FOURTH FIVE-YEAR REVIEW REPORT FOR WYCKOFF/EAGLE HARBOR SUPERFUND SITE KITSAP COUNTY, WASHINGTON

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9/26/17

Date

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LIST OF ABBREVIATIONS & ACRONYMS

AOC	administrative order on consent
ARAR	applicable or relevant and appropriate requirement
BMP	best management practices
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cPAH	carcinogenic polycyclic aromatic hydrocarbon
COC	contaminant of concern
CSL	cleanup screening level
CSM	conceptual site model
EBS	exposure barrier system
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FYR	Five-Year Review
HAET	high apparent effects threshold
HPAH	high molecular weight PAH
HQ	hazard quotient
ICs	institutional controls
LPAH	low molecular weight PAH
MCUL	minimum cleanup level
MNR	monitored natural recovery
MTCA	Washington State Model Toxics Control Act
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
OMMP	operations, maintenance, and monitoring plan
OU	operable unit
PAH	polycyclic aromatic hydrocarbons
PCP	pentachlorophenol
PRG	preliminary remediation goal
PRP	potentially responsible party
RAO	remedial action objectives
RI	remedial investigation
ROD	Record of Decision
RPM	remedial project manager
SCO	sediment cleanup objective
SMS	Washington State Sediment Management Standards
SQS	Washington State Sediment Quality Standards
TarGOST	Tar-specific Green Optical Scanning Tool
TBC	to be considered
UAO	unilateral administrative order
USACE	U.S. Army Corps of Engineers
UU/UE	unlimited use and unrestricted exposure
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries

1. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fourth FYR for the Wyckoff/Eagle Harbor Superfund Site. The triggering action for this statutory review is the completion of the previous FYR on September 27, 2012. This FYR has been prepared due to the fact that hazardous substances, pollutants, or contaminants remain at the site at levels above those that would allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of four operable units (OUs), with two of the OUs managed together (Figure 1). All four OUs will be addressed in this FYR. OU-1, East Harbor, addresses the offshore sediments in Eagle Harbor and the nearshore sediments adjacent to the former Wyckoff Company wood-treatment facility (Wyckoff facility). OU-2/OU-4, Soil and Groundwater, address the soil and groundwater at the former Wyckoff facility, as well as remaining buried structures. OU-3, West Harbor, addresses the upland areas, offshore, and nearshore sediments associated with the former shipyard operations in the western portion of Eagle Harbor.

The Wyckoff/Eagle Harbor Superfund Site Five-Year Review was led by Helen Botcher, EPA Remedial Project Manager (RPM); and Bonnie Arthur, EPA RPM. Participants included Kayla Patten, U.S. Army Corps of Engineers (USACE) Environmental Engineer; Ben McKenna, USACE Geologist; and Ellen Brown, USACE Project Manager. The review began on 12/1/2016.

1.1. Site Background

The Wyckoff/Eagle Harbor Superfund site (Site) is located on the east side of Bainbridge Island in central Puget Sound, Washington (Figure 1). Current land use on Bainbridge Island is principally residential, with some commercial and light industrial use. Shorelines around Eagle Harbor include residences, city parks, marinas, the Washington State Ferries (WSF) maintenance facility and Bainbridge Island WSF terminal. Land use is not expected to change in the near future. Eagle Harbor is heavily used by recreational boaters, house boats, and the ferry to and from Seattle. Eagle Harbor also is within the adjudicated usual and accustomed fishing area (U&A) of the Suquamish Tribe, whose reservation is located on the Kitsap Peninsula north of Bainbridge Island. EPA recognizes that the Suquamish Tribe has Treaty-reserved or other fishing rights in the areas impacted by the Site and expects cleanup efforts to continue to improve habitat.

The Site includes the upland area of the former Wyckoff facility, the upland area of the former shipyard, and the subtidal and intertidal sediments in Eagle Harbor. Operation of the former Wyckoff facility led to soil, groundwater, and sediment contamination by several wood-treatment compounds, such as polycyclic aromatic hydrocarbons (PAHs). Operation of the former shipyard on the north shore of Eagle Harbor lead to soil and sediment contamination by heavy metals, primarily mercury. Following reports of oil observed on beaches, EPA began investigating the Site in 1971. In July 1987, the Site was listed

on the National Priorities List (NPL). Currently EPA Region 10 serves as the lead agency with technical support from USACE. Washington Department of Ecology (Ecology) is responsible for operation and maintenance (O&M) for OU-2/OU-4. Additional history on the Site is detailed in Appendix B.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Wyckoff/Eagle Harbor Superfund Site		
EPA ID: WAD009248295		
Region: 10	**State:** WA	**City/County:** Bainbridge Island, Kitsap County

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: EPA
Author names: Helen Bottcher and Bonnie Arthur
Author affiliation: EPA Region X
Review period: 12/1/2016 - 9/27/2017
Date of site inspection: 1/12/2017
Type of review: Statutory
Review number: 4
Triggering action date: 9/27/2012
Due date: 9/27/2017

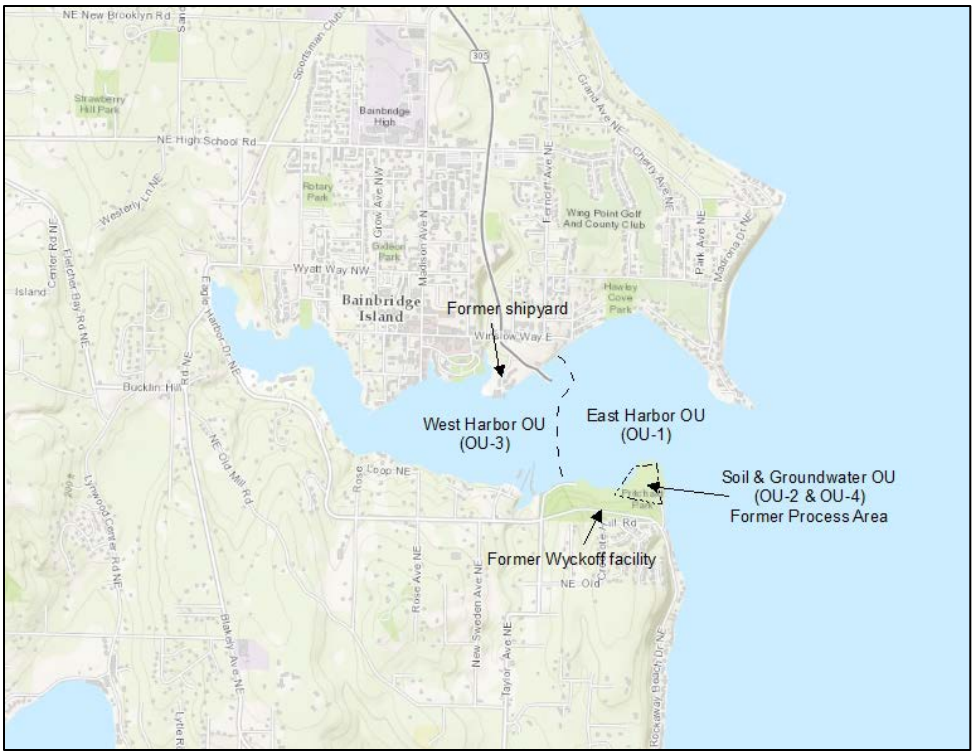

Figure 1. Location Map

2. RESPONSE ACTION SUMMARY

2.1. OU-1 East Harbor

2.1.1. Basis for Taking Action

The contaminants of concern (COCs) for subtidal and intertidal sediments in OU-1 are mercury, PAHs, and pentachlorophenol (PCP) (

Table 1).

The human health risk assessment for OU-1 (EPA, 1994b) evaluated exposure to residents, site workers, and the general public, through exposure by ingestion and dermal contact with intertidal sediments, and ingestion of fish and shellfish. Human health cancer risks and non-cancer hazard indices from ingestion of intertidal sediment were within EPA's acceptable risk range. Non-cancer hazard indices for dermal exposure were below EPA's risk threshold. Cancer risk for dermal exposure could not be calculated due to lack of appropriate toxicity parameters. The risk assessment found that the highest risks at the site were from consumption of fish and shellfish, with consumption of clams collected adjacent to the Wyckoff facility showing the highest risk.

Ecological risk for Eagle Harbor sediments was evaluated through several means. First, acute bioassays of fish and shellfish showed toxicity in many sampling locations; with locations nearest the Wyckoff facility showing the most severe responses. Second, there was a higher incidence of liver lesions and tumors in English sole within Eagle Harbor compared to other Puget Sound embayments. Lastly, the presence of mercury and PAHs in fish and shellfish tissue indicated uptake of sediment contamination, both of which are known to bioaccumulate in the food chain. Together, these results indicated ecological risk due to the contamination present on the site.

2.1.2. *Response Actions*

In 1993 and 1994, EPA conducted a non-time-critical cleanup action to cap more than 54 acres of sediment in Eagle Harbor, to cover areas that had been shown to cause significant adverse biological effects. This would be later termed the "Phase I" cap.

In September 1994, the East Harbor Record of Decision (ROD) (EPA, 1994b) was signed, which described the following long-term goals (now considered the remedial action objectives [RAOs]):

- Achievement of the Washington State Sediment Management Standards (SMS) minimum cleanup levels (MCULs) (for protection of benthic invertebrates)
- Reduction of contaminants in fish and shellfish to levels protective of human health and the environment.

The sediment cleanup levels selected in the 1994 ROD are shown in

Table 1 and Table 2 and were based on the SMS. The sediment quality standards (SQS) values represent long-term goals, but the MCUL values are considered the measurable site specific cleanup objective. The intertidal MCULs were supplemented with an objective of 1,200 µg/kg (dry weight) HPAHs, which was developed by EPA to address human health risks from consumption of shellfish. For subtidal sediment, MCULs must be achieved in the top 10 cm immediately following completion of the remedy. For intertidal sediment, MCULs and the HPAH objective must be achieved in the top 10 cm within ten years of completion of source control.

The remedy selected in the 1994 ROD was capping in subtidal areas and monitored natural recovery (MNR) in intertidal areas. Subtidal areas with COC concentrations above the MCUL were to be capped with an approximately 3 ft thick cap. For intertidal sediments, monitoring was required to determine if the surface 10 cm would achieve the MCULs and the HPAH objective within 10 years. Institutional controls, such as a health advisory, and use and access restrictions were also required OU-wide.

After complaints from citizens in 2005, EPA discovered creosote contamination in beach sediments at the Site. In 2007, EPA released an Explanation of Significant Differences (ESD) (EPA, 2007) requiring the construction of an exposure barrier system (EBS) to cover the recently discovered contaminated sediments of the West Beach, and construction of a subtidal cap extension to cover nearby sediments not previously capped. The beach cover system on West Beach was to consist of a geotextile layer, 1 ft of cobbles, and 2 ft of habitat fill. The subtidal cap extension was to be constructed the same as the 3 ft thick cap previously placed in other subtidal areas. The ESD also expanded the cleanup levels to include the Washington State Model Toxics Control Act (MTCA) soil cleanup levels (see

Table 1) to address potential human direct contact exposure to sediments at low tide. The MTCA cleanup levels are only applicable to intertidal sediment along West Beach.

Table 1. Sediment Chemical Cleanup Levels for OU-1.

Contaminant of Concern	SQS Chemical Criteria[1] (mg/kg oc)	MCUL Chemical Criteria[2] (mg/kg oc)	MTCA Method B Soil Cleanup Level[3] (mg/kg)
Mercury	0.41 (mg/kg dw)	0.59 (mg/kg dw)	--
LPAHs	370	780	--
Naphthalene	99	170	3,200
Acenaphthylene	66	66	--
Acenaphthene	16	57	4,800
Fluorene	23	79	3,200
Phenanthrene	100	480	--
Anthracene	220	1,200	24,000
2-Methylnaphthalene	38	64	320
HPAHs	960	5,300 1,200 [4]	--
Fluoranthene	160	1,200	3,200
Pyrene	1,000	1,400	2,400
Benz[*a*]anthracene	110	270	0.14
Chrysene	110	460	0.14
Benzo[*b*]fluoranthene	--	--	0.14
Benzo[*k*]fluoranthene	--	--	0.14
Total Benzofluoranthenes	230	450	--
Benzo[*a*]pyrene	99	210	0.14
Indeno[1,2,3-*cd*]pyrene	34	88	0.14
Dibenzo[*a*,*h*]anthracene	12	33	0.14
Benzo[*g*,*h*,*i*]perylene	31	78	--
Pentachlorophenol	--	--	8.3

NOTES:
1 – The SQS criteria are conceptual target conditions. These are applicable to all subtidal and intertidal sediment. The SQS criteria are presented in the 1994 ROD.
2 – The MCUL criteria are the measurable cleanup levels to be achieved in top 10 cm. These are applicable to all subtidal and intertidal sediment. Subtidal sediment must meet MCULs immediately following remedy completion; intertidal sediment must meet MCULs within 10 years of completion of source control. The MCUL criteria are presented in the 1994 ROD.
3 – The MTCA Method B criteria are applicable for the intertidal sediment along West Beach. These were based on the CLARC database for unrestricted land use and direct contact exposure. The MTCA Method B criteria are presented in the 2007 ESD.
4 – The MCUL criteria were supplemented with this objective in the ROD, developed to address human health risks. This objective is applicable to intertidal sediment only.

dw	dry weight
HPAH	high molecular weight polycyclic aromatic hydrocarbons
LPAH	low molecular weight polycyclic aromatic hydrocarbons
MCUL	minimum cleanup level (now renamed cleanup screening level [CSL])
MTCA	Washington State Model Toxics Control Act
oc	organic carbon
SQS	sediment quality standard (now renamed to the sediment cleanup objective [SCO])

Table 2. Sediment Biological Cleanup Criteria for OU-1.

SQS[a] Biological Criteria	MCUL[b] Biological Criteria
Sediments are determined to have adverse effects on biological resources when any one of the confirmatory marine sediment biological tests of WAC 173-204- 315(1) demonstrate the following results: (a) Amphipod: The test sediment has a higher[c] mean mortality than the reference sediment and the test sediment mean mortality exceeds 25%, on an absolute basis. (b) Larval: The test sediment has a mean survivorship of normal larvae that is less[c] than the mean normal survivorship in the reference sediment and the test sediment mean normal survivorship is less than 85% of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than 15% relative to time-final in the reference sediment). (c) Benthic abundance: The test sediment has less than 50% of the reference sediment mean abundance of any one of the following major taxa: Crustacea, Mollusca, or Polychaeta, and the test sediment abundance is statistically different[c] from the reference sediment abundance. (d) Juvenile polychaete: The test sediment has a mean biomass of less than 70% of the reference sediment mean biomass and the test sediment biomass is statistically different from the reference sediment biomass. (c) Microtox: The mean light output of the highest concentration of the test sediment is less than 80% of the reference sediment, and the two means are statistically different.	The MCUL is exceeded when any two of the biological tests exceed the SQS biological criteria; or one of the following test determinations is made: (i) Amphipod: the test sediment has a higher mean mortality than the reference sediment and the test sediment mean mortality is more than 30% higher than the reference sediment mean mortality, on an absolute basis. (ii) Larval: the test sediment has a mean survivorship of normal larvae that is less than the mean normal survivorship in the reference sediment and the test sediment mean normal survivorship is less than 70% of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than 30% relative to time final in the reference sediment). (iii) Benthic abundance: The test sediment has less than 50% of the reference sediment mean abundance of any two of the following major taxa: Crustacea, Mollusca, or Polychaeta, and the test sediment abundances are different from the reference abundances. (iv) Juvenile polychaete: The test sediment has a mean biomass of less than 50% of the reference sediment mean biomass and the test sediment biomass is statistically different from the reference sediment biomass.

[a] Sediment Quality Standards
[b] Minimum Cleanup Level
[c] Statistical Significance is defined with a test, p less than or equal to 0.05.

Test results from at least two acute effects tests and one chronic effects test shall be evaluated. The biological tests shall not be considered valid unless test results for the appropriate control and reference sediments samples meet the performance standards described in WAC 173-204-315(2).

2.1.3. Status of Implementation

The OU-1 subtidal and intertidal caps required in the 1994 ROD were completed in three phases between 1993 and 2002 (Figure 2). The Phase I cap was completed in 1993 (pre-ROD) as a non-time-critical removal action and covered 54 acres of subtidal sediment. Phase II extended the original cap by an additional 15 acres toward the former Wyckoff site. This area was not remediated during Phase I due to lack of upland source control at the time. The Phase III cap was completed in 2002 and placed in shallow subtidal and intertidal areas to create intertidal habitat and a continuous beach along the shoreline.

In 2001, construction was completed on a habitat mitigation beach, offsetting habitat loss associated with the sheet pile wall installation for OU-2/OU-4. The mitigation beach was renamed West Beach and is considered part of OU-1. Construction of the EBS was completed in 2008 on the West Beach. Final construction included a bottom geotextile layer, a 1 ft thick cobble layer, and a 2 ft thick habitat fill layer, in accordance with the 2007 ESD requirements.

In 2011, sampling of the intertidal sediment confirmed that, despite significant decreases in PAH concentrations, cleanup levels in the 1994 ROD had not been reached (HDR, 2012) in the East Beach and North Shoal areas. In addition, material loss was seen on the northern portion of the subtidal Phase I cap, along the ferry lane, in particular at the approach to the Winslow terminal.

In 2016 EPA issued a Proposed Plan (EPA, 2016) to address remaining contamination in the intertidal sediment (data have shown the subtidal cap is effectively isolating contamination so no additional action is needed in the subtidal area). The preferred alternative was partial excavation of beach sediment and capping. This remedy would be implemented in four target locations based on the history of NAPL presence. The remaining beach area would be remediated through monitored natural recovery. The ROD Amendment selecting the final remedy is expected to be signed in late 2017.

In early 2017, repairs were made to the subtidal cap in the area where previous studies revealed ferry propeller wash had displaced portions of the existing Phase 1 cap, along the ferry lane. To restore necessary isolation, one foot of clean sand was added over the exposed area (9.3 acres). The high impact center of the ferry lane (3.5 acres) also received an additional 2-foot thick layer of 6 inch quarry rock for armoring. Repairs were completed on February 23, 2017. (FPM-CTI, 2017)

2.1.4. *IC Summary Table*

Table 3 summarizes the institutional controls (ICs) required for OU-1. Of particular note is that EPA has closed the North Shoal and East Beach areas due to remaining contamination. Beach closure signs have been posted at the beach access areas, and informational pamphlets have been mailed to area residents (see Appendix J). Despite these efforts, it is well known that individuals still choose to access the closed portions of the beach.

Table 3. Summary of Planned and/or Implemented ICs for OU-1

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date
Fish and shellfish tissue	Yes	Yes, 1994 ROD	Intertidal and subtidal areas	Health notices, advising against harvesting fish or shellfish from Eagle Harbor.	Kitsap Public Health District currently maintains shellfish advisories for Eagle Harbor (see Appendix I)
Subtidal and intertidal sediment	Yes	Yes, 1994 ROD	Intertidal and subtidal areas	Use and access restrictions to ensure protection of the completed remedy.	Prospective Purchasers Agreement, 2004[1] Health advisories (see Appendix I); beach closure notifications (see Appendix J); "no anchor" area notifications (see Appendix K)

1 –Document reviewed for this FYR and verified it is recorded with Kitsap County.

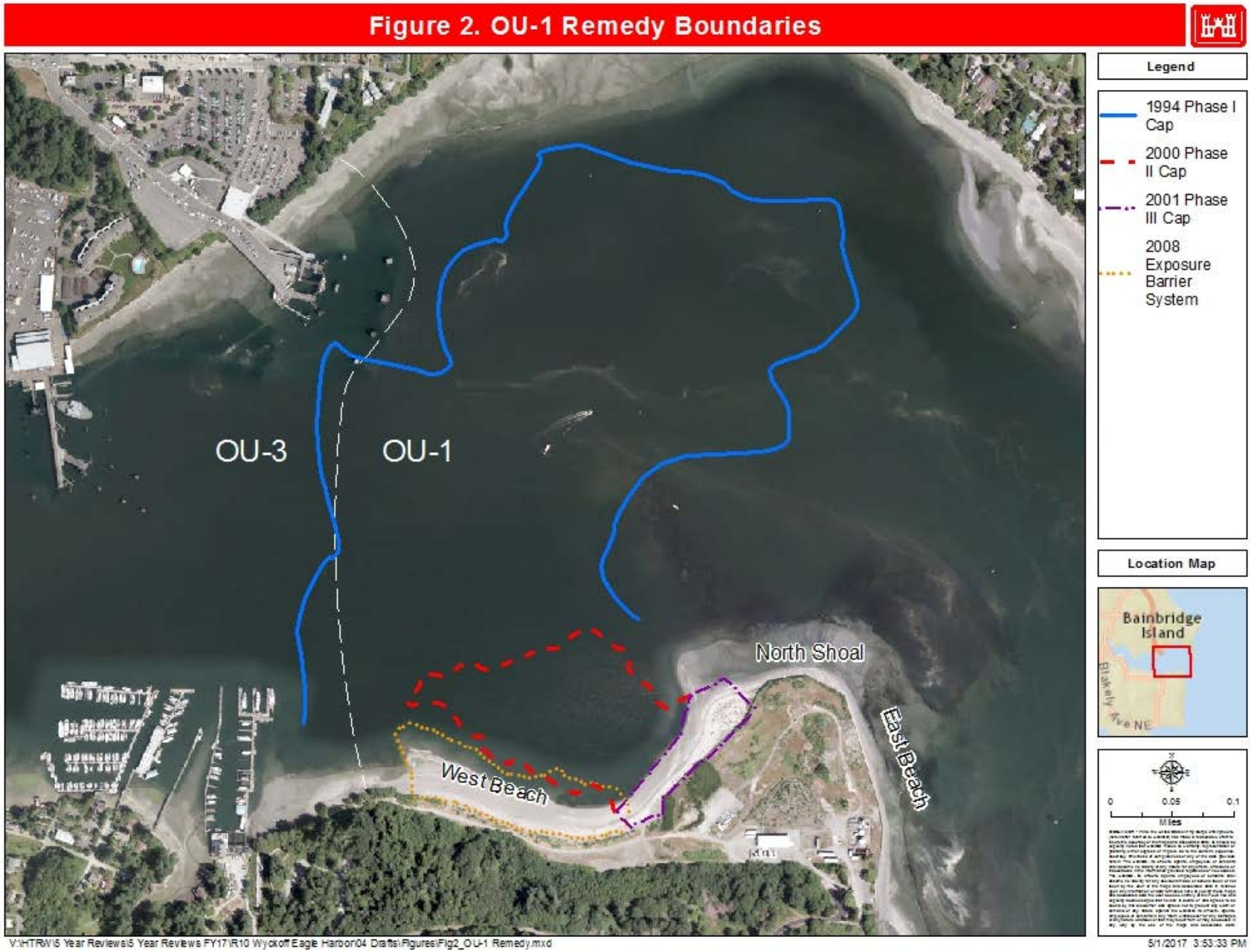

Figure 2. OU-1 Remedy Boundaries

2.1.5. Systems Operations/Operation & Maintenance

EPA is conducting long-term monitoring of the subtidal and intertidal areas of the East Harbor according to the Operations, Maintenance, and Monitoring Plan (OMMP) that was approved by EPA in July 1994, and most recently amended in December 2016. The primary activities associated with the OMMP include the following:

- Subtidal sediment cap monitoring to determine physical stability, effectiveness of containing underlying contaminated sediments, and potential for recontamination.
- Intertidal area monitoring to determine physical stability in areas where cap material was placed, effectiveness of containing underlying contaminated sediments, natural recovery, and habitat use.
- EBS monitoring to determine physical stability, effectiveness of containing underlying contaminated sediments, and habitat function.

Results from the latest monitoring are presented in the Data Review section below (section 4.2). Total costs associated with sediment sampling, clam sampling, and reporting for the East Harbor for the past five years are approximately $500,000. The cap repair, completed in 2017, cost approximately $3.8 million.

2.2. OU-2/OU-4 Soil and Groundwater

2.2.1. Basis for Taking Action

The COCs for OU-2 and OU-4 are PAHs, PCP, and dioxins (measured as dioxin toxic equivalents [dioxin TEQ]) (Table 4).

The baseline human health and ecological risk assessments were carried out for OU-2/OU-4 in the mid-1990s, and were presented in the 1997 remedial investigation (RI) report (CH2MHill, 1997). The soil exposure scenario evaluated in the human health risk assessment was residential exposure, which was the most conservative scenario and represented the most likely future land use for much of the Wyckoff property. Specifically, ingestion of surface and shallow subsurface soil, ingestion of groundwater, and inhalation of groundwater vapors were evaluated.

For ingestion of surface and shallow subsurface soil, approximately 46% of the soil OU area showed excess cancer risk above the 10^{-6} threshold, and approximately 15% of samples were above the 10^{-4} threshold. Most of these exceedances were located in the northern portion of the OU. All surface and shallow subsurface samples with a hazard quotient (HQ) greater than the threshold of 1 were associated with samples with an excess cancer risk greater than 10^{-6}. The primary contributor to cancer risk was benzo[*a*]pyrene, whereas non-cancer risk was driven by naphthalene.

For upper-aquifer groundwater south and west of the Former Process Area, excess cancer risk from ingestion of contaminated groundwater by future residents' cancer risk ranged from 5×10^{-6} to 4×10^{-4}, and non-cancer HQs exceeded the threshold of 1. For lower-aquifer groundwater, cancer risk ranged from 10^{-5} to 10^{-4}, and one of four groundwater wells exceeded a non-cancer HQ of 1.

The ecological risk assessment did not include scenarios for soil at the former process area, because it was assumed these soils would be remediated based on human health concerns. Also, the area was heavily developed at the time of the risk assessment and therefore little suitable habitat was available for wildlife. An ecological evaluation was completed for soils adjacent to the former process area, which

showed non-cancer HQs greater than 1. Ecological receptors evaluated included plants, invertebrates, mammals, and birds. The primary risk drivers were PAHs.

2.2.2. Response Actions

The remedy for OU-2/OU-4 has changed several times since contamination was discovered in 1984. The following sections describe the response actions taken prior to the current selected remedy.

2.2.2.1. Pre-ROD Response Actions

Following discovery of contamination, in 1984 EPA issued a Unilateral Administrative Order (UAO) requiring the Wyckoff Company to conduct environmental investigation activities, which revealed the presence of significant soil and groundwater contamination.

In 1990, the original groundwater pump and treat system was constructed and began operation. From April 1992 through April 1994, EPA conducted a time-critical removal action where creosote and PCP-contaminated sludge was excavated at the site. The 28,500 tons of sludge that was excavated was then buried or stored in various above-ground vessels. This included 99,987 gallons of creosote and PCP contaminated oil, 426 cubic yards of asbestos, and 2,240 pounds of scrap steel.

In 1993, EPA assumed control of site operation and found the treatment plant and extraction systems in a state of disrepair. New extraction wells were installed and several operational and process improvements were made by EPA. In August 1994, the Wyckoff Company entered into a Consent Decree with EPA for reimbursement of remedial costs, and with several natural resource trustees for reimbursement of environmental restoration.

2.2.2.2. 1994 Interim ROD Response Actions

In September 1994, EPA issued an interim ROD (EPA, 1994a) for groundwater to prevent contaminated groundwater and NAPL from moving offsite into Eagle Harbor and from reaching deeper aquifers. By 2000, design of many of the elements of the remedy had been completed but implementation of some awaited a final decision on the Groundwater OU remedy. The elements and their status are described below:

- Replacement of the existing treatment plant.
    - The design of a new treatment plant began in late 1996 and was completed in July 1998. The plant was not constructed, pending a final decision on the groundwater remedy.
- Evaluation, maintenance, and upgrade of the existing extraction system and hydraulic barrier operations.
    - These activities were completed in 1995.
- Evaluation of the performance of the existing extraction system and installation of a physical barrier, if needed.
    - Because of continued releases to Eagle Harbor and Puget Sound despite ongoing pumping, a slurry wall was proposed as the most appropriate kind of physical barrier. The designs were put on hold, pending a final decision regarding the groundwater remedy.
- Sealing of on-site water supply wells.
    - These activities were completed in 1995.

2.2.2.3. 2000 ROD Response Actions

In February 2000, EPA issued a final ROD for OU-2/OU4 (EPA, 2000). The RAOs were divided into soil and groundwater RAOs, as follows:

- Soil OU RAOs:

  - Prevent human exposure through direct contact (ingestion, inhalation, or dermal contact) with contaminated soil
  - Prevent storm water runoff containing contaminated soil from reaching Eagle Harbor.
- Groundwater OU RAOs:
  - Reduce the non-aqueous phase liquid (NAPL) source and the quantity of NAPL leaving the upper-aquifer beneath the Former Process Area sufficiently to protect marine water quality, surface water, and sediments (e.g. ensure the quantity of NAPL leaving the site will not adversely affect aquatic life and sediments). Site-specific groundwater contaminant concentration limits will be met at the mudline.
  - Ensure contaminant concentrations in the upper-aquifer groundwater leaving the Former Process Area will not adversely affect marine water quality, and aquatic life in surface water and sediment.
  - Protect humans from exposure to groundwater containing contaminant concentrations above maximum contaminant levels (MCLs).
  - Protect the groundwater outside the Former Process Area and in the lower aquifers, which are potential drinking water sources.

The remedy selected in the 2000 ROD included:

- Construction of a sheet pile wall around the Former Process Area (i.e. the pilot study area) to localize the focus of the remediation pilot study.
- Conducting a pilot study to test the applicability and effectiveness of thermal remediation. The pilot study was to be designed and implemented with the ability to expand to the full-scale system. The pilot study would test steam injection and electrical resistance heating (as a supplemental technology to steam injection).
- If the pilot study was successful at meeting performance expectations, then the remedy was to include:
  - Consolidation of contaminated hot spots from the Former Log Storage/Peeler Area and the well CW01 area within the Former Process Area.
  - Remediation of the soil and groundwater within the Former Process Area by full-scale thermal treatment.
  - Construction of a vapor cover over the treatment area to enhance recovery of vapors, minimize emissions to the atmosphere, and reduce odors.
  - Monitoring of biodegradation, oxidation, and other thermally-enhanced attenuation processes in soil and groundwater during and after active thermal treatment was completed to confirm whether further reductions in contaminant concentrations were being achieved.
- If the pilot study was not successful, then the remedy was to include:
  - Construction of a sheet pile wall around the entire Former Process Area for soil containment.
  - A new pump and treat system to prevent precipitation accumulation within the sheet pile wall which could cause downward leakage of contaminated groundwater.
  - Capping of soil in the Former Log/Storage Area and the Former Process Area.
- Monitoring of both the upper aquifer outside the Former Process Area and the lower aquifer beneath the Soil and Groundwater OU to identify any trends in groundwater data and determine contaminant trends.
- Establishment of institutional controls to:
  - ensure that the upper aquifer groundwater outside the Former Process Area and the lower aquifer remain unused for drinking water until protective levels are reached;

- ensure that the upper aquifer groundwater within the Former Process Area remains unused due to contaminants that may remain after thermal treatment or will remain as part of the contingency remedy; this portion of the upper aquifer is also not potable due to high salinity levels; and
- restrict site use to reduce the risk of direct exposure to surface soil, as necessary.

The soil cleanup levels established for the vadose zone (unsaturated soil to a depth of 15 ft bgs) were based on MTCA, and are presented in Table 4. Because upper-aquifer groundwater at the site is not potable, cleanup levels were set for protection of surface water, sediments, and human consumption of organisms. Groundwater cleanup levels (applicable to both the upper and lower aquifer) are presented in Table 4.

Table 4. Soil and Groundwater Cleanup Levels for OU-2/OU-4

Contaminant of Concern	MTCA Method B Soil Cleanup Level[1] (mg/kg)	Groundwater Cleanup Level[2] (µg/L)
LPAHs		
Naphthalene	3,200	83
Acenaphthylene	--	--
Acenaphthene	4,800	3
Fluorene	3,200	3
Phenanthrene	--	--
Anthracene	24,000	9
HPAHs	--	0.254
Fluoranthene	3,200	3
Pyrene	2,400	15
Benz[*a*]anthracene	0.137	0.0296[a]
Chrysene	0.137	0.0296 [a]
Benzo[*b*]fluoranthene	0.137	0.0296 [a]
Benzo[*k*]fluoranthene	0.137	0.0296 [a]
Benzo[*a*]pyrene	0.137	0.0296 [a]
Indeno[*1,2,3-cd*]pyrene	0.137	0.0296 [a]
Dibenzo[*a,h*]anthracene	0.137	0.007
Benzo[*g,h,i*]perylene	--	--
Pentachlorophenol	8.33	4.9
Dioxin TEQ[3]	6.67×10^{-6}	--

1 – As presented in the 2000 ROD. MTCA Method B values are based on future unrestricted land use.
2 Cleanup levels are based on calculated porewater concentrations that are protective of sediments, see 2000 ROD, Table 13. a – These cleanup levels are based on MTCA Method B surface water for human consumption of organism.
3 – TEQ as calculated with Ecology's TEFs

MTCA Washington Model Toxics Control Act
TEF toxicity equivalency factor
TEQ toxic equivalents

2.2.3. Status of Implementation

The sheet pile wall around the full Former Process Area was installed in 2001. The thermal treatment pilot study was conducted between October 2002 and April 2003. It was determined that performance

expectations could not be met due to numerous technical challenges[1], so the contingency remedy was initiated in 2004. The new (and current) groundwater treatment plant, which utilizes carbon adsorption for treatment, was constructed in 2010 and has been operating since 2010. Long-term groundwater monitoring of water levels and contaminant concentrations began in March 2004 and remains ongoing. Institutional controls to prevent groundwater access were implemented in the form of a Prospective Purchasers Agreement between EPA and the City of Bainbridge Island in 2004. Engineering controls implemented included fencing, signage, and other site access controls. The site soil cap required in the contingency remedy has not been completed.

In 2012, Ecology assumed operation of the groundwater extraction and treatment system, pursuant to a State Superfund Contract. In the same year, EPA began reevaluating whether additional source removal actions may be needed at OU-2/OU-4.

An Uplands NAPL Site Investigation (CH2MHill, 2013e) was completed in September of 2013 and an update to the conceptual site model (CSM) was completed in February 2014 (CH2MHill, 2014a). The CSM update incorporated new information from the Uplands NAPL site investigation, groundwater characterizations from the upper and lower aquifers, and other site related activities. Results of these investigations are discussed in the Data Review section. A focused feasibility study was completed in April 2016 (CH2MHill, 2016c). EPA issued a Proposed Plan describing a new proposed cleanup alternative for OU-2/OU-4 (EPA, 2016). The preferred alternative was in-situ solidification and stabilization in the most highly contaminated areas, NAPL recovery through new extraction wells, and enhanced aerobic biodegradation along the perimeter wall to treat groundwater draining to Eagle Harbor. The interim ROD Amendment selecting the final remedy is expected to be signed in late 2017.

2.2.4. IC Summary Table

Table 5 summarizes the institutional controls (ICs) required for OU-2/OU-4.

Table 5. Summary of Planned and/or Implemented ICs for OU-2/OU-4

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)[1]
Groundwater	Yes	Yes, 2000 ROD	Former Wyckoff Facility	Restrict use of upper and lower aquifer groundwater	Prospective Purchasers Agreement, 2004
Soils	Yes	Yes, 2000 ROD	Former Process Area	Restrict site use to reduce direct exposure to surface soil	Prospective Purchasers Agreement, 2004

1 – Document reviewed for this FYR and verified it is recorded with Kitsap County.

[1] The 2012 Five-Year Review (USACE, 2012) includes a detailed summary of the pilot study performance.

2.2.5. Systems Operations/Operation & Maintenance

O&M for OU-2/OU-4 consists of the operation of the groundwater extraction and treatment plant, which has been in operation since 2010. The extraction system is operated to maintain an upward vertical gradient to prevent contaminated groundwater migration to the lower aquifer or Puget Sound. A detailed evaluation of the upward gradient is presented in Appendix E. NAPL is recovered during the extraction process, stored in an on-site tank, and eventually shipped off-site for disposal. The extraction and treatment system is generally operated 7 days a week, 24 hours per day all year round, except for maintenance. Annual operations and maintenance costs for the extraction system and treatment plant are $800,000.

2.3. OU-3 West Harbor

2.3.1. Basis for Taking Action

The COCs for subtidal and intertidal sediments in OU-3 are mercury and PAHs.

The risk assessment, which is summarized in the 1992 OU-3 ROD (EPA, 1992), showed that human populations potentially exposed to contamination at OU-3 include children and adults who consume contaminated fish and/or shellfish, and individuals who might be exposed to contaminated intertidal sediments through dermal exposure or incidental ingestion. Waterfront residences, public parks, and fishing piers provide access to potentially contaminated intertidal beaches and harvestable seafood. Marine organisms potentially exposed to contaminated sediments include sediment-dwelling organisms. Marine animals such as bottom-feeding fish and crabs are exposed to both contaminated sediments and contaminated prey organisms. Animals higher in the food chain may in turn be exposed.

In samples from Eagle Harbor collected for the RI (CH2MHill, 1989), subtidal mercury concentrations exceeded maximum background values by between two and twenty times throughout the harbor and were particularly high near the former shipyard. Samples from locations adjacent to the former shipyard contained concentrations up to 95 mg/kg mercury, over 100 times higher than concentrations acutely toxic to oyster larvae. EPA defined sediments containing concentrations of 5 mg/kg or more mercury as the principal threat in the West Harbor.

PAH concentrations were extremely high in intertidal sediments adjacent to the Wyckoff facility (OU-1) and, to a lesser extent, near the ferry terminal (OU-3). Concentrations of PAH in sediment adjacent to the former shipyard in the West Harbor were lower, but were still higher than concentrations measured at intertidal background stations. Subtidal samples showed several high PAH values near the former shipyards in the West Harbor.

