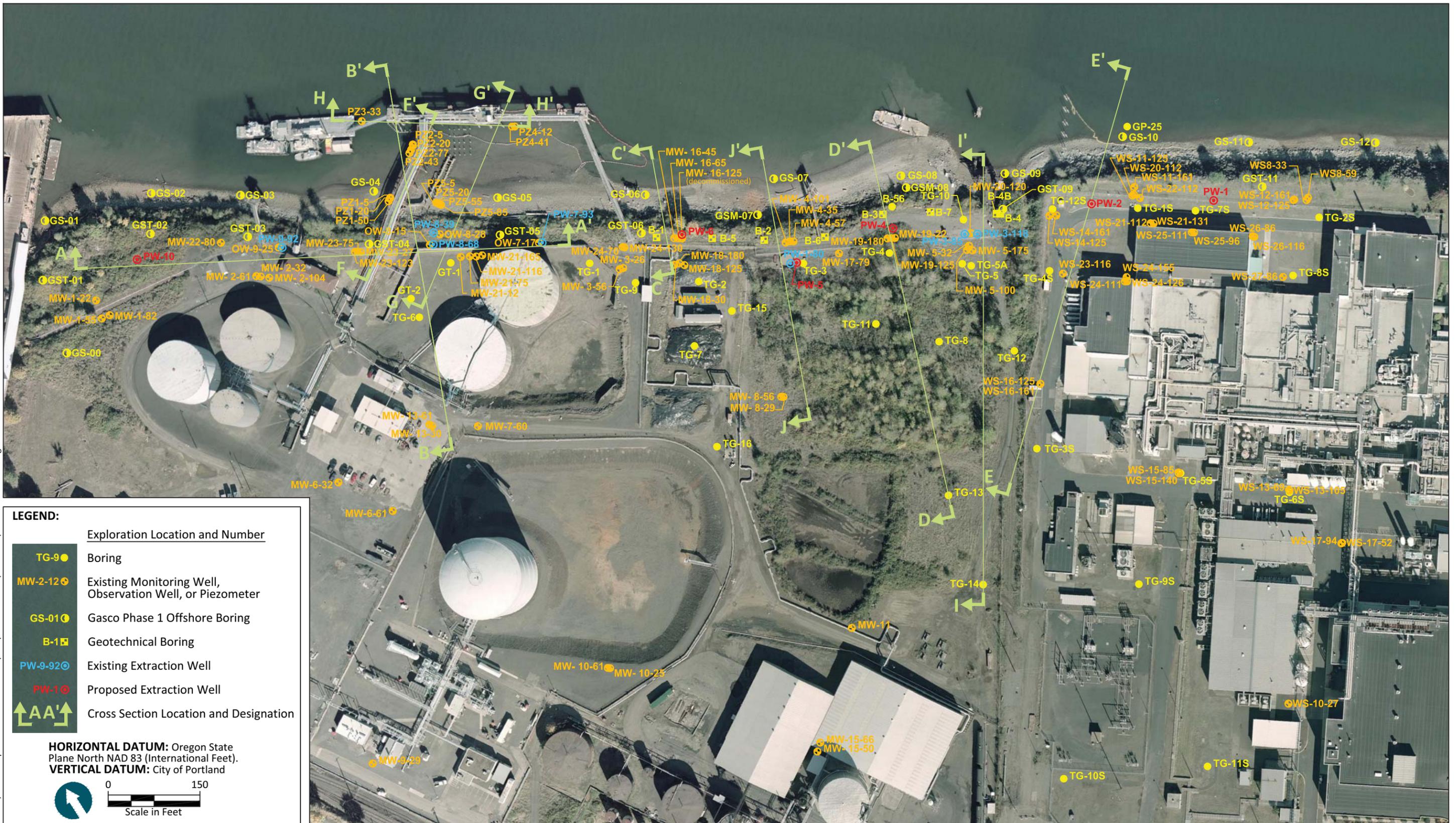
SAMPLING METHOD	VOC HEAD-SPACE (ppm)	HCN (PPM)	ULTRA-VIOLET FLUORESCENCE	RECOVERY (FEET)	DEPTH IN FEET	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION	GRA %	SAND %	SLT %
CB	0.0	NA	No	2/5	85			49.8 to 85.5 feet: SAND (SP), continued.	0	95-100	0-5
	0.0	NA	No							Total depth = 85.5 feet.	
					90			<p>WELL COMPLETION DETAILS</p> <p>+6.0 to 80.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.</p> <p>80.1 to 84.9 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machined slots.</p> <p>84.9 to 85.2 feet: 2-inch-diameter threaded end cap.</p> <p>+0.3 to 1.0 foot: Concrete.</p> <p>1.0 to 16.5 feet: Bentonite chips.</p> <p>16.5 to 75.8 feet: Bentonite grout.</p> <p>75.8 to 80.1 feet: 100 Colorado Silica Sand.</p> <p>80.1 to 85.2 feet: 10-20 Colorado Silica Sand.</p> <p>85.2 to 85.5 feet: Native.</p>			
					95						
					100						

REMARKS

NA = Not Analyzed.

