

Technical Memorandum

TO: Mohsen Kourehdar, PE, Washington State Department of Ecology
FROM: Christine Kimmel, LG, and Sierra Mott
DATE: December 29, 2016
RE: **Groundwater Quality Results**
Dry Season 2016 Long-Term Compliance Monitoring
Cascade Pole Site, Olympia, Washington

At the request of Mr. Don Bache of the Port of Olympia, we are providing the Washington State Department of Ecology (Ecology) with the results of the Dry Season sampling event conducted in September 2016, along with one focused verification sampling event conducted in November 2016. Groundwater sampling was conducted as part of the Long-Term Groundwater Compliance Monitoring (LTGCM) program for the Cascade Pole site (Site) in Olympia, Washington.

Groundwater Monitoring

Groundwater elevation measurements were collected on September 4, 2016, and are presented in Table 1. All interior perimeter well groundwater elevations achieved the current hydraulic control goals identified for the Site, except for one well. The groundwater elevation observed at perimeter well LW-4R during September exceeded the goal of elevation 15.5 ft mean lower low water (MLLW).

A total of 15 water quality samples (14 wells and 1 quality assurance sample) were collected during the Dry Season sampling event. Samples were collected from the following well pairs: PZ-12 and PZ-13, LW-3 and PZ-17, LW-4R and PZ-18, and MW-02S and PZ-19. Samples were also collected from interior monitoring wells MW-01S, MW-01D, MW-02D, MW-05S, MW-05D, and CW-13. The locations of the sampled wells are shown on Figures 1 and 2.

In addition to the routine Dry Season sampling event (September 2016), one verification sample was collected in November 2016 from well PZ-17 based on the concentration of pentachlorophenol (PCP) in the routine monitoring round, as discussed below.

Groundwater samples were submitted to Analytical Resources Inc. (ARI), located in Tukwila, Washington for analysis of polycyclic aromatic hydrocarbons (PAHs) using US Environmental Protection Agency (EPA) Method 8270D, with select ion monitoring (SIM); follow-up PCP analysis was conducted using EPA Method 8041 if PCP results from initial analyses using EPA Method 8270D(SIM) were nondetect at the higher reporting limit; total petroleum hydrocarbons (TPH) in the gasoline Range (TPH-G) using Method NWTPH-G; and diesel-range (TPH-D) and oil-range TPH (TPH-O) using Method NWTPH-Dx. The verification sample collected in November was submitted to two laboratories for PCP analyses. One split sample was submitted to ARI using EPA Method 8041 with a reporting limit of 0.25 micrograms per liter ($\mu\text{g/L}$) and another split sample was submitted to Spectra Laboratories

located in Tacoma, Washington for analysis of PCP using EPA Method 8270(SIM) with a lower reporting limit of 0.100 µg/L.

Analytical Results

Analytical results were compared to the cleanup screening levels based on protection of marine surface water previously established for the Site. To evaluate the analytical data for the carcinogenic PAHs (cPAHs), the toxicity equivalency quotients (TEQ) of individual cPAHs were calculated and summed for comparison to the benzo(a)pyrene cleanup level using the methodology established in Washington Administrative Code (WAC) 173-340-708. To calculate the TEQ, the toxicity equivalency factor (TEF) for a given cPAH compound was multiplied by the compound concentration, or half the reporting limit for compounds that were not detected above the laboratory reporting limit, and the resulting values were summed. The analytical results for the Dry Season sampling event (September 2016) and the focused verification sampling event (November 2016) are summarized in Table 2.

An internal data quality evaluation was performed by Landau Associates on all groundwater analytical data to determine acceptability of the analytical results. The data quality evaluation conducted included the following review:

- Chain-of-custody records
- Holding times
- Laboratory method blanks
- Surrogate recoveries
- Laboratory matrix spikes and matrix spike duplicates
- Blank spikes/laboratory control samples
- Laboratory and field duplicates
- Completeness
- Overall assessment of data quality.

The laboratory reports are included in Attachment 1.

The analytical results for the Dry Season indicate concentrations below the respective laboratory reporting limits for wells PZ-13, PZ-18 and PZ-19 (slurry wall exterior wells) and PZ-12 and LW-4R (wells located inside the slurry wall). Low-level concentrations were reported at interior wells CW-13, MW-1D, MW-02S, MW-02D, MW-05S, and MW-05D; however, the concentrations were below the respective cleanup screening levels. Creosote-range hydrocarbons were reported slightly above the cleanup screening levels (500 µg/L) at interior shallow well LW-3 (501 µg/L).