2.3.2. *Response Actions*

The ROD for OU-3 was signed on September 29, 1992 (EPA, 1992). The primary RAO was the "achievement of the SQS and reduction of contaminants in fish and shellfish to levels protective of human health and the environment." In order to define areas requiring remedial action, the following additional objectives were added to supplement the RAO:

- To address sediments containing 5 mg/kg (dry weight) or more of mercury ("Mercury Hotspot"), as a means of source control;
- To address intertidal sediments containing 1,200 µg/kg (dry weight) or more of HPAH ("Intertidal HPAH Areas"). Shellfish in such areas contained carcinogenic HPAH above EPA acceptable levels for protection of human health;

- To address predicted biological impacts, minimize potential sediment resuspension, and limit biological uptake in areas where sediment concentrations of mercury exceed 2.1 mg/kg mercury dry weight ("Mercury High Apparent Effects Threshold [HAET] Areas").

The major components of the selected remedy in the OU-3 West Harbor ROD included:

- Excavation, solidification/stabilization (if necessary), and upland disposal for Mercury Hotspot areas where mercury sediment concentrations exceeded 5 mg/kg (dry weight);
- Placement of a 1 meter thick cap in Mercury HAET Areas where mercury sediment concentrations were greater than 2.1 mg/kg (dry weight);
- Natural recovery and institutional controls in Intertidal HPAH areas where HPAH concentrations were greater than 1,200 µg/kg. (For intertidal HPAH areas that also exceeded a mercury threshold, the appropriate mercury remedial action would be implemented.)
- Thin-layer placement of clean sediments to enhance sediment recovery in MCUL Areas where mercury or PAH sediment is above the MCUL, but all other site objectives are met (i.e. not included in a previous category);
- Natural recovery and monitoring in SQS Areas where SQS criteria are exceeded but other site objectives are met;
- Source control efforts to evaluate and control significant upland sources of contamination to West Harbor, including: stormwater discharges from urban runoff, marine operations (e.g. boatyards and marinas), and releases from contaminated uplands;
- Continued institutional controls to protect human health from exposure to contaminated fish and shellfish; and
- Long-term environmental monitoring to evaluate the effectiveness of the remedy.

In December 1995, EPA issued a ROD Amendment (EPA, 1995) to alter the disposal method of Mercury Hotspot areas, and to include source control. The following changes were made to the remedy:

- Source control measures at the Former Shipyard were required to comply with MTCA Method C (supplemented with Method A) soil cleanup standards for protection of human health, based on current and future industrial land use, or for protection of surface water, whichever was more stringent.
    - Source control measures included solidification/stabilization for soils above the stabilization action levels[2]. Remaining soils above 2 mg/kg mercury or 250 mg/kg copper were to be covered with an asphalt cap. Groundwater diversion and tidal water barriers were to be used to minimize water entering the subsurface and leaching metals from contaminated soils.
- Disposal of approximately 7,000 cubic yards of mercury hot-spot sediments was to occur in a nearshore confined disposal facility (CDF) adjacent to the Former Shipyard. The CDF was to be constructed on 0.9 acres of intertidal land adjacent to the Former Shipyard and be capped with low-permeability material such as asphalt.
    - Sediments containing less than 5 mg/kg mercury but greater than 2.1 mg/kg mercury could be included in the CDF at the discretion of EPA, provided the 0.9 acre footprint was not exceeded and sediment and water quality was not affected.

[2] The ROD Amendment identified these action levels as "soil cleanup standards", but they were intended to be applied only to identify necessary remedial measures, not as ongoing cleanup standards.

- Sediments characterized as hazardous waste totaled approximately 230 cubic yards and would be treated to meet land disposal restrictions prior to disposal at an off-site landfill. Treatment of these sediments addressed a principal threat at the site.

Sediment cleanup levels set in the 1992 ROD are similar to those for OU-1 presented in Tables 1 and 2, except pentachlorophenol is not a COC in OU-3. The SQS represent conceptual target conditions, but the MCULs are considered the measurable site specific objective. MCULs must be achieved in the top 10 cm in OU-3 within 10 years from construction completion.

2.3.3. Status of Implementation

In November 1993, EPA and PACCAR, Inc. (the potentially responsible party at OU-3) entered into an Administrative Order on Consent (AOC) (EPA, 1993b), which set forth the requirements for remedial design of those actions described in the 1992 ROD.

The initial OU-3 remedial construction was completed during the summer of 1997. The tidal barrier system, which includes the seep remediation cap, was completed in 2006 (Figure 3). The total remedy consisted of the following activities:

- Source control through soil stabilization of two upland "hot spot" areas;
- Installation of a drainage system along the northern boundary of the site (known as the Northern Cutoff Drainage System) to intercept and cut off surface and shallow subsurface water run-on;
- Installation of an asphalt concrete cap across the upland area;
- Implementation of upland best management practices, including stormwater treatment;
- Institutional controls including deed restrictions and site-access controls for the active WSF maintenance yard;
- Construction of the CDF;
- Dredging of hot spot sediments (mercury concentrations greater than 5 mg/kg dry weight) and placement in the CDF;
- Construction of a 39-inch cap over sediment with mercury concentrations between 2.1. and 5.0 mg/kg dry weight;
- Construction of a 6-inch cap over sediment with mercury concentrations between 0.59 and 2.1 mg/kg dry weight;
- Installation of a tidal barrier system along the western portion of the CDF to minimize the potential for seeps that could impact capped sediments; and
- Continued monitoring of intertidal sediments and shellfish.

2.3.4. IC Summary Table

Table 6 summarizes the institutional controls required for OU-3.

Table 6. Summary of ICs for OU-3.

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Fish and Shellfish Tissue	Yes	Yes, 1992 ROD	Intertidal and subtidal areas	Health notices, advising against harvesting fish or shellfish from Eagle Harbor.	Kitsap Public Health District currently maintains shellfish advisories for Eagle Harbor (see Appendix I)
Deed Restriction	Yes	Yes, 1995 ROD Amendment	Ferry Maintenance Facility	Deed restriction to perpetuate industrial site use.	*See summary below.

*PACCAR provided electronic survey data to WSF Terminal Engineering in late May 1998. WSF uses the data to determine environmental requirements and land use restrictions for any proposed excavation actions by WSF. The deed restrictions will be reiterated in any lease agreements administered by WSF. However, WSF has not entered into any lease agreements on the Eagle Harbor property since remedial actions were implemented at the site.

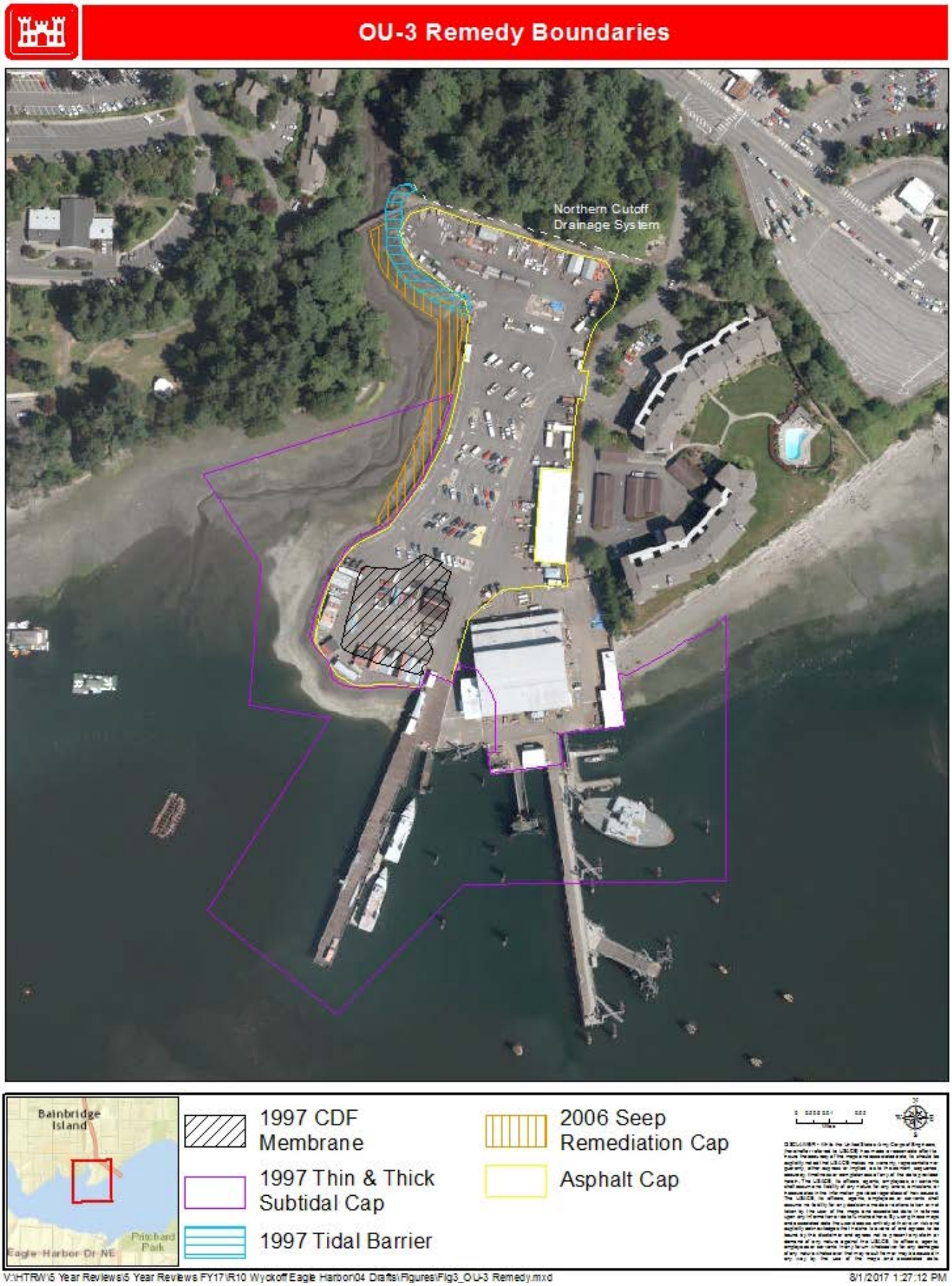

Figure 3. OU-3 Remedy Boundaries

2.3.5. Systems Operations/Operation & Maintenance

WSF conducted long-term monitoring of the subtidal and intertidal areas of the West Harbor from 1997 to 2007 (Years 1 through 10) in accordance with the 1997 OMMP. In 2008, the OMMP was updated for use from 2008 to 2017 (Years 11 through 20). Monitoring has occurred each year according to the updated OMMP.

The primary activities associated with the OMMP include:

- Annual inspections of the upland area (i.e. asphalt cap), shoreline area, and the stormwater drainage system, and
- Groundwater and intertidal seep monitoring once every five years (most recently in 2016).

In the last five years, some ongoing issues persisted, as detailed further below. Otherwise, OU-3 is in good condition. No fencing damage was observed, minimal ponding was evident on the asphalt cap surface, and seeps observed in the seep remediation cap area were flowing clear.

Cracking on the asphalt surface is a continuing problem at OU-3. Several long cracks along the construction joints were originally discovered in 2009 and were sealed with asphalt the same year. Additional repairs were subsequently made in 2011 and 2012. In 2011 a pavement engineer evaluated the asphalt cap surface and found it in overall good structural condition, though showing signs of aging. In 2013 the cracks were resealed using a new method. The cap condition was again evaluated in 2016 and 2017 and found to be in sound structural condition despite the signs of aging. It was decided to continue monitoring semiannually to determine when a full asphalt overlay is needed.

One portion of the asphalt cap has had continued subsidence issues. In 1999, a subsidence was discovered on the southern shoreline adjacent to Pier A (Figure 4) and was repaired with an asphalt patch. An investigation concluded that the subsidence may have been caused either by displacement of fines through tidal action or by differential settlement of the berm material. Additional repairs were made in 2006 and 2009. In 2013, a hole 2 feet in diameter and 2 feet deep formed (Figure 5). A more permanent repair was designed. The August 2013 repair included the installation of concrete locks along the under pier edge to prevent sloughing of fill material. In May 2014, under pier elevation markers were installed to monitor scour and settlement of material near this subsidence area. These markers are now monitored during annual site inspections. As of 2016, no significant erosion has been observed at these markers.

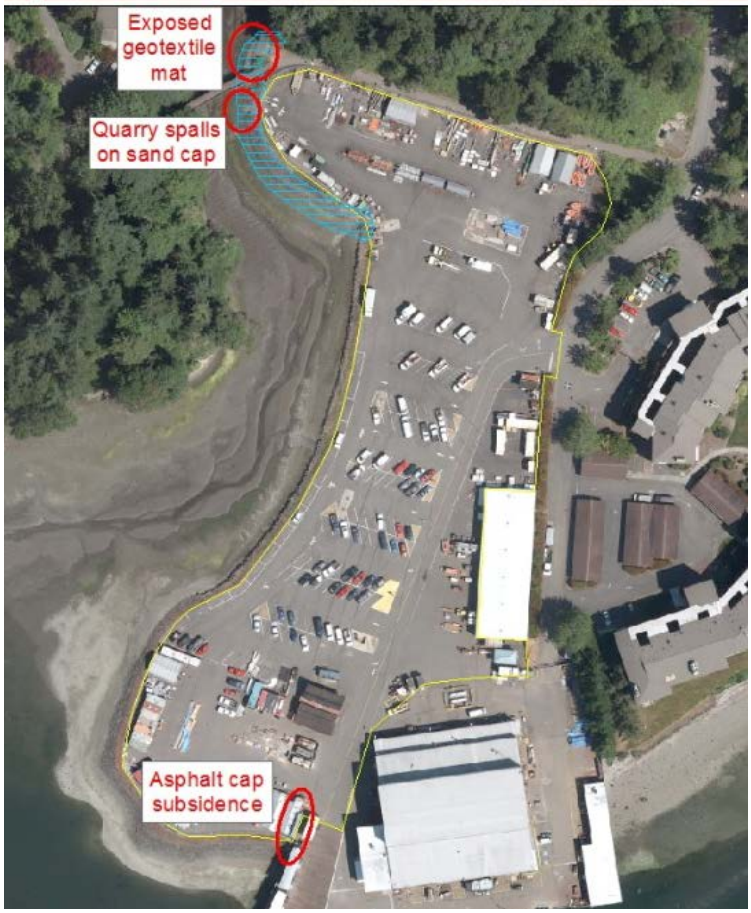

Figure 4. Location of Persistent Issues at OU-3

Figure 5. 2013 Asphalt Cap Subsidence and Repair, OU-3

A portion of the shoreline geotextile mat north of and under the footbridge (Figure 4) has continued to be exposed (approximately 25 ft^2), and began to show signs of deterioration and cracking in 2012. Repairs were made in August 2013 by placing additional quarry spall and boulders (Figure 6).

Figure 6. 2013 Geotextile Mat Exposure and Repair, OU-3

In 2016 quarry spalls were observed on the sand cap along the rockery south of the footbridge (Figure 7 and Figure 4). These spalls appeared to have either fallen or been thrown down the slope. It did not appear to the inspectors that this would impact the integrity of the rockery.

Figure 7. Quarry Spalls on Sand Cap, OU-3

Annual operation and maintenance costs are approximately $20,000-$30,000 per year, and did not vary greatly over the last five years. Other costs during the last five years included the 2013 pavement and geotextile mat repairs, which cost approximately $100,000, and additional crack sealing in 2016 for $8,500.

3. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness statements from the last (third) FYR for all of the OUs (Table 7), as well as the recommendations from the last FYR and their current status (Table 8).

Table 7. Protectiveness Statements from the 2012 (Third) FYR

OU #	Protectiveness Determination	Protectiveness Statement
1 – East Harbor	Will be Protective	The remedy is expected to be protective of human health and the environment after replacement and extension of the subtidal cap in the areas of the ferry navigation lane and grid cell J-9, respectively and continued monitoring of East Beach and North Shoal shows that natural recovery goals have been met.
2&4 – Soil and Groundwater	Will be Protective	The remedy is expected to be protective of human health and the environment when the soil cap is constructed and appropriate institutional controls are in place for the anticipated future land use (currently planned to be a park). Exposure pathways that could result in unacceptable risks are currently being controlled by the fencing, sheet pile wall and groundwater treatment system and no one is currently using the groundwater as a drinking water source.
3 – West Harbor	Protective	The remedy is protective of human health and the environment, and exposure pathways that could result in unacceptable risks are being controlled by the asphalt cap and intertidal barrier system.

Table 8. Status of Recommendations from the 2012 (Third) FYR.

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
1	Cap material in the subtidal cap within the ferry navigation zone is less than the target remedial goal. This reduces the effectiveness of the cap to isolate underlying contaminated sediments.	Repair cap to the target thickness.	Completed	Sand and quarry rock armoring were placed in the damaged areas.	2/23/2017

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
1	Cap material in the subtidal cap within grid cell J-9 is less than the target remedial goal. This may reduce the effectiveness of the cap to isolate underlying contaminated sediments in the future.	Further evaluate whether additional thickness is needed for long-term protectiveness and construct cap to the target thickness as necessary.	Completed	Subtidal surface sediment sampling at J-9 was completed as part of the 2017 OMMP monitoring. Chemical results showed no exceedances of ROD cleanup levels.	1/24/2017
1	Two surface sediment sampling locations at the East Beach and North Shoal have not met the natural recovery goal. Subsurface sediments still contain substantive residual hydrocarbons.	Continue to monitor the East Beach for natural recovery and evaluate the necessity for a remedial action to mitigate subsurface residual contamination.	Completed	No monitoring has occurred at East Beach and the North Shoal. Visual observations have noted NAPL seeps along the beaches. The Proposed Plan issued in 2016 addresses contamination in these areas.	
1	Clam tissue sampling at Intertidal Beach, North Shoal and East Beach show elevated levels of contaminants which are still above risk based levels.	Continue monitoring clam tissue to establish time trends and continue shellfish restrictions.	Completed	Clam tissue was sampled in May 2014 and July 2016. No trend was seen due to significant variance over years and between locations (Appendix E). Shellfish restrictions continue to be implemented (Appendix I).	
2&4	Hydraulic containment may not be demonstrated during the wet season or periods of heavy precipitation.	Optimize the operation of the extraction system to ensure hydraulic containment is met during all seasons.	Ongoing	In March 2012 down-hole transducers were installed in well pairs screened in the upper and lower aquifers to provide constant vertical groundwater gradient data. Monitoring of the vertical gradient is ongoing.	Ongoing
2&4	No soil cap has been constructed.	Construct soil cap of impermeable material per the ROD.	Considered But Not Implemented	The soil cap was not constructed. The Proposed Plan issued in 2016 provides further detail regarding the soil cap remedy.	

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
2&4	Institutional controls have not been established to prevent exposure to contaminated soils in the Former Process Area.	Establish institutional controls after the construction of the soil cap to allow for maximum use.	Completed	The soil cap was not constructed. The Proposed Plan issued in 2016 provides further detail regarding the soil cap requirement for the remedy. Institutional controls are in place as noted in Table 5.	
2&4	The groundwater quality monitoring program is inconsistent	Implement a groundwater quality monitoring program with regularly scheduled sampling events to obtain a comprehensive assessment of hydraulic contaminant and long-term concentration trends.	Ongoing	Groundwater quality monitoring/sampling continues to occur on a sporadic basis. In the last five years, there have been three groundwater sampling events. It is recommended that annual sampling of the lower aquifer be conducted at a minimum.	Ongoing
2&4	Corrosion of the outer sheet pile wall.	Evaluate current wall thickness and provide corrosion protection of the sheet pile wall.	Ongoing	Evaluations of the sheet pile wall were completed in 2013, 2016, and 2017. Monthly visual inspections are scheduled, and reports are issued which indicate increasing corrosion. Corrosion protection has not been implemented. The Proposed Plan issued in 2016 provides a plan to address the sheet pile wall.	Ongoing.

4. FIVE-YEAR REVIEW PROCESS

4.1. Community Notification, Involvement & Site Interviews

Several public notices were made available by mail, email, and newspaper informing the public that there was an ongoing five-year review and inviting the public to submit any comments to the EPA. These notifications are included in Appendix H and summarized below:

- An email was sent on January 6, 2017 to the Wyckoff/Eagle Harbor email distribution list, which consists of 553 individuals and organizations.
- In December 2016, post cards were sent by mail to the Wyckoff/Eagle Harbor mailing distribution list, which consists of 875 individuals and organizations.
- A public notice was placed in the local newspaper, the *Bainbridge Islander*, on January 6, 2017.
- The City of Bainbridge Island included a notification of the public kick-off meeting in its January 6, 2017 'City Manager's Report' email.
- EPA included a notification on the Wyckoff/Eagle Harbor website.

EPA received comments from seven individuals. Comments included:

- Observations of potential creosote-stained sand;
- Concerns about the current [February] subtidal cap repair project, including early morning noise, overall cost, and preferred method for notifying nearby residents of construction;
- Concerns about future funding to complete the Wyckoff cleanup;
- Questions about potential groundwater well contamination;
- Recommendations to lower ferry speed limit to reduce impacts;
- Suggestions on appropriate technologies/methodologies to use for the Wyckoff cleanup; and
- Concerns about Suquamish Tribes' Treaty-reserved rights and resources.

The results of the review and the report will be made available at the Site information repository located at Bainbridge Island Public Library, 1270 Madison Avenue, Bainbridge Island, WA.

4.1.1. Site Interviews

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date**.** Several interviews were conducted for each OU and are summarized below. Details of the interviews can be found in Appendix G.

Interviews for OU-1 included Susannah Edwards from Ecology, and Rich Brooks from the Suquamish Tribe. Ms. Edwards indicated that the intertidal caps are performing as expected. The subtidal cap was just repaired and she is still awaiting results of cap survey; other areas of the subtidal cap are performing well. Ms. Edwards walks the beaches at Wyckoff regularly and has observed NAPL seeps and sediment movement in some areas that has resulted in the sand cap washing away. Ms. Edwards noted that the SMS was revised in 2013 and that this may affect the cleanup levels. She also suggested that Ecology work with EPA to evaluate risks from dioxins and furans, which were not listed as COCs in the 1994 ROD or Proposed Plan. Mr. Brooks was supportive of the current efforts to amend the ROD, and expressed the Suquamish Tribe's strong preference for a remedy that includes significant mass removal of contaminants in the upland area (OU-2/OU-4) and addresses remaining contamination in the nearshore areas of OU-1. Contaminated releases within the nearshore areas continue to affect the Suquamish Tribes' Treaty-reserved rights and resources, including the rights to harvest these resources.

Interviews for OU-2/OU-4 included Sam Meng from Ecology, and Ken Scheffler and Stanley Warner from CH2MHill. Dr. Meng commented that Ecology and EPA are making periodic visits to the site to monitor progress and evaluate the sheet pile wall. All interviewees indicated that the system is performing very well and continues to remove contaminants and maintain hydraulic control. Mr. Warner indicated that the monitoring data does not seem to demonstrate any increasing or decreasing trends in contaminant levels. He noted that annual maintenance of the system is conducted in the summer months when rain is minimal and therefore poses a low risk to losing hydraulic containment. Upcoming annual maintenance includes upgrading the wiring to the extraction wells and painting all pipes in the tank farm with ultraviolet resistant paint to extend longevity. Mr. Ken Scheffler indicated that the system is exceeding the design criteria and the carbon life is at 160% of the initial design life. Mr. Scheffler also indicated that there were no discernable trends in groundwater quality data but the system continues to maintain hydraulic control. Mr. Scheffler indicated that they would like to see the construction of the impermeable cap commence as the system currently treats millions of gallons of rainwater per year and the cap would allow them to reduce costs significantly[3]. All interviewees indicated significant concern over the condition of the sheet pile wall. The significant corrosion of the sheet pile wall has been

[3] It is noted that the impermeable cap Mr. Scheffler referenced is a part of the current remedy. An impermeable cap was not included in the preferred alternative in the 2016 Proposed Plan.

documented by multiple subject matter experts and all interviewees hoped that repair plans would be developed soon.

Interviews for OU-3 included Kevin Bartoy, Nancy Adams, and Tom Castor from the Washington State Department of Transportation (WSDOT), Ferries Division; and Rob Zisette from Herrera Environmental Consultants (a consultant to WSDOT). All interviewees indicated that the remedy is performing well, but that the asphalt cap is showing signs of aging. Specifically, cracking is becoming more regular, however, these cracks are superficial, and don't extend through the full depth of the cap. WSDOT is actively pursuing budget requests for a replacement of the asphalt cap. Mr. Zisette also indicated that a subsidence of the asphalt cap occurred on the southern boundary, which required repair. The cause of this subsidence was unclear. Ms. Adams indicated that the stormwater oil water separator outfalls don't have proper valves to keep tidewater from entering the oil water separator vaults. Mr. Zisette mentioned that the seep chemical monitoring data did show an increase in zinc concentrations when sampled in 2016 (compared to 2011 results). Although chemical samples are collected every five years, visual inspection for rust-colored water is performed annually, which Mr. Zisette said indicate high metals concentrations. Mr. Castor, who oversees maintenance, expressed concerns with not having a good as-built showing where contamination is located. This makes it difficult for him to identify where worker exposure could occur during O&M activities.

4.2. Data Review

Data available for the site was reviewed in detail in Appendix E, and is summarized below.

4.2.1. OU-1 East Harbor

Monitoring of OU-1 was conducted in the subtidal and intertidal portions of the OU. Subtidal sediments were evaluated to determine the effectiveness of containing underlying contaminated sediments. Intertidal sediments were evaluated for physical stability, effectiveness of containing underlying contaminated sediments, and for natural recovery. In addition, biological monitoring, in the form of clam tissue collection, was conducted to asses if shellfish are safe for human consumption.

In the spring of 2012 an assessment of the extent of NAPL in the intertidal zone of OU-1 was conducted utilizing laser-induced fluorescence (LIF) via Dakota Technologies' Tar-specific Green Optical Scanning Tool (TarGOST) technology. The assessment was used to update the existing Conceptual Site Model (CSM) for OU-1. The results of the assessment demonstrated that the active NAPL transport mechanisms of seep migration, sheen migration and groundwater advection with NAPL buoyancy are affecting the beach surface area. Because of these active pathways and tidal exchange effect, NAPL that is resident within the active tidal zone or migrates to this horizon from below is subject to release into the beach environment (CH2MHill, 2013f).

In January 2017, the subtidal sediments were sampled for PAHs, PCP, and mercury in seven locations (each a composite of three sub-locations; see Figure E-1). Sampling was focused in the North Shoal subtidal area, an off-cap area that had not been previously characterized (locations J7, J8, K7, K8, and L8), and in a capping area where the 2011 sampling showed that cap material wasn't meeting target thicknesses (locations J9 and J10). During the sampling, no NAPL or hydrocarbon odors or sheen were observed in any of the samples. The chemical results showed that five of the locations (J7, J8, J9, J10, and K7) were below the ROD cleanup levels. Locations K8 and L8 showed exceedances of the criteria values for three PAHs (acenaphthene, fluorene, and phenanthrene); see Figure E-1. These exceedances, however, were slight and within the expected variability due to total organic carbon normalization.

Because of this, it was concluded that concentrations in the subtidal areas were unlikely to pose a risk to benthic organisms.

Also in January 2017, the intertidal sediments were monitored at six locations on the EBS and the off-cap area west of West Beach (each a composite of three sub-locations; see Figure E-3). Samples were collected at four locations on the EBS (F12, H12, H12-c3, and I12) and two locations in the off-cap area west of West Beach (D12 and E11). Locations H12-c3 and E11 were discretionary locations chosen at the time of field sampling because of the observed exposure of the underlying cobble layer (H12-c3) and the presence of historic creosote pilings (E11). At all six locations, sediment samples were collected and analyzed for PAHs and PCP, and habitat layer depth measurements were made. The results showed concentrations below the ROD cleanup levels (both benthic and human health) for all locations except for E11. E11 showed exceedances of five PAH human health criteria (benzo[*a*]anthracene, chrysene, benzo[*b*]fluoranthene, benzo[*a*]pyrene, and total HPAHs).

To evaluate physical stability of the EBS habitat layer, depth measurements were taken at the same locations as the sediment chemistry samples (i.e. three measurements at each of locations F12, H12, H12-c3, and I12; see Figure E-4). Results showed at least one foot of habitat layer in most of the EBS except for H12-c3 and one of the three measurements at H12. No habitat layer was measured at H12-c3, confirming the visual observation, and reason this discretionary location was chosen, that the underlying cobble layer was exposed. At H12, only one of the three measurements was below the 1 ft target thickness, measured at 0.95 ft. The 2016 monitoring report recommended additional evaluation of the habitat layer depth to determine if further maintenance is required on the EBS.

Clam tissue in OU-1 was sampled in May 2014 and July 2016. Samples were collected from the intertidal areas around the Wyckoff facility (see Figure E-5) and at a background location at Point No Point Park, and analyzed for carcinogenic PAHs (cPAHs). The results show significant variability within each sample area and through time (since 2011; see Figures E-6 and E-7). No definitive trends could be discerned due to this variability. Although the OU-1 ROD does not include a tissue-based cleanup goal, EPA is proposing a goal of 0.12 µg/kg benzo[*a*]pyrene-equivalents (USACE, 2017), which is based on background concentrations of clam tissue collected from nonurban areas in the Puget Sound. Benzo[a]pyrene equivalent cPAH concentrations in all of the clam tissue collected since 2011 have been well above this potential goal. Additional monitoring is required to determine if tissue data are showing decreasing trends toward this goal.

4.2.2. OU-2/OU-4 Soil and Groundwater

Data reviewed for this five-year period included a soil investigation using TarGOST technology as well as three groundwater quality sampling events and continuous vertical gradient monitoring data for hydraulic containment.

4.2.2.1. Soil

In September of 2013 an Uplands NAPL Site Investigation (CH2MHill, 2013e) was completed which utilized TarGOST to determine the relative distribution of NAPL in the subsurface of OU-2/OU-4. The 2013 TarGOST investigation concluded that the NAPL distribution in the upper aquifer is thickest in the center of the site, where higher TarGOST responses were reported. NAPL lenses are vertically distributed, but not in any obvious patterns with depth. Details of this investigation are presented in Appendix E.

4.2.2.2. Groundwater Hydraulic Containment

Vertical gradients between the upper and lower aquifers are monitored by an array of transducers that were installed in March of 2012. The transducers monitor the hydraulic head measurements of well pairs that are screened in the upper and lower aquifers.

A review of the vertical gradient data for each monitoring period between 2012 and 2016 indicated that, overall, containment was generally demonstrated (Table E-1 and Figures E-10 through E-17). However, there are monitoring periods that have a higher percentage of negative gradient (downward flow) time where containment was not fully demonstrated. An evaluation of the percentage of time that negative gradients occur during monitoring periods and cumulative precipitation between 2012 and 2016 indicated that some of the monitoring periods show higher negative gradient percentages during periods of heavy rainfall, particularly during the fall and winter months.

Existing data indirectly support a hydraulic connection between the upper and lower aquifers. The aquitard thickness has been shown to vary over the site and has been shown to thin to less than 4 feet and potentially disappear altogether in the southeast and southwest corners of the site. Based on multiple lines of evidence, including aquitard thickness and depressions on the aquitard surface where NAPL could pool, the presence of NAPL in the aquitard is likely in the northern portion of the site.

4.2.2.3. Groundwater Contaminants

An update to the CSM was completed in February 2014 (CH2MHill, 2014a) which summarized the site investigations and incorporated new information from the TarGOST investigation, groundwater characterizations from the upper and lower aquifers, and other site-related activities. Updates to the CSM included a revised estimate of the NAPL volume in the upper aquifer from the previous estimate of 1,200,000 gallons to 650,000 gallons.

Information collected from the three sampling events in this five year period was included in the updated CSM. The CSM concluded that NAPL and dissolved NAPL constituents have been detected in the lower aquifer wells monitored at the site. June 2012 NAPL measurements indicate the presence of NAPL in three lower aquifer wells (VG-2L, P-3L, and CW15) in the northern area of the site. This is consistent with the groundwater monitoring results, which indicate the presence of acenaphthene and other PAH constituent concentrations near or above cleanup levels in wells located in the northern portion of the site. Elevated PAHs are also detected in the southwest portion of the site, surrounding piezometer PZ-11.

A summary of contaminant concentration data and time-series graphs are presented in Appendix E. From 2012 and 2016, PAHs were detected above cleanup levels in monitoring wells CW05, CW09, CW15, VG-2L, P-3L in the northeastern portion of the Site and PZ-11 located in the southwestern portion of the Site. A trend analysis for lower aquifer wells with PAHs detected above cleanup levels showed increasing trends for wells CW05, PZ-11, P-3L and VG-2L which corresponds with the NAPL detections in these same wells from the TarGOST report. A groundwater monitoring program with regularly scheduled sampling events has not been implemented in order to obtain a comprehensive assessment of hydraulic containment and long-term concentration trends. A groundwater monitoring program that includes annual sampling of the lower aquifer is recommended.

4.2.2.4. Groundwater Treatment Plant

A comparison of treatment plant influent and effluent total PAH and PCP concentrations shows that the treatment system is removing a significant amount of contamination from the groundwater. Effluent

concentrations were nearly all non-detect indicating that the treatment system is being operated properly and the activated carbon is being replaced at appropriate intervals.

The influent PCP data did show a statistically significant upward trend in the last five years. Because current effluent data is nearly all non-detect, it does not appear that these increasing concentrations are currently affecting the performance of the treatment plant. Plant operators confirmed that there has not been an increase in need to replace the activated carbon. However, if this trend continues, it is possible the treatment system will be impacted in the future. It is likely the activated carbon will need to be changed out more frequently resulting in higher operating costs.

4.2.2.5. Sheet-Pile Wall

In December 2013 a Technical Memorandum was submitted evaluating construction methods, exposure scenarios, tidal profiles and life-span evaluations (CH2MHill, 2013g). The structural evaluation indicated the minimum expected lifespan of the sheet pile wall in the "splash" zone due to general corrosion rates would be approximately 13.5 years. Wall failure due to general corrosion rates would likely be in the form of a localized, ductile failure that will be seen as bulging of the wall, or splitting or cracking of the sheet pile sections. The report concluded that with periodic inspection, these localized failures could be dealt with on a case-by-case basis and repaired as needed. The sheet pile in the "splash" zone was also expected to be vulnerable to the development of small holes due to pitting corrosion that would grow larger if not monitored and repaired.

An observation report in August 2016 noted two previously unidentified piling interlocks that were separating along the top of the wall on the eastern section of the wall (CH2M, 2016d). The locations of the two separated interlocks are in the vicinity of well P-1L. While the interlocks were observed being completely disengaged at the top of the wall they appeared to re-engage just below the ground surface inside the wall. Observations from the outside of the wall noted corrosion/erosion on the interlocks at the mudline.

An additional study of the sheet pile wall in October 2016 was conducted by a contractor involved with the initial installation in 2001 (SSW, 2016). The evaluation included a site visit to the wall to evaluate corrosion and a review of the field notes from the installation of the piles to note any issues with installation that may affect performance. The study reported that multiple piles had to be re-driven due to the piles leaning and the only notable records of difficult driving were reported at depths of 60' to 65' where most of the hard driving that was experienced occurred. Overall there was nothing on record to suggest that there was significant difficulty during installation of the wall that would affect performance.

All evaluations of the wall cite the overall corrosion occurring above the mudline and localized pitting of the steel. All evaluations give timelines of loss of structural integrity within five years. No subsurface evaluation of the sheet pile wall status was conducted during the review period but is scheduled for late 2017. All evaluations of the sheet pile wall urgently recommend repair/replacement of the wall as soon as possible.

4.2.3. OU-3 West Harbor

Chemical monitoring of the intertidal seeps showed increased concentrations of dissolved zinc compared to the 2011 results, however all dissolved zinc and copper concentrations were still below the marine water quality criteria. Monitoring of one groundwater well showed concentrations of dissolved copper, zinc, and mercury, and total mercury below the marine water quality criteria. Monitoring of subtidal sediment at OU-3 has not occurred since 2005.

4.3. Site Inspections

The site inspections for all three OUs were conducted on 1/12/2017. The purpose of the inspections was to assess the protectiveness of the remedies. The full site inspection trip reports are presented in Appendix F and summarized below.

4.3.1. OU-1 East Harbor

In attendance were Helen Bottcher, EPA RPM; Hun Seak Park and Sam Meng, Ecology; and Kayla Patten, Ben McKenna, and Ellen Brown, USACE. The inspection team walked the beaches from West Beach to the northern portion of the sheet pile wall. Along the beaches, the sediment was sandy and showed no sign of exposing the subsurface cobble. No seeps were seen. From the beach, several of the no-anchoring buoys could be seen, and no-anchoring signage was present on the Wyckoff property fencing.

4.3.2. OU-2/OU-4 Soil and Groundwater

In attendance were Helen Bottcher, EPA RPM; Hun Seak Park and Sam Meng, Ecology; Kayla Patten, Ben McKenna, and Ellen Brown, USACE; and Stan Warner, CH2MHill (plant operator). During the inspection, the team viewed the outer perimeter of the western sheet pile wall, several extraction wells, the eastern sheet pile wall (from the inner side), the tank area, and the treatment system building. At the time of the inspection, the extraction system and treatment plant were not operational due to below-freezing temperatures.

By far, the greatest concern seen during the site inspection was the very poor condition of the eastern sheet pile wall. Some portions of the wall had rusted away to less than one centimeter thick, and large chunks were observed flaking off the wall (Figure 8).

The other aspects of OU-2/OU-4 remedy were in good condition. Although not operational at the time, the extraction wells appeared to be in good condition; however, ice had pooled at the bottom of the containment area posing a safety hazard for personnel maintaining the extraction system. Vegetation around the site was significantly overgrown. Pathways between the extraction wells were cut into the vegetation, but general vegetation cut-back should occur. The tank area and treatment system building were in excellent condition; well organized and kept clean.

Figure 8. OU-2/OU-4 Sheet Pile Wall Corrosion

4.3.2.1. OU-2/OU-4 April Follow-up Site Visit

On April 28, 2017, an informal follow-up site visit was conducted by USACE to view the sheet pile wall again but with structural engineers present to provide expertise. This site visit was conducted at very low tide so the sheet pile wall could be viewed from the outer side (beach side). The engineers noted the same significant corrosion seen during the formal site visit. Engineers documented visible scouring of the sheet pile joints at the mudline where it was suggested that the tidal influence agitates the sand and rock within the insets of the wall to significantly erode the steel (Figure 9).