SITE MAP AND CROSS SECTIONS

K:\Jobs\000029-GASCO\00002902\00002902-RP-114.dwg FIG x
Jan 17, 2011 3:47pm cavidson



LEGEND:

Exploration Location and Number	
TG-9 ●	Boring
MW-2-12 ⊕	Existing Monitoring Well, Observation Well, or Piezometer
GS-01 ●	Gasco Phase 1 Offshore Boring
B-1 ⊠	Geotechnical Boring
PW-9-92 ⊕	Existing Extraction Well
PW-1 ⊕	Proposed Extraction Well
AA' ↑	Cross Section Location and Designation

HORIZONTAL DATUM: Oregon State Plane North NAD 83 (International Feet).
VERTICAL DATUM: City of Portland

0 150
Scale in Feet

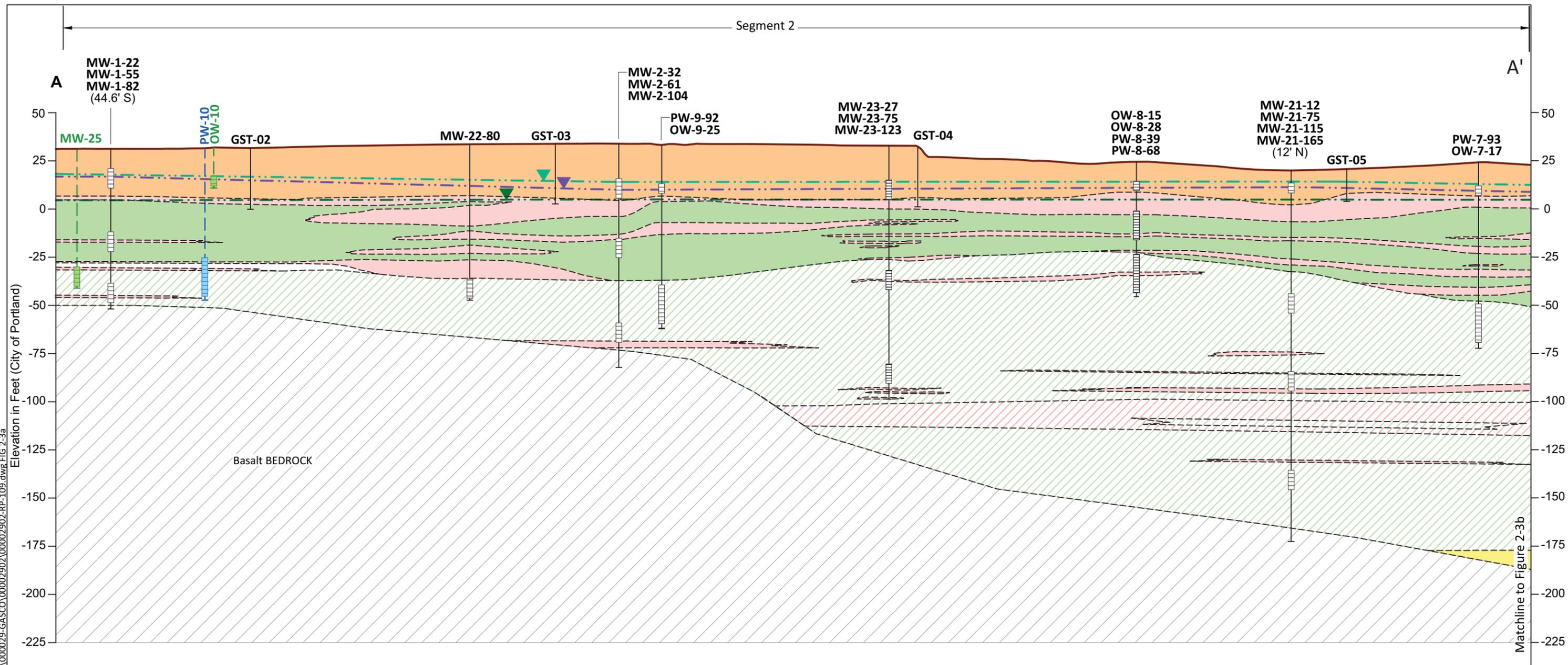
PRIVILEGED AND CONFIDENTIAL



PRELIMINARY RESULTS

CROSS SECTION LOCATION MAP

K:\Jobs\000029-GASCO\00002902\00002902-RP-109.dwg FIG 2-3a
Dec 14, 2010 12:35pm cdavidson