PCP was detected at exterior shallow well PZ-17 at a concentration of 5.42 µg/L, which is above the cleanup screening level (3 µg/L). This is the first time PCP was detected at this well; therefore, we

collected a verification sample for PCP at this well in November 2016. A verification split-sample was submitted to ARI and Spectra Laboratories and the results indicate that PCP was not detected at concentrations above the respective reporting limits. The verification results are consistent with historical results and, therefore, are considered to be accurate and representative of groundwater quality conditions at the respective well, and the initial detection of PCP at this location is considered anomalous.

Analytical results from shallow interior well MW-01S indicate the following compounds were detected at concentrations above the respective cleanup screening levels: TPH-G (37,200 µg/L), TPH-D (6,110 µg/L), and creosote-range hydrocarbons (23,700 µg/L), along with PCP at 3,950 µg/L and naphthalene at 6,790 µg/L.

* * * * *

The next semiannual sampling event is planned for early 2017 and will include both groundwater elevation monitoring and groundwater quality sample collection at the following well pairs: PZ-12 and PZ-13, LW-3 and PZ-17, LW-4R and PZ-18, and MW-02S and PZ-19, along with samples from interior shallow and deep wells MW-01S, MW-01D, MW-02S, MW-02D, MW-05S, MW-05D, and CW-13.

The results of the Dry Season sampling event (September 2016) and the verification sampling event (November 2016), along with the pending Wet Season sampling event (early 2017), will be presented in an annual progress report that will summarize the LTGCM program.

Limitations

This technical memorandum has been prepared for the exclusive use of the Port of Olympia for specific application to the long-term compliance monitoring project at the Cascade Pole Site. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

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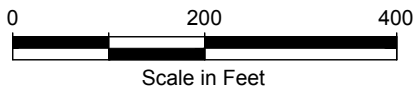
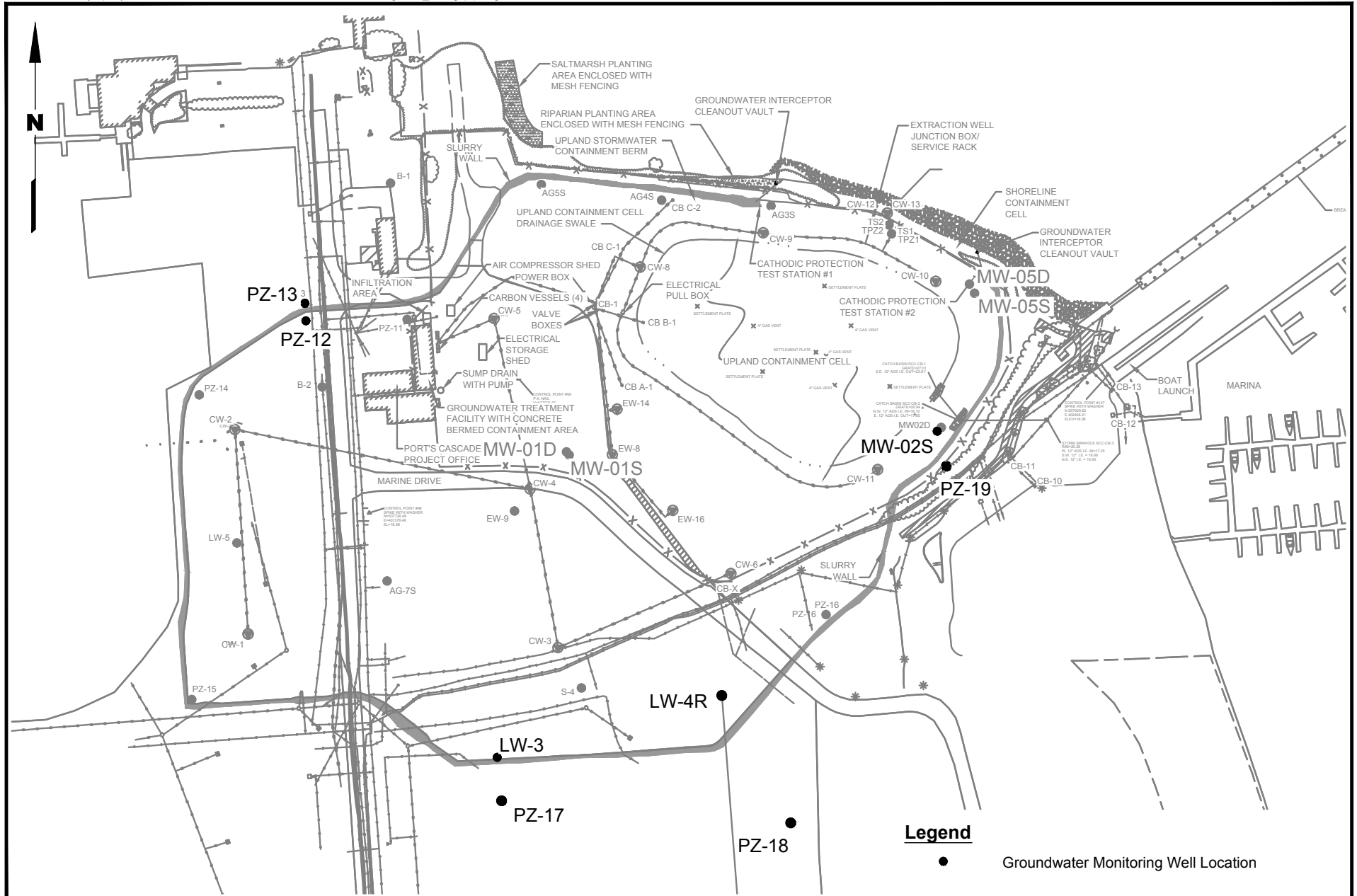
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Attachments