While testing the thickness of the wall by tapping a rock along the surface, a section about 4 inches in diameter broke off of the sheet pile wall. Soil and water began leaking out of the hole (Figure 9). Subsequent site visits attempted unsuccessfully to find the location of the break for verification. The initial break from tapping may potentially have been blister in the exfoliating layers of the wall that contained soil and water. The engineers noted that the sheet pile wall would not likely fail by collapsing, but that holes, like the one created, would become more common.

Figure 9. OU-2/OU-4 Outer Sheet Pile Wall Corrosion

4.3.3. OU-3 West Harbor

In attendance were Helen Bottcher and Bonnie Arthur, EPA; Hun Seak Park and Sam Meng, Ecology; R.J. Kelley and Kevin Bartoy, WSDOT Ferries Division; Kayla Patten, Ben McKenna, and Ellen Brown, USACE; and one private citizen who is heavily involved at the site. The site visit team inspected the interior and perimeter of the asphalt cap, the northern cutoff drainage system footpath, and the northern portion of the tidal barrier. The asphalt cap was in fair condition. Many cracks were present but all had been sealed; no new cracks were observed. Some denting of the asphalt was observed where storage containers had been placed. The stormwater system was in good condition. The fencing showed no damage or signs of unauthorized access. However, the main gate to the site remains open during the day, and a previous incident of unauthorized access and theft was reported. The northern portion of the tidal barrier (near the pedestrian footbridge) showed erosion, exposing the concrete liner. The area exposed was approximately 3 ft by 5 ft and was located high on the bank.

5. TECHNICAL ASSESSMENT

5.1. OU-1 East Harbor

5.1.1. QUESTION A: Is the remedy functioning as intended by the decision documents?

No, the remedy is not functioning as intended by decision documents. Chemistry data from the intertidal area has shown that the cleanup criteria were not met within the ten year recovery period as required by the ROD. In addition, the 2017 monitoring showed that the EBS cap is eroding in places and may not meet the designed habitat layer depth. NAPL seeps are still observed in portions of the intertidal sediment. These beach areas are currently closed to the public, but it is known that individuals do still choose to access these areas. Shellfish advisories remain in effect for the entire OU.

The TarGOST assessment of the extent of NAPL in the intertidal zone of OU-1 demonstrated that the active NAPL transport mechanisms of seep migration, sheen migration and groundwater advection with NAPL buoyancy are affecting the beach surface area. Because of these active pathways and tidal exchange effect, NAPL that is resident within the active tidal zone or migrates to this horizon from below may be subject to release into the beach environment.

The subtidal sediment remedy appears to be functioning as intended, following repair of the cap in the ferry lane in 2017. Subtidal data has shown that the cap is effectively isolating underlying contamination. Although the 2017 monitoring data were not conclusive, the data are showing reduced concentrations of contaminants to levels unlikely to pose a risk to benthic organisms.

5.1.2. QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. All OU-1 cleanup levels are based on state ARARs, specifically, MTCA and SMS. The SMS was amended in 2013 as described in Appendix C. The amended SMS now includes protection of human health and higher trophic level organisms. For Wyckoff this includes the evaluation of cleanup levels based on dermal contact or incidental ingestion of sediment. Standards to protect benthic invertebrates are unchanged. Changes in ARARs-based cleanup standards are small and do not affect overall protectiveness. However, EPA has reevaluated the cleanup levels based on direct contact and incidental ingestion and has proposed new risk-based Preliminary Remediation Goals (PRGs) in the 2016 Proposed Plan. Appendix C details this analysis.

Exposure assumptions and RAOs at the time of the remedy remain valid. Contaminant concentrations in subtidal sediments are progressing toward meeting the 1994 ROD cleanup levels, however intertidal sediment concentrations still remain above the cleanup levels beyond the ten year recovery period. Concentrations in clams do not show a conclusive trend to assess if progress is being made toward achievement of the shellfish RAO.

5.1.3. QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light which may affect the protectiveness of the remedy.

5.2. OU-2/OU-4 Soil and Groundwater

5.2.1. QUESTION A: Is the remedy functioning as intended by the decision documents?

No. In the last five years, PAHs have been detected in lower aquifer wells with increasing trends, indicating that the remedy is not protecting this potential drinking water source as required by the

RAOs. Generally, hydraulic containment of the groundwater is being demonstrated for most of the year, but there are periods of the year where full containment is not demonstrated, typically in the wet winter months. Groundwater monitoring is not occurring on a regular basis, which prevents a comprehensive assessment of hydraulic containment and long-term concentration trends. In addition, the soil cap required as part of the contingency remedy was never constructed, so soil containment is not occurring as intended by the remedy.

The sheet pile wall is showing signs of significant corrosion. Although the sheet pile wall is still functioning as a containment mechanism, the corrosion has significantly reduced its expected life span. Several studies of the sheet pile wall since 2013 have recommended repair or full replacement of the wall.

The groundwater treatment plant is maintained in excellent condition and is treating groundwater to concentrations that are below ROD cleanup levels for COCs. Institutional controls are in place to prevent drinking water well installation. Fencing and warning signs help limit site access.

5.2.2. QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. Soil and groundwater cleanup levels are based on MTCA. There have been some small changes in risk-based MTCA values that would result in a different cleanup level if calculated today, but they are not significant enough to affect overall protectiveness. PRGs proposed in the 2016 Proposed Plan are consistent with the current MTCA standards. Appendix C details this analysis.

Exposure assumptions and RAOs at the time of the remedy remain valid and progress is being made toward meeting many of the RAOs, but not all. For soil, direct contact with contaminated soil is limited by fencing and other access restrictions at the site; however, as noted above, some unauthorized access has been reported. The RAO to prevent stormwater runoff to Eagle Harbor is being achieved with the sheet pile wall surrounding the site. For groundwater, the extraction system is reducing the volume of NAPL, and the extraction system combined with the sheet pile wall are preventing upper-aquifer groundwater from leaving the site. The human exposure RAO is being achieved by institutional controls which prevent exposure to groundwater. In addition, the lower aquifer is not currently being used as a drinking source. The RAO to protect groundwater outside the site and in the lower aquifers is not being achieved; recent groundwater data has shown increasing PAH concentrations in the lower aquifer, indicating that the remedy is not achieving the RAO of protecting this potential future drinking water source.

5.2.3. QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light which may affect the protectiveness of the remedy.

5.3. OU-3 West Harbor

5.3.1. QUESTION A: Is the remedy functioning as intended by the decision documents?

Yes. The CDF continues to contain the dredged sediment and the tidal barrier system minimizes seep impact to capped sediments. Copper and zinc concentrations in the seeps remain below surface water criteria. Although the asphalt cap is showing signs of aging, it is currently in good structural condition and is repaired in a timely manner when needed. Plans are being made for a more significant repair or replacement of the cap in the near future.

5.3.2. QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. Cleanup levels are based on promulgated numerical ARARs that have not changed. Exposure assumptions and RAOs at the time of remedy selection still remain valid. Continued progress toward meeting the SQS RAO could not be evaluated because sediment data has not been collected since 2005.

5.3.3. QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light which may affect the protectiveness of the remedy.

6. ISSUES/RECOMMENDATIONS

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): OU-1	**Issue Category:** Remedy Performance			
	Issue: The exposure barrier system (EBS) habitat layer is eroding in places and may not meet the design depth in all areas.			
	Recommendation: Additional evaluation of sediment depth is needed to inform replenishment needs and timing.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	9/30/2021
OU(s): OU-1	**Issue Category:** Remedy Performance			
	Issue: Recent and past intertidal data show that cleanup levels were not achieved within the ten year recovery period required by the Record of Decision. In addition, NAPL seeps continue to be observed in the intertidal areas and it is known that the public does access these areas of the beach despite current beach closure notifications.			
	Recommendation: Additional beach closure notifications or barriers need to be added to areas known to be accessed by the public. In addition, evaluate the need for additional remedial action to address NAPL seeps.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Yes	Yes	EPA	EPA	3/30/2018
OU(s): OU-2/OU-4	**Issue Category:** Remedy Performance			
	Issue: The soil cap has not been constructed as required under the ROD contingency remedy.			
	Recommendation: Construct a soil cap to minimize surface water infiltration.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	9/30/2022
OU(s): OU-2/OU-4	**Issue Category:** Monitoring			
	Issue: Groundwater monitoring in the lower aquifer is not occurring on a regular basis.			
	Recommendation: Implement regularly scheduled monitoring to obtain a comprehensive assessment of hydraulic containment and long-term concentration trends.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	6/29/2018

OU(s): OU-2/OU-4	**Issue Category:** Remedy Performance			
	Issue: The sheet pile wall has experienced significant corrosion reducing its life span.			
	Recommendation: Perform repairs, or replace, the sheet pile wall to prevent leaks and other failures.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	6/29/2018
OU(s): OU-2/OU-4	**Issue Category:** Remedy Performance			
	Issue: Recent groundwater data has shown increasing PAH concentrations in the lower aquifer, which is considered a potential drinking water source.			
	Recommendation: Evaluate opportunities to limit migration of contamination to the lower aquifer.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	9/30/2022

6.1. OTHER FINDINGS

In addition, the following are recommendations that were identified during the FYR which may improve performance of the remedies and improve site security, but do not affect current and/or future protectiveness:

- The influent PCP concentrations to OU-2/OU-4 groundwater treatment plant have increased over the last five years. The existing treatment plant is capable of processing the increase in influent concentrations although more frequent carbon change-outs may be necessary.
- Vegetation around the site (OU-2/OU-4) must be cut back regularly to maintain access to all remedy components.
- Denting of the asphalt cap at OU-3 has been observed, caused by the feet of storage containers. Metal plates should be placed under the storage container feet to disperse the weight and prevent damage to the cap. Continue prioritizing regular maintenance of the asphalt cap, including yearly inspection, to ensure crack repair or replacement is done to extend the life of the cap.
- The oil water separator outfalls at OU-3 should be outfitted with outlet valves to prevent tidewater from entering the oil water separators.
- Sediment quality monitoring at OU-3 has not occurred since 2005. Sediment monitoring should be performed to confirm cleanup levels are being achieved.

7. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)	
Operable Unit: OU-1 East Harbor	*Protectiveness Determination:* Not Protective
Protectiveness Statement: The remedy at OU-1 is not protective in intertidal areas because of the following issues: NAPL seeps are observed in the intertidal areas, where public access does occur despite beach closure notifications; and contaminant concentrations in shellfish tissue remain above levels safe for human consumption. The following actions need to be taken to ensure protectiveness: additional beach closure notifications or barriers need to be implemented; additional evaluation of the exposure barrier system (EBS) cover thickness to inform replenishment need and timing; and additional action is required to stop intertidal NAPL seeps and mitigate residual contamination above the cleanup levels.	
Operable Unit: OU-2/OU-4 Soil and Groundwater	*Protectiveness Determination:* Short-term protective
Protectiveness Statement: The remedy at OU-2/OU-4 currently protects human health and the environment because contamination is contained by a sheet pile wall, site access is restricted and ICs are in place to prevent use of groundwater. However, in order for the remedy to be protective in the long-term, the following actions need to be taken: the remedy needs to be modified to minimize contaminant migration to the lower aquifer; the soil cap needs to be constructed; monitoring of the lower groundwater aquifer needs to be implemented on a regular schedule; and the sheet pile wall needs significant improvement or replacement.	
Operable Unit: OU-3 West Harbor	*Protectiveness Determination:* Protective
Protectiveness Statement: The remedy at OU-3 is protective of human health and the environment. The asphalt cap continues to prevent exposure to the contaminated dredged sediment and recent seep water quality monitoring shows concentrations below surface water criteria.	

8. NEXT REVIEW

The next five-year review report for the Wyckoff/Eagle Harbor Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

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APPENDIX B – DETAILED SITE BACKGROUND

General Site Info

The Wyckoff/Eagle Harbor Superfund site is located on the east side of Bainbridge Island in central Puget Sound, Washington (Figure 1). The Wyckoff Site includes the former Wyckoff Company wood-treatment facility, contaminated subtidal and intertidal sediments in Eagle Harbor, and other upland sources of contamination to the harbor, including a former shipyard on the north shore. At the former Wyckoff facility (OU-2/OU-4), soil and groundwater are contaminated with creosote-derived polycyclic aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), and other wood-treatment compounds. In Eagle Harbor, marine sediments are contaminated with PAHs, other organics associated with wood treating, and with heavy metals such as mercury, copper, lead, and zinc from the shipyard. Wood treating contamination in Eagle Harbor is a result of direct discharges to the waterway as well as contaminant transport through the subsurface groundwater and sediments.

More than 23,000 people live on Bainbridge Island. Land use on Bainbridge Island is principally residential, with some commercial and industrial use. The town center, known as Winslow, lies to the north of Eagle Harbor. The northern shoreline consists of residences, commercial centers, city parkland, several marinas, the Washington State Ferry maintenance and repair yard, and the ferry terminal. The western and southern shores are lined with residences, farms, marinas, a boatyard, city parkland, and, at the harbor mouth, the former wood-treating facility which extends into the harbor on fill. Eagle Harbor is heavily used by recreational boaters, house boats, and ferries to and from Seattle. Fishing, crabbing, and clam-digging were common recreational activities until 1985, when the Bremerton-Kitsap County Health District issued a health advisory to address bacterial and chemical contamination of seafood in Eagle Harbor. The advisory, recommending against the harvest and consumption of fish and shellfish, has significantly reduced recreational harvest of seafood from the harbor.

Eagle Harbor is within the adjudicated usual and accustomed fishing area (U&A) of the Suquamish Tribe, whose reservation is located on the Kitsap Peninsula north of Bainbridge Island. EPA recognizes that the Suquamish Tribe has Treaty-reserved or other fishing rights in the areas impacted by the Site and expects cleanup efforts to continue to improve habitat.

OU-1 Details

OU-1, East Harbor, includes offshore sediments in Eagle Harbor and nearshore sediments adjacent to the former Wyckoff facility (Figure B-1). East Harbor is heavily used by recreational boaters and the ferry to and from Seattle. The ferry currently makes about 46 trips per day (23 round trips) across Eagle Harbor as it travels between Seattle and Bainbridge Island.

On the southern edge of OU-1 lies Prichard Park, which includes the intertidal beaches of the OU. Current zoning along the shorelines of OU-1 include water-dependent industrial (the former Wyckoff facility), the ferry terminal district, and various residential zones. Anticipated future land use is the same, however specific residential zoning may change as population density changes.

OU-2/OU-4 Details

OU-2/OU-4, Soil and Groundwater, includes soils and groundwater at the former Wyckoff facility as well as remaining buried structures. The Former Process Area and surrounding area (50 acres total) were purchased by the City of Bainbridge Island in 2006 with the intent for the land to be used as a park. Although the Former Process Area lies within the current boundaries of Prichard Park, it remains off-limits to the public.

The current zoning of the former Wyckoff facility is water-dependent industrial. Uses under the current zoning may include retail commercial, indoor entertainment, cultural and government facilities, associated parking, agriculture, boatyards, and marine sales and repair. Reasonably anticipated future use for the Soil and Groundwater OU hillside is to remain parkland. The Former Process Area will continue to be excluded from public use until cleanup has been achieved. Currently, approximately 2,000 people live within one mile of the Wyckoff Site; the nearest residence is located less than 1/4 mile away.

The upper aquifer beneath the Former Process Area is classified as non-potable due to salinity. Groundwater in the upper aquifer south and west of the Former Process Area and in the lower aquifer is not currently used as drinking water, but the aquifers are assumed to be potential sources of drinking water.

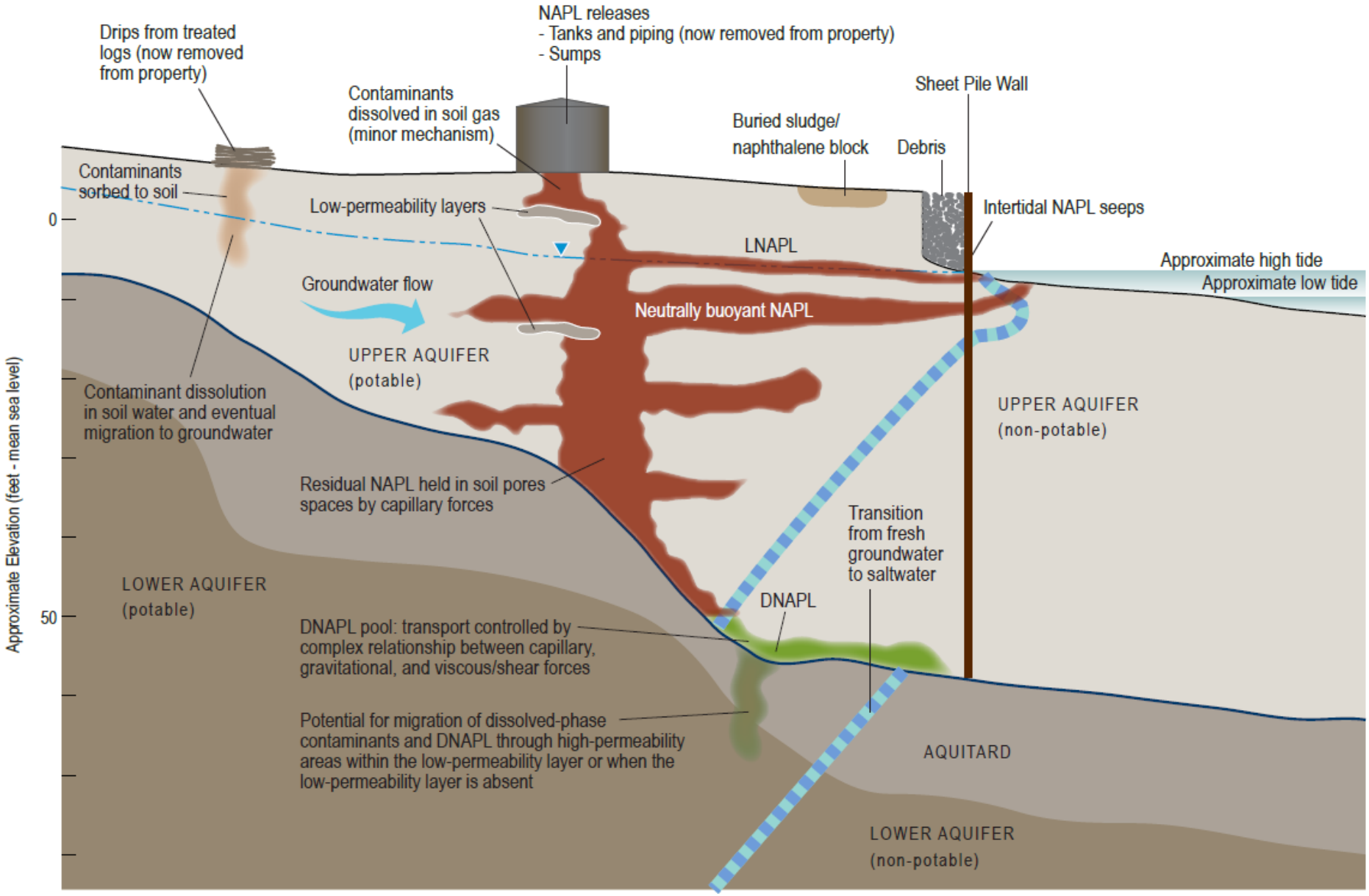

Figure B-1. Conceptual Hydrogeologic Model for OU-2/OU-4

OU-3 Details

OU-3, West Harbor, includes upland areas as well as offshore and nearshore sediments associated with the former shipyard operations in the western portion of Eagle Harbor. West Harbor is heavily used for marinas and boat moorage, in addition to the Washington State Ferries maintenance facility. Current zoning along the shorelines of OU-3 include residential, water-dependent industrial (the former shipyard area), and the Core District (the main town center). Future land use is anticipated to continue as the Washington State Ferries maintenance facility.

Past operations at the former shipyard included a bulkhead construction business and a yacht repair yard. The only ongoing operation is the ferry maintenance facility. These operations could be associated with recent or continuing sources of contamination to the harbor. Other minor sources of contamination may include other boat yards and marinas, surface water and groundwater from contaminated areas of the shipyard, and storm drain releases from paved parking areas and streets.

History of contamination

Former Wyckoff Facility

From 1904 through 1988, a succession of companies treated wood at the Wyckoff property for use as railroad ties and trestles, telephone poles, pilings, docks, and piers. Initially the poles were treated by wrapping with burlap and asphalt, but by 1910 pressure treatment began with creosote/bunker oil. The Wyckoff wood-preserving plant was one of largest in the United States and its products were sold throughout the nation and the rest of the world. Wood preserving operations included: (1) the use and storage of creosote, pentachlorophenol, solvents, gasoline, antifreeze, fuel and waste oil, and lubricants; (2) management of process wastes; (3) wastewater treatment and discharge; and (4) storage of treated wood and wood products.

The main features of the wood-treating operation included: (1) a process area, which included numerous storage tanks and process vessels such as retorts; (2) a log storage and log peeler area; and (3) a treated log storage area.

There is little historical information about the waste management practices at the Wyckoff facility. Prior to the expansion and reconstruction of the Wyckoff facility in the 1920s, it is reported that logs were floated in and out of a lagoon that once existed at the site. The lagoon has since been filled. Treated logs were also transported to and from the facility at the former West Dock via a transfer table pit, along which the chemical solution used in the treating cycle drained directly on the ground and seeped into the soil and groundwater below the surface. This practice began around the mid-1940s and continued until operations ceased in 1988. Wastewater was also discharged into Eagle Harbor for many years, and the practice of storing treated pilings and timber in the water continued until the late 1940s. Further site contamination occurred due to drips from treated poles and sloppy handling of used treatment product. The log storage area was primarily used to store untreated wood.

Former Shipyard

The shipyard began operation in 1902 under the Hall Brothers Marine Railway and Shipbuilding Company. Operations included shipbuilding with associated buildings such as machine shops, a powerhouse, sawmill, and warehouse (White, 2008). In 1916 the shipyard was sold and changed ownership several times until 1959. During World War II, the shipyard was used to repair damaged vessels and build minesweepers. In 1959 the shipyard finally closed, at which point the property was then split into a marina, an apartment complex, and a Washington State Ferries maintenance facility (Colton, 2016).

In the West Harbor, PAH contamination in nearshore sediments is believed to be from combustion products, minor spills, and pilings and piers in the waterway. Subtidal sediment PAH contamination is believed to reflect a combination of these sources, as well as disposal practices at the former shipyard and releases from the former Wyckoff facility in East Harbor. Elevated concentrations of metals, particularly near the former shipyard, are clearly associated with past shipyard operations, including the application, use, and removal (by sandblasting) of bottom paints and antifoulants.

Initial Response

Due to reports of oil observed on the beach, the U.S. Environmental Protection Agency (EPA) began investigating the property in 1971. In 1984, EPA issued a Unilateral Administrative Order (UAO) requiring the Wyckoff Company to conduct environmental investigations under the Resource Conservation and Recovery Act (RCRA) authority. Data collected at the time revealed the presence of significant soil and groundwater contamination. In the early to mid-1980s, the Wyckoff Company, EPA, Ecology, and the National Oceanic and Atmospheric Administration (NOAA) all investigated many aspects of the site. In July 1987, the site, including Eagle Harbor, the wood-treating facility, and other sources of contamination to Eagle Harbor, was listed on the National Priorities List (NPL).

In July 1988, the Wyckoff Company was ordered by EPA to install groundwater extraction wells and a groundwater treatment plant in an effort to halt continuing release of wood-treating contaminants to Eagle Harbor. The groundwater pump-and-treat systems were put online in 1990. In November 1993, EPA assumed control of the site and operation of the systems and discovered that both the treatment plant and extraction systems were in a state of disrepair. New extraction wells were installed to replace the original seven extraction wells and a variety of operational and process improvements were made to the treatment system.

A settlement with the Wyckoff Company was embodied in a Consent Decree entered in Federal District Court in August 1994. The Decree created the Pacific Sound Resources (PSR) Environmental Trust into which the heirs of the Wyckoff Company founders, owners, and operators placed all ownership rights and shares in the Company to allow the Trust to maximize liquidation of all company assets, including non-wood-treating holdings, for the benefit of the environment. The beneficiaries of the Trust are the United States Department of Interior, NOAA, and the Suquamish and Muckleshoot Tribes, as Natural Resource Trustees, as well as EPA for reimbursement of CERCLA remedial costs. A memorandum of agreement was entered into by the beneficiaries of the Trust to ensure that settlement proceeds would be applied toward both environmental response and natural resource restoration goals.

Other actions taken to deal with the contamination include demolition and removal of the buildings, structures, above ground and underground storage tanks, underground foundations and piping, and the removal of asbestos, sludge, and some heavily contaminated soil.

Wyckoff Site Chronology

Table B-1 provides a summary of events, decisions, and actions for the Wyckoff/Eagle Harbor Superfund site.

Table B-1. Chronology of Wyckoff/Eagle Harbor Superfund Site

OU(s)	Action	Date
All	Wyckoff property used for wood treatment via burlap and asphalt, or creosote/bunker oil.	1904-1988
OU-3	The former shipyard was used for shipbuilding and ship repair.	1902-1959
All	Pollution Control Commission reported direct discharge of oily material from the Wyckoff wood-treating facility to Puget Sound; oil observed on beach adjacent to the facility.	December 1952
All	EPA began investigating the property due to reports of oil observed on the beach adjacent to the Wyckoff property.	1971
All	EPA and the Washington Department of Ecology (Ecology) reported oil seepage to Eagle Harbor and required the Wyckoff Company to take immediate action to determine the source and reduce or eliminate seepage.	April 1972
All	U.S. Coast Guard issued Notice of Violation for oil discharge from the facility to Puget Sound.	May 1975
All	NOAA advised EPA and Ecology that samples of sediments, fish, and shellfish from Eagle Harbor contained elevated levels of PAHs in both sediments and biota.	March 1984
All	EPA issued a UAO requiring the Wyckoff Company to conduct environmental investigation activities under the RCRA Section 3013 (42 USC §6924), and Ecology issued an Order requiring immediate action to control stormwater runoff and seepage of contaminants. Data collected at the time revealed the presence of significant soil and groundwater contamination.	August 1984
All	The Wyckoff/Eagle Harbor Superfund site was proposed for listing on NPL.	September 1985
All	NOAA completed a study relating the presence of PAHs in sediment to the high rate of liver lesions in English Sole from Eagle Harbor.	1985
All	The Wyckoff Company entered into an Administrative Order on Consent (AOC) with EPA for further investigation of the wood treatment facility.	March 1987
All	The site was added to the NPL.	July 1987
All	Under an AOC, the Wyckoff Company agreed to conduct an Expedited Response Action (ERA). The ERA, intended to minimize releases of oil and contaminated groundwater to Eagle Harbor, called for a groundwater extraction and treatment system and other source control measures.	July 1988
All	Wyckoff Company ceased wood-preserving operations.	December 1988
All	Completed Remedial Investigation (RI) for Eagle Harbor.	November 1989
OU-2/ OU-4	Groundwater extraction and treatment system began operating at selected wells.	January 1990
OU-2/ OU-4	EPA issued a UAO requiring the Wyckoff Company (renamed and currently known as Pacific Sound Resources, Inc.) to continue the ERA with enhancements. The UAO called for increased groundwater extraction and treatment rates, improved system monitoring, and removal of sludge stored or buried at the Wyckoff facility.	June 1991
All	Completed Feasibility Study (FS) for Eagle Harbor.	November 1991
OU-2/ OU-4	EPA conducted a time-critical removal action at the Wyckoff facility removing creosote sludges and contaminated oils; disposing asbestos; installing steel sheet-	June 1992 – April 1994

OU(s)	Action	Date
	pile; repairing and constructing bulkhead; recycling materials from retorts, tanks, and other on-site steel.	
OU-3	ROD was signed for West Harbor.	September 1992
OU-1	EPA placed approximately 209,000 cubic meters of clean sediment materials over a 54-acre area of contaminated sediments in Eagle Harbor (Phase I cap).	September 1993 - March 1994
OU-2/ OU-4	EPA assumed responsibility for operation and maintenance (O&M) of the groundwater extraction and treatment system.	November 1993
OU-3	Administrative Order on Consent for Remedial Design for the West Harbor issued to PACCAR Inc., Washington State Department of Transportation, and Bainbridge Marine Services.	November 1993
OU-2/ OU-4	A time-critical removal action was conducted at the groundwater extraction system and treatment plant to repair/replace failing equipment, upgrade system parts, and perform clean-out of system units.	May – December 1994
OU-2/ OU-4	Pacific Sound Resources, Inc., and their principals settled their CERCLA liability with EPA and the federal and tribal natural resource trustees in a Consent Decree.	August 1994
OU-2/ OU-4	Completed Focused RI/FS for the Groundwater OU.	July 1994
OU-2/ OU-4	EPA issued Interim Record of Decision (ROD) for the Groundwater OU.	September 1994
OU-1	EPA issued the ROD for the East Harbor.	September 1994
OU-2/ OU-4	Signed Superfund State Contract (SSC) with Ecology for Groundwater OU Interim Remedial Action.	November 1994
OU-2/ OU-4	RI field investigations for the Soil and Groundwater OUs	1994 & 1995
OU-2/ OU-4	EPA sealed and abandoned 12 on-site wells, including two deep drinking water wells, due to concerns that they could provide conduits for migration of contaminants to the deep aquifers.	January – June 1995
OU-2/ OU-4	Seven original extraction wells were abandoned and replaced by eight new groundwater extraction wells; additional treatment plant upgrades including piping replacement, carbon handling, and installation of dewatering press.	June – December 1995
OU-3	West Harbor ROD Amendment was completed.	December 1995
OU-2/ OU-4	Non-time-critical removal action in the Soil and Groundwater OU: Site structures were demolished and debris was removed and disposed off-site.	January – June 1996
OU-3	West Harbor potentially responsible parties (PRPs) constructed the remedy at the old shipyard in accordance with the December 1995 ROD Amendment.	March - December 1997
OU-3	EPA issued a Water Quality Certification for the West Harbor remedial work.	April 1997
OU-3	West Harbor PRPs provided the Suquamish Tribe with $110,000 for clam enhancements and other restoration projects performed by the Tribe.	Summer 1997
OU-3	West Harbor PRPs constructed the 2-acre Schel-chelb Estuary restoration at the south shore of Bainbridge Island (“South Bainbridge Estuarine Wetland and Stream Restoration Site”). Planting occurred during February through late Spring 1998.	Summer 1997 - Spring 1998
OU-2/ OU-4	Completed removal of upland subsurface structures, such as process piping, utility lines, foundations, concrete pads, and asphaltic concrete.	November 1997
OU-2/ OU-4	EPA issued a “final” Proposed Plan which preferred containment as the cleanup strategy for soil and groundwater.	November 1997

OU(s)	Action	Date
OU-2/ OU-4	Long-term O&M associated with the containment strategy were of concern to the Department of Ecology; EPA evaluated thermal technologies for possible application at Wyckoff.	1998 – 1999
OU-2/ OU-4	Region 10 presented thermal technologies evaluation activities and proposed new remedy for removal of contaminants in the soil and groundwater at Wyckoff to the National Remedy Review Board.	July 1998
OU-3	West Harbor PRPs established a 0.6-acre eelgrass planting site immediately west of West Harbor confined disposal facility (CDF) and cap.	September - October 1998
OU-2/ OU-4	Completed Focused Feasibility Study Comparative Analysis of Containment and Thermal Technologies	April 1999
OU-3	West Harbor PRPs repaired 3 feet deep by 2 feet wide by 5 feet long depression that developed in surface of CDF during March - April 1999	June 1999
OU-2/ OU-4	Completed Conceptual Design for thermal remediation of the Soil and Groundwater OUs.	September 1999
OU-2/ OU-4	EPA issued a second Proposed Plan for the Wyckoff Soil and Groundwater OUs. This Proposed Plan replaced the November 1997 Proposed Plan and presented a change in the cleanup strategy. EPA's preferred remedy in this plan (now the selected cleanup remedy) focused on an innovative technology, called steam injection, to actively remove contaminants from the soil and groundwater. The Proposed Plan presented a contingent containment remedy if it was found through a treatability study that thermal treatment couldn't meet Remedial Action Objectives.	September 1999
OU-1	Completed removal of the West Dock in the East Harbor.	December 1999
OU-2/ OU-4	EPA issued ROD for Wyckoff Soil and Groundwater OUs.	February 2000
OU-2/ OU-4	EPA signed Superfund State Contract with Ecology for Soil and Groundwater OUs.	May 2000
OU-2/ OU-4	Completed the following construction activities in the Soil and Groundwater OU: installed over 1,800 lineal feet of sheet-pile containment wall around the Former Process Area; installed 530 lineal feet of sheet-pile wall within a highly contaminated 1-acre area of the site for the steam injection pilot study; created 2 acres of habitat beach to mitigate for habitat loss resulting from construction of the outer sheet-pile wall; extended the existing sediment cap by an additional 15 acres (Phase II cap).	February 2001
OU-2/ OU-4	Completed the following construction activities in the Soil and Groundwater OU: vapor cap over the steam injection pilot area, all 16 injection wells and seven extraction wells, over 600 thermal monitoring devices, boiler building; on-site water well for boiler feed water; removed additional 10,000 cubic yards of contaminated soil (20,000 cubic yards of contaminated soil were removed during habitat beach construction) to complete cleanup of the Former Log Storage/Peeler Area; Complete capping in East Harbor - more materials were placed extending out several hundred feet from the Wyckoff property to form a gently sloping beach which connects the habitat beach to the west with existing intertidal areas to the east.	February 2002
OU-2/ OU-4	Completed the following construction activities in the Soil and Groundwater OU: modifications to the existing groundwater treatment plant for treatment of new waste streams extracted from the steam injection pilot area; installation of boiler, water softening equipment, heat exchangers, thermal oxidizer, compressor, injection and extraction pumps and associated conveyance pumps and piping, and other pilot system equipment in the boiler building and within the pilot area; and start-up for all new equipment.	September 2002

OU(s)	Action	Date
All	Completed First Five-Year Review	September 2002
OU-2/ OU-4	Thermal Remediation Pilot Study conducted	October 2002 – April 2003
OU-2/ OU-4	Soils and Groundwater OU Contingent Containment Remedy is implemented.	April 2004
OU-2/ OU-4	Completed Up-Gradient Cutoff Wall soil and groundwater investigation	September 2004
OU-2/ OU-4	Completed Engineering Evaluation for Thermal and Containment Alternatives	April 2005
OU-2/ OU-4	Completed South Hillside soil investigation	October 2005
OU-2/ OU-4	The Soil and Groundwater OU property was sold to the City of Bainbridge	February 2006
OU-3	Completed West Harbor tidal barrier and seep remediation cap	August 2006
OU-2/ OU-4	Completed Thermal Pilot Study Summary Report	October 2006
OU-1	Completed West Beach sediment investigation	November 2006
All	Completed Second Five-Year Review	September 2007
OU-1	Explanation of Significant Differences (ESD) for the West Beach Exposure Barrier System signed	September 2007
OU-1	Completed West Beach Exposure Barrier System (EBS)	2008
OU-2/ OU-4	Replacement groundwater treatment plant (GWTP) construction complete and online	April 2010
OU-2/ OU-4	Old GWTP demolished	Summer 2011
OU-1	Operations, Maintenance and Monitoring Plan (OMMP) Addendum for East Harbor completed	May 2011
OU-1	Year 17 monitoring for East Harbor	July – November 2011
OU-2/ OU-4	State Superfund Contract signed with Ecology. Ecology takes over operation and maintenance of groundwater treatment plant until April 2014. EPA agrees to conduct Focused Feasibility Study to evaluate additional source removal options for the Soils and Groundwater OUs.	April 2012
All	Completed Third Five-Year Review	September 2012
OU-2/ OU-4	Completed the Upland NAPL Field Investigation	September 2013
OU-2/ OU-4	Sheet pile wall effectiveness evaluation completed	December 2013
OU-2/ OU-4	Conceptual Site Model Update report complete	2014
OU-1	East Harbor FFS completed	April 2016
OU-2/ OU-4	Soil and Groundwater OU NAPL Focused FFS completed	April 2016
OU-1 & OU-2/	Proposed Plan for amending the OU-1 and OU-2/OU-4 RODs published	April 2016

OU(s)	Action	Date
OU-4		
OU-1	Subtidal cap repair along ferry route completed	February 2017
OU-1	2016 Year 22 Monitoring Report completed	September 2017

Figure B-2. Wyckoff-Eagle Harbor Superfund Site

Legend

- Ferry Route
- OU-1 Cap Boundaries
  - 1994 Phase I Cap
  - 2000 Phase II Cap
  - 2001 Phase III Cap
  - Exposure Barrier System
- OU-3 Cap Boundaries
  - 1997 CDF Membrane
  - 1997 Thin & Thick Subtidal Cap
  - 1997 Tidal Barrier
  - 2006 Seep Remediation Cap
  - Asphalt Cap

Location Map

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APPENDIX C – REVIEW OF ARARS

Section 121(d)(2)(A) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) specifies that Superfund remedial actions must meet any Federal standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARs). ARARs are those standards, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

OU-1 East Harbor

Chemical-specific ARARs identified in the 1994 Record of Decision (ROD) for sediment at OU-1 were based on Washington Sediment Management Standards (SMS), and the chemical-specific ARARs identified in the 2007 Explanation of Significant Differences (ESD) for intertidal sediment at West Beach were based upon the Washington Model Toxics Control Act (MTCA).

Since the last FYR, Ecology amended the SMS rule with an effective date of September 1, 2013. The SMS amendments integrate SMS and MTCA cleanup requirements; clarify requirements for protection of human health and higher trophic level species from sediment contamination; and promulgate numeric chemical and biological criteria for freshwater sediment to protect the benthic community. The numeric chemical and biological criteria for marine sediments to protect the benthic community were not changed. These changes are not significant enough to affect the overall protectiveness of the remedy. EPA proposed in the 2016 Proposed Plan amending the RODs for OUs 1, 2, and 4 to use the amended SMS as the appropriate ARAR for setting cleanup levels in intertidal and subtidal sediments. The 2016 Proposed Plan revised the OU-1 sediment cleanup levels to Preliminary Remedial Goals (PRGs) for protection of human health protective of dermal contact and incidental ingestion of sediments for future shellfish collectors (Table C-1), consistent with the SMS. Cleanup levels for the protection of benthic invertebrates remain the same.