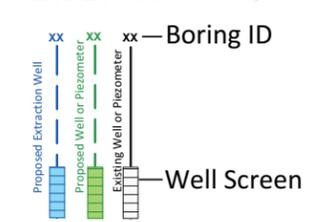


LEGEND:

- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Aquitard; Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily medium grained SAND with generally less than 15% fines.
- Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Basalt BEDROCK
- Fill composed of gravel, silt, sand, metal, brick, and concrete debris

- ▼ Potentiometric Surface of Surficial Fill (measured June 3, 2009)
- ▼ Potentiometric Surface of Surficial Fill (measured August 5, 2009)
- ▼ Potentiometric Surface of Alluvium (measured August 5, 2009)
- Existing Ground Surface

MW-21-116—Boring ID



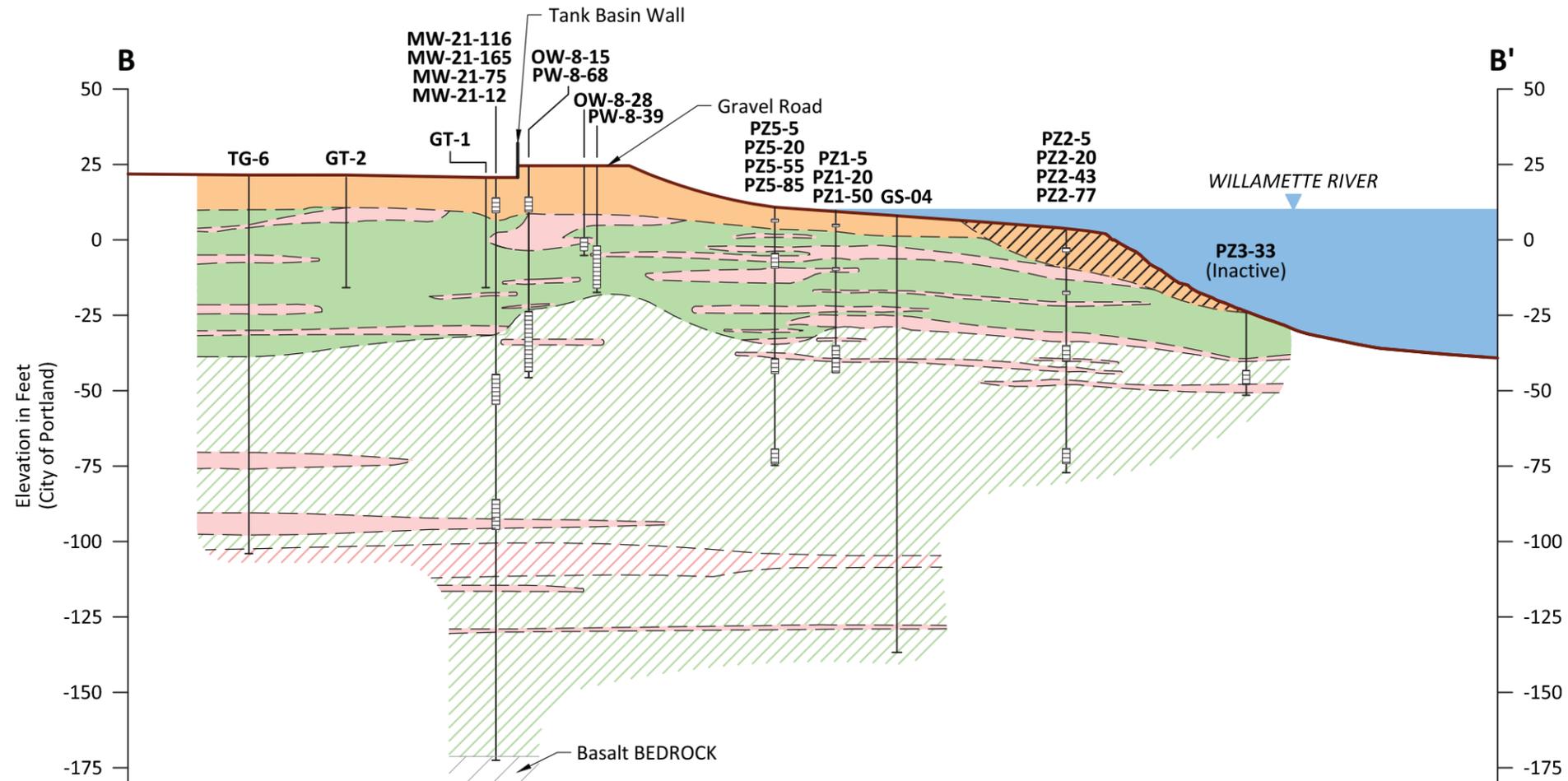
NOTES:
Geologic contacts are inferred between borings.