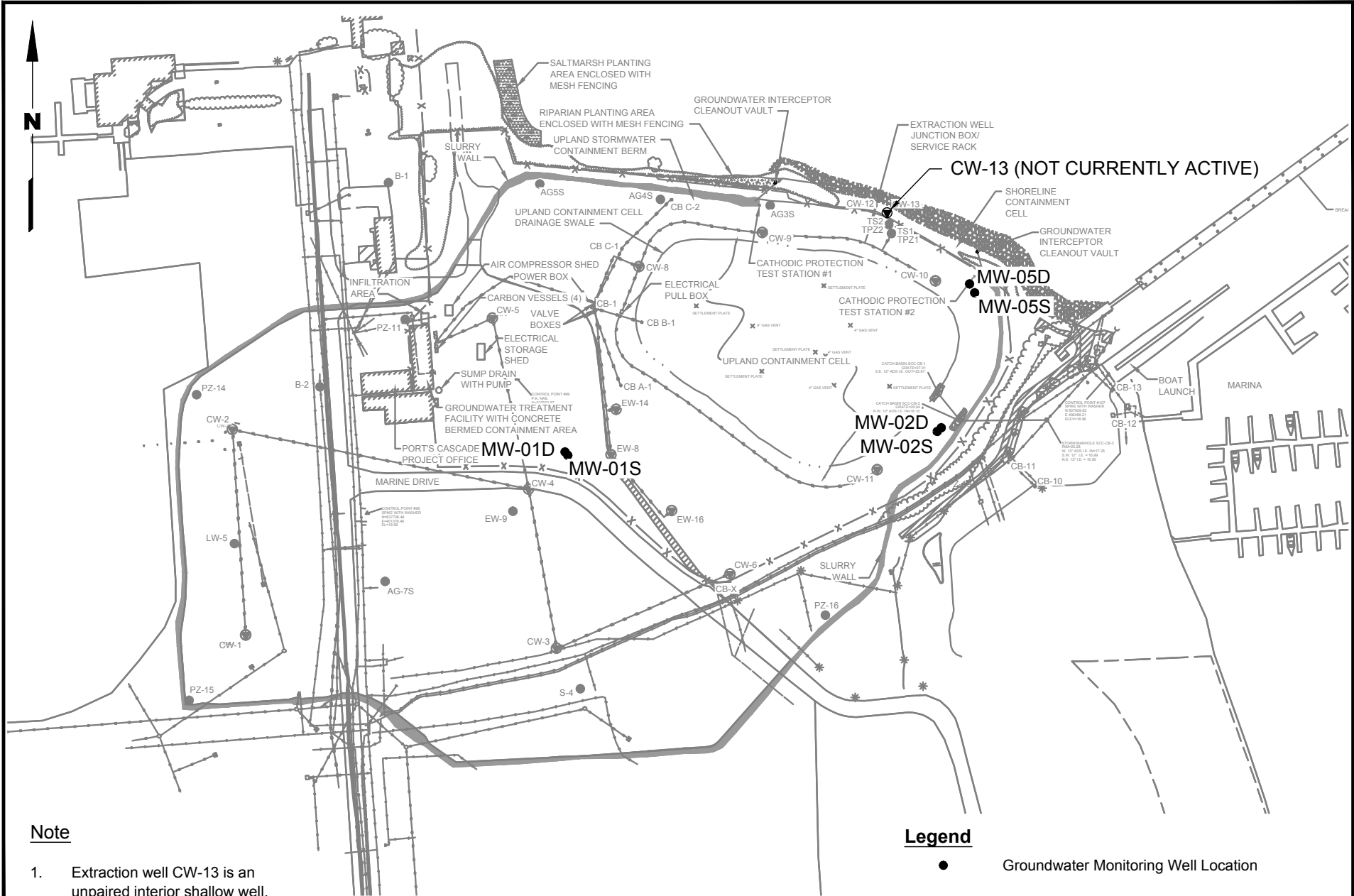
- Figure 1 Paired Shallow Groundwater Monitoring Network Well Locations
- Figure 2 Deep and Shallow Groundwater Monitoring Well Pairs
- Table 1 Groundwater Elevations
- Table 2 Summary of Current Analytical Results
- Attachment 1 Laboratory Data