Other ARARs (e.g. action-specific ARARs) identified in the OU-1 ROD and ESD are no longer applicable as remedy construction is complete.

Table C-1. Preliminary Sediment Remediation Goals for Protection of Human Health in 2016 Proposed Plan.

Chemical Parameter[1]	Sediment PRG[2] ppb (µg/kg) Dry Weight
Benz(a)anthracene	631
Chrysene	63,083
Benzo(b)fluoranthene	631
Benzo(k)fluoranthene	6,308
Benzo(a)pyrene	63
Indeno(1,2,3,c,d)pyrene	631
Dibenzo(a,h)anthracene	63
cPAHs (sum TEQ)	63

1 – Toxicity values for PCP have changed, however PCP sediment concentrations have been well below levels of concern for human health for several years.
2 – These PRGs would be compared to the average concentration of COCs in the top two feet of beach sediment. These values are protective of Suquamish tribal shellfish collectors, and assumes shellfish are collected in bare feet (no boots). The combined risk of incidental ingestion and dermal update was used to generate these values.

µg/kg	micrograms per kilogram
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbons
ppb	parts per billion
PRG	preliminary remediation goal
TEQ	toxicity equivalent quotient

OU-2/OU-4 Soil and Groundwater

Chemical-specific ARARs identified in the 2000 ROD for soils at OU-2/OU-4 are shown below in Table C-2. The 2016 Proposed Plan revises OU-2/OU-4 PRGs to address changes in the MTCA-based soil ARARs due to changes in toxicity values (as shown in Table C-2). For naphthalene and pentachlorophenol, a soil cleanup level based upon current toxicity values would result in a more stringent level. For the other PAHs and dioxin toxicity equivalents (TEQ), a soil cleanup level based upon current toxicity values would result in a less stringent level. It is noted that for dioxin TEQ, the non-cancer reference dose change would result in a lowered cleanup level; however, this level is still less stringent than the raised cleanup level resulting from the change in the cancer slope factor. These changes are not significant enough to affect the overall protectiveness of the remedy. For groundwater, the 2016 Proposed Plan evaluated the previous clean up levels and further clarifies that groundwater cleanup levels are to be based on MCLs rather than the MTCA-based values calculated in the 2000 ROD.

Table C-2. Changes to soil chemical-specific ARARs for OU-2/OU-4

Contaminant of Concern	MTCA Method B Soil Cleanup Level (mg/kg)		Did ARAR change?
	ROD Cleanup Level	Current Standard[1]	
LPAHs			
Naphthalene	3,200	1,600	Yes
Acenaphthylene	--	--	--
Acenaphthene	4,800	4,800	No
Fluorene	3,200	3,200	No
Phenanthrene	--	--	--
Anthracene	24,000	24,000	No
HPAHs			
Fluoranthene	3,200	3,200	No
Pyrene	2,400	2,400	No
Benz[*a*]anthracene	0.137	10	Yes
Chrysene	0.137	1,000	Yes
Benzo[*b*]fluoranthene	0.137	10	Yes
Benzo[k]fluoranthene	0.137	100	Yes
Benzo[*a*]pyrene	0.137	1 [a]	Yes
Indeno[1,2,3-*cd*]pyrene	0.137	10	Yes
Dibenzo[*a*,*h*]anthracene	0.137	1	Yes
Benzo[*g*,*h*,*i*]perylene	--	--	--
Pentachlorophenol	8.33	2.5	Yes
Dioxin TEQ[2]	6.67×10^{-6}	1.28×10^{-5}	Yes

1 – Current MTCA Method B cleanup levels were calculated according to WAC 173-340-740(3) incorporating current toxicity values (shown in Appendix D).

2 – Cleanup level for 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). For compliance, TEQ is calculated with Ecology's TEFs and compared to the cleanup level for 2,3,7,8-TCDD.

a – This value is based upon the current cancer slope factor for benzo[*a*]pyrene. The calculated value based on the current non-caner reference dose is less stringent and is therefore not applicable.

Highlighted cells indicate cleanup levels that changed

Table C-3 summarizes changes to action- and location-specific ARARs identified in the 2000 ROD. Only ARARs which remain applicable to the OU remedy were reviewed. As shown, changes have occurred to the action- and location-specific ARARs, but they do not affect protectiveness.

Table C-3. Changes to action- and location-specific ARARs for OU-2/OU-4

Requirement and Citation	Document	Description	Amendment Date	Effect on Protectiveness	Comments
Washington Dangerous Waste Regulations WAC 173-303	2000 ROD	This is applicable to the treatment, storage or disposal of solid wastes which are dangerous or extremely hazardous to public health and the environment. Sludges, NAPL, tank bottom sediments, and spent carbon will be disposed off-site.	Several amendments since 2000.	No effect on protectiveness	
Resource Conservation and Recovery Act (RCRA) 40 CFR 261	2000 ROD	This applies to the identification of hazardous wastes. The NAPL and the treatment plant waste streams (sludges, tank bottom sediments, and spent carbon) are listed hazardous wastes.	Several amendments since 2000.	No effect on protectiveness	2015 revisions include new requirements for management of tank systems and containers, and air emission standards for tanks and containers.
RCRA 40 CFR 264.1080 and 265.1080 Subpart CC	2000 ROD	Air Emission Standards for Tanks, Surface Impoundments and Containers - This is relevant and appropriate to tanks, containers, surface impoundments, etc., that manage volatile hazardous waste.	July 14, 2006	No effect on protectiveness	
Off-site Disposal Rule 40 CFR 300.440	2000 ROD	Wastes being treated or disposed off-site may only go to facilities that are in compliance with EPA's Off-site Rule.	No revisions since 2000.		
National Pollutant Discharge Elimination System WAC 173-220	2000 ROD	The Washington State NPDES program provides conditions for authorizing direct discharges to surface waters and specifies point source standards for such discharges. The substantive NPDES standards are applicable to discharges to surface waters by the groundwater treatment plant. Substantive discharge standards have been developed for the existing treatment plant and, with some modifications, will also be applicable to the thermal pilot study treatment system.	March 18, 2002	No effect on protectiveness	

Requirement and Citation	Document	Description	Amendment Date	Effect on Protectiveness	Comments
Federal Endangered Species Act of 1973 16 USC 1531 et seq. 50 CFR 200, 402	2000 ROD	This regulation is applicable to any remedial action performed at this site since this area is potential habitat for threatened and/or endangered species. The special species of concern for the Wyckoff site and surrounding marine habitats include Puget Sound Chinook, bull trout, Stellar sea lion, bald eagle, and marbled murrelet.	Several amendments since 2000.	No effect on protectiveness	
U.S. Fish and Wildlife Coordination Act 16 USC 661 et seq.	2000 ROD	Eagle Harbor provides potential habitat for the species identified above and is used as a salmonid migratory route. This act prohibits water pollution with any substance deleterious to fish, plant life, or bird life, and requires consultation with the U.S. Fish and Wildlife Service and appropriate state agencies. Criteria are established regarding site selection, navigational impacts, and habitat remediation. These requirements are applicable for remedial activities on the site.	Several amendments since 2000.	No effect on protectiveness	

OU-3 West Harbor

Chemical-specific ARARs identified in the OU-3 1992 ROD (EPA, 1992) for sediments were based on the SMS criteria for protection of marine benthic invertebrates. No changes have occurred to these requirements. Other ARARs (e.g. action-specific ARARs) identified in the OU-3 ROD are no longer applicable as remedy construction is complete. The 1995 ROD Amendment (EPA, 1995) added MTCA Method C (supplemented with Method A) soil cleanup standards as an ARAR for implementation of the soil remedy. As remedy construction is now complete, these cleanup standards are also no longer applicable.

APPENDIX D – TOXICITY REVIEW

All cleanup levels in the OU1, OU-2/OU-4, and OU-3 RODs are ARARs-based and toxicity changes are reflected in the 2016 Proposed Plan Table 7-2. However, these changes in toxicity do not affect protectiveness. As discussed in Appendix C, human heath dermal contact and incidental ingestion risks for future collectors of shellfish on the OU-1 beaches was evaluated as part of the 2016 Proposed Plan. Revised PRGs based on this risk evaluation are presented in Table C-1.

APPENDIX E – DATA REVIEW

OU-1 East Harbor

During the last five years, ongoing operation and maintenance monitoring of East Harbor included monitoring of both subtidal and intertidal sediments. Subtidal sediments were evaluated to ensure the placed cap continued to contain the underlying contaminated sediments. The intertidal sediments were evaluated to ensure the physical stability of the placed cap and the cap's ability to contain contaminated sediments. Additional clam tissue sampling was conducted to asses if clams in the intertidal areas were safe for human consumption. During this five-year review period, subtidal and intertidal monitoring was conducted once (in 2017), and clam tissue sampling was conducted twice (in 2014 and 2016).

The 2017 subtidal and intertidal sediment monitoring results were presented in the *Final 2016 year 22 Monitoring Report* (HDR, 2017). The clam tissue data were presented in the 2014 and 2016 clam tissue collection reports (USACE, 2015; USACE 2017). The intertidal sediment beach elevation survey (i.e. topography) is expected to be completed by summer 2017.

Subtidal Sediment

The purpose of the subtidal sediment chemical isolation monitoring is to ensure that the cap is meeting cleanup goals defined in the 1994 Record of Decision (ROD). Sample locations in 2017 were focused in two areas identified for additional characterization. The first was the North Shoal subtidal area, an off-cap area that had not been previously characterized (locations J7, J8, K7, K8, and L8). The second area was the J9 and J10 area, an area identified during the 2011 OMMP sampling and in the 2012 Five-Year Review as an area where capping material was not meeting target thicknesses. At each of these sample locations, three individual samples were collected (see Figure E-1), which were then composited into one sample for that location. The chemical results were compared to either the lower apparent effects threshold (LAET) or the Washington Sediment Management Standards (SMS) criteria (e.g. sediment quality standard [SQS] or minimum cleanup level [MCUL] values), depending upon the total organic carbon (TOC) content of the sample.

Surface sediment samples were collected in the J9 and J10 areas and analyzed for polycyclic aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), and mercury. The results show that all samples contained concentrations of PAHs, PCP, and mercury below the SMS criteria, consistent with the results of the 2011 sampling. No hydrocarbon odors or sheen, or non-aqueous phase liquid (NAPL) were observed in any of the samples.

Surface sediment samples were collected in the North Shoal subtidal area (J7, J8, K7, K8, and L8) and analyzed for PAHs, PCP, and mercury. The results showed that most of the samples contained concentrations of PAHs, PCP, and mercury below the LAET or SMS criteria, with two exceptions. For the K8 sample, the acenaphthene concentration (17.61 mg/kg organic carbon [oc]) slightly exceeded the SQS criteria (16 mg/kg oc). For the L8 sample, the acenaphthene concentration (31.21 mg/kg oc) exceeded the SQS criteria (16 mg/kg oc), the fluorene concentration (36.52 mg/kg oc) exceeded the SQS criteria (23 mg/kg oc), and the phenanthrene concentration (102.42 mg/kg oc) exceeded the SQS (100 mg/mg oc). It was noted in the monitoring report that the nearby J9 replicate sample showed variability in TOC by 0.46%. Both the K8 and L8 samples had TOC values very near the cut-off for comparison between LAET or SMS, well within this variability seen in the replicate TOC values. All concentrations at K8 and L8 were well below the LAET criteria. It was concluded that the concentrations measured at all of the North Shoal subtidal locations would likely not pose a risk to benthic organisms.

Additional subtidal coring was completed in the North Shoal (see Figure E-2) to assess the presence of non-aqueous phase liquid (NAPL). Cores were taken to a depth of 2 feet and did not show any evidence of NAPL.

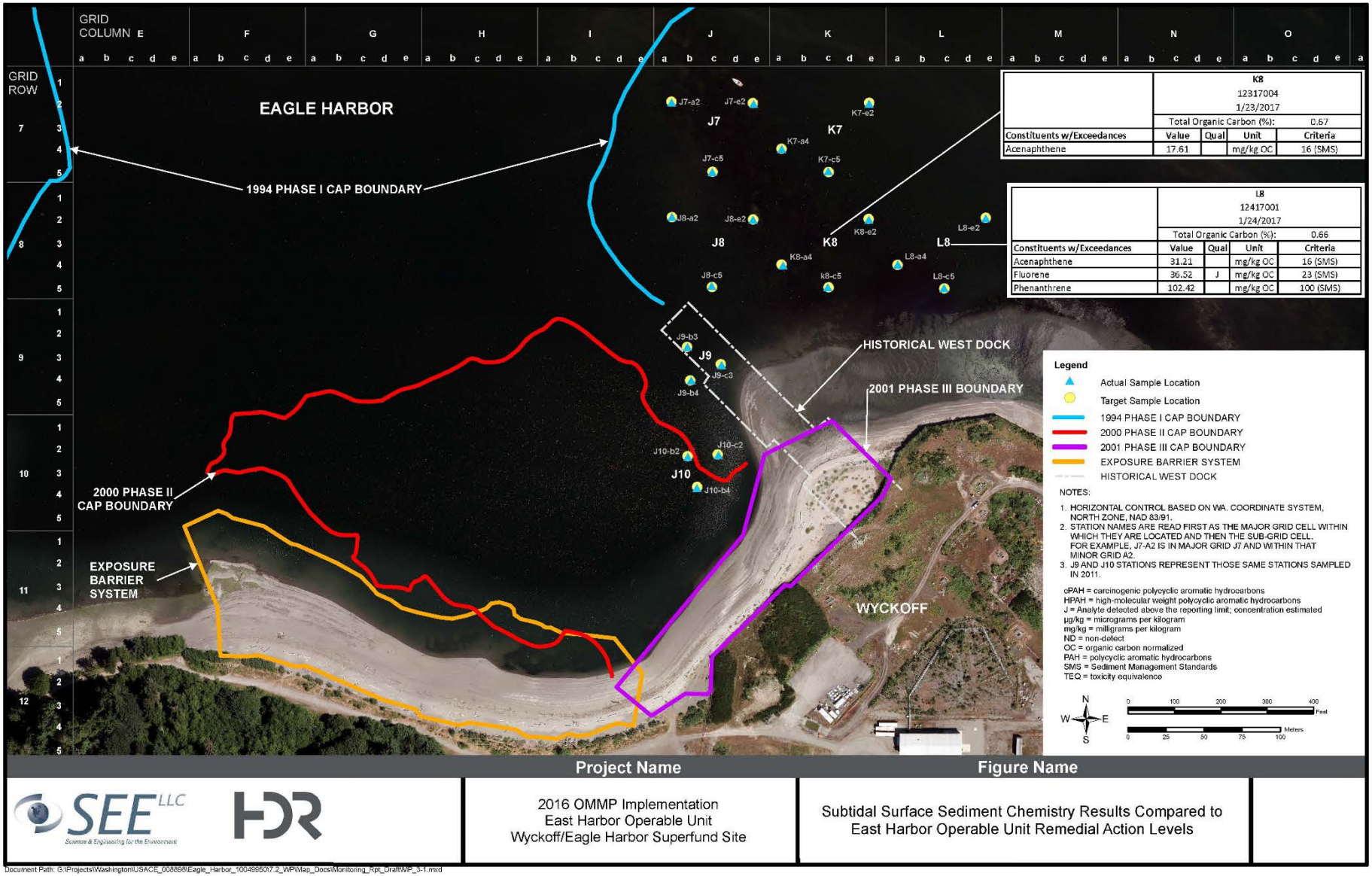


Figure E-1. OU-1 2017 Subtidal Surface Sediment Sample Locations

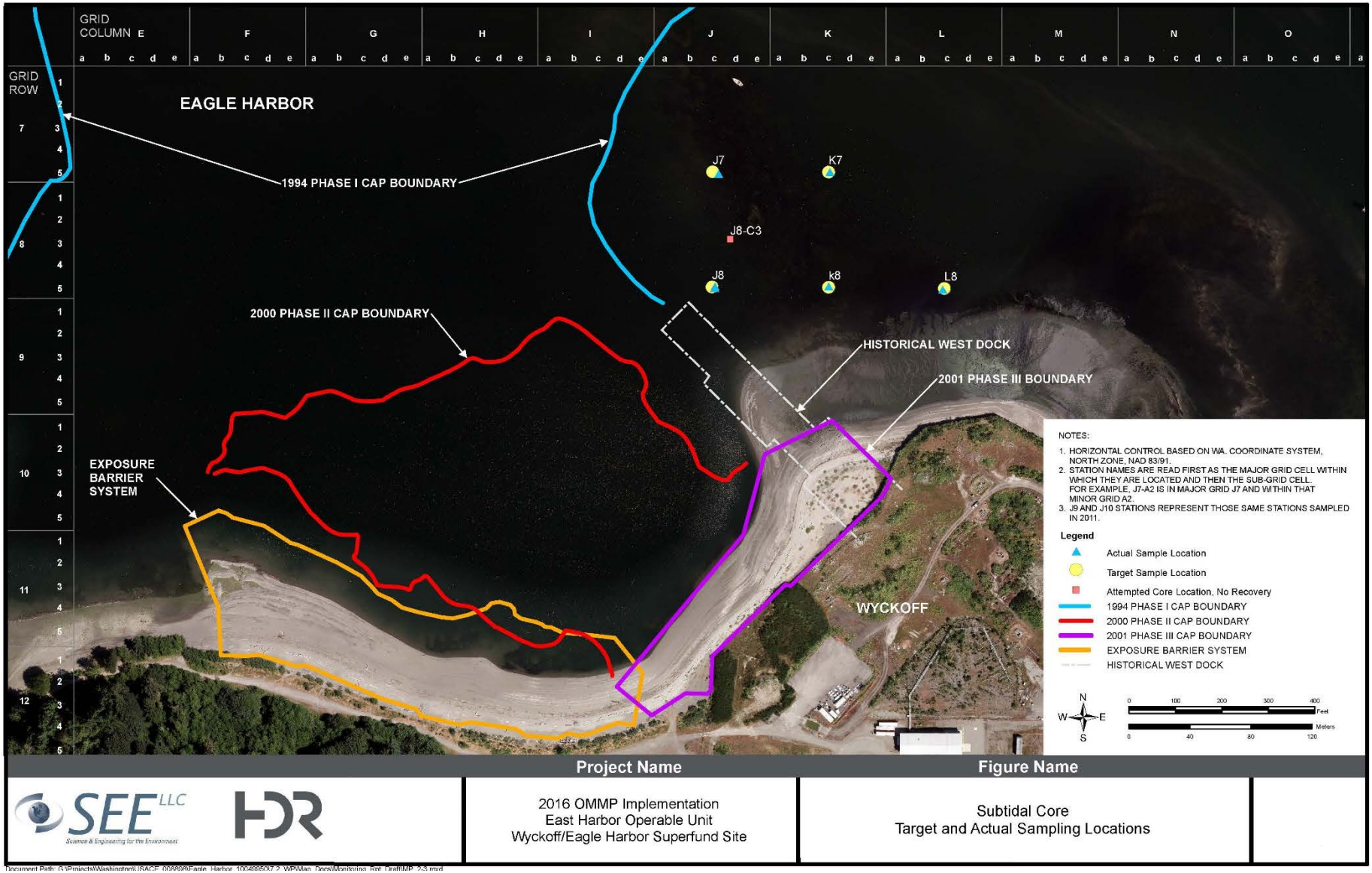


Figure E-2. OU-1 2017 Subtidal Sediment Core Locations

Intertidal Sediment - Chemistry

The purpose of the intertidal chemistry monitoring was to assess chemical isolation effectiveness of the Exposure Barrier System (EBS), and determine if concentration of contaminants of concern (COCs) in the surface sediment impact recreational users of the beach. Intertidal sediment chemistry samples were collected at six locations on the EBS and the off-cap area west of West Beach (locations D12, E11, F12, H12, H12-c3, and I12; see Figure E-3). Four of these locations were pre-determined (D12, F12, H12, and I12), and two were discretionary locations chosen at the time of the field sampling (E11 and H12-c3). For these two discretionary samples, location E11 was chosen because of the presence of historic creosote pilings, and H12-c3 was chosen because of the apparent exposure of the underlying cobble layer. At each sample location three grab samples were collected, composited, then analyzed for PAHs and PCP. The chemical results were compared to ROD cleanup levels.

All six intertidal sediment locations were below the cleanup levels for all chemicals analyzed. Most samples were also below the MTCA human health criteria, with the exception of the E11 discretionary sample. E11 had several exceedances for high molecular weight PAHs (HPAHs): benzo[*a*]anthracene (142 µg/kg dry weight [dw]), chrysene (299 µg/kg dw), benzo[*b*]fluoranthene (238 µg/kg dw), benzo[*a*]pyrene (146 µg/kg dw), each exceeded their MTCA criteria value of 140 µg/kg dw. Total HPAHs (2,575.1 µg/kg dw) also exceeded the ROD human health objective (1,200 µg/kg dw).

Intertidal Sediment – EBS Habitat Mixture Depth

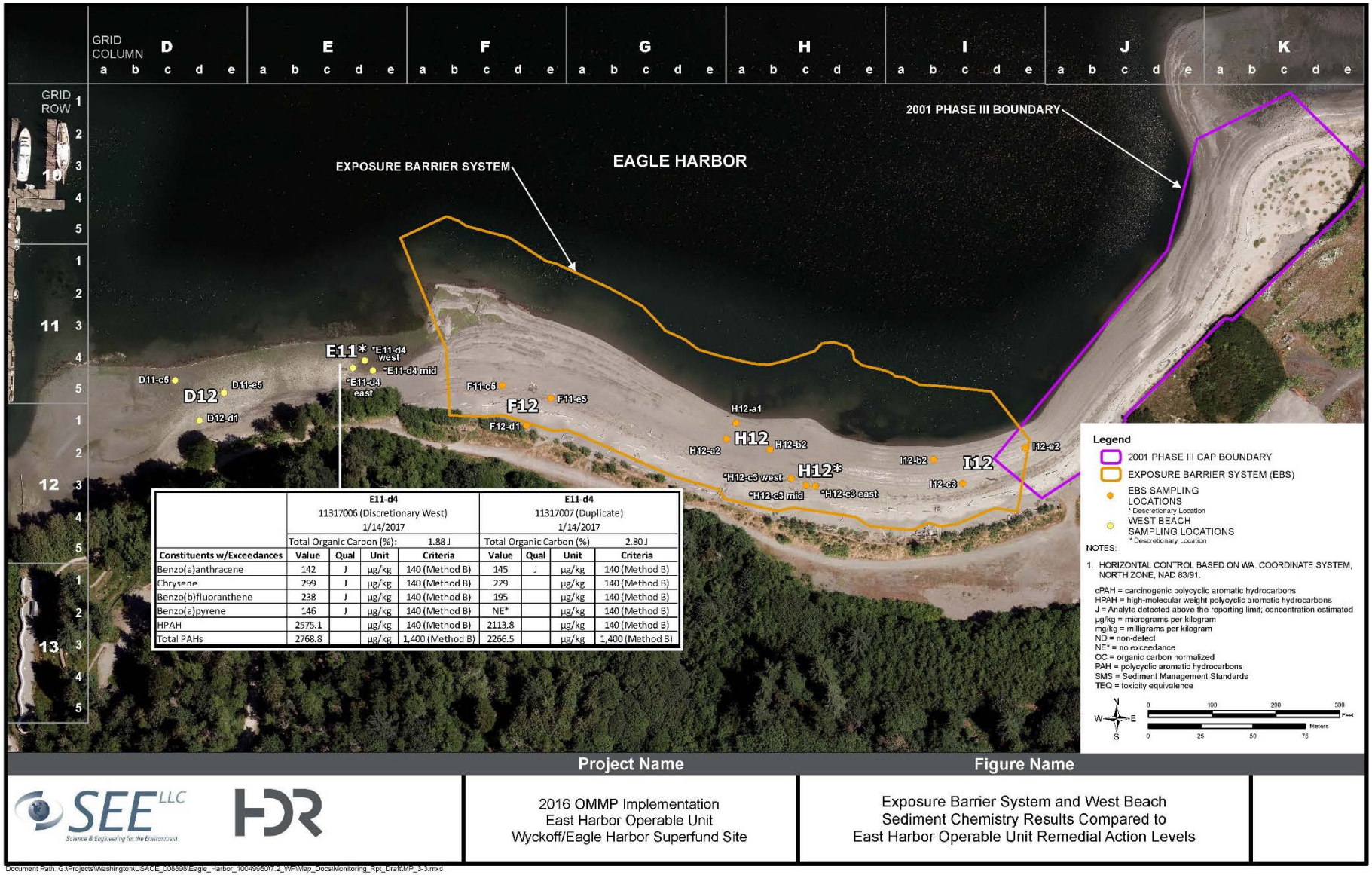
On the EBS, the thickness of the remaining habitat mixture was evaluated to determine how much of the original two feet of habitat mixture was still in place. Habitat mixture depth measurements were collocated with the intertidal individual grab sample sediment chemistry locations (i.e. three measurements at each of locations F12, H12, H12-c3, and I12; see Figure E-4). Locations F12, H12, and I12 were also previously measured in 2011, and as previously noted, location H12-c3 was a discretionary location chosen because of the apparent (i.e. visual) exposure of the underlying cobble layer. To measure the habitat layer depth, a rod was pushed through the habitat sediment layer until the underlying cobble was reached. A minimum of 1 ft of material was chosen as the relevant performance criterion.

The depth measurement results show that at least 1 ft of a habitat mixture remains in a large portion of the EBS with the exception of H12-c3 and one of the three measurements taken at I12 (see Figure E-4). At H12-c3 no habitat cover was measured (i.e. 0 ft), confirming the visual observation and reason that location was chosen as a discretionary sample. At location I12, two measurements were above the 1 ft target thickness (2 ft and 2.34 ft), and one sample was slightly below the target at 0.95 ft.

To understand the impact of these locations below the target thickness, it was recommended in the monitoring report to evaluate the seasonality changes of the depth of cover material. This would be accomplished by systematic grid-based measurements of cover thickness twice per year for two or more years. These results could inform a decision to perform further maintenance on the EBS.

Intertidal Sediment - Physical Stability (Topography)

The topographic survey of the EBS and area west of West Beach had not yet been completed at the time of writing this report. Poor weather conditions in early 2017 prevented collection of LiDAR topographical data. This monitoring is expected to be completed by summer 2017.



	E11-d4 11317006 (Discretionary West) 1/14/2017				E11-d4 11317007 (Duplicate) 1/14/2017			
	Total Organic Carbon (%):			1.88 J	Total Organic Carbon (%)			2.80 J
Constituents w/Exceedances	**Value**	**Qual**	**Unit**	**Criteria**	**Value**	**Qual**	**Unit**	**Criteria**
Benzo(a)anthracene	142	J	µg/kg	140 (Method B)	145	J	µg/kg	140 (Method B)
Chrysene	299	J	µg/kg	140 (Method B)	229		µg/kg	140 (Method B)
Benzo(b)fluoranthene	238	J	µg/kg	140 (Method B)	195		µg/kg	140 (Method B)
Benzo(a)pyrene	146	J	µg/kg	140 (Method B)	NE*		µg/kg	140 (Method B)
HPAH	2575.1		µg/kg	140 (Method B)	2113.8		µg/kg	140 (Method B)
Total PAHs	2768.8		µg/kg	1,400 (Method B)	2266.5		µg/kg	1,400 (Method B)

Figure E-3. OU-1 2017 Intertidal Sediment Sample Locations

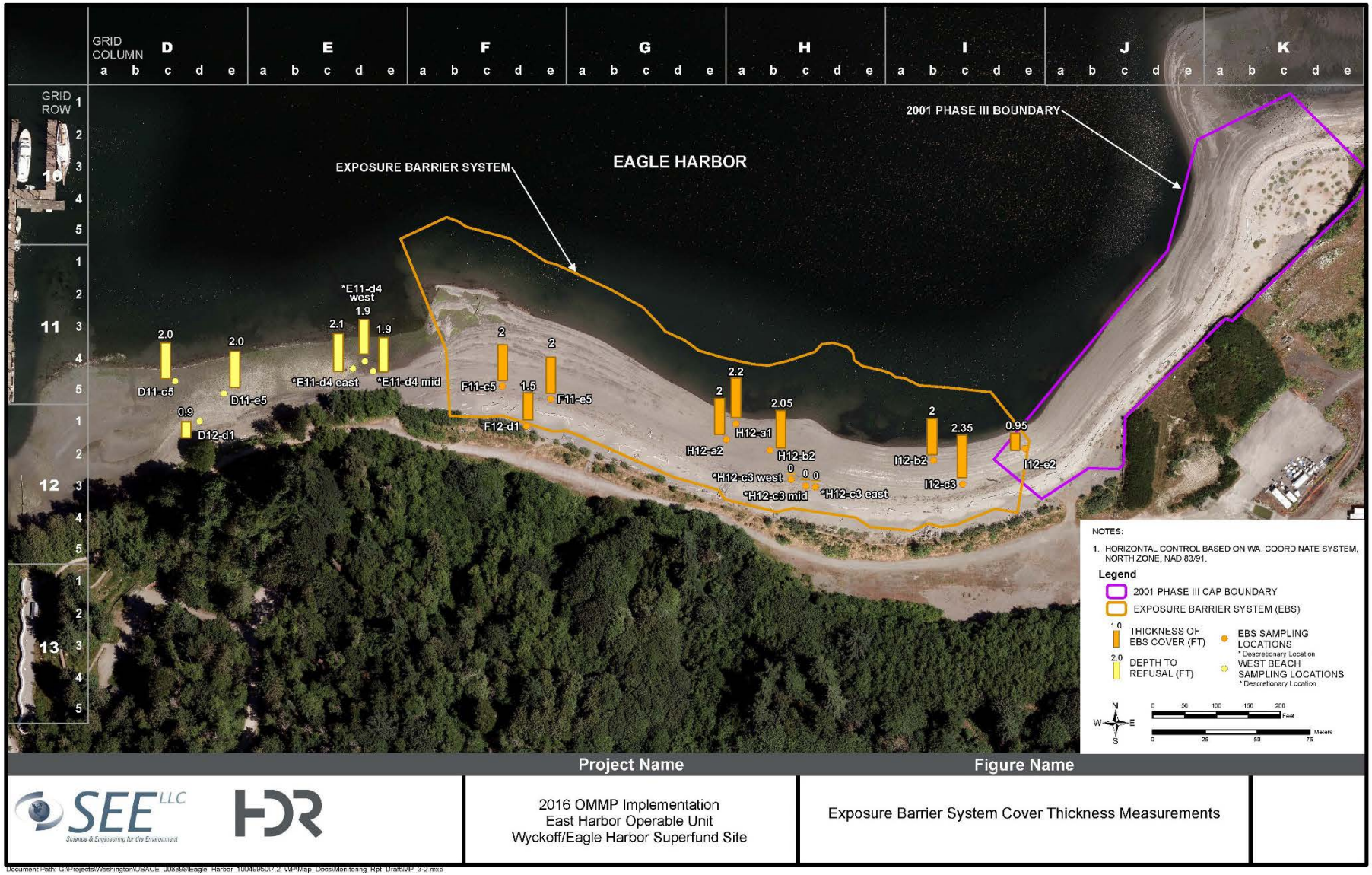


Figure E-4. 2017 EBS Habitat Mixture Depth Measurement Locations

Clam Tissue

The purpose of the clam tissue collection was to assess the extent of natural recovery since the May 2011 monitoring event, and to provide additional human health risk information. During the last five years clam tissue was sampled in May 2014 and July 2016. Clams were sampled at several points within the West Beach, Intertidal Cap, North Shoal, and East Beach areas of OU-1 (see Figure E-5). Each year clams were collected at approximately the same locations, but this varied somewhat depending upon where harvestable clams were actually found. Clam tissue was analyzed for PAHs, from which a potency equivalency factor (PEF) based carcinogenic PAH toxicity equivalent (cPAH TEQ) value was calculated.

PEF data for each sample location for the 2011, 2014, and 2016 data are shown in Figure E-6. Figure E-7 shows the PEF data averaged for each beach section. As can be seen, the data for each year and each location was quite variable, meaning definitive trends could not be discerned. However, in general for each location sampled, the 2016 PEF results were higher than the 2014 results, and generally lower than the 2011 results. North Shoal generally shows a decreasing trend in PEF, but this may be skewed by one very high PEF result in 2014 and only one North Shoal data point in 2016.

The OU-1 Record of Decision does not include a tissue-based cleanup goal. However, in the 2016 Proposed Plan, EPA included a target shellfish tissue cleanup goal of 0.12 µg/kg for benzo[*a*]pyrene-equivalents (USACE, 2017). All of the clam tissue data collected is well above this potential cleanup goal. Continued monitoring is required to determine if tissue data is showing decreasing trends toward this goal.

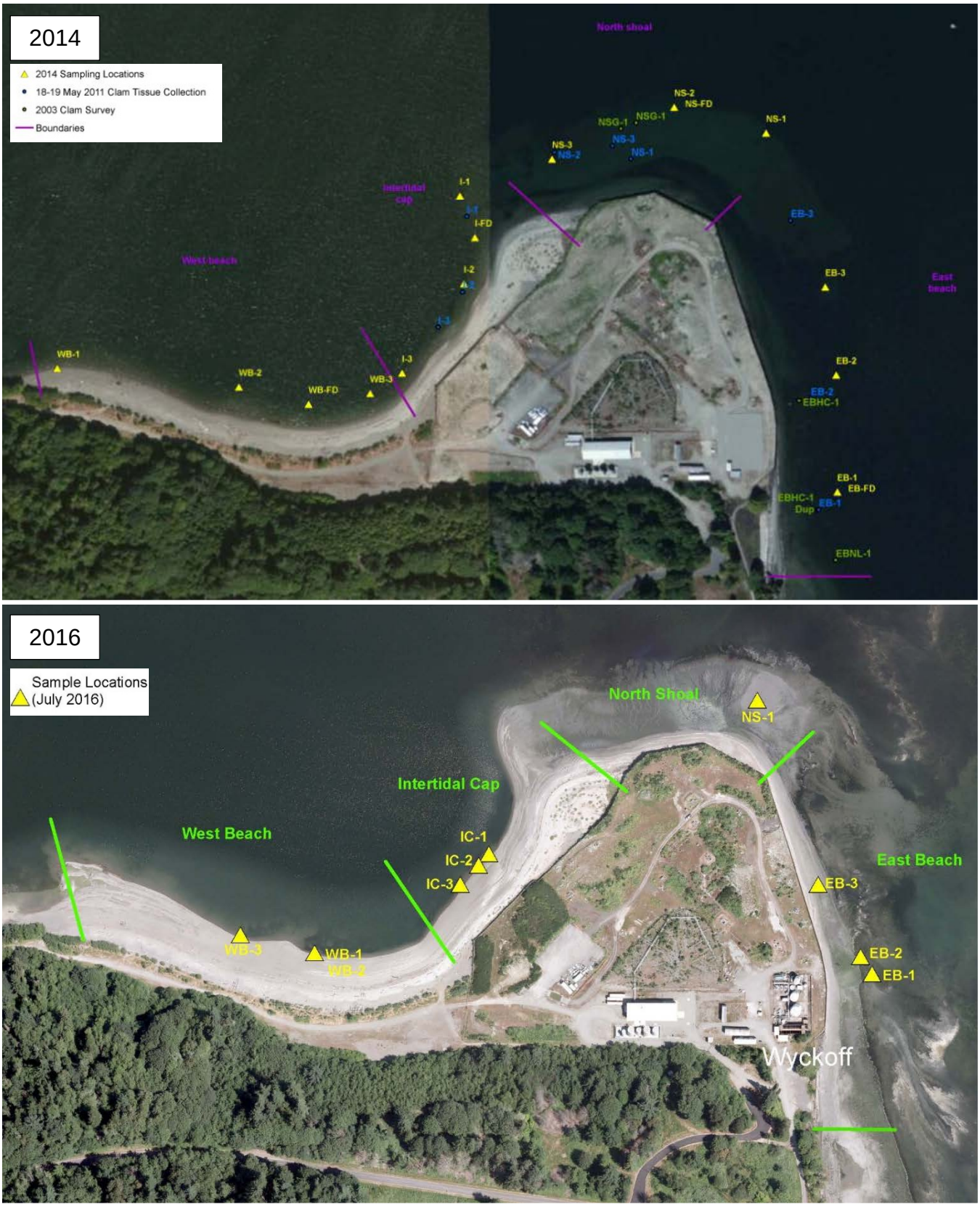


Figure E-5. 2014 and 2016 Clam Sample Locations

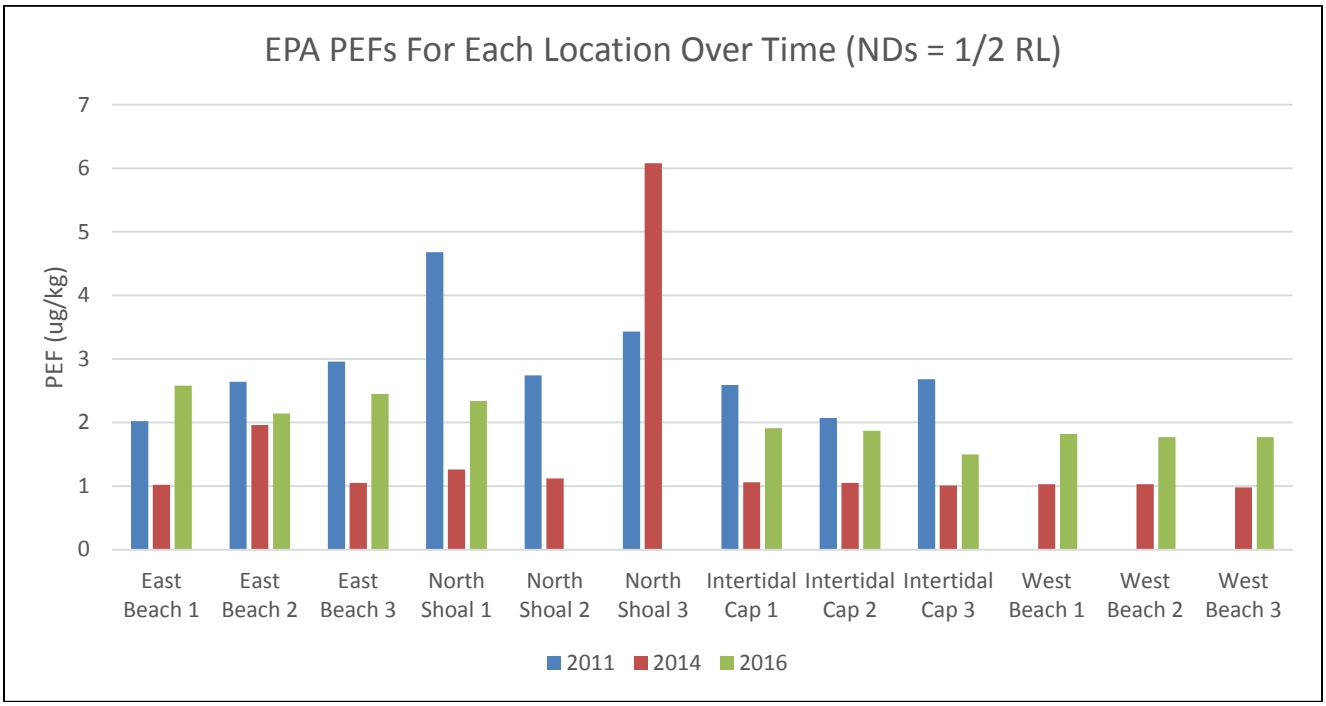


Figure E-6. Clam tissue cPAH TEQs for Sample Locations Over Time

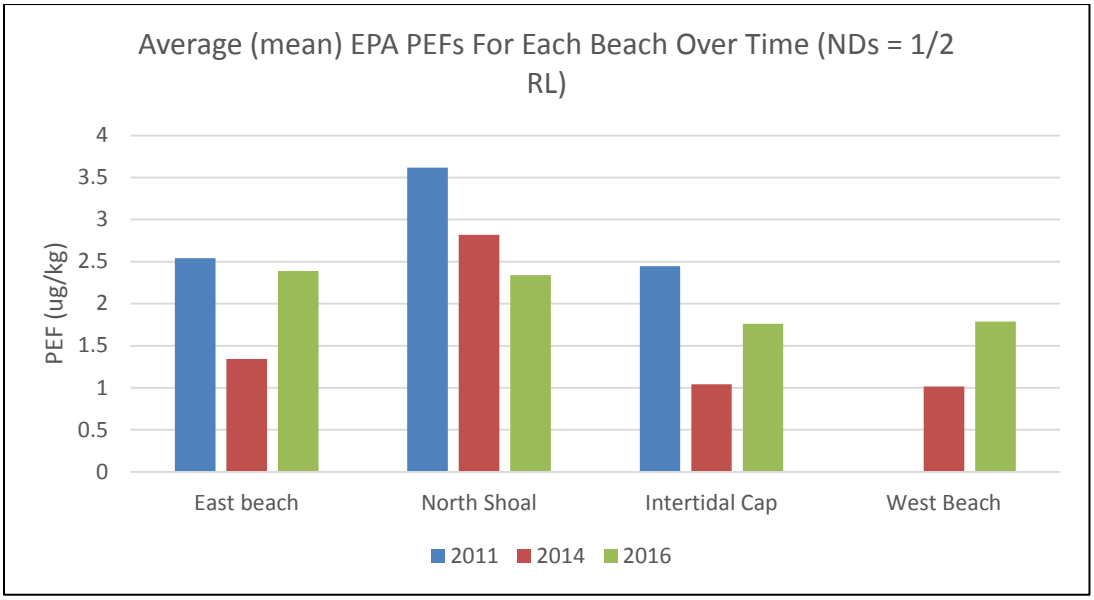


Figure E-7. Average Clam Tissue cPAH TEQ for OU-1 Beach Areas

OU-2/OU-4 Soil and Groundwater

Soil

The 2013 Upland NAPL Field Investigation (CH2MHill, 2013e) collected site data using Dakota Technologies' Tar-specific Green Optical Scanning Tool (TarGOST) to determine the relative distribution of NAPL in the subsurface of OU-2/OU-4 (see Figure E-8). The evaluation of the confirmation core visual NAPL observations with the ex situ TarGOST results indicates that a TarGOST response (%RE) between 5%RE and 10%RE can be justifiably selected as representing the presence of NAPL. TarGOST responses of 10%RE and greater are inferred to indicate that NAPL is present at measured locations.