PRELIMINARY RESULTS

CROSS SECTION A-A'



Dec 22, 2010 10:15am cdaavidson K:\jobs\1000029-GASCO\100002902\100002902-RP-108.dwg FIG 2-4 BB IDR

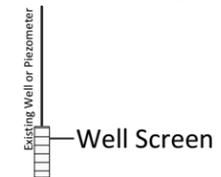


LEGEND:

- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Aquitard; Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily medium grained SAND with generally less than 15% fines.
- Fill composed of gravel, silt, sand, metal, brick, and concrete debris

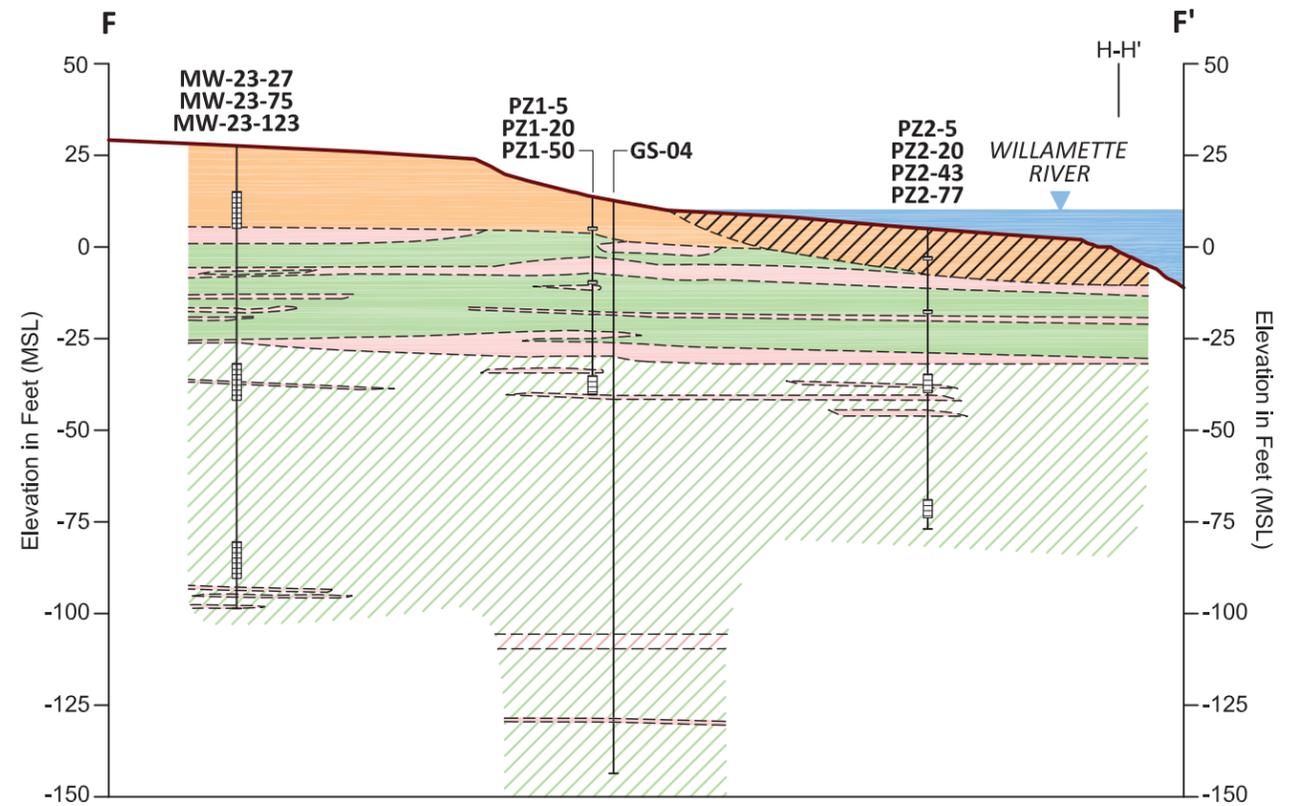
- SAND and SILT mixed with wood chips and anthropogenic material (wood, metal, cardboard)
- Basalt BEDROCK
- Existing Ground Surface
- Approximate Willamette River Elevation