Port of Olympia
Olympia, Washington

**Paired Shallow Groundwater
Monitoring Network
Well Locations**

Figure
1



Note
 1. Extraction well CW-13 is an unpaired interior shallow well.

Legend
 ● Groundwater Monitoring Well Location

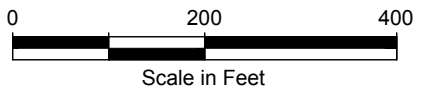


Table 1
Groundwater Elevations
Cascade Pole Site
Port of Olympia, Washington

Well Pair	Collection Date	Well ID	Depth to Groundwater (ft) (a)	Top of Well Casing Elevation (MLLW)	Groundwater Elevation (MLLW) (a)	Maximum Elevation Goal (b)	Goal Exceeded?
1	9/4/2016	PZ-13	7.32	19.50	12.18	--	No
	9/4/2016	PZ-12	5.14	19.00	13.86	15.50	
2	9/4/2016	PZ-17	7.37	20.48	13.11	--	No
	9/4/2016	LW-3	5.88	19.83 (c)	13.95	15.50	
3	9/4/2016	PZ-18	6.28	21.2	14.92	--	Yes
	9/4/2016	LW-4R	6.23	22.02	15.79	15.50	
4	9/4/2016	PZ-19	15.37	23.67	8.30	--	No
	9/4/2016	MW-02S	17.09	31.96	14.87	15.50	
5	9/4/2016	MW-02S	17.09	31.96 (d)(e)	14.87	--	
	9/4/2016	MW-02D	20.48	31.81 (d)(e)	11.33	--	
6	9/4/2016	MW-01S	7.20	21.64	14.44	--	
	9/4/2016	MW-01D	9.68	21.72 (f)	12.04	--	
7	9/4/2016	MW-05S	14.23	29.45 (d)	15.22	16.50	No
	9/4/2016	MW-05D	15.18	26.50 (d)	11.32	--	

ID = identification

MLLW = Mean low low water.

PVC = polyvinyl chloride

(a) Below top of PVC well casing.

(b) Hydraulic gradient direction of groundwater. Long-term goal is inward for well pairs 1, 2, 3, and 4, and upward for well pairs 5, 6, and 7. Long-term goals initiated in 2012.

(b) Short-term hydraulic control goal is 15.5 feet along the majority of the cutoff wall alignment and 16.5 feet adjacent to Budd Inlet.

(c) Well LW-3 casing modified and re-surveyed January 2009. On 7/28/10, the well casing at LW-3 cut down 0.2 feet to make room for new well monument lid. Elevation was adjusted from 20.03 to 19.83.

(d) Wells MW-02s, MW-02d, MW-05s, and MW-05d were modified during construction activities and re-surveyed February 2009.

(e) MW-02D and MW-02S inner north rim elevations modified in September 2011.

(f) On 12/8/11, the inner well casing was cut down at MW-01D by 0.15 feet. Outer casing cut down corresponding amount. New MW-01D measuring point elevation is 21.72 feet MLLW.

NOTE: Groundwater elevations are determined by subtracting depth to groundwater below top of casing (ft) from top of well casing elevation (MLLW, ft).