- In general, NAPL is thickest in the center of the site where higher TarGOST responses are located, then transitions to thinner lenses with lower response as the fence diagrams move radially away from the center of the Former Process Area (FPA) and potential source(s).
- Beyond the center of the FPA and potential sources, the NAPL lenses are vertically distributed but not in any obvious pattern with depth. This distribution is likely a result of multiple source areas, preferential pathways associated with interbedded lithologies, and interaction with variable fluid densities resulting from the upper aquifer's transition from freshwater to saltwater and operation of the hydraulic containment system.
- Deeper (near the aquitard) TarGOST responses at greater than 10 percent appear to terminate at or above the TarGOST boring refusal depths. In general, where comparable lithology is available, TarGOST boring refusal is coincident with or slightly below the transition from the upper aquifer to the glacial till (e.g. a layer within the aquitard). These factors suggest that the glacial till is restricting the migration of NAPL to lower elevations.
- Along the FPA's west side and north end, elevated TarGOST readings were measured adjacent to the outer sheet pile wall at depths at and above the glacial till layer. In these areas, the sheet pile wall driven depths are greater than the deepest elevated TarGOST responses.

The results of the TarGOST investigation were included in the 2014 Conceptual Site Model (CSM) Update (CH2MHill, 2014a). The updated CSM was in turn used for the Focused Feasibility Study (CH2MHill, 2016c) and Propose Plan (EPA, 2016) for the new remedy for OU-2/OU-4.

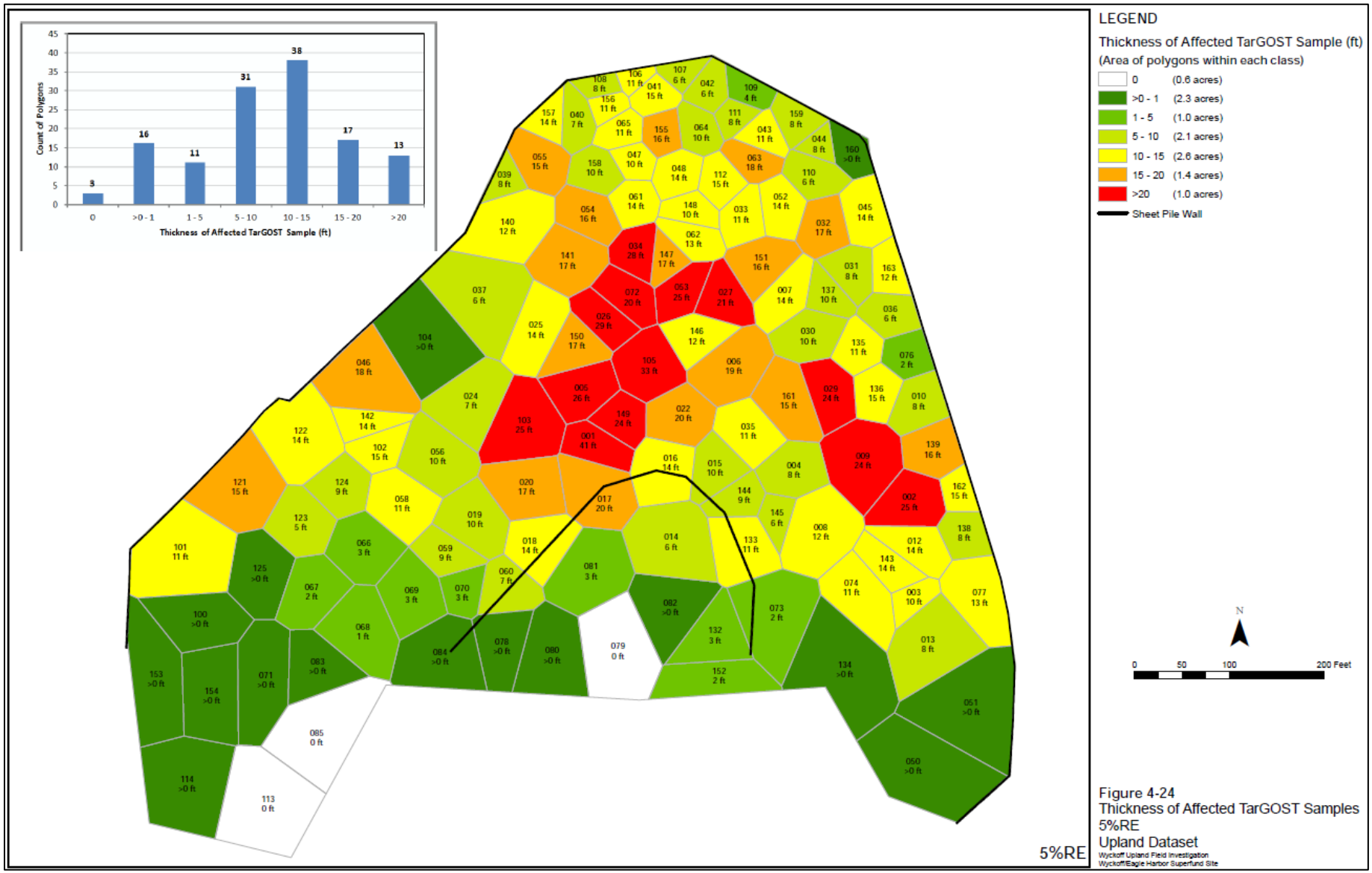


Figure E-8. Thickness of Affected TarGOST Samples, OU-2/OU-4

Groundwater

Groundwater monitoring is used to evaluate hydraulic containment/isolation performance and consists of water level monitoring in the upper and lower aquifers and contaminant concentration monitoring in the lower aquifer.

Hydraulic Containment

Water level data is currently assessed at 10 upper/lower aquifer well pairs: CW03/CW02, CW08/P4L, CW13/VG4L, MW14/CW05, MW18/CDMW01, PO03/CDMW02, PO13/VG1L, VG2U/VG2L, VG3U/VG3L, and VG5U/VG5L. Model 705 KPSITM Level and Pressure Transducers were installed in the 10 upper/lower well pairs in March of 2012. The transducers and are calibrated regularly and record the water levels used to assess the hydraulic containment.

Containment is evaluated by comparing the average water levels recorded during a monitoring period, which is typically 90 days. If the average lower aquifer elevation is greater than the average upper aquifer elevation (i.e. upward or positive gradient), then containment is demonstrated. A negative gradient indicates downward flow of groundwater from the upper aquifer to the lower aquifer and non-containment.

A review of the gradient data for each monitoring period between 2012 and 2016 indicated, that overall, containment was generally demonstrated (Table E-1 and Figures E-10 through E-17). However, there are periods of negative gradients since 2010 when containment was not demonstrated. An evaluation of the negative gradients and cumulative precipitation between 2012 and 2016 indicated that some of the highest negative gradient percentages occur during periods of heavy rainfall, particularly during the fall and winter months.

During the summer months the extraction system is temporarily shut down for annual inspections and maintenance. During the summertime shutdown the seasonal influx of rainwater is minimal and poses a low risk to the hydraulic containment to have the system off at that time. These periods of annual maintenance may appear as loss of gradient control in contrast to lack of precipitation. Additional anomalies to the negative gradient data can include variable response time of the water table to system shutdowns due to proximity to extraction wells during active and inactive phases and aquitard thickness at well pair locations.

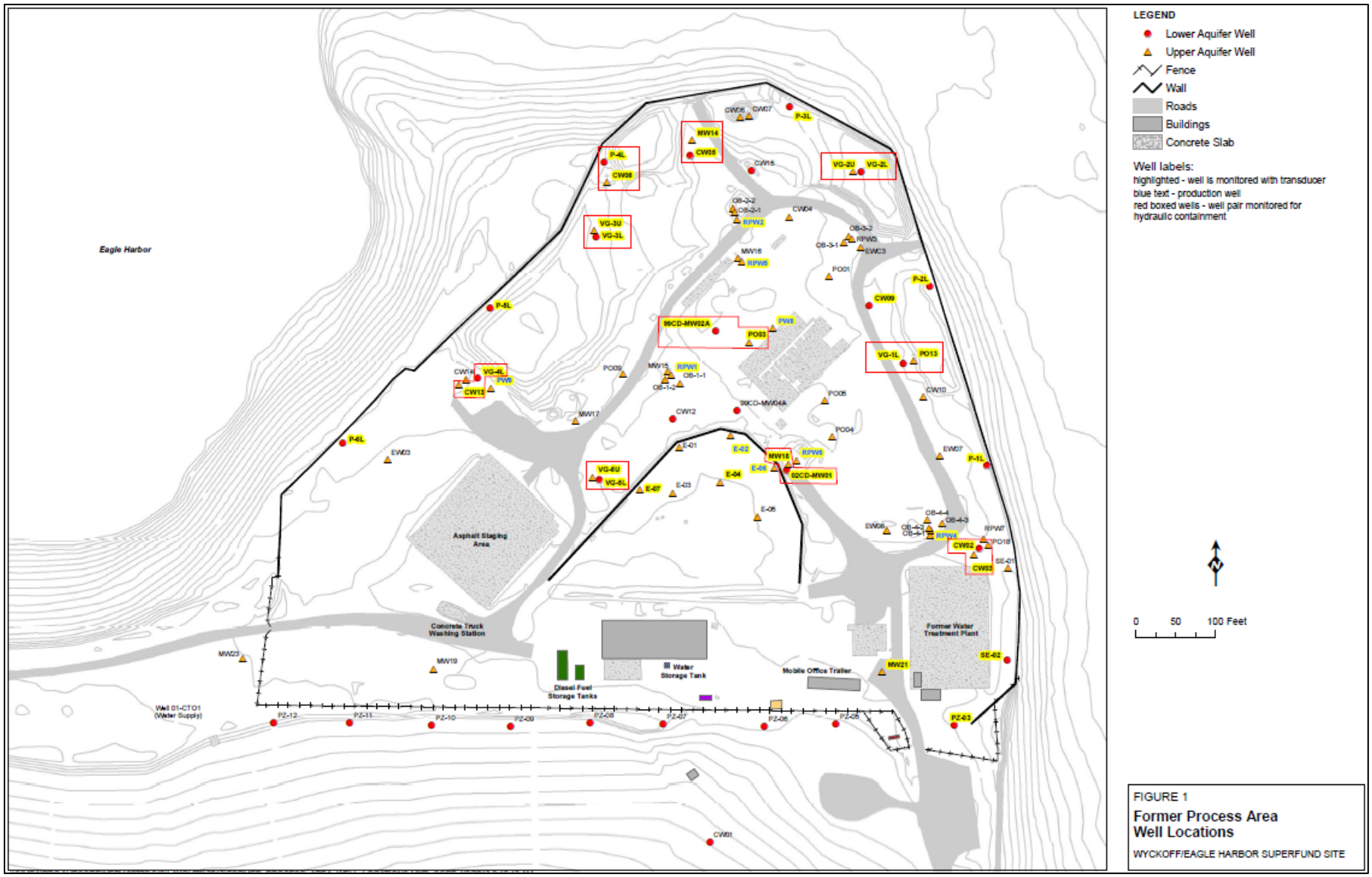


Figure E-9. Vertical Gradient Monitoring Well Pairs

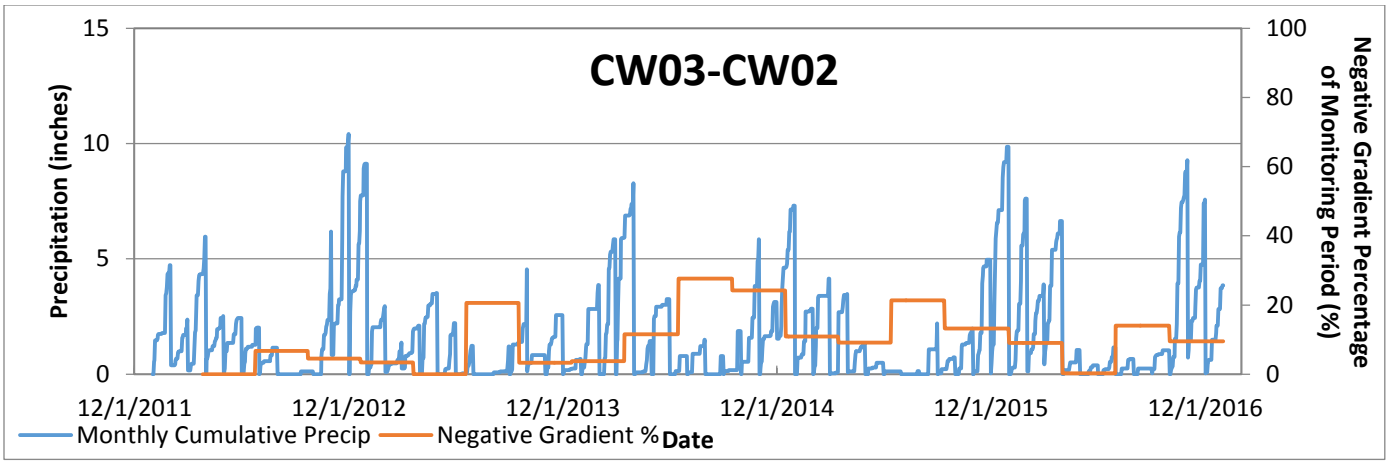


Figure E-10. Vertical Well Pair Negative Gradient Duration percentage & Cumulative Precipitation CW03-CW02

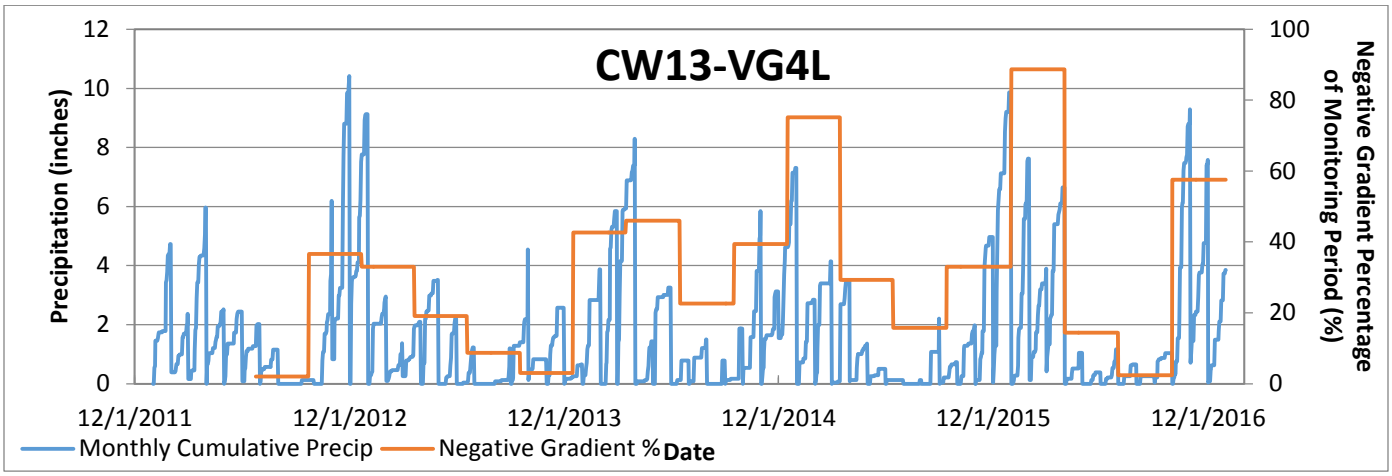


Figure E-11. Vertical Well Pair Negative Gradient Duration percentage & Cumulative Precipitation CW13-VG4L

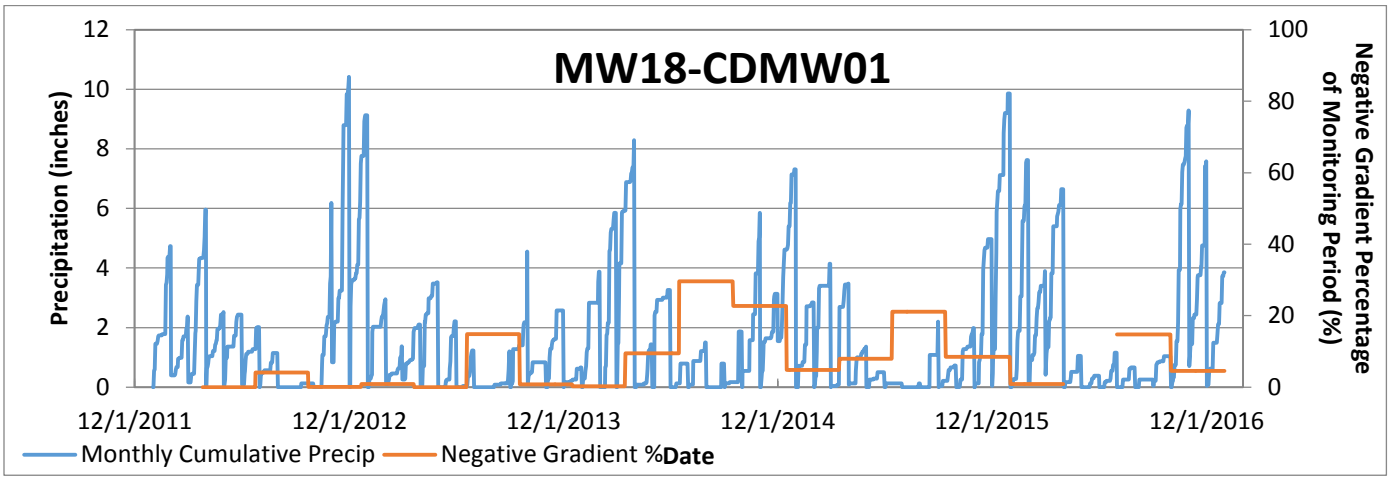


Figure E-12. Vertical Well Pair Negative Gradient Duration percentage & Cumulative Precipitation MW18-CDMW01

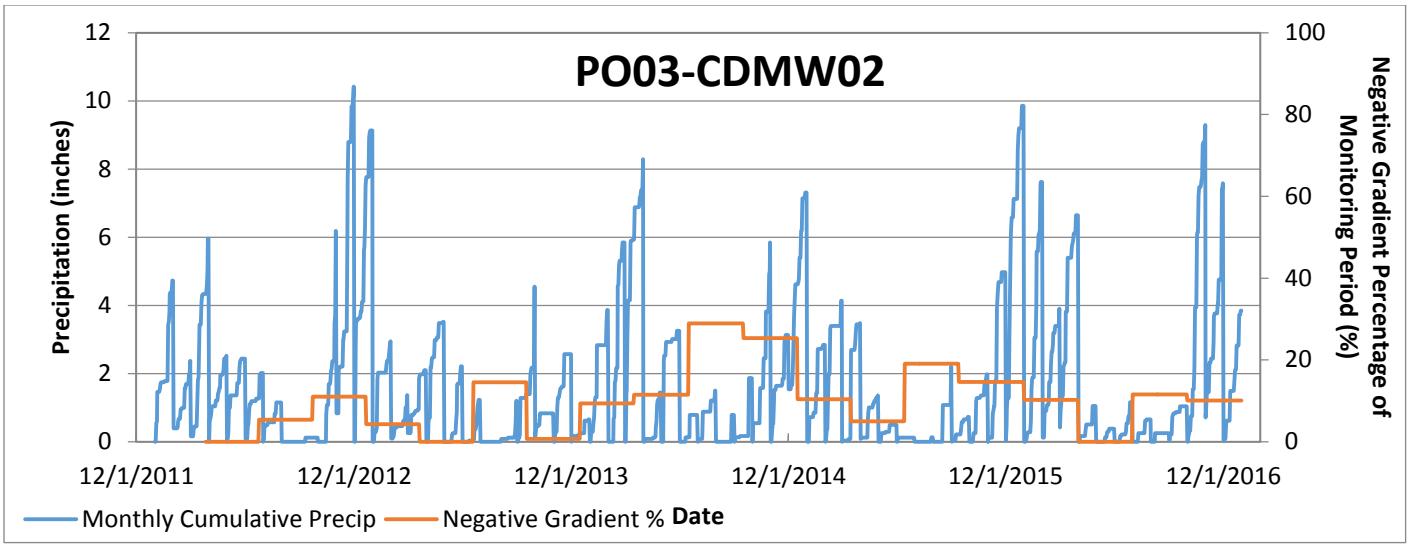


Figure E-13. Vertical Well Pair Negative Gradient Duration percentage & Cumulative Precipitation PO03-CDMWW02

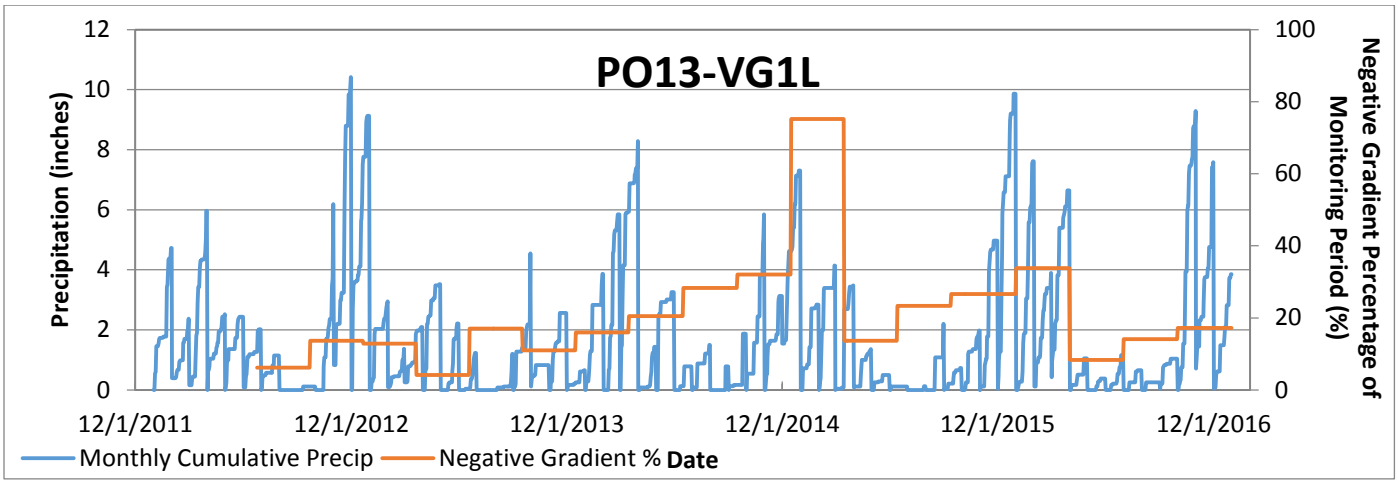


Figure E-14. Vertical Well Pair Negative Gradient Duration percentage & Cumulative Precipitation PO13-VG1L

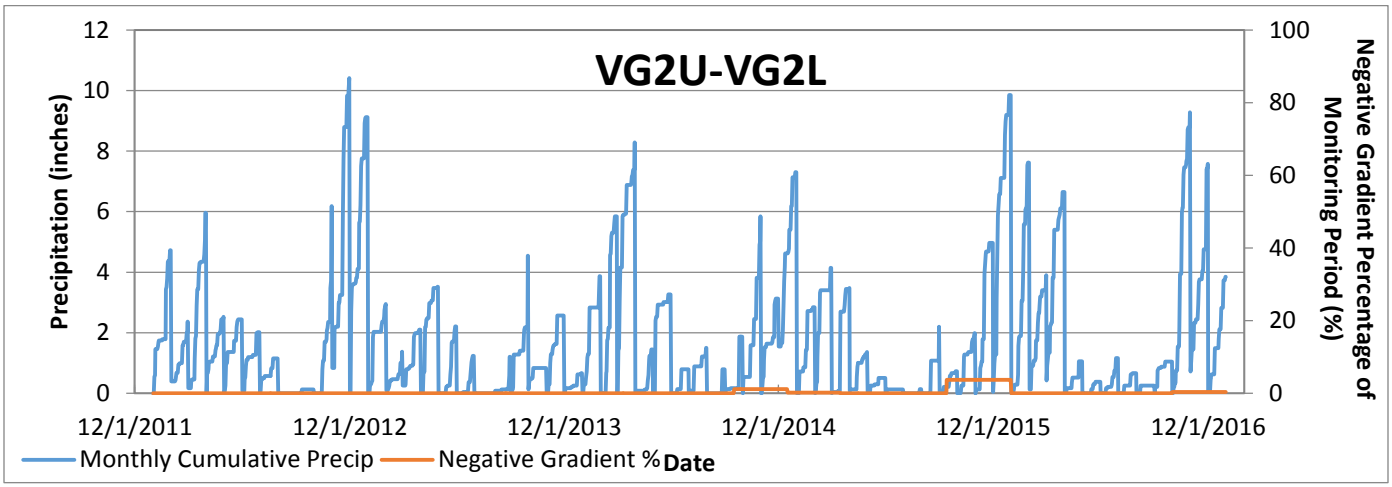


Figure E-15. Vertical Well Pair Negative Gradient Duration percentage & Cumulative Precipitation VG2U-VG2L

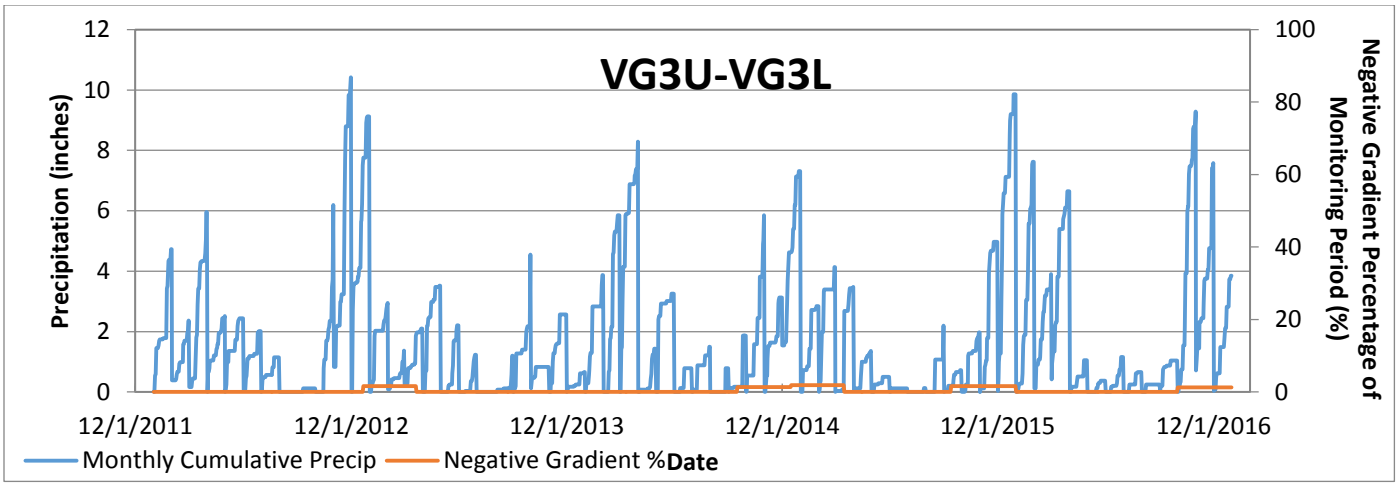


Figure E-16. Vertical Well Pair Negative Gradient Duration percentage & Cumulative Precipitation VG3U-VG3L

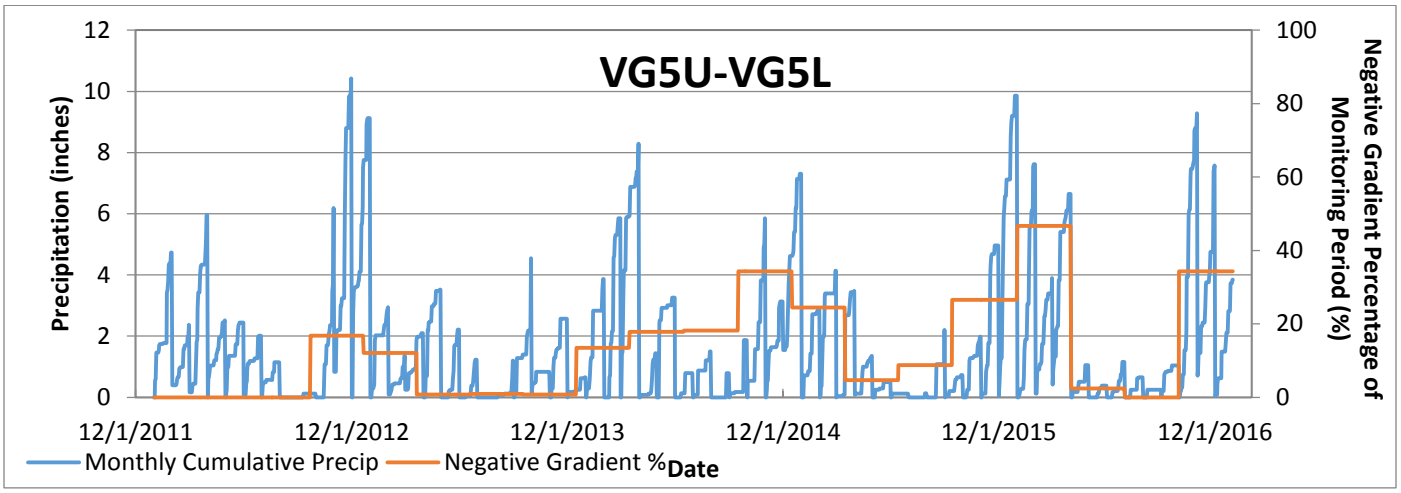


Figure E-17. Vertical Well Pair Negative Gradient Duration percentage & Cumulative Precipitation VG5U-VG5L

Table E-1. Negative Gradient Duration Analysis

Monitoring Period	Negative Gradient Duration Analysis																			
	CW03/CW02				CW08/P4L				CW13/VG4L				MW14/CW05				MW18/CDMW01			
	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period
12/27/11 - 3/25/12	N/A				N/A				N/A				None				N/A			
3/26/12 - 6/23/12	None				N/A				N/A				None				None			
6/24/12 – 9/21/12[a]	46	3.2	6.1	6.7%	94	4.3	17	18.9%	24	1.8	1.8	2.0%	28	2	2.3	2.6%	30	3	3.7	4.1%
9/22/12 – 12/20/12	32	3.03	4	4.5%	102	6.35	27	30.0%	44	17.99	33	36.6%	45	4.59	8.6	9.6%	3	0.83	0.1	0.1%
12/21/12 – 3/20/13	20	6.75	3.1	3.4%	130	19.5	40.6	45.1%	99	22.25	29.7	33.0%	53	4.88	10.8	12.0%	5	3.75	0.8	0.9%
3/21/13 – 6/18/13	None				101	4.88	20.5	22.8%	92	4.49	17.2	19.1%	10	2.08	0.9	1.0%	None			
6/19/13 – 9/16/13	94	4.72	18.5	20.6%	117	5.62	27.4	30.4%	69	2.72	7.8	8.7%	77	3.51	11.3	12.5%	75	4.25	13.3	14.8%
9/17/13 – 12/15/13	20	4	3	3.3%	111	5	23	26.1%	28	2	3	3.0%	33	2	3	3.4%	8	2	1	0.8%
12/16/13 – 3/15/14	29	3	3	3.8%	119	6	31	34.2%	63	15	38	42.7%	40	3	6	6.1%	4	1	0	0.2%
3/16/14 – 6/15/14	57	4	11	11.5%	153	7	44	47.9%	122	8	42	46.0%	70	4	12	13.1%	41	5	9	9.5%
6/16/14 - 9/15/14	81	5	17	27.6%	109	7	30	47.1%	73	5	14	22.6%	69	5	14	52.3%	83	5	19	29.6%
9/16/14 - 12/15/14	107	5	22	24.2%	161	7	50	55.2%	110	8	36	39.4%	108	5	21	22.6%	92	5	21	22.7%
12/16/14 – 3/15/15	50	5	10	10.9%	154	9	57	63.8%	92	18	68	75.2%	82	5	17	18.8%	19	5	4	4.8%
3/16/15 – 6/13/15	50	4	8	9.1%	134	6	31	34.5%	106	6	26	29.3%	45	3	5	5.3%	40	4	7	7.9%
6/14/15 – 9/12/15	93	5	19	21.3%	141	6	36	40.1%	84	4	14	15.8%	87	4	16	17.5%	86	5	19	21.1%
9/13/10 – 12/31/15	72	5	15	13.2%	145	7	40	36.1%	48	18	36	33.0%	70	6	19	16.8%	41	5	9	8.5%
1/1/16 – 3/31/16	52	4	8	9.0%	145	10	62	67.6%	64	6	81	88.7%	116	5	26	28.0%	8	3	1	0.9%
4/1/16 – 6/30/16	4	1	0	0.2%	113	5	25	27.0%	64	5	13	14.4%	21	3	3	2.9%	N/A			
7/1/16 – 9/30/16[b]	75	4	13	14.0%	115	5	23	24.7%	30	2	2	2.4%	66	3	8	8.8%	63	4	11	14.7%
10/1/16 – 12/31/16	49	4	8.8	9.5%	118	7	34.3	37.3%	84	15	53	57.6%	49	5	10.6	11.5%	20	5	4.2	4.5%

Notes

N/A - Data not availible or not applicable

Percent Duration of Monitoring Period = total duration of negative gradient in days divided by the number of calendar days in the monitoring period.

a - Due to programming issue with transducer in VG-3L, water levels from 6/29/2012 at 09:14 through 7/11/2012 at 08:23 were not properly recorded. The hydraulic containment for this well pair is for less than 90-days

b - Data for well pair MW18/CDMW01 evaluated over 75 dyas from July 18 to September 30, 2016 after transducer in well CDMW01 resumed normal operation

Monitoring Period	Negative Gradient Duration Analysis																			
	PO03/CDMW02				PO13/VG1L				VG2U/VG2L				VG3U/VG3L				VG5U/VG5L			
	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period	Numer of Negative Gradient Events	Avg Negative Gradient Duration (hrs)	Total Duration of Neg Grad (days)	Percent Duration of Monitoring Period
12/27/11 - 3/25/12	N/A				N/A				None				None				None			
3/26/12 - 6/23/12	None				N/A				None				None				None			
6/24/12 – 9/21/12[a]	37	3.2	4.9	5.4%	52	2.6	5.6	6.2%	None				14	2.5	1.5	1.6%	None			
9/22/12 – 12/20/12	37	6.4	9.9	11.0%	70	4.21	12.3	13.7%	None				None				53	6.86	15.15	16.8%
12/21/12 – 3/20/13	20	4.66	3.9	4.3%	56	14.75	11.6	12.9%	None				None				46	10.5	10.86	12.1%
3/21/13 – 6/18/13	None				38	2.38	3.8	4.2%	None				None				9	1.97	0.74	0.8%
6/19/13 – 9/16/13	78	4.01	13	14.5%	89	4.13	15.3	17.0%	None				None				10	1.85	0.77	0.9%
9/17/13 – 12/15/13	6	2	1	0.7%	73	3	10	11.0%	None				None				6	3	1	0.8%
12/16/13 – 3/15/14	47	4	8	9.4%	82	4	14	16.0%	None				None				55	5	12	13.5%
3/16/14 – 6/15/14	51	5	11	11.5%	95	5	19	20.5%	None				None				85	5	16	17.8%
6/16/14 - 9/15/14	82	5	18	28.9%	82	5	18	28.3%	None				None				64	4	11	18.2%
9/16/14 - 12/15/14	105	5	23	25.3%	128	5	29	32.0%	15	2	1	1.1%	11	3	1	1.4%	114	7	31	34.3%
12/16/14 – 3/15/15	45	5	9	10.4%	92	18	68	75.2%	2	1	0	0.1%	10	4	2	1.9%	82	6	22	24.5%
3/16/15 – 6/13/15	29	4	5	5.0%	87	3	12	13.7%	None				None				44	2	4	4.7%
6/14/15 – 9/12/15	87	5	17	19.1%	101	5	21	23.3%	None				None				59	3	8	8.8%
9/13/10 – 12/31/15	48	8	16	14.6%	64	11	29	26.6%	2	0	4	3.7%	6	7	2	1.6%	64	11	29	26.6%
1/1/16 – 3/31/16	49	5	9	10.2%	128	6	31	33.8%	None				None				134	8	42	46.7%
4/1/16 – 6/30/16	None				55	3	8	8.3%	None				None				17	3	2	2.4%
7/1/16 – 9/30/16[b]	72	4	11	11.6%	86	4	13	14.1%	None				None				None			
10/1/16 – 12/31/16	48	5	9.3	10.1%	76	5	15.5	17.2%	4	2	0.3	0.3%	7	4	1.2	1.3%	116	7	31.5	34.3%

Notes

N/A - Data not availible or not applicable

Percent Duration of Monitoring Period = total duration of negative gradient in days divided by the number of calendar days in the monitoring period.

a - Due to programming issue with transducer in VG-3L, water levels from 6/29/2012 at 09:14 through 7/11/2012 at 08:23 were not properly recorded. The hydraulic containment for this well pair is for less than 90-days

b - Data for well pair MW18/CDMW01 evaluated over 75 dyas from July 18 to September 30, 2016 after transducer in well CDMW01 resumed normal operation

Groundwater Contaminants

Contaminant concentrations in the lower aquifer are monitored to determine long-term concentration trends of chemicals of concern in the lower aquifer. Groundwater samples are collected according to the Sampling and Analysis Plan (USACE and SCS, 2004; USACE, 2005); however there is no specified schedule or well list. A groundwater monitoring program with regularly scheduled sampling events has not been implemented in order to obtain a comprehensive assessment of hydraulic containment and long-term concentration trends.