PW-8-37—Boring ID



NOTES:

1. City of Portland vertical datum
2. Geologic contacts are inferred between borings.



LEGEND:

- | | | |
|---|---|-----------------------------------|
| <ul style="list-style-type: none"> Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers Aquitard; Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers Fill composed of gravel, silt, sand, metal, brick, and concrete debris | <ul style="list-style-type: none"> SAND and SILT mixed with wood chips and anthropogenic material (wood, metal, cardboard) Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt Primarily medium grained SAND with generally less than 15% fines. Basalt BEDROCK Existing Ground Surface | <p>MW-23-123—Boring ID</p> |
|---|---|-----------------------------------|



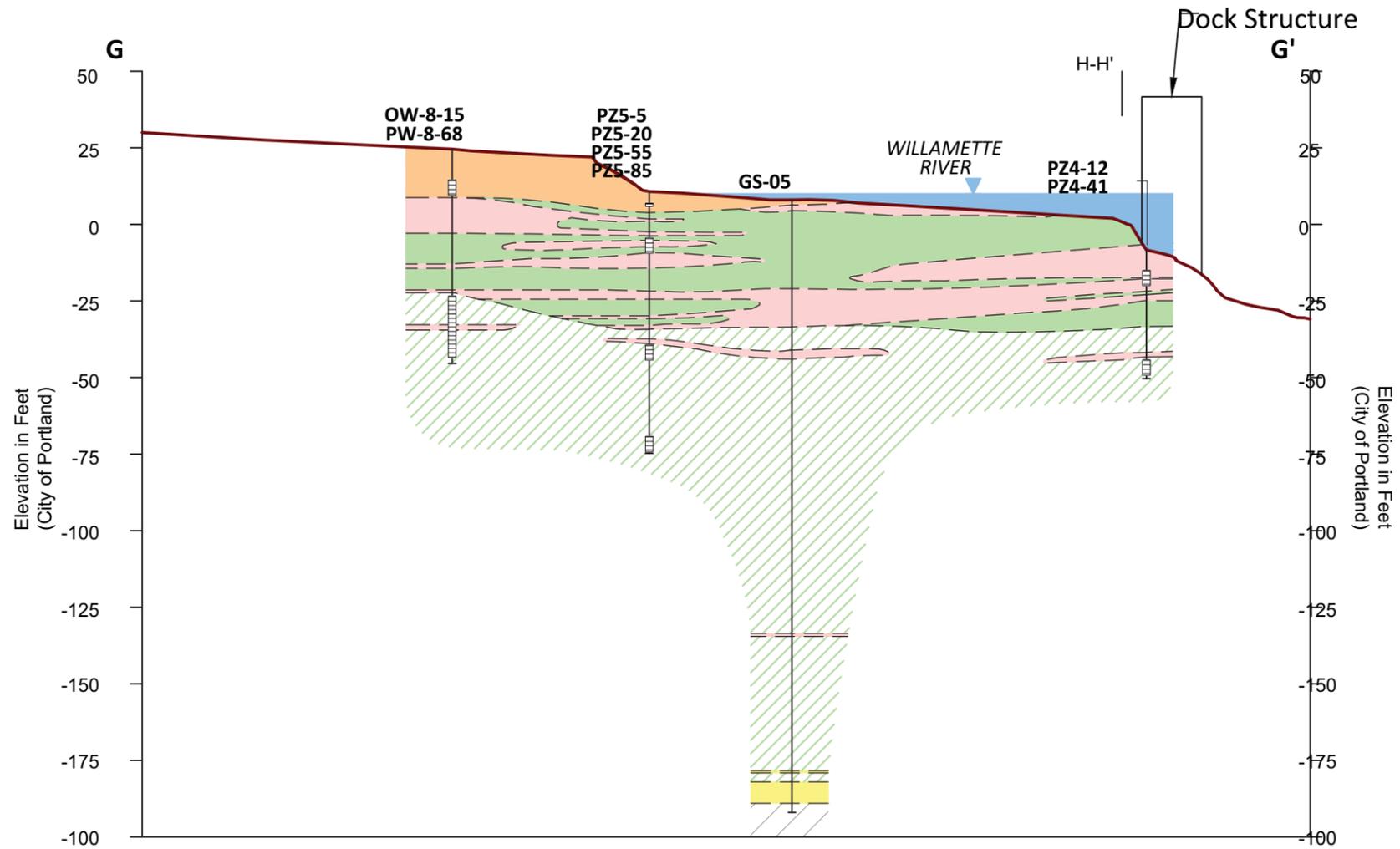
K:\jobs\000029-GASCO\00002902\00002902-RP-086.dwg F-F'