Table 2
Summary of Current Analytical Results
Cascade Pole Site
Port of Olympia, Washington

	Cleanup Screening Levels	PZ-12 16I0325-11 9/20/2016	PZ-13 16I0325-12 9/20/2016	PZ-17 16I0325-13 9/20/2016	PZ-17 16K0034-01 11/1/2016	PZ-17 (c) 2016110077 11/1/2016	PZ-18 16I0325-14 9/20/2016	PZ-19 16I0325-15 9/21/2016	LW-3 16I0325-03 9/20/2016
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) (µg/L)									
EPA Method SW8270D / SW8270D-SIM									
Naphthalene	4900	1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.1
2-Methylnaphthalene		1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.0 U
Acenaphthylene		1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.0 U
Acenaphthene		1.0 U	1.0 U	2.3	NA	NA	1.0 U	1.0 U	1.0 U
Dibenzofuran		1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.0 U
Fluorene		1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.0 U
Pentachlorophenol	3	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U
Phenanthrene		1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.0 U
Anthracene		1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.0 U
Fluoranthene		1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.0 U
Pyrene	2600	1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.0 U
Benzo(a)Anthracene		0.10 U	0.10 U	0.10 U	NA	NA	0.10 U	0.10 U	0.10 U
Chrysene		0.10 U	0.10 U	0.10 U	NA	NA	0.10 U	0.10 U	0.10 U
Benzo(a)Pyrene		0.10 U	0.10 U	0.10 U	NA	NA	0.10 U	0.10 U	0.10 U
Indeno(1,2,3-cd)Pyrene		0.10 U	0.10 U	0.10 U	NA	NA	0.10 U	0.10 U	0.10 U
Dibenz(a,h)Anthracene		0.10 U	0.10 U	0.10 U	NA	NA	0.10 U	0.10 U	0.10 U
Benzo(g,h,i)Perylene		1.0 U	1.0 U	1.0 U	NA	NA	1.0 U	1.0 U	1.0 U
1-Methylnaphthalene		1.0 U	1.0 U	2.8	NA	NA	1.0 U	1.0 U	1.0 U
Total Benzofluoranthenes		0.20 U	0.20 U	0.20 U	NA	NA	0.20 U	0.20 U	0.20 U
cPAH TEQ (a)	0.1 (b)	ND	ND	ND	NA	NA	ND	ND	ND
cPAH TEQ (a) (Using 1/2 RL for ND)	0.1 (b)	0.076	0.076	0.076	NA	NA	0.076	0.076	0.076
PENTACHLOROPHENOL (µg/L)									
EPA Method SW8041A/SW8270C,D									
Pentachlorophenol	3	0.25 U	0.25 U	5.42 J	0.25 U	0.100 U	0.25 U	0.25 U	0.57
PETROLEUM HYDROCARBONS									
Method NWTPH-Gx (µg/L)									
Gasoline	1,000	100 U	100 U	154	NA	NA	100 U	100 U	150
Method NWTPH-Dx (µg/L)									
Diesel	500	100 UJ	100 UJ	100 UJ	NA	NA	100 UJ	100 UJ	143 J
Motor Oil	500	200 U	200 U	200 U	NA	NA	200 U	200 U	200 U
Creosote Oil	500	100 U	100 U	126	NA	NA	100 U	100 U	501

Table 2
Summary of Current Analytical Results
Cascade Pole Site
Port of Olympia, Washington