Between 2012 and 2016, there were three sampling events: June 2012, May 2014, and October 2014. The June 2012 event characterized the groundwater quality of both the upper and lower aquifers. The May 2014 sampling event focused on the upper aquifer groundwater and NAPL characterization and the October 2014 event focused on the lower aquifer groundwater quality. The information from the three sampling events was summarized in the 2014 Update to the Conceptual Site Model (CSM).

The CSM concluded that NAPL and dissolved NAPL constituents have been detected in the lower aquifer wells monitored at the site. June 2012 NAPL measurements indicate the presence of NAPL in three lower aquifer wells (VG-2L, P-3L, and CW15) in the northern area of the site. This is consistent with the groundwater monitoring results, which indicate the presence of acenaphthene and other PAH constituent concentrations near or above cleanup levels in wells located in the northern portion of the site. Elevated PAHs are also detected in the southwest portion of the site, surrounding piezometer PZ-11.

A summary of contaminant concentration data and time-series graphs are presented in Table E-2 and Figures E-18 through E-29. A trend analysis for lower aquifer wells with PAHs detected above cleanup levels showed increasing trends for wells CW05, PZ-11, P-3L and VG-2L during the five year review period. The increasing contaminant trends corresponds with the NAPL detections in these same wells from the TarGOST report.

Table E-2: Upper Aquifer Groundwater Quality Data

Chemical Group	Analyte	Units	Groundwater Cleanup Level (ug/L)*	CW01 (1)	CW02 (2)		CW05 (3)		CW09 (3)		CW12 (2)		CW15 (3)		02CD-MW01 (2)		99CD-MW02 (3)		99CD-MW04 (2)		SE-02 (2)		PZ-03 (2)	
					Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
General	Dissolved Oxygen	mg/L	--	***9.33***	***1.72***	***2.20***	***0***	***0.3***	0.0	0	***2.19***	***2.63***	***0***	***0.49***	***1.06***	***2***	***0***	***3.63***	***1.13***	***2.9***	***4.69***	***6.25***	***0***	***0***
General	Eh	mV	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
General	Oxidization Reduction Potential	mV	--	***179***	***72***	***113***	***-299***	***-225***	***-48***	***-2***	***57***	***70***	***-310***	***-124***	***65***	***127***	***-132***	***-2***	***-86***	***9***	***239***	***239***	***-68***	***-57***
General	pH	units	--	***7.09***	***7.18***	***7.51***	***6.71***	***7.41***	7.08	7.51	***7.2***	***7.72***	***6.98***	***7.1***	***8.93***	***8.98***	***8.09***	***8.64***	***7.82***	***7.84***	***7.1***	***7.33***	***7.28***	***7.42***
General	Salinity	%	--	***0.01***	***0.1***	***0.20***	***1.45***	***10.4***	1.3	9.1	***0***	***0***	***1.5***	***4.8***	***0***	***0***	0	***0.1***	***0***	***0***	--	***0***	***0.05***	***0.1***
General	Specific Conductivity	mS	--	***0.368***	***0.333***	***2.67***	***2.57***	***24.2***	2.21	49.9	***0.344***	***0.963***	***8.51***	***43.3***	***0.945***	***37.7***	***0.264***	***33.1***	***0.933***	***35.1***	***0.881***	***507***	***0.858***	***0.999***
General	Temperature	℃	--	***13.1***	***12.8***	***13.59***	***12.25***	***13.79***	13.4	14.81	***13.05***	***14.22***	***12.36***	***13.59***	***13.6***	***15.08***	***13***	***14.24***	***13.8***	***13.95***	***11.32***	***13.85***	***11.61***	***12.59***
General	Turbidity	ntu	--	***60.9***	***60***	***110.0***	***7***	***40.4***	144	180.0	***59.9***	***84.2***	***0***	***48.2***	***21***	***83.3***	***11.2***	***210***	***100***	***397***	***13.9***	***19.8***	***10***	***47.6***
BNA	1,1'-Biphenyl	ug/L	--	1 U	1 U	1 U	***9.9***	***23***	1 U	1.1 U	1 U	1.1 U	1 U	***7.2 J***	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	1,2,4,5-Tetrachlorobenzene	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 UJ	1 U	1.1 U	1 U	1 UJ	1 U	1.1 U	1 U	1 U	1 U	1.1 UJ
BNA	1,2,4-Trichlorobenzene	ug/L	--	1 U	1 UJ	1 U	1 UJ	1.1 UJ	1 U	1.1 UJ	1 UJ	1.1 U	1 UJ	1 UJ	1 UJ	1.1 U	1 U	1 UJ	1 UJ	1.1 U	1 UJ	1 U	1 UJ	1.1 U
BNA	1,2-Dichlorobenzene	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	1,2-Diphenylhydrazine	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	1,3-Dichlorobenzene	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	1,4-Dichlorobenzene	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	1-Methylnaphthalene	ug/L	--	1 U	1 U	1 U	***89***	***190***	1 U	***1.6***	1 U	1.1 U	***1.9***	***56***	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	2,3,4,6-Tetrachlorophenol	ug/L	--	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	2,4,5-Trichlorophenol	ug/L	--	2 U	1 U	2 U	1 U	***2.8***	1 U	2 U	1.1 U	2 U	1 U	2.1 UJ	1.1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	2,4,6-Trichlorophenol	ug/L	--	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	2,4-Dichlorophenol	ug/L	--	1 U	1 U	1 U	1 U	***1.4***	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	2,4-Dimethylphenol	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	2,4-Dinitrophenol	ug/L	--	4.1 UJ	2.1 U	4 UJ	2.1 U	4 UJ	2.1 U	4.1 UJ	2.2 U	4.1 UJ	2.1 U	4.2 UJ	2.1 U	4.1 UJ	2.1 UJ	4.1 UJ	2.1 U	4.1J UJ	2.1 U	4.1 UJ	2.1 U	4.1 UJ
BNA	2,4-Dinitrotoluene	ug/L	--	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	2,6-Dinitrotoluene	ug/L	--	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	2-Chloronaphthalene	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	2-Chlorophenol	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	2-Methylnaphthalene	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	2-Methylphenol	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	2-Nitroaniline	ug/L	--	2 U	1 U	2 U	1 U	2.1 U	1.1 U	2.1 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	2-Nitrophenol	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	3,3'-Dichlorobenzidine	ug/L	--	1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.2 U	1 U	2.1 U	1 U	1.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 UJ
BNA	3-Nitroaniline	ug/L	--	2 U	1 U	2 U	1 U	2.1 U	1.1 U	2 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	4,6-Dinitro-2-methylphenol	ug/L	--	4.1 U	1 U	4 U	1 U	4 U	1.1 U	4.1 U	1.1 U	4.1 U	1 U	4.2 U	1.1 U	4.1 U	1 U	4.1 U	1.1 U	4.1 U	1 U	4.1 U	1.1 U	4.1 U
BNA	4-Bromophenyl-phenylether	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	4-Chloro-3-methylphenol	ug/L	--	2 U	1 U	2 U	1 U	1.1 U	1 U	2 U	1.1 U	2 U	1 U	2.1 UJ	1.1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	4-Chloroaniline	ug/L	--	1 UJ	1 UJ	1 U	1 UJ	1.1 U	1 U	1.1 UJ	1 UJ	1.1 UJ	1 UJ	1 UJ	1 UJ	1.1 UJ	1 U	1 UJ	1 UJ	1.1 UJ	1 UJ	1 UJ	1 UJ	1.1 UJ
BNA	4-Chlorophenyl-phenylether	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	4-Methylphenol	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	4-Nitroaniline	ug/L	--	4.1 U	2.1 U	4 U	1.1 U	4 U	1 U	4.1 U	2.2 U	4.1 U	1 U	***2.5 J***	2.1 U	4.1 U	1 U	4.1 U	2.1 U	4.1 U	2.1 U	4.1 U	2.1 U	4.1 U
BNA	4-Nitrophenol	ug/L	--	4.1 U	1 U	4 U	1 U	4 U	1.1 U	4.1 U	1.1 U	4.1 U	1 U	4.2 UJ	1.1 U	4.1 U	1 U	4.1 U	1.1 U	4.1 U	1 U	4.1 U	1.1 U	4.1 U
BNA	9H-Carbazole	ug/L	--	1 U	1 U	1 U	***39***	***100***	1 U	1.1 U	1 U	1.1 U	***1***	***14***	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Acenaphthene	ug/L	3.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Acenaphthylene	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Anthracene	ug/L	9.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Atrazine	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Benzaldehyde	ug/L	--	2 U	1 U	2 U	1.1 U	***2***	1 U	2 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	Benzenemethanol	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Benzo(a)anthracene	ug/L	0.030	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Benzo(a)pyrene	ug/L	0.030	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Benzo(b)fluoranthene	ug/L	0.030	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Benzo(g,h,i)perylene	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Benzo(k)fluoranthene	ug/L	0.030	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Benzoic acid	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	bis(2-Chloroethoxy)methane	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	bis(2-Chloroethyl)ether	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	bis(2-chloroisopropyl)ether	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	bis(2-ethylhexyl)phthalate	ug/L	--	2 U	1 U	2 U	1 U	2.1 U	2 U	2.1 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	Butylbenzylphthalate	ug/L	--	2 U	1 U	2 U	1 U	2.1 U	1.1 U	2.1 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	Caffeine	ug/L	--	1 U	1 U	1 U	1 U	1.1 UJ	1 U	1.1 U	1 U	1.1 U	1 U	1 UJ	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Caprolactam	ug/L	--	***2.7 J***	1 UJ	2 UJ	1 UJ	4.3 UJ	1.1 UJ	4.2 UJ	1.1 UJ	2 UJ	1 UJ	4.2 UJ	1.1 UJ	2 UJ	1 UJ	4.2 UJ	1.1 UJ	2 UJ	1 UJ	2 UJ	1.1 UJ	2 UJ
BNA	Chrysene	ug/L	0.030	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Dibenzo(a,h)anthracene	ug/L	0.0070	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Dibenzofuran	ug/L	--	1 U	1 U	1 U	***45***	***75***	1 U	***2.2***	1 U	1.1 U	***3***	***45***	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Diethylphthalate	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Dimethylphthalate	ug/L	--	1 U	1 U	1 U	1 UJ	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Di-n-butylphthalate	ug/L	--	2 U	1 U	1 U	1 U	2.1 U	1 U	2.1 U	1 U	1.1 U	1 U	2.1 U	1 U	1.1 U	1 U	2.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Di-n-octylphthalate	ug/L	--	2 U	1 U	2 U	1 U	2.1 U	1.1 U	2.1 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	Ethanone, 1-phenyl-	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Fluoranthene	ug/L	3.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Fluorene	ug/L	3.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Hexachlorobenzene	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Hexachlorobutadiene	ug/L	--	1 UJ	1 UJ	1 UJ	1 UJ	4.3 UJ	1 UJ	4.2 UJ	1 UJ	1.1 UJ	1 UJ	4.2 UJ	1 UJ	1.1 UJ	1 UJ	4.2 UJ	1 UJ	1.1 UJ	1 UJ	1 UJ	1 UJ	1.1 UJ
BNA	Hexachlorocyclopentadiene	ug/L	--	2 UJ	1 UJ	2 UJ	1 UJ	2 UJ	1 UJ	2 UJ	1.1 UJ	2 UJ	1 UJ	2.1 UJ	1.1 UJ	2 UJ	1 UJ	2 UJ	1.1 UJ	2 UJ	1 UJ	2 UJ	1.1 UJ	2 UJ
BNA	Hexachloroethane	ug/L	--	1 UJ	1 UJ	1 U	1 UJ	1.1 UJ	1 U	1.1 UJ	1 UJ	1.1 UJ	1 UJ	1 UJ	1 UJ	1.1 U	1 UJ	1 UJ	1 UJ	1.1 UJ	1 UJ	1 U	1 UJ	1.1 UJ
BNA	Indeno(1,2,3-cd)pyrene	ug/L	0.030	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Isophorone	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	Naphthalene	ug/L	83	--	--	--	--	--	1 U	1 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Nitrobenzene	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U
BNA	n-Nitrosodimethylamine	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	n-Nitrosodinpropylamine	ug/L	--	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2.1 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1.1 U	2 U
BNA	n-Nitrosodiphenylamine	ug/L	--	1 UJ	1 U	1 UJ	1 U	1.1 U	1 UJ	1.1 U	1 U	1.1 UJ	1 U	1 UJ	1 U	1.1 UJ	1 U	1 U	1 U	1.1 UJ	1 U	1 UJ	1 U	1.1 UJ
BNA	Pentachlorophenol	ug/L	4.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Phenanthrene	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BNA	Phenol	ug/L	--	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U

BNA	Pyrene	ug/L	15	--		--		--		--		--		--		--		--		--		--		--		--		--		--	
BNA	Retene	ug/L	--	--		--		--		--		--		--		--		--		--		--		--		--		--		--	
PAH	1-Methylnaphthalene	ug/L	--	--		--		--		--		--		--		--		--		--		--		--		--		--		--	
PAH	2-Chloronaphthalene	ug/L	--	--		--		--		--		--		--		--		--		--		--		--		--		--		--	
PAH	2-Methylnaphthalene	ug/L	--	0.03	U	0.03	U	0.03	U	***0.081***		***1.8***		0.029	U	0.03	U	0.03	U	0.03	U	0.029	U	***1.7***		0.03	U	0.03	U	0.029	U	***0.064***		0.03	U	0.03	U	***0.031***		0.03	U	0.03	U
PAH	Acenaphthene	ug/L	3.0	0.03	U	0.03	U	0.03	U	***81***		***170***		***0.029***		***14***		0.03	U	0.03	U	***66***		***170***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
PAH	Acenaphthylene	ug/L	--	0.03	U	0.03	U	0.03	U	***1.8***		***2.6***		0.029	U	***0.26***		0.03	U	0.03	U	***1.2***		***1.6***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
PAH	Anthracene	ug/L	9	0.03	U	0.03	U	0.03	U	***3.3***		***3.7***		0.029	U	***2.9***		***0.063***		***0.063***		***2.2***		***4.6***		***0.041***		***0.042***		0.029	U	0.031	U	***0.033***	U	***0.033***		0.03	U	0.031	U	***0.058***		***0.061***	
PAH	Benzo(a)anthracene	ug/L	0.030	0.03	U	0.03	U	0.03	U	0.1	U	***0.31***		0.029	U	***2.7***		0.03	U	0.03	U	0.17	U	***3.9***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Benzo(a)pyrene	ug/L	0.030	0.03	U	0.03	U	0.03	U	0.029	U	***0.097***		0.029	U	***0.08***		0.03	U	0.03	U	***0.049***		***1***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Benzo(b)fluoranthene	ug/L	0.030	0.03	U	0.03	U	0.03	U	0.033	U	***0.16***		0.029	U	***1.7***		0.03	U	0.03	U	0.069	U	***1.5***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Benzo(g,h,i)perylene	ug/L	--	0.03	U	0.03	U	0.03	U	0.029	U	0.03	U	0.029	U	***0.18***		0.03	U	0.03	U	0.03	U	***0.19***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Benzo(k)fluoranthene	ug/L	0.030	0.03	U	0.03	U	0.03	U	0.029	U	***0.085***		0.029	U	***1.8***		0.03	U	0.03	U	0.042	U	***0.86***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Chrysene	ug/L	0.030	0.03	U	0.03	U	0.03	U	0.1	U	***0.26***		0.029	U	***2***		0.03	U	0.03	U	0.16	U	***3.8***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Dibenzo(a,h)anthracene	ug/L	0.0070	0.03	U	0.03	U	0.03	U	0.029	U	0.03	U	0.029	U	***0.065***		0.03	U	0.03	U	0.029	U	***0.076***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Fluoranthene	ug/L	3.0	0.03	U	0.03	U	0.03	U	***3.3***		***4.5***		***0.04***		***13***		0.03	U	0.03	U	***2.7***		***13***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Fluorene	ug/L	3.0	0.03	U	0.03	U	0.03	U	***38***		***55***		0.029	U	***7.8***		0.03	U	0.03	U	***2.5***		***32***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	HPAH	ug/L	0.25	0.03	U	0.03	U	0.03	U	***4.8 C***		***7.73 C***		***0.04***	C	***30.43***	C	0.03	U	0.03	U	***3.9 C***		***33.32 C***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Indeno(1,2,3-cd)pyrene	ug/L	0.0296	0.03	U	0.03	U	0.03	U	0.029	U	0.03	U	0.029	U	***0.18***		0.03	U	0.03	U	0.03	U	***0.19***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Naphthalene	ug/L	83	0.03	U	***0.043***		***0.071***		***260***		***890***		0.029	U	***0.22***		0.03	U	0.03	U	***0.69***		***160***		***0.032***	U	***0.038***		***0.098***		***0.9***		0.03	U	0.03	U	***0.07***		***0.1***		0.03		***0.057***	U
PAH	Phenanthrene	ug/L	--	0.03	U	0.03	U	0.03	U	***36***		***44***		0.029	U	***20***		0.03	U	0.03	U	***1.1***		***40***		0.03	U	0.03	U	0.03	U	***0.049***		0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PAH	Pyrene	ug/L	15	0.03	U	0.03	U	0.03	U	***1.5***		***2.9***		0.029	U	***8***		0.03	U	0.03	U	***1.2***		***8.8***		0.03	U	0.03	U	0.029	U	0.031	U	0.03	U	0.03	U	0.03	U	0.031	U	0.03	U	0.03	U
PCP	Pentachlorophenol	ug/L	4.9	0.077	U	0.076	U	0.077	U	0.074	U	0.076	U	0.074	U	0.077	U	0.077	U	0.077	U	0.074	U	0.078	U	0.076	U	0.077	U	0.074	U	***0.61***		0.077	U	0.077	U	0.076	U	0.078	U	0.076	U	0.078	U
TPH	Diesel (#2)	mg/L	--	--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--	
TPH	Gasoline	mg/L	--	--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--	
TPH	Lube Oil	mg/L	--	--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--		--	
TPH	TPH-GC/Diesel Range Organics	ug/L	--	100	U	97	U	98	U	95	U	***3700***		96	U	***310***		96	U	100	U	98	U	***830***		96	U	96	U	96	U	190	U	96	U	100	U	95	U	96	U	96	U	100	U
TPH	TPH-GC/Motor Oil Range Organic	ug/L	--	190	U	190	U	200	U	190	U	480	U	190	U	470	U	190	U	190	U	190	U	480	U	190	U	190	U	190	U	480	U	190	U	190	U	190	U	190	U	190	U	190	U

NOTES:

CW01 (4) = Monitoring Well Name. Number of sampling events in parentheses.

BNA = base/neutral and acid extractables

General = general chemistry

HPAH = High molecular weight Polynuclear Aromatic Hydrocarbon compounds

PAH = polynuclear aromatic hydrocarbons

TPH = total petroleum hydrocarbons

* From Wyckoff ROD 2/2000

U Upper Aquifer Well

Bold and italics = Detected value

Reporting limit for non-detect value exceeds Groundwater Cleanup Level

Detected value exceeds Groundwater Cleanup Level

PZ-09 (2)		PZ-11 (3)		P-1L (2)		P-2L (2)		P-3L (3)		P-4L (3)		P-5L (2)		P-6L (2)		VG-1L (3)		VG-2L (3)		VG-3L (2)		VG-4L (3)		VG-5L (3)	
Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
3.84	4.72	0	0.4	0	0.3	0	0.5	0	0.51	0	0.69	7.18	8.41	2.63	6.3	0	0.38	0	2.21	5.73	6.58	3.03	6.38	0	2
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191	198	-6	131	-148	8	-35	-18	-262	-231	-127	-47	-6	58	40	73	6	105	-257	-158	41	82	19	67	-155	97
6.47	6.49	6.48	6.64	6.88	7.06	7.14	7.38	6.83	7.13	7.44	7.59	7.38	7.4	8.34	8.98	7.15	7.18	7.02	7.24	7.91	8.04	7.91	9.45	7.94	8.92
0.01	0.02	0	0.1	1	2.9	1.3	3	1.76	14.2	2	11.9	0	0.01	0	0.01	0.2	1.7	1.77	15.1	0	0.02	0	0.1	0	0.1
0.258	0.4	0.161	23.2	1.79	44.6	2.15	47	23.8	40.4	20.1	56	0.301	0.328	0.3	0.32	2.97	4.76	3.09	28.8	0.442	0.475	0.233	0.862	0.278	35.6
8.95	9.5	10.4	11.64	13.2	14.12	12.8	12.87	11.92	13.13	12.18	14.93	12.79	13.37	12.22	12.56	11.58	13.61	13.82	15.4	12.69	13.51	12.88	13.85	14	14.53
0	15.7	12.4	118	120	136	3	25.2	0	25.5	0	142	19	41	26.8	45.8	4.4	82.4	0	33.5	25.6	32.2	0	70.3	5.3	39.4
1 U	1.1 U	3.2	5.8	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	4	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 U	1 U	1.1 UJ	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 UJ	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 UJ	1 U	1.1 UJ	1 UJ	1 U	1 UJ	1 U	1 U	1.1 UJ	1 U	1.1 UJ	1 UJ	1 U	1 UJ	1.1 U	1 U	1.1 UJ	1 U	1.1 UJ	1 UJ	1 U	1 U	1.1 UJ	1 UJ	1 U
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1 U	1.1 U	8	15	1 U	1 U	1 U	1 U	4.4	11	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	3	39	1 U	1 U	1 U	1.1 U	1 U	1 U
1.1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U
1.1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 UJ
1.1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 U	1 UJ	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
2.1 UJ	4.1 U	2.1 UJ	4.1 UJ	2.1 U	4.1 UJ	2.1 U	4.1 UJ	2.1 U	4.1 UJ	2.1 U	4.1 UJ	2.1 U	4.1 UJ	2.1 U	4.1 UJ	2.1 UJ	4.1 UJ	2.1 U	4.1 U	2.1 U	4 UJ	2.1 U	4.1 UJ	2.1 UJ	4.1 UJ
1.1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U
1.1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
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1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1.1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1.1 U	2.1 U	1.1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	2.1 U	1 UJ	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U	1 U	2.1 U
1.1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1.1 U	2.1 U	1.1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 UJ
1.1 U	4.1 U	1.1 U	4.1 U	1 U	4.1 U	1 U	4.1 U	1.1 U	4.1 U	1 U	4 U	1 U	4.1 U	1.1 U	4.1 U	1.1 U	4.1 UJ	1.1 U	4.1 UJ	1 U	4 U	1.1 U	4.1 U	1 U	2.1 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1.1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U
1 UJ	1.1 UJ	1 UJ	1.1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1.1 U	1.1 UJ	1 UJ	1.1 U	1 UJ	1 UJ	1 UJ	1.1 UJ	1 U	1.1 UJ	1 U	1.1 U	1 UJ	1 UJ	1 U	1.1 UJ	1 U	1 UJ
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
2.1 U	4.1 U	1 U	4.1 U	2.1 U	4.1 U	2.1 U	4.1 U	1.1 U	4.1 U	1.1 U	4 U	2.1 U	4.1 U	2.1 U	4.1 U	1 U	4.1 U	1 U	4.1 U	2.1 U	4 U	1 U	4.1 UJ	1 U	4.1 U
1.1 U	4.1 U	1.1 U	4.1 U	1 U	4.1 U	1 U	4.1 U	1.1 U	4.1 U	1 U	4 U	1 U	4.1 U	1.1 U	4.1 U	1.1 U	4.1 U	1.1 U	4.1 U	1 U	4 U	1.1 U	4.1 U	1 U	4.1 U
1 U	1.1 U	11	15	1 U	1 U	1 U	1 U	2.1	6.2	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	3.5	26	1 U	1 U	1 U	1.1 U	1 U	1 U
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1 U	0.62 J	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1.1 UJ	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U
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1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 U	1 UJ	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1.1 U	2 U	1.6 U	2.1 UJ	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1.1 U	2.1 U	1.1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 U
1.1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1.1 U	2.1 U	1.1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 U
1.1 U	2 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 UJ	1.1 UJ	1 U	1.1 UJ	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 I	1 UJ
1.1 UJ	2 UJ	1.1 UJ	4.2 UJ	1 UJ	2 UJ	1 UJ	2 UJ	1.1 UJ	4.3 UJ	1 UJ	4.3 UJ	1 UJ	2 UJ	1.1 UJ	2.1 UJ	1.1 UJ	4.2 UJ	1.1 UJ	4.2 UJ	1 UJ	2 UJ	1.1 UJ	4.2 UJ	1 UJ	4.2 UJ
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1 U	1.1 U	8.2	16	1 U	1 U	1 U	1 U	1.1	1.9	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	29	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 UJ	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 U	1.1 U	1 U	2.1 U	1 U	1 U	1 U	1 U	1 U	2.1 U	1 U	2.1 U	1 U	1 U	1 U	1.1 U	1 U	2.1 UJ	1 U	2.1 UJ	1 U	1 U	1 U	2.1 U	1 U	2.1 U
1.1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1.1 U	2.1 U	1.1 U	2.1 U	1 U	2 U	1.1 U	2.1 U	1 U	2.1 U
1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
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1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
1 UJ	1.1 UJ	1 UJ	4.2 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	4.3 UJ	1 UJ	4.3 UJ	1 UJ	1 UJ	1 UJ	1.1 UJ	1 U	4.2 UJ	1 U	4.2 UJ	1 UJ	1 UJ	1 UJ	4.2 UJ	1 UJ	4.2 UJ
1.1 UJ	2 UJ	1 UJ	2 UJ	1 UJ	2 U	1 UJ	2 UJ	1.1 UJ	2 UJ	1 UJ	2 UJ	1 UJ	2 UJ	1.1 UJ	2.1 UJ	1 UJ	2 U	1 UJ	2 U	1 UJ	2 UJ	1 UJ	2 UJ	1 UJ	2 UJ
1 UJ	1.1 UJ	1 UJ	1.1 UJ	1 UJ	1 U	1 UJ	1 UJ	1 UJ	1.1 UJ	1 UJ	1.1 UJ	1 UJ	1 UJ	1 UJ	1.1 UJ	1 U	1.1 UJ	1 U	2 UJ	1 UJ	1 UJ	1 UJ	1.1 U	1 UJ	1 UJ
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1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
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1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U
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1.1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2 U	1 U	2 U	1 U	2 U	1.1 U	2.1 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U
1 UJ	1.1 U	1 U	1.1 U	1 U	1 UJ	1 U	1 UJ	1 UJ	1.1 U	1 U	1.1 U	1 U	1 UJ	1 U	1.1 UJ	1 U	1.1 U	1 U	1.1 U	1 U	1 UJ	1 U	1.1 U	1 U	1 UJ
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1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U	1.1 U	1 U	1 U

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0.03 U	0.03 U	***0.049***	***1.4***	0.03 U	0.03 U	0.03 U	0.03 U	***0.15***	***0.73***	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***0.087***	***11***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	***10***	***18***	0.03 U	***0.047***	0.03 U	0.03 U	***14***	***50***	0.029 U	***0.098***	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***15***	***40***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	***0.46***	***0.83***	0.03 U	0.03 U	0.03 U	0.03 U	***0.16***	***0.36***	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***0.3***	***0.76***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.083	***0.088***	***0.26***	***0.69***	0.03 U	0.03 U	0.03 U	0.03 U	***0.35***	***2.1***	0.029 U	***0.032***	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***0.89***	***3.2***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	***0.96***	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***0.28***	***1.8***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.029 U	***0.26***	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***0.079***	***0.42***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.029 U	***0.35***	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***0.11***	***0.57***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.029 U	***0.06***	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	0.029 U	***0.1***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.029 U	***0.24***	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***0.061***	***0.37***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	***0.89***	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***0.23***	***1.5***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.029 U	0.032 U	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	0.029 U	***0.038***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	***0.16***	0.03 U	0.03 U	0.03 U	0.03 U	***0.81***	***3.9***	***0.06***	***0.092***	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	***0.032***	***3.1***	***11***	0.03 U	***0.04***	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	***2.4***	***5.2***	0.03 U	0.03 U	0.03 U	0.03 U	***2.4***	***4.4***	0.03 U	***0.1***	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***0.78***	***19***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	***0.201 C***	0.03 U	0.03 U	0.03 U	0.03 U	***1.29 C***	***7.12 C***	***0.096 C***	***0.145 C***	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	***0.032 C***	***5.986 C***	***22 C***	0.03 U	***0.04*** C	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.029 U	***0.06***	0.029 U	0.03 U	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	0.029 U	***0.1***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	***57***	***490***	***0.048***	***0.075***	0.03 U	***0.054***	***8.4***	***34***	0.03 U	***0.045***	***0.046***	0.031 U	0.03 U	***0.035***	***0.036***	***0.074***	***3.1***	***190***	0.03 U	0.03 U	0.03 U	***0.035***	0.029 U	***0.14***
0.03 U	0.03 U	***0.28***	***2.6***	0.03 U	0.03 U	0.03 U	0.03 U	***1.2***	***13***	0.03 U	***0.13***	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***1.8***	***36***	0.03 U	***0.1***	0.03 U	0.031 U	0.029 U	0.03 U
0.03 U	0.03 U	0.029 U	***0.041***	0.03 U	0.03 U	0.03 U	0.03 U	***0.48***	***2.2***	***0.036***	***0.053***	0.03 U	0.031 U	0.03 U	0.031 U	0.029 U	0.031 U	***2***	***6.1***	0.03 U	0.03 U	0.03 U	0.031 U	0.029 U	0.03 U
0.077 U	0.077 U	0.074 U	0.076 U	0.076 U	0.076 U	0.076 U	0.077 U	0.074 U	0.082 U	0.074 U	0.077 U	0.076 U	0.031 U	0.077 U	0.078 U	0.074 U	0.08 U	0.074 U	0.076 U	0.077 U	0.078 U	0.078 U	0.079 U	0.074 U	0.077 U
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96 U	100 U	***340***	***400***	96 U	97 U	96 U	96 U	100 U	***470***	95 U	190 U	96 U	99 U	95 U	100 U	96 U	190 UJ	97 U	***1400***	95 U	98 U	95 U	190 U	96 U	190 U
190 U	190 U	190 U	470 U	190 U	190 U	190 U	190 U	190 U	480 U	190 U	470 U	190 U	200 U	190 U	200 U	190 U	460 U	190 U	480 U	190 U	200 U	190 U	470 U	190 U	480 U

NOTES:
CW01 (4) = Monitoring Well Name. Number of sampling events in parentheses.
BNA = base/neutral and acid extractables
General = general chemistry
HPAH = High molecular weight Polynuclear Aromatic Hydrocarbon compounds
PAH = polynuclear aromatic hydrocarbons
TPH = total petroleum hydrocarbons
* From Wyckoff ROD 2/2000
[U] Upper Aquifer Well
Bold and italics = Detected value
Reporting limit for non-detect value exceeds Groundwater Cleanup Level
Detected value exceeds Groundwater Cleanup Level