Jun 23, 2010 2:07pm cdavidson

PRELIMINARY RESULTS

CROSS SECTION F-F'





LEGEND:

- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Aquitard; Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Primarily medium grained SAND with generally less than 15% fines.
- Basalt BEDROCK
- Existing Ground Surface
- Boring ID
- Well Screen



K:\Jobs\000029-GASCO\00002902\00002902-RP-086.dwg G-G'

Jan 03, 2011 2:13pm cdavidson

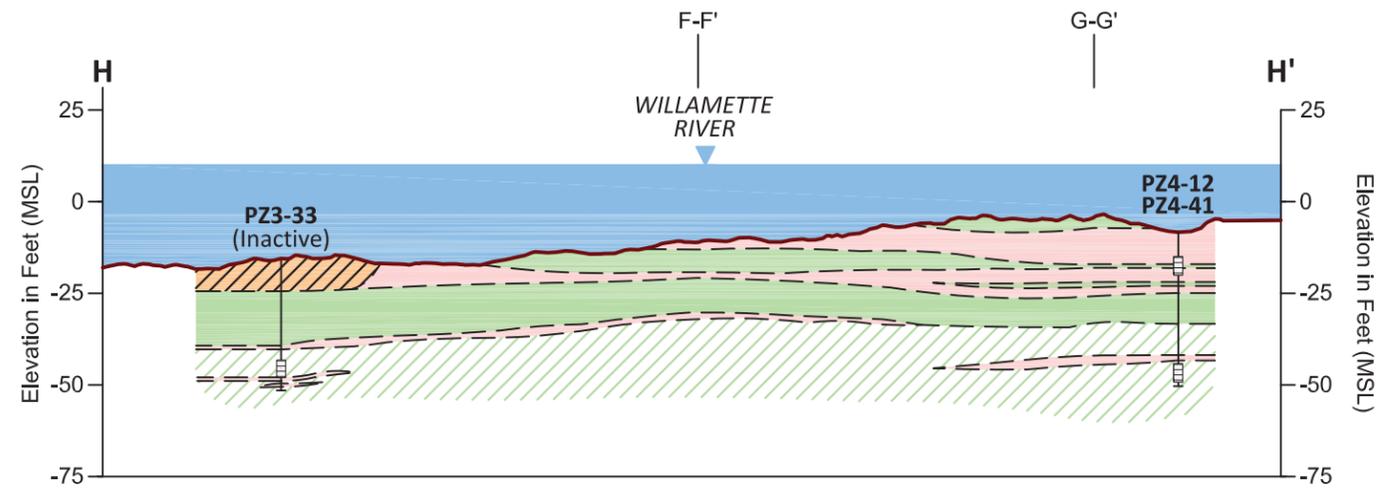
PRIVILEGED AND CONFIDENTIAL



PRELIMINARY RESULTS

CROSS SECTION G-G'

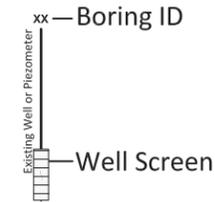
K:\jobs\000029-GASCO\00002902\00002902-RP-V10-086.dwg H-H'



LEGEND:

- | | | | |
|---|---|---|---|
|  | Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers |  | Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt |
|  | Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers |  | Primarily medium grained SAND with generally less than 15% fines. |
|  | Fill composed of gravel, silt, sand, metal, brick, and concrete debris |  | Basalt BEDROCK |
|  | SAND and SILT mixed with wood chips and anthropogenic material (wood, metal, cardboard) |  | Existing Ground Surface |

PZ3-33 — Boring ID



PRELIMINARY RESULTS

CROSS SECTION H-H'



DATA CD