	Cleanup Screening Levels	LW-4R	MW-01S	MW-02S	MW-05S	Dup of MW-05S		MW-01D	MW-02D	MW-05D
		16I0325-04 9/20/2016	16I0325-06 9/21/2016	16I0325-08 9/20/2016	16I0325-10 9/20/2016	PZ-30 16I0325-16 9/20/2016	16I0325-05 9/21/2016	16I0325-07 9/20/2016	16I0325-09 9/20/2016	
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) (µg/L)										
EPA Method SW8270D / SW8270D-SIM										
Naphthalene	4900	1.0 U	6,790	1.7	1.0 U	1.0 U	1.3	1.7	U	1.0 U
2-Methylnaphthalene		1.0 U	654	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
Acenaphthylene		1.0 U	30 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
Acenaphthene		1.0 U	221	1.6	10.8	10.1	1.0 U	1.0 U	U	3.2
Dibenzofuran		1.0 U	97.6	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
Fluorene		1.0 U	63.5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
Pentachlorophenol	3	10 U	3,950	10 U	10 U	10 U	10 U	10 U	U	10 U
Phenanthrene		1.0 U	52.6	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
Anthracene		1.0 U	30 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
Fluoranthene		1.0 U	30 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
Pyrene	2600	1.0 U	30 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
Benzo(a)Anthracene		0.10 U	2.5 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	U	0.10 U
Chrysene		0.10 U	2.5 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	U	0.10 U
Benzo(a)Pyrene		0.10 U	2.5 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	U	0.10 U
Indeno(1,2,3-cd)Pyrene		0.10 U	2.5 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	U	0.10 U
Dibenz(a,h)Anthracene		0.10 U	2.5 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	U	0.10 U
Benzo(g,h,i)Perylene		1.0 U	30 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
1-Methylnaphthalene		1.0 U	373	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	U	1.0 U
Total Benzofluoranthenes		0.20 U	5.0 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	U	0.20 U
cPAH TEQ (a)	0.1 (b)	ND	ND	ND	ND	ND	ND	ND	ND	ND
cPAH TEQ (a) (Using 1/2 RL for ND)	0.1 (b)	0.076	1.89	0.076	0.076	0.076	0.076	0.076	U	0.076
PENTACHLOROPHENOL (µg/L)										
EPA Method SW8041A/SW8270C,D										
Pentachlorophenol	3	0.25 U	NA	0.25 U	0.25 U	0.25 U	0.31	0.25 U	U	0.79 J
PETROLEUM HYDROCARBONS										
Method NWTPH-Gx (µg/L)										
Gasoline	1,000	100 U	37,200	100 U	100 U	100 U	100 U	140	U	100 U
Method NWTPH-Dx (µg/L)										
Diesel	500	100 UJ	6,110 J	100 UJ	100 UJ	100 UJ	100 UJ	100 UJ	U	100 UJ
Motor Oil	500	200 U	1000 U	200 U	200 U	200 U	200 U	200 U	U	200 U
Creosote Oil	500	100 U	23,700	100 U	121	153	100 U	100 U	U	100 U

Table 2
Summary of Current Analytical Results
Cascade Pole Site
Port of Olympia, Washington

	Cleanup Screening Levels	CW-13 16I0325-02 9/20/2016
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) (µg/L)		
EPA Method SW8270D / SW8270D-SIM		
Naphthalene	4900	1.0 U
2-Methylnaphthalene		1.0 U
Acenaphthylene		1.0 U
Acenaphthene		1.0 U
Dibenzofuran		1.0 U
Fluorene		1.0 U
Pentachlorophenol	3	10 U
Phenanthrene		1.0 U
Anthracene		1.0 U
Fluoranthene		1.0 U
Pyrene	2600	1.0 U
Benzo(a)Anthracene		0.10 U
Chrysene		0.10 U
Benzo(a)Pyrene		0.10 U
Indeno(1,2,3-cd)Pyrene		0.10 U
Dibenz(a,h)Anthracene		0.10 U
Benzo(g,h,i)Perylene		1.0 U
1-Methylnaphthalene		1.0 U
Total Benzofluoranthenes		0.20 U
cPAH TEQ (a)	0.1 (b)	ND
cPAH TEQ (a) (Using 1/2 RL for ND)	0.1 (b)	0.076
PENTACHLOROPHENOL (µg/L)		
EPA Method SW8041A/SW8270C,D		
Pentachlorophenol	3	0.88 J
PETROLEUM HYDROCARBONS		
Method NWTPH-Gx (µg/L)		
Gasoline	1,000	100 U
Method NWTPH-Dx (µg/L)		
Diesel	500	100 UJ
Motor Oil	500	200 U
Creosote Oil	500	100 U

cPAH = carcinogenic polycyclic aromatic hydrocarbon

µg/L = micrograms per liter

EPA = US Environmental Protection Agency

MTCA = Model Toxics Control Act

NA = not analyzed

ND = Not Detected.

NWTPH-Dx = total petroleum hydrocarbons diesel range

NWTPH-Gx = TPH gasoline range

PCP = pentachlorophenol

RL = reporting limit

SIM = select ion monitoring

WAC = Washington Administrative Code

U = Indicates the compound was undetected at the given reporting limit.

J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

Bold indicates detected compound. Box indicates exceedance of screening levels.

Box indicates exceedance of screening level.

(a) Toxicity equivalency factor (TEQ) as described in WAC 173-340-708 (8).

(b) cPAH cleanup screening levels based on practical quantitation limit (PQL) for individual cPAHs.

(c) Verification sample analyzed using SW8270-SIM.