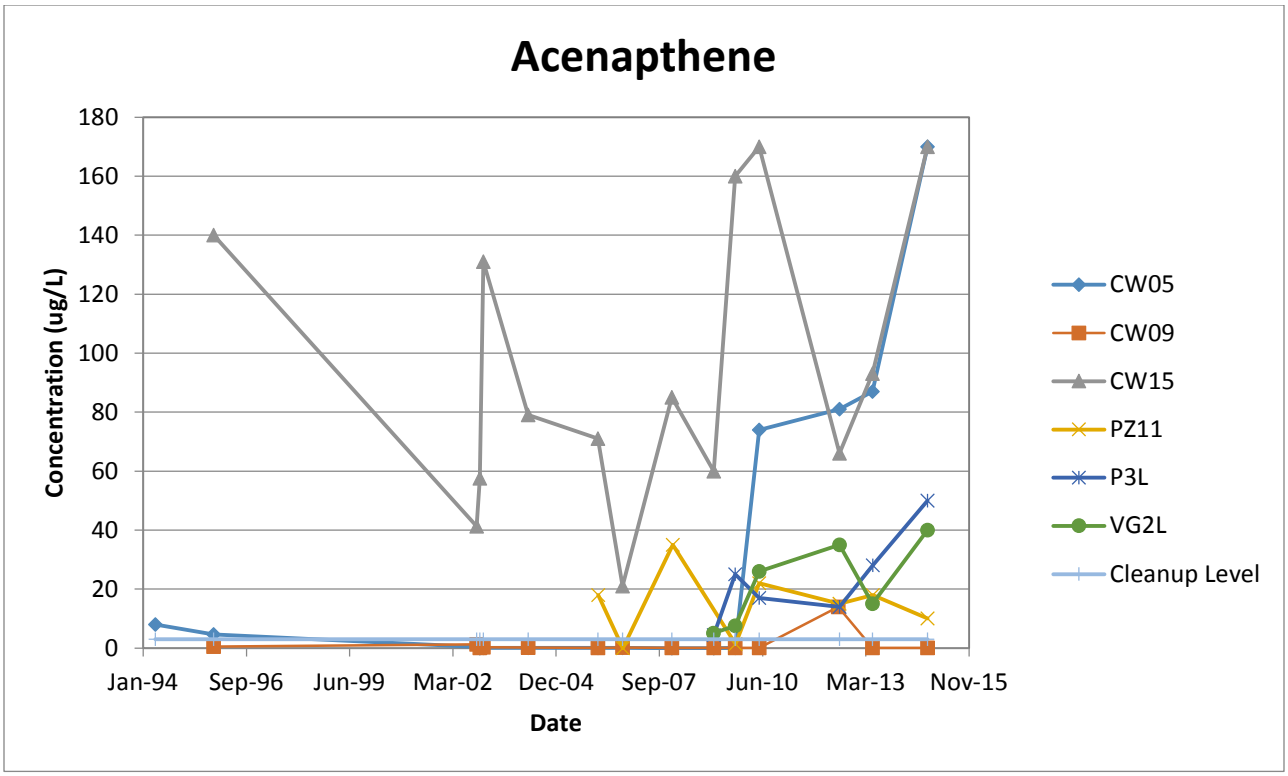

Figure E-18: Acenapthene Concentration over Time

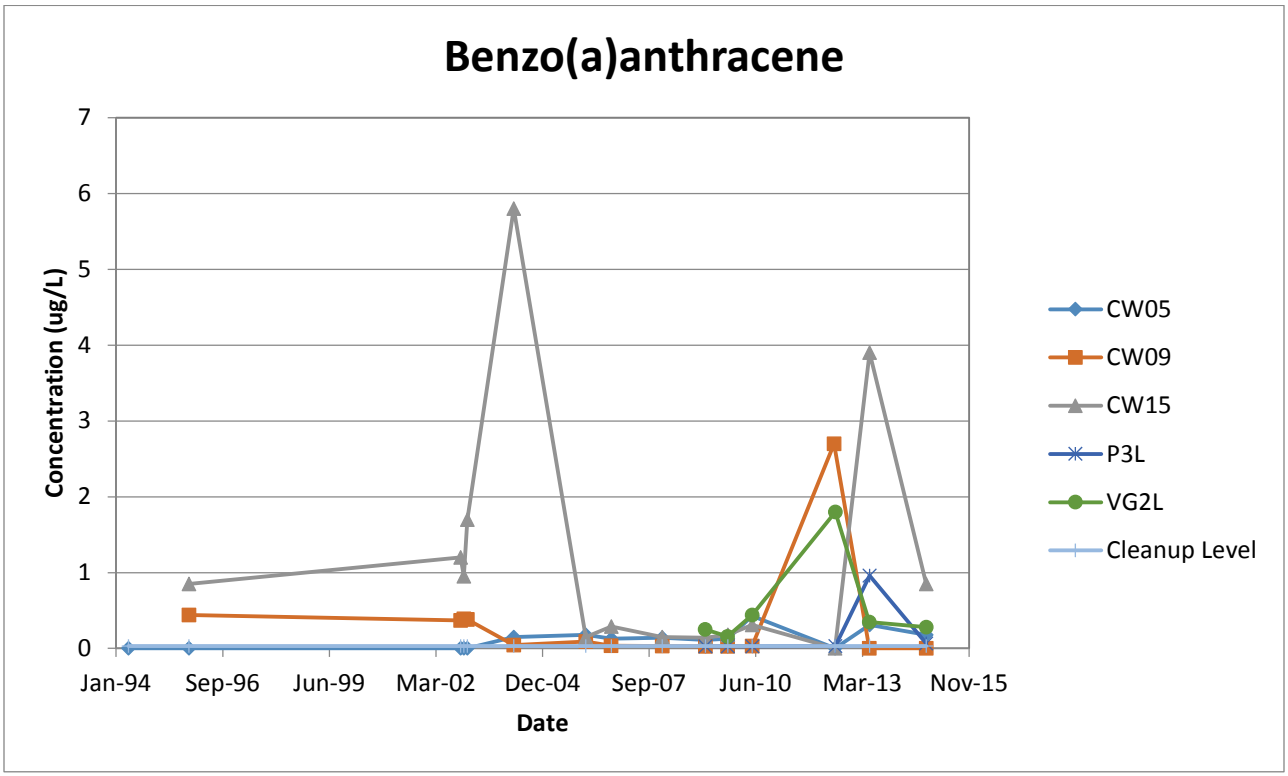

Figure E-19: Benzo(a)anthracene Concentration over Time

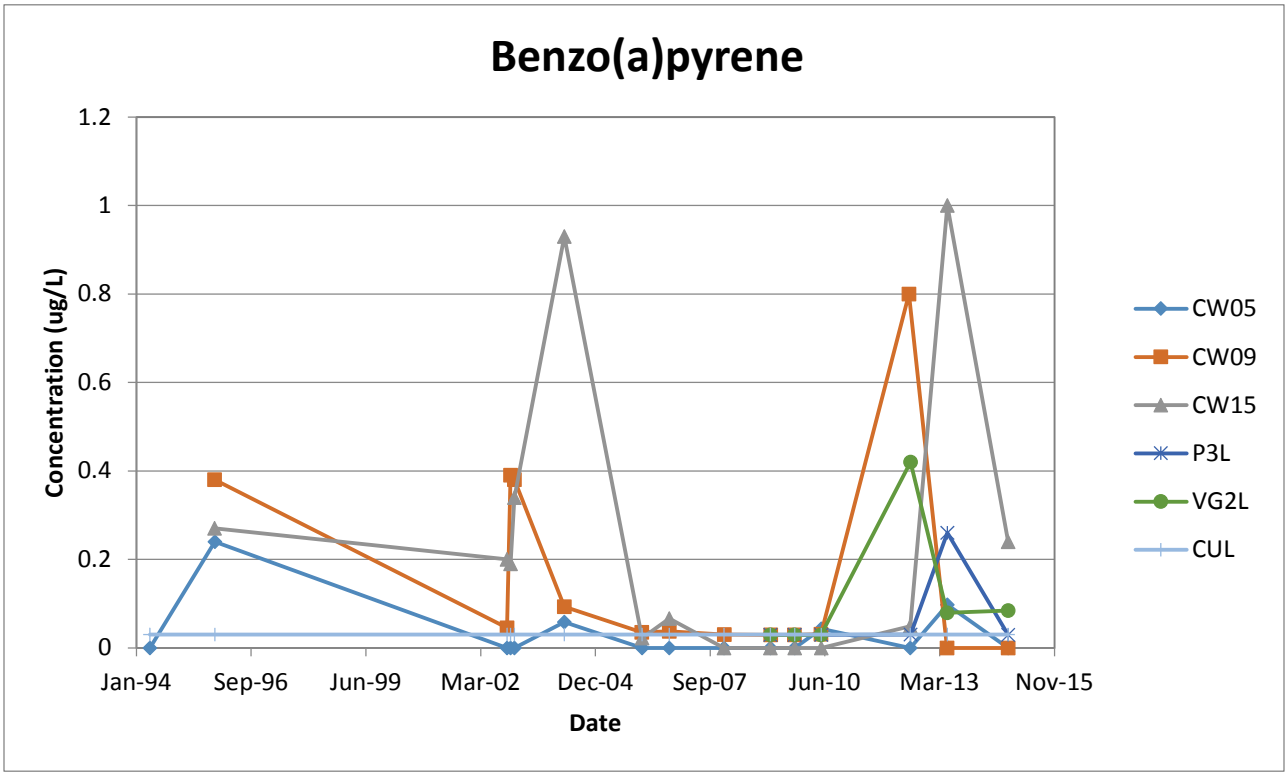

Figure E-20: Benzo(a)pyrene Concentration over Time

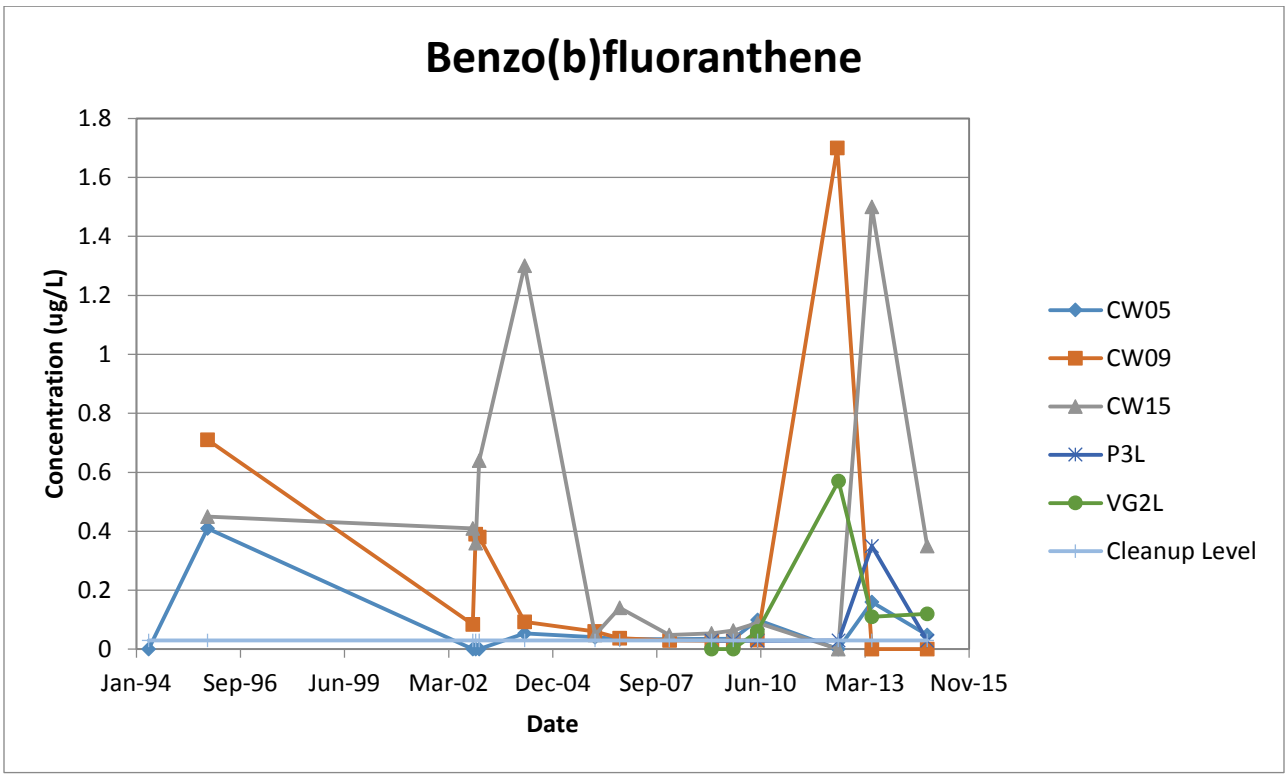

Figure E-21: Benzo(b)fluoranthene Concentration over Time

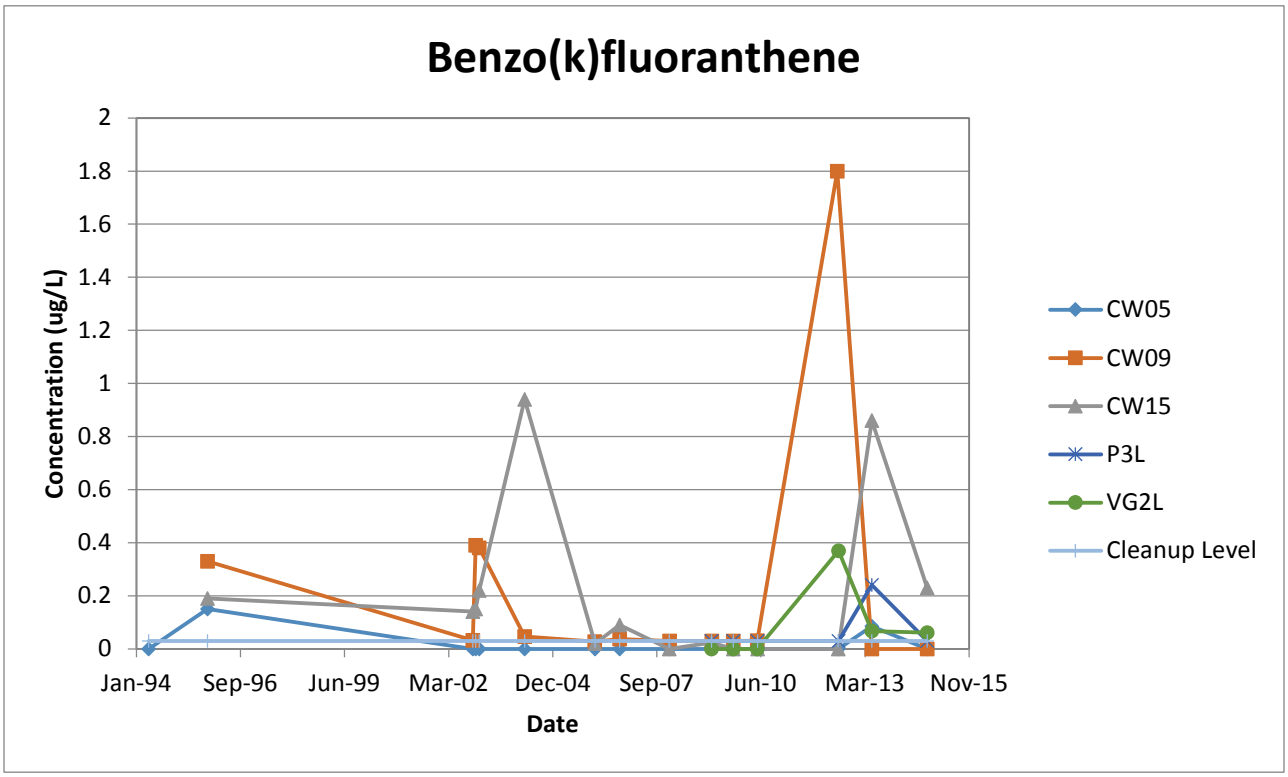

Figure E-22: Benzo(k)fluoranthene Concentration over Time

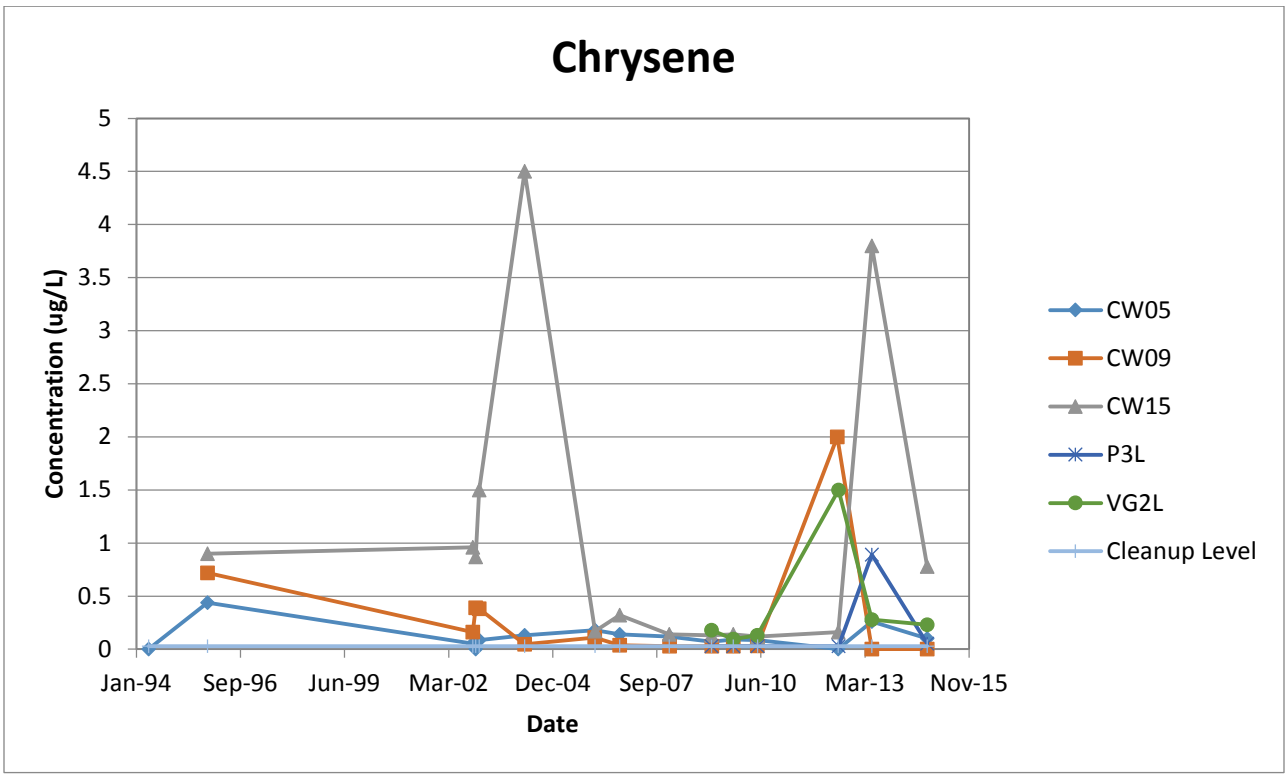

Figure E-23: Chrysene Concentration over Time

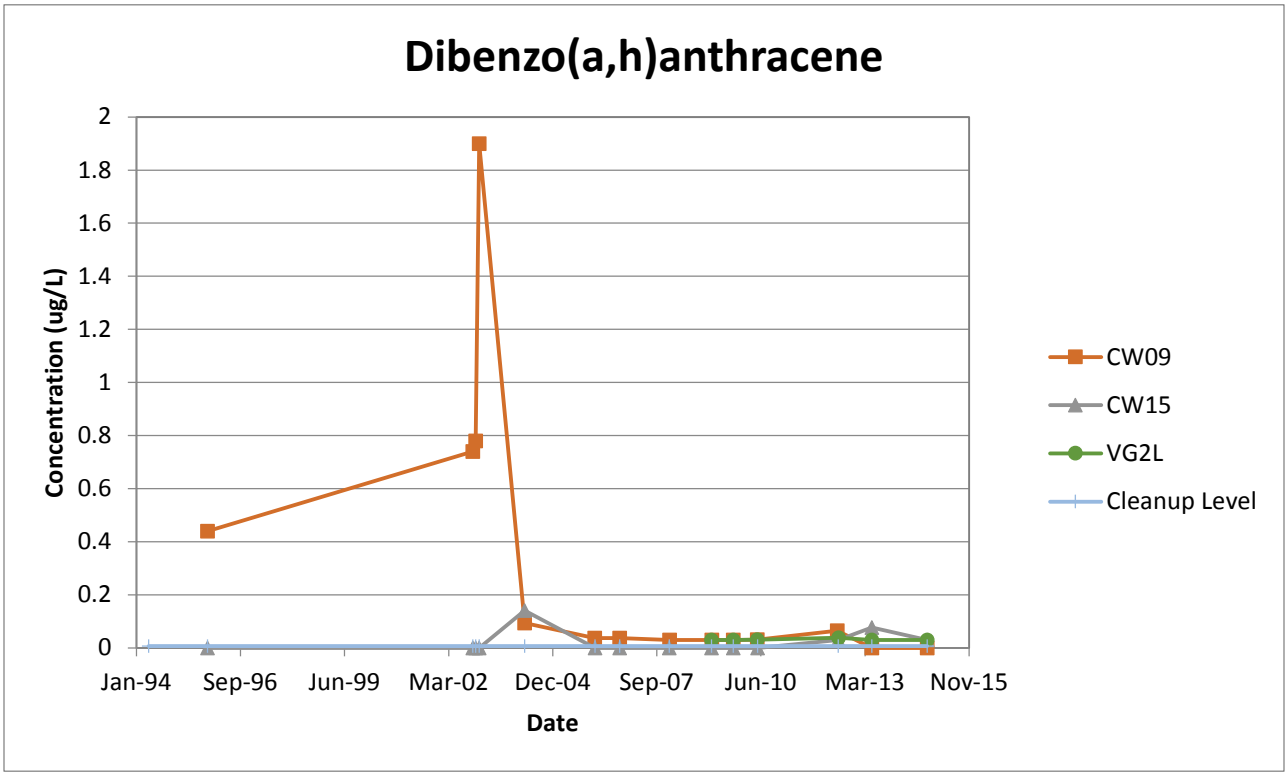

Figure E-24: Dibenzo(a,h)anthracene Concentration over Time

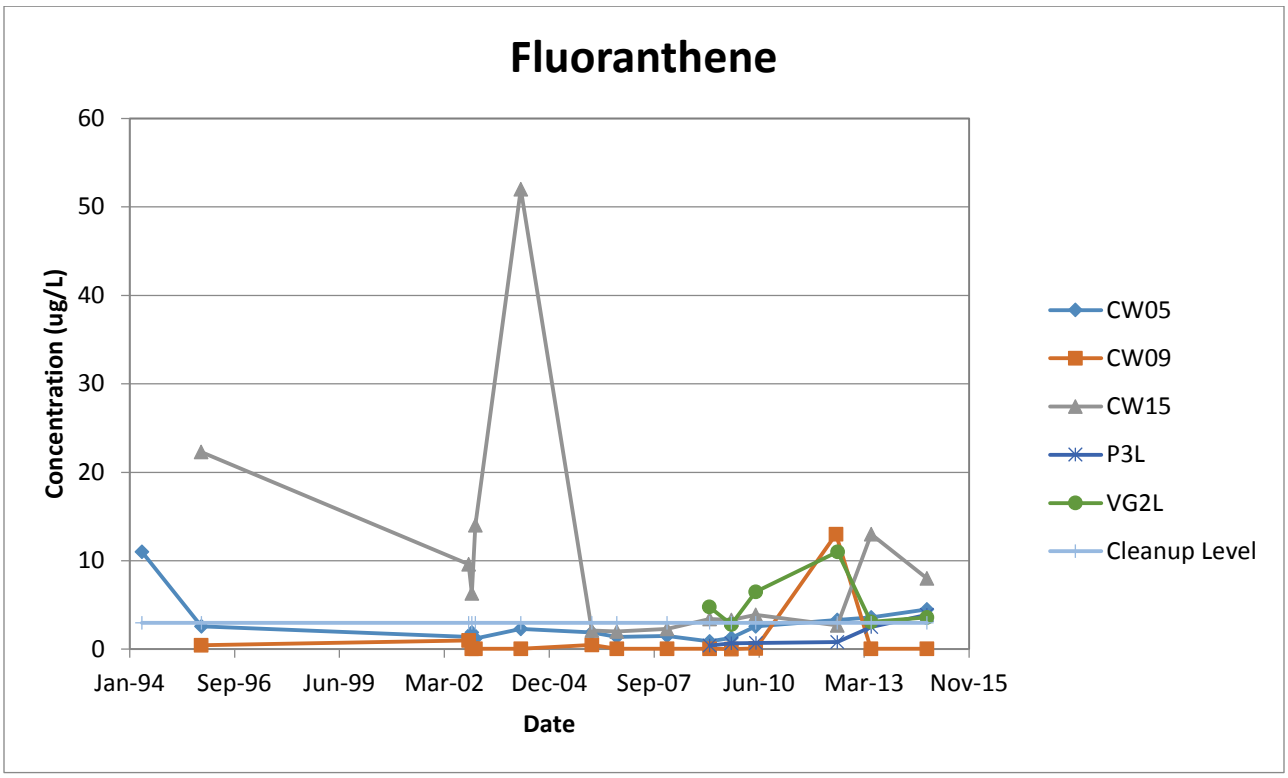

Figure E-25: Fluoranthene Concentration over Time

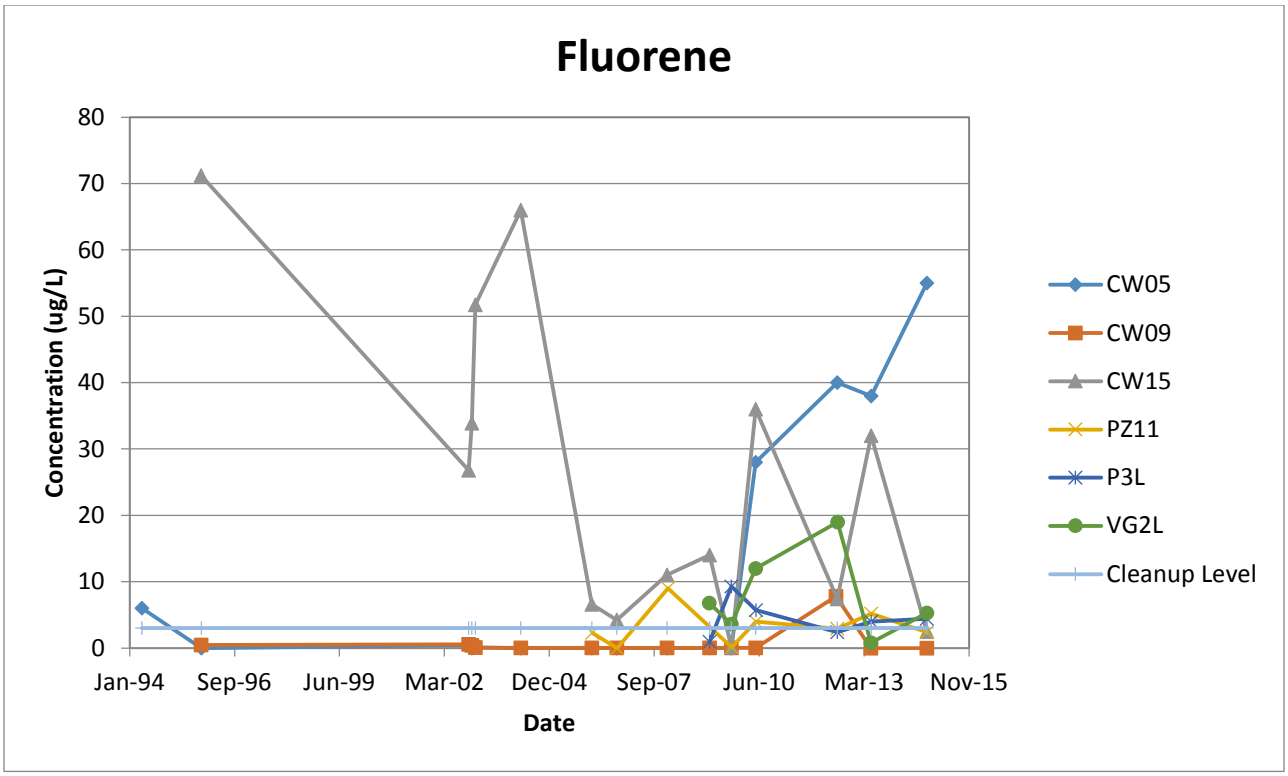

Figure E-26: Fluorene Concentration over Time

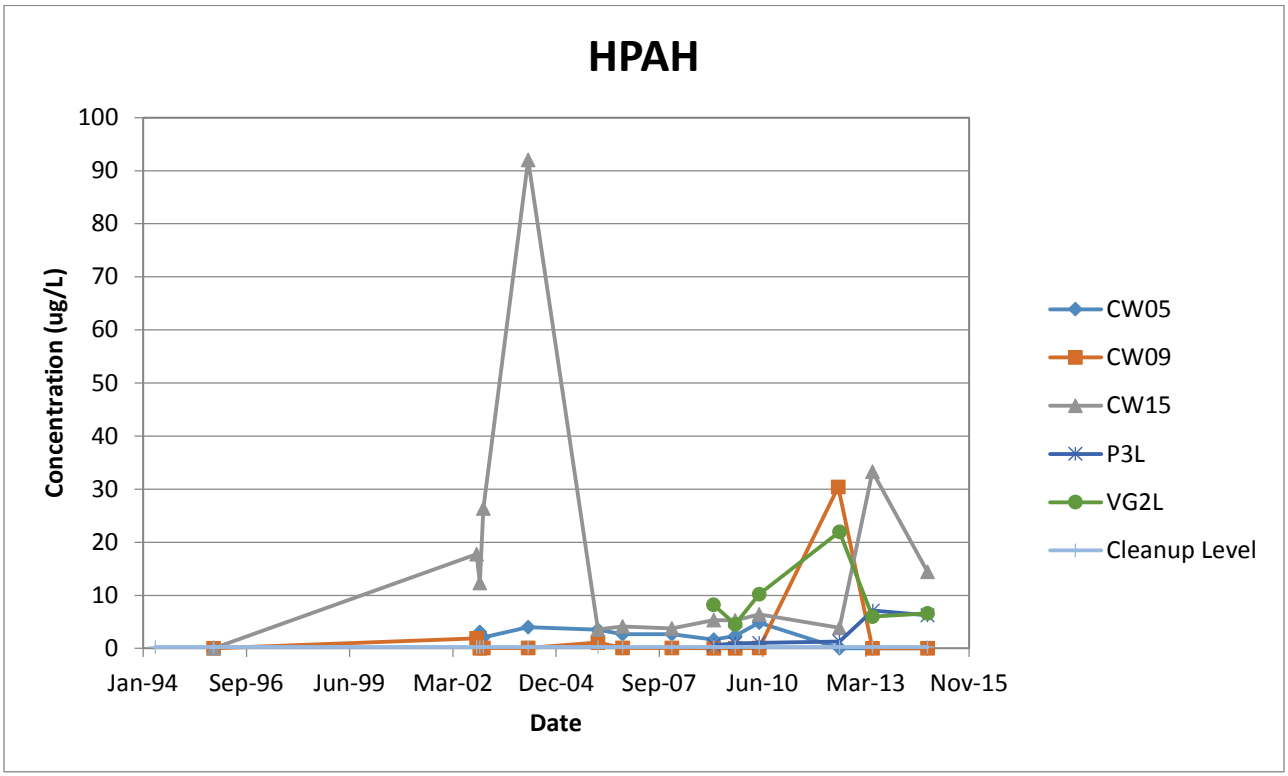

Figure E-27: High Molecular Weight Polycyclic Aromatic Hydrocarbon (HPAH) Concentration over Time

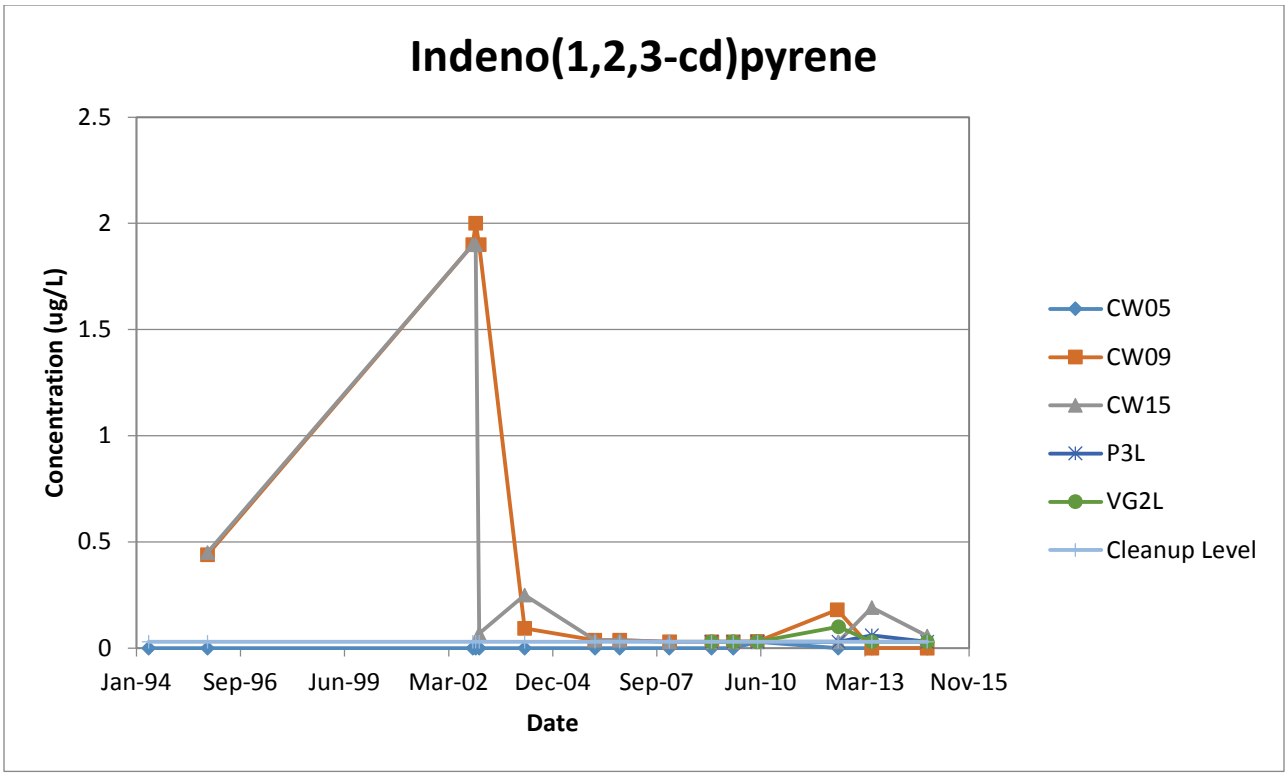

Figure E-28: Indeno(1,2,3-cd)pyrene Concentration over Time

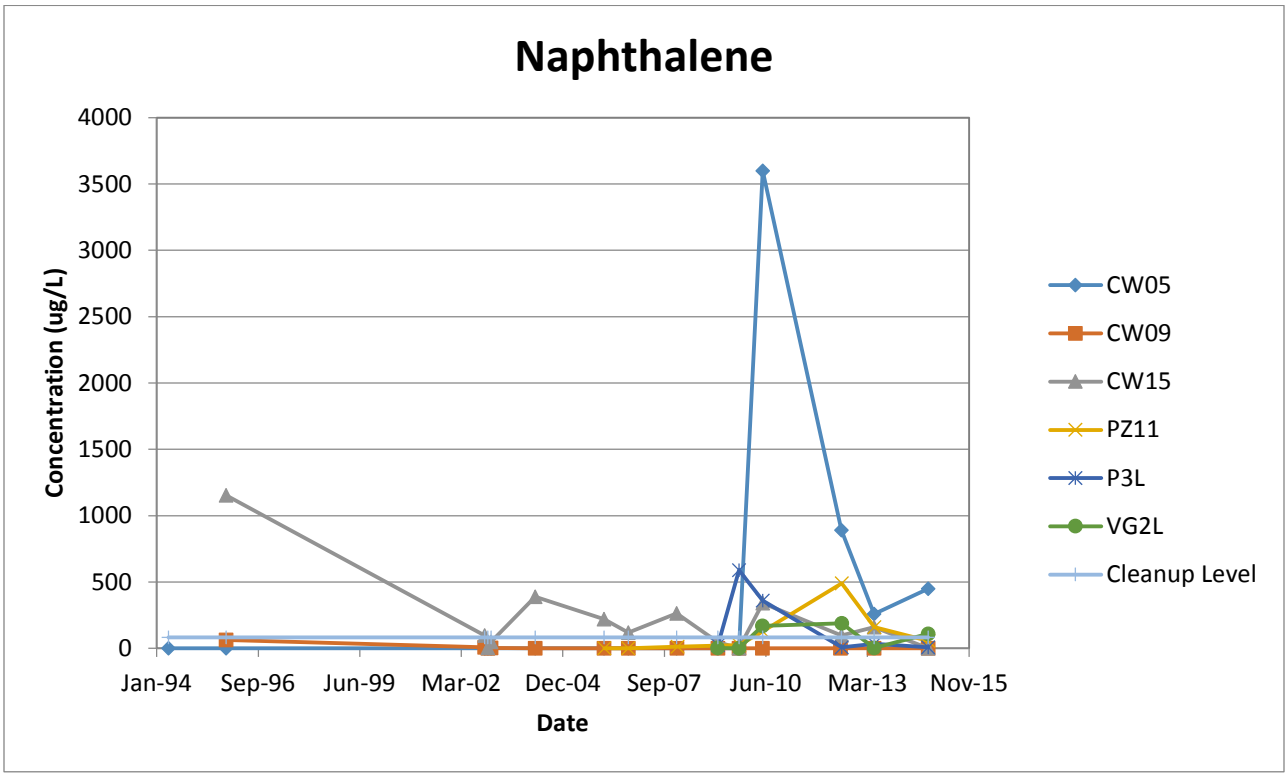

Figure E-29: Napthalene Concentration over Time

Groundwater Treatment Plant

Treatment plant influent and effluent data from January 2012 through February 2017 was reviewed. Data was provided by the treatment plant operators to the five-year review team as raw data. Influent total PAH data ranged from 8,600 to 130,000 µg/L, with an average of 17,633 µg/L. A Mann-Kendall trend analysis indicated that the influent total PAH data was stable. Effluent total PAH concentrations showed nearly all non-detect values, except for two detected concentrations just above the detection limit of 1 µg/L Influent PCP concentrations ranged from 120 µg/L to 400 µg/L, with an average of 233 µg/L. A Mann-Kendall statistical analysis show statistically significant upward trend (with greater than 95% confidence) is occurring. Despite this upward trend, effluent PCP data were all non-detect values. Figure E-30 presents graphs for total PAH and PCP influent and effluent data.

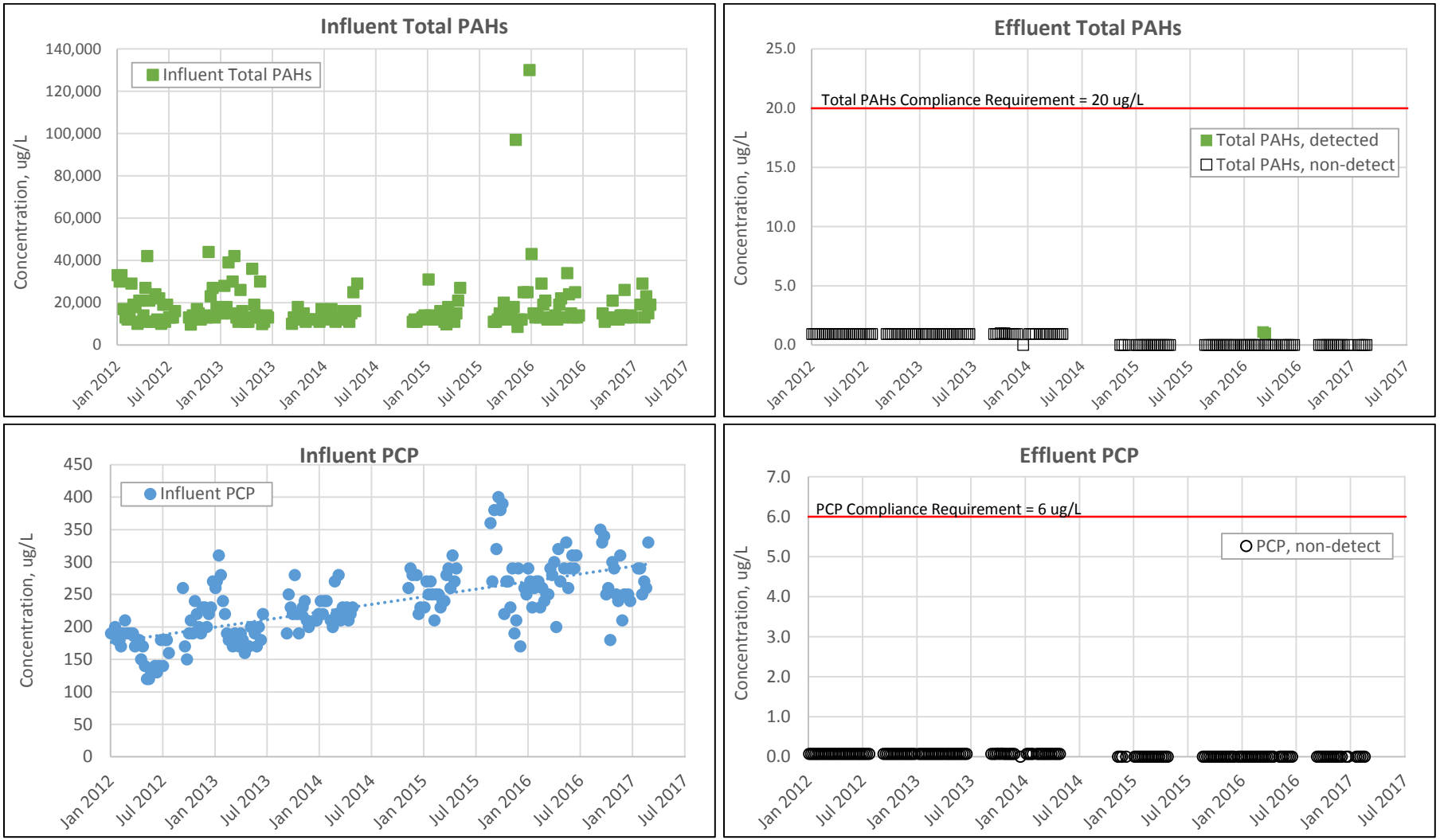

Figure E-30. Groundwater Treatment Plant Data, Jan 2012 through Feb 2017

OU-3 West Harbor

The OMMP for West Harbor was updated in 2008 for monitoring Years 11 through 20 (2008 through 2017), which covers monitoring requirements for the remedial action as well as the facility's stormwater permit. Annual reports are prepared each year documenting the monitoring and inspections completed for the upland cap area, the shoreline area, and the stormwater draining system. Annual reports for monitoring Years 14 through 19 (2011 through 2016) were reviewed for this data analysis.

Subtidal Sediment

No subtidal sediment data was collected within the last five years. According to the 2014 annual monitoring report, the last time sediment samples were collected was in monitoring Year 8 (2005).

Intertidal Seep Monitoring

In 2016, water quality sampling of seeps (which occurs once every five years) was completed. Four seeps with a flow rate over 1 gallon per minute were sampled and analyzed for dissolved copper and zinc. Results show all copper concentrations were below the marine water quality criteria. Zinc concentrations increased compared to the 2011 samples, but were still much less than the pre-construction monitoring, and were below the marine water quality criteria.

Groundwater Monitoring

One monitoring well (MW-01; see Figure E-31) was sampled for dissolved copper, zinc, and mercury, and total mercury. Results showed that all chemicals were below their respective marine water quality criteria. Water levels were also measured at two piezometers (PZ-02 and PZ-03). The water levels were within the range previously measured in 2011.

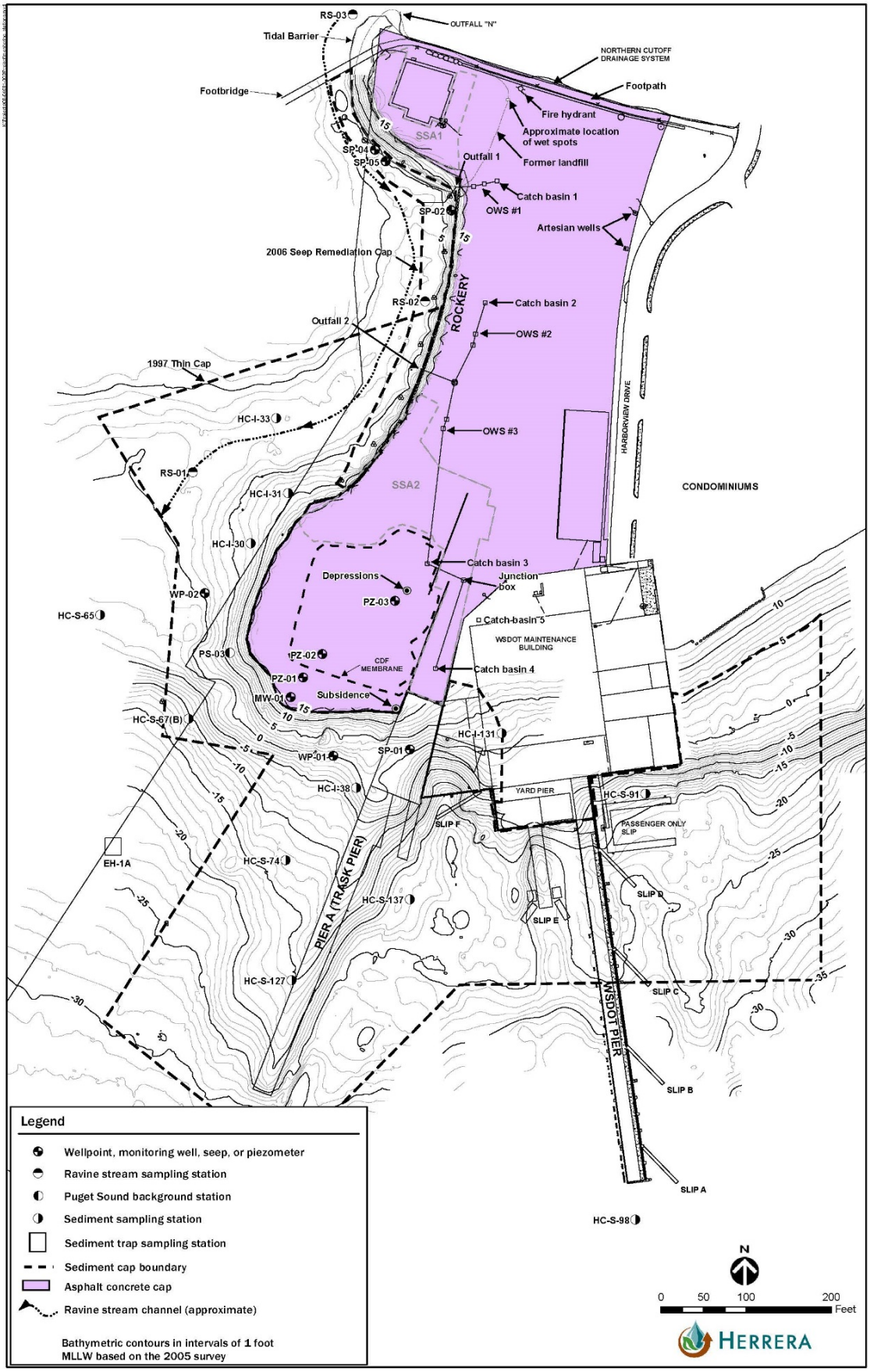

Figure E-31. West Harbor Site Features

APPENDIX F – SITE INSPECTIONS

OU-1 – East Harbor
OU-2/OU-4 – Soil and Groundwater
OU-3 – West Harbor

OU-1 - WEST HARBOR SITE INSPECTION

Trip Report
OU-1, Wyckoff Superfund Site
Bainbridge Island, Washington

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1. INTRODUCTION

a. Date of Visit: January 12, 2017

b. Location: Bainbridge Island, WA

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Kayla Patten	USACE, Seattle District, Env. Engineer	206-316-3855
Ben McKenna	USACE, Seattle District, Geologist	206-764-3803
Ellen Brown	USACE, Env. Engineer/Project Manager	206-764-3536
Helen Bottcher	EPA, Remedial Project Manager	206-553-6069
Hun Seak Park	Ecology	360-407-7189
Sam Meng	Ecology	360-407-7239

2. SUMMARY

The site visit for OU-1 occurred from 1:30 to 2:00 pm. The weather was sunny with temperatures in the low 30s°F. The tidal level was about 8 ft, which was near the lower-high tidal level for the day. The site visit team walked beach area from the western end, and around the Wyckoff sheet pile wall as far as the beach extended above the tide level. From the beach, several of the no-anchor buoys could be seen. The beach sediment appeared to be in good condition. No chemical seeps were observed. There was one small area of the beach that contained coarser gravel, compared to the remaining beach which consisted of sand. It was not clear why this area would contain different sediment.

Later in the day, around 4:30 pm the in-water cap replacement was observed from the ferry boat. Placement appeared to be going well and no suspended sediment was observed near the site.

3. ACTIONS

The USACE will incorporate information obtained from the site visit into the Five Year Review report.

Kayla Patten
Environmental Engineer
CENWS-EN-TS-ET

Photo 1. No-anchor buoy

Photo 2. Beach sediment

Photo 3. No-anchor sign at the beach

Photo 4. Gravel patch (right side)

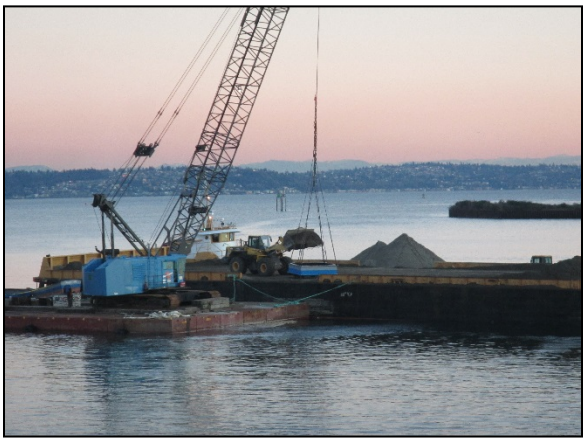

Photo 5. Subtidal cap repair along ferry route

OU-1 Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Wyckoff/Eagle Harbor OU 1	**Date of inspection:** January 12, 2017
Location: Bainbridge Island, Washington	**EPA ID:** WAD009248295
Agency, office, or company leading the five-year review: USACE, Seattle District	**Weather/temperature:** sunny, low 30s

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☐ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: *Sediment capping*
- ☒ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS

No interviews were conducted during the site visit. Interviews will be conducted at a later time via phone

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☐ O&M manual	☐ Readily available	☐ Up to date	☒ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☒ N/A

Remarks_____

2. **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☒ N/A
   ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A
   Remarks_____

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks_____

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits_____	☐ Readily available	☐ Up to date	☒ N/A

   Remarks_____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks_____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks_____

7. **Groundwater Monitoring Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks_____

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks_____

9. **Discharge Compliance Records**
☐ Air ☐ Readily available ☐ Up to date ☒ N/A
☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A
Remarks_____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A
Remarks The beach is open to the public. During the site visit, visitors were observed using the beach.

IV. O&M COSTS

O&M Costs were not gathered at the site visit. These will be compiled at a later date.

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☒ N/A
Remarks_____

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks_____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _____
Frequency _____
Responsible party/agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ☒ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☒ No ☐ N/A
Other problems or suggestions: ☐ Report attached
Several of the no-anchor buoys could be seen from the shoreline. In addition, the no-anchor sign attached to the fence near the beach was in good condition and would be visible from the water.

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks: Ms. Bottcher has been told by the public that some boating GPS systems do not readily display the no-anchor area.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks: The no-anchor buoys could not be observed up-close as they are in deep water.

2. **Land use changes on site** ☐ N/A
Remarks:

3. **Land use changes off site** ☐ N/A
Remarks:

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☒ N/A

B. Other Site Conditions

Remarks: The beach sediment appeared to be in good condition. No chemical seeps were observed. It was clear that the public uses this beach often; one person was observed walking their dogs during the site visit.

VII. SEDIMENT CAP ☒ Applicable ☐ N/A

A. Sediment/Beach Surface

1. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent_____ Depth_____
Remarks Erosion was not evident, however this area is used by the public and therefore the surface is uneven.

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The purpose of the remedy is to prevent human exposure, until the time which cleanup levels are achieved through monitored natural recovery. The beach/sediment cap is preventing exposure to the public. There is no evidence of chemical seeps along the beach. The institutional controls (i.e. no-anchor buoys and sings) appear to be working, however violations may not always be discovered.

B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. O&M for the remedy includes chemical monitoring and cap depth measurements. These appear to be adequate to maintain the integrity of the beach cap.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. No early indicators of potential issues was observed.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No opportunities for optimization were noted.


OU1
Legend
In-water cap replacement
No anchor buoys
Gravel patch
Beach cap
EBS
Google earth
© 2016 Google
N
800 ft

OU-2/OU-4 – SOIL AND GROUNDWATER SITE INSPECTION

Trip Report
OU-2 and OU-4,Wyckoff Superfund Site
Bainbridge Island, Washington

---

1. INTRODUCTION

a. Date of Visit: January 12, 2017

b. Location: Bainbridge Island, WA

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Kayla Patten	USACE, Seattle District, Env. Engineer	206-316-3855
Ben McKenna	USACE, Seattle District, Geologist	206-764-3803
Ellen Brown	USACE, Env. Engineer/Project Manager	206-764-3536
Helen Bottcher	EPA, Remedial Project Manager	206-553-6069
Hun Seak Park	Ecology	360-407-7189
Sam Meng	Ecology	360-407-7239
Stan Warner	CH2MHill, Treatment Plant Operator	

2. SUMMARY

The site visit occurred from 2:00 to 3:00 pm. The weather was sunny with temperatures in the low 30s°F. Prior to beginning the site visit, Mr. Warner provided a safety briefing and provided necessary PPE. The team viewed the outer perimeter of the western sheet pile wall, several extraction wells, the eastern sheet pile wall, the tank area, and the treatment system building.

The outside of the western sheet pile wall showed signs of water leakage at joint areas, but no major gaps or wall failures were observed. The fencing along the top of the sheet pile wall was in good condition; however, vegetation had overgrown the fence in some areas. The gates were locked and showed no signs of unauthorized access.

Groundwater wells outside the southern edge of the site were locked and in good condition, but did have graffiti on them. There were no signs that anyone had tried to access the well. Warning signs at the western and main entrance were in good condition. The main and western gates remain locked at all times.

The extraction and treatment system was not operational at the time of the site visit due to below-freezing temperatures. Mr. Warner indicated that it had been off for several days. The extraction wells were in good condition; however, ice was pooled at the bottom of the containment area.

The eastern portion of the sheet pile wall was in very poor condition. There were some areas where the wall had rusted away and was less than one centimeter thick. The steel was flaking off in very large chunks. It was unclear if the degradation extended below the soil/sediment line.

The tank area and treatment system were in very good condition. The areas were very clean, well-organized, and well maintained. All labels were in good condition and easily readable. It was clear that the plant operators are taking very good care of the treatment system.

3. ACTIONS

The USACE will incorporate information obtained from the site visit into the Five-Year Review report.

Kayla Patten
Environmental Engineer
CENWS-EN-TS-ET

Ben McKenna
Geologist
CENWS-EN-TS-GE

Photo 1. Gates along northwestern wall; vegetation overgrowth in some areas.

Photo 2. Fence along northwestern wall.

Photo 3. Outer edge of western sheet pile wall; some leakage stains observed.

Photo 4. Western gate.

Photo 5. Southern fence along walking path. Some trash observed within fenceline.

Photo 6. Groundwater monitoring wells. Graffiti observed.

Photo 7. Main entrance and signs.

Photo 8. PPE exclusion area and decontamination station.

Photo 9. Extraction well and pump system.


Photo 10. Monitoring wells.

Photo 11. Site vegetation.

Photo 12. Former test pilot area.

Photo 13. Degraded eastern sheet pile wall.

Photo 14. Tank area.

Photo 15. Treatment system controller

Photo 16. Activated carbon tanks.

Photo 17. Treatment system pumps.

OU-2/OU-4 Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Wyckoff/Eagle Harbor OU 2&4	**Date of inspection:** January 12, 2017
Location: Bainbridge Island, Washington	**EPA ID:** WAD009248295
Agency, office, or company leading the five-year review: USACE, Seattle District	**Weather/temperature:** Sunny, 30s°F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other: In-situ solidification/stabilization
- ☐ Monitored natural attenuation
- ☒ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Check all that apply)

No interviews were conducted at the site visit. Interviews will be completed at a later date via phone.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☒ Up to date	☐ N/A
☒ As-built drawings	☐ Readily available	☐ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks Documents for the remedy were readily available.

2. **Site-Specific Health and Safety Plan** ☒ Readily available ☒ Up to date ☐ N/A
   ☒ Contingency plan/emergency response plan ☒ Readily available ☒ Up to date ☐ N/A
   Remarks

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☐ N/A
   Remarks

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits	☐ Readily available	☐ Up to date	☒ N/A

   Remarks

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks

7. **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date ☐ N/A
Remarks

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks

9. **Discharge Compliance Records**
☐ Air ☐ Readily available ☐ Up to date ☒ N/A
☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A
Remarks

10. **Daily Access/Security Logs** ☒ Readily available ☒ Up to date ☐ N/A
Remarks A kiosk is maintained where all visitors check in.

IV. O&M COSTS

O&M costs were not gathered during the site visit. This will be obtained from the site managers at later date.

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A
Remarks Fencing was in good condition. There were areas of significant vegetation growth on the fence, but did not damage the fence.

B. Other Access Restrictions

1. **Signs and other security measures** ☒ Location shown on site map ☐ N/A
Remarks Warning signs were in good condition.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Reported by Ecology contractor
Frequency Annual
Responsible party/agency Contractor to Wa. Dept. of Ecology
Contact _____ _____ _____ _____
Name Title Date Phone no.

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☐ No ☒ N/A
Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☐ No vandalism evident
Remarks: Some trash was observed long the inner side of the fence line. Indications of site access were not observed. Monitoring wells outside the fence along the walking path did have graffiti. Wells were locked and showed no signs of access.

2. **Land use changes on site** ☐ N/A
Remarks:

3. **Land use changes off site** ☐ N/A
Remarks:

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks:

B. Other Site Conditions

Remarks: Vegetation on site was very overgrown. Many areas could not be accessed due to the density blackberry and scotch broom. Walking paths between wells were maintained and clear of vegetation. The old test pilot area was heavily over grown with vegetation and the system piping has not been maintained.

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☒ Applicable ☐ N/A

1. **Settlement** ☐ Location shown on site map ☒ Settlement not evident
Areal extent_____ Depth_____
Remarks_____
_____

2. **Performance Monitoring** Type of monitoring visual inspection
☐ Performance not monitored
Frequency weekly ☐ Evidence of breaching
Head differential_____
Remarks The sheet pile wall showed significant corrosion, particularly along the eastern (open water) side._____
_____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks At the time of the site visit the groundwater extraction system was not in operation due to below-freezing temperatures.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
☒ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☒ Carbon adsorbers
☐ Filters
☐ Additive (*e.g.*, chelation agent, flocculent)
☐ Others
☐ Good condition ☐ Needs Maintenance
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☐ Quantity of groundwater treated annually
☐ Quantity of surface water treated annually
Remarks The treatment system was in extremely good condition. The area was clean, well organized, and well maintained.

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☐ Good condition ☒ Proper secondary containment ☐ Needs Maintenance
Remarks

4. **Discharge Structure and Appurtenances**
☐ N/A ☐ Good condition ☐ Needs Maintenance
Remarks The discharge structure is offshore and was therefore not assessed during the site visit.

5. **Treatment Building(s)**
☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair
☒ Chemicals and equipment properly stored
Remarks_____

6. **Monitoring Wells** (pump and treatment remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks_____

D. Monitoring Data

1. **Monitoring Data**
☐ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring data suggests:**
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

The sheet pile wall functions to contain groundwater and NAPL at the site. Along the eastern side of the site, where the wall is exposed to Puget Sound, the sheet pile wall is extremely degraded. The wall has significant rust and in areas was less than one centimeter thick. Large flakes of steel are sloughing off of the wall as it degrades. It is unclear if the degradation extends below the soil/sediment line, where it is serving as a groundwater barrier.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

During the site visit, the pump and treat system was not actively running due to below-freezing temperatures. However, the remedy was in very good condition and appeared to be functioning as designed.

B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. The operation and maintenance of the pump and treat system was excellent. The treatment system and building were in very good condition: the area was very clean, well organized, and well maintained.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. Other than the sheetpile wall degradation, no early indicators of problems with the remedy were observed.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. During the site visit, the pump and treat system was not operational due to below-freezing temperatures. Although freezing temperatures are uncommon in the Seattle area, any time spent offline may impact the remedy. If the pump and treat system were to continue be operated long-term, the site managers should consider options for winterizing the system so it can operate in all weather conditions.


Extraction wells
Pilot test area
Corroded wall
Treatment bldg
Tanks
Trash and well vandalism
West gate; signs
Entrance; signs
Creosote Pt NE
© 2016 Google
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Google

OU-3 - EAST HARBOR SITE INSPECTION

Trip Report
OU-3, Wyckoff Superfund Site
Bainbridge Island, Washington

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1. INTRODUCTION

a. Date of Visit: January 12, 2017

b. Location: Bainbridge Island, WA

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Kayla Patten	USACE, Seattle District, Env. Engineer	206-316-3855
Ben McKenna	USACE, Seattle District, Geologist	206-764-3803
Ellen Brown	USACE, Env. Engineer/Project Manager	206-764-3536
Helen Bottcher	EPA, Remedial Project Manager	206-553-6069
Bonnie Arthur	EPA, Remedial Project manager	206-553-4072
Hun Seak Park	Ecology	360-407-7189
Sam Meng	Ecology	360-407-7239
R.J. Kelly	WSDOT Ferries Division	206-780-3101
Kevin Bartoy	WSDOT Ferries Division	206-515-3856
XXXX	Citizen, City of Bainbridge Island	

2. SUMMARY

The site visit occurred from 10:30am to 12:00pm. The weather was sunny with temperatures in the low 30s °F. The tidal level was about 7 ft, which was at the lower-high tide level for the day. The site visit team walked to perimeter and interior of the asphalt cap, and the northern cutoff drainage system footpath.

Overall the site is being used for employee vehicle parking, and equipment and materials storage. Although areas of the site were disorganized, the site was clear of debris and hazards. Covers had been placed over much of the storage area, preventing stormwater contact with potential contaminants. Some storage containers showed significant rusting, which may impact stormwater quality.

The asphalt surface was in overall good condition. There were many repaired cracks, however there were no new cracks evident. Past repairs appeared to be effective and were not deteriorating. Dents were observed in the asphalt, which were caused by the weight of previously stored containers. Staff recently started placing container feet on larger plates to distribute the weight and prevent denting the asphalt. One dent appeared to be a hole in the asphalt as the surface consisted of granular material and moss. The hole was about 5 square inches and less than one inch deep. Ponding was present in one area, which included two puddles about 5ft x 5ft each. Ice was present in the puddles. The area of previous subsidence was in good condition. No additional subsidence or cracking was present.
The stormwater catchment basins were clear of debris. The filter socks were visible through the grating and appeared to be in good condition. The stormwater outfall was in good condition. Monitoring wells were locked and in good condition.

The fence surrounding the site was in good condition. There was no evidence of vandalism or signs of unauthorized access. The main entrance gate was open to allow employees to enter and exit as needed. Signs were present indicating only authorized personnel are allowed access; however, there are no

physical barriers preventing unauthorized access via the front gate. Mr. Kelly indicated one prior incident of unauthorized access and theft.

The pathway over the northern cutoff drainage system was in good condition. No ponding was evident on the pathway.

At the northern end of the tidal barrier, near the footpath bridge, the armoring has eroded away exposing the geomat liner. The area exposed was about 3ft by 5ft and was high on the bank. Damage to the geomat liner was observed, however it was minimal. Armoring rocks were seen in the channel bed, evidence of erosion.

3. ACTIONS

USACE will incorporate information obtained from the site visit into the Five Year Review report.

Kayla Patten
Environmental Engineer
CENWS-EN-TS-ET


Photo 1. Main cap area. Repaired cracks seen as darker lines.


Photo 2. Uncovered storage areas. Repaired cracks seen as darker lines.


Photo 3. Covered storage areas.

Photo 4. Repaired cracks.

Photo 5. Dents caused by storage container feet. Photo on right was potentially a hole.

Photo 6. Plates placed under recent storage containers to prevent denting. Also note rusting on containers.

Photo 7. Ponding area on cap. Ice was present; white material is deicing salt.

Photo 8. Area of previous subsidence.


Photo 9. Stormwater catch basins.

Photo 10. Stormwater outfall.

Photo 11. Monitoring well.

Photo 12. Fencing surrounding the site.

Photo 13. Locked gates along fencing.

Photo 14. Main entrance and signage.

Photo 15. Path over northern cutoff drainage system.

Photo 16. Armor rocks visible in the channel bed.

Photo 17. Exposed geomat on the tidal barrier.

Photo 18. Tidal barrier armoring.

OU-3 Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Wyckoff/Eagle Harbor OU-3	**Date of inspection:** January 12, 2017
Location: Bainbridge Island, Washington	**EPA ID:** WAD009248295
Agency, office, or company leading the five-year review: USACE, Seattle District	**Weather/temperature:** Sunny, 30s°F, tide 8-10 ft

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☐ Institutional controls
- ☐ Groundwater pump and treatment
- ☒ Surface water collection and treatment
- ☒ Other: confined disposal facility, tidal barrier
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Check all that apply)

No interviews were conducted at the site inspection. Interviews will be conducted alter via phone.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☒ Up to date	☐ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks_____

2. **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☐ N/A
   ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☐ N/A
   Remarks_____

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☐N/A
   Remarks_____

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐Up to date	☒ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits_____	☐ Readily available	☐ Up to date	☒ N/A

Remarks_____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks_____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks_____

7. **Groundwater Monitoring Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks

9. **Discharge Compliance Records**
☐ Air ☐ Readily available ☐ Up to date ☒ N/A
☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A
Remarks

10. **Daily Access/Security Logs** ☐ Readily available ☒ Up to date ☐ N/A
Remarks Site visitors are required to sign-in at the main office.

IV. O&M COSTS

O&M costs will be obtained during interviews.

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A
Remarks Fencing was in good condition. Fence gates were locked. The main entrance remains open at all times during the day.

B. Other Access Restrictions

1. **Signs and other security measures** ☒ Location shown on site map ☐ N/A
Remarks Signs in good condition

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Self- monitoring
Frequency Weekly
Responsible party/agency WSDOT, Ferries Division
Contact Nancy Adams (Name) Project Engineer (Title) _____ (Date) 206-780-3147 (Phone no.)

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☒ No ☐ N/A
Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks: The site manager did report a prior incidence of theft. The individual gained access through the main gate.

2. **Land use changes on site** ☐ N/A
Remarks:

3. **Land use changes off site** ☐ N/A
Remarks:

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☒ N/A

B. Other Site Conditions

Remarks: The paved lot is used for employee parking and for equipment and material storage. The storage areas are not well organized, however minimal debris was found. Covers have been placed over much of the storage areas, limiting runoff that may come in contact with metals or other substances.

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent_____ Depth_____
Remarks_____
_____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
Lengths_____ Widths_____ Depths_____
Remarks No new cracks were evident at the site visit, however numerous repaired cracks were observed. Cracks largely along original paving lines. Site manager reported crack repairs are very common. They are working on finding a repair method that is more durable and permanent.
_____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent_____ Depth_____
Remarks_____
_____

4. **Holes** ☒ Location shown on site map ☐ Holes not evident
Areal extent <1 sq ft Depth 1 inch
Remarks One hole was found. It appeared to be caused by pressure from storage container feet. Several areas were observed where storage containers had caused dents in the asphalt. Only one had eventually become a hole.
_____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established
☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram)
Remarks_____

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
Remarks The site is paved with asphalt. Regular cracking was evident, as were dents created by storage containers. Recently placed containers were placed on larger metal plates to distribute the weight and prevent denting.

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
Areal extent_____ Height_____
Remarks_____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☒ Ponding ☒ Location shown on site map Areal extent 20-40 sq ft
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks: Ponding was evident as patches of ice at the site visit. The site manager indicated ponding areas are not uncommon. Past repairs have been done to repave these areas.

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent_____
Remarks:

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☒ Functioning ☐ N/A
Remarks Stormwater catch basins were clear and appeared to be functioning. Outlet piping not inspected as it is outside the fenceline and not accessible.

2. **Outlet Rock Inspected** ☒ Functioning ☐ N/A
Remarks_____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
   - ☐ Metals removal ☒ Oil/water separation ☐ Bioremediation
   - ☐ Air stripping ☐ Carbon adsorbers
   - ☒ Filters__filter sock at CB-1&4 for sediment & oil, metal-adsorbing sock at CB-2,3,&5_____
   - ☐ Additive (*e.g.*, chelation agent, flocculent)_____
   - ☐ Others_____
   - ☐ Good condition ☐ Needs Maintenance
   - ☐ Sampling ports properly marked and functional
   - ☒ Sampling/maintenance log displayed and up to date
   - ☐ Equipment properly identified
   - ☐ Quantity of groundwater treated annually_____
   - ☐ Quantity of surface water treated annually_____

   Remarks The stormwater catch basin filter socks were difficult to observe, however they appeared to be in good condition._____

2. **Electrical Enclosures and Panels** (properly rated and functional)
   - ☒ N/A ☐ Good condition ☐ Needs Maintenance

   Remarks_____

3. **Tanks, Vaults, Storage Vessels**
   - ☒ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance

   Remarks_____

4. **Discharge Structure and Appurtenances**
   - ☒ N/A ☐ Good condition ☐ Needs Maintenance

   Remarks_____

5. **Treatment Building(s)**
   - ☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair
   - ☐ Chemicals and equipment properly stored

   Remarks_____

6. **Monitoring Wells**
   - ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
   - ☐ All required wells located ☐ Needs Maintenance ☐ N/A

   Remarks_____

D. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☒ N/A
Remarks_____
_____

X. OTHER REMEDIES

The site is surrounded by a tidal barrier wall to prevent infiltration of seawater into the disposal facility. The EPA RPM indicated that seeps have been observed following high tides; however, sampling has shown the water to be clean. It is believed that that the seeps are simply seawater slowly draining out of the tidal barrier following saturation at high tide.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy is a confined disposal facility intended to prevent human exposure and leaching into the adjacent waterway. The asphalt cap is preventing exposure as intended. Cracks are repaired promptly. There is no evidence that seeps from the contaminated material is occurring at the site.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Regular inspection of the cap is catching cracks as they occur. Repairs are made promptly. Dents from container storage may lead to future holes in the cap. The facility has recently placed small plates below the container feet to prevent denting. This appears to be solving the issue and should be continued.

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. The rate cracks occur on the site is significant. Regular repairs are causing a large overall O&M efforts. Continued cracking may lead to more significant issues in the future, however there are no current indicators of major issues. Maintenance personnel have looked into repaving the site, however this too is a significant cost that must be planned and budgeted for.

D.	Opportunities for Optimization
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No opportunities for optimization were identified.


Exposed geoliner
Shannon Dr SE
Waterfront Trail
Harborview Dr SE
Main entrance, signs
Hole
Ponding
Former subsidence
© 2016 Google

APPENDIX G – INTERVIEWS

OU-1 – East Harbor
OU-2/OU-4 – Soil and Groundwater
OU-3 – West Harbor

OU-1 - WEST HARBOR INTERVIEWS

Five-Year Review Interview Record			
Site:	Wyckoff/Eagle Harbor Superfund Site, OU-1	**EPA ID No:**	WAD009248295
Interview Type: Telephone Date: March 30, 2017 Time: 1:00 PM			

Interviewers		
Name	**Title**	**Organization**
Kayla Patten	Environmental Engineer	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Susannah Edwards	Ecology	Environmental Specialist	360-280-1963	sued461@ecy.wa.gov

Summary of Conversation

Ms. Edwards is Ecology's designated sediment specialist for OU 1. Been on site since March 2014. Is involved in sampling and analysis plans, and field work.

1) What is your overall impression of the project?
EPA and Ecology have put in substantial time and effort into assessing the performance of the remedial actions. West beach and intertidal cap are going as expected. They are colonized by benthic invertebrates and forage fish. West beach might be losing material. Last time Ms. Edwards was out at the site, saw sand was washed away. May need to add material to provide habitat.

For subtidal, the ferry channel was just repaired. Ecology is doing a joint inspection with EPA of the ferry area. Once Ecology approves of the construction, Ecology will be taking over O&M of the subtidal area. EPA is doing a good job to address issues in the subtidal areas. The North Shoal might need some work. Ms. Edwards walks the beaches often, and has seen NAPL seeps. The concentrations are showing exceedances of ROD criteria. EPA is looking into removing sediment where mobile NAPL may be present.

2) Is the remedy functioning as expected? How well is the remedy performing?
Yes, for the repaired subtidal cap and capped intertidal beaches.
No, for the uncapped intertidal beaches. [see above]

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
Over, seeing decreasing concentrations. Clam tissue data is inconclusive, can't tell much. The north shoal and east beach are decreasing but still have exceedances of ROD criteria.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
N/A

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
N/A

6) What are the annual operating costs for your organization's involvement with the site?
N/A

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
The Ferry lane needed repair, which was completed. Currently, seeing that the west beach may need nourishment.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
N/A

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
In 2013 Washington State SMS were revised, updated criteria for human health risks. This resulted in lower cleanup levels for bioaccumulative levels. That update might affect protectiveness.

10) Do you have any comments, suggestions, or recommendations regarding the project?
Ms. Edwards suggests that EPA and Ecology develop a plan to evaluate risks from dioxins and furans (D/F). D/F were not considered a COC in the 1994 ROD, or in the current Proposed Plan for the new ROD Amendment. It is being assumed that D/F are co-located with the primary COCs. Ms. Edwards doesn't know of any analysis that has been done on D/F in OU-1. It should be verified that concentrations will be reduced to acceptable levels within a reasonable timeframe. D/F should be added to sampling plans in the future.

Additional Site-Specific Questions

11) How do you think the recent cap repair in the ferry lane went?
Haven't seen final bathymetry data yet, so not sure on final construction achievement. The repair process was pretty smooth. No major issues during the repair. Ms. Edwards was out at the site yesterday doing a visual survey with an underwater camera and didn't see any issues.

Addendum - Five-Year Review Interview Record				
Site:	Wyckoff/Eagle Harbor Superfund Site, OU-1		**EPA ID No:**	WAD009248295
Interview Type: Email Date: Time:				

Interviewers

Name	**Title**	**Organization**
Kayla Patten	Environmental Engineer	USACE

Interviewees

Name	**Organization**	**Title**	**Telephone**	**Email**
Susannah Edwards	Ecology	Environmental Specialist	360-280-1963	sued461@ecy.wa.gov

Summary of Conversation

Ms. Edwards provided additional comments on September 1, 2017, which are summarized below.

- Ms. Edwards observed NAPL "blebs" on the western edge of the EBS resulting in samples to be collected as part of 2016 monitoring effort. .
-Ms. Edwards requested dioxin/furans analysis be performed on future fish/shellfish samples.

Five-Year Review Interview Record			
Site:	Wyckoff/Eagle Harbor Superfund Site, OU-1	**EPA ID No:**	WAD009248295

Interview Type: Telephone
Date: May 12, 2017
Time: 10:00 am

Interviewers

Name	Title	Organization
Kayla Patten	Environmental Engineer	USACE

Interviewees

Name	Organization	Title	Telephone	Email
Rich Brooks	Suquamish Tribe	Environmental Program Manager	360-394-8442	rbrooks@suquamish.nsn.us

Summary of Conversation

Rich has been involved at Wyckoff since the 1990s. The Suquamish Tribe has treaty and resource rights in the area; they are also a natural resource trustee. Rich is familiar with OU-1 and OU-2/OU-4.

1) What is your overall impression of the project?
In 2008, the Tribe expressed their strong preference for the significant, or mass, removal of contaminants in the Wyckoff upland area, and that contamination issues within the nearshore areas of OU1 are addressed. They are supportive of the current efforts to amend ROD and implement a new remedy. The Tribe commented on the Proposed Plan in June 2016, and follow up information and discussions with EPA are still pending.

2) Is the remedy functioning as expected? How well is the remedy performing?
The degree of seeps in the nearshore have reduced since the sheet pile wall was installed (around 2001). Contamination within the nearshore area does still affect the Tribe's Treaty-reserved resources and rights. The subtidal sediment cap appears to be effective. The recent repair was needed to continue to isolate contaminants.

The ROD does need to be amended with a new remedy. The Tribe supports the partial excavation and capping alternative in the nearshore area.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
No comments at this time.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
Tribe does not conduct O&M. Rich does not get out to the site as often as he'd like.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
N/A

6) What are the annual operating costs for your organization's involvement with the site?
N/A

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
N/A

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
N/A

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
N/A

10) Do you have any comments, suggestions, or recommendations regarding the project?
The Tribe is interested in harvesting Treaty-reserved resources from the Wyckoff site area in the future. The Suquamish Tribe, EPA, and Washington Department of health worked collaboratively in the collection of geoduck tissue samples from the Port Blakely and the Tyee Shoal tracts. These samples were collected in 2005 and 2008 from depths of -18 to -70 feet MLLW and analyzed for PAHs, PCBs, dioxin/furans, metals, and percent lipids. Results showed that the concentration of contaminants in the geoduck tissues did not represent an unacceptable health risk. This effort supported upgrades and an 'Approved' shellfish growing classification within these geoduck tracts. Mr. Brooks provided shellfish growing area classification reports that depict the classifications in 2006, 2010, 2013, and 2015.

Additional Site-Specific Questions

11) How do you feel the coordination for the recent cap repair went?
Tribes appreciated the communication and having the opportunity to observe the repair work. Overall communication was good.

12) Are there any ongoing issues/concerns that need to be addressed further?
The ROD does need to be amended, and this largely depends on what final remedy is selected.

OU-2/OU-4 – SOIL AND GROUNDWATER INTERVIEWS

Five-Year Review Interview Record			
Site:	Wyckoff/Eagle Harbor: OU-2/OU-4	**EPA ID No:**	WAD009248295

Interview Type: Teleconference
Date: 3/14/2017
Time: 1300

Interviewers		
Name	**Title**	**Organization**
Ben McKenna	Geologist	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Ken Scheffler	CH2M	Project Manager	206-465-3913	Ken.Scheffler@ch2m.com

Summary of Conversation

1) What is your overall impression of the project?
Overall the remedy is effective and working very well. I would give it a 95% efficiency.

2) Is the remedy functioning as expected? How well is the remedy performing?
The plant is exceeding the design criteria and performing excellently! The carbon life is at 160% of what the initial designs were. A lot of thought was put into the design of the system and the expansions in the design have extended the financial & mechanical life of the system. Having 4 carbon beds versus 3 allows us to maximize the loads before we have to change out carbon and the upgraded backwashing system allows us to get more use from our carbon. We save a lot of money on carbon change out.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
I'd have to say no. The data shows that we are maintaining hydraulic containment in the upper aquifer but we aren't seeing a significant decrease in contaminants there. And there is not much changing in the lower aquifer. [Editorial note: Mr. Scheffler later clarified that he only views trends over a one-year interval.]

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
Absolutely. Stan Warner can best describe that.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
None.

6) What are the annual operating costs for your organization's involvement with the site?
Right now we spend about $50,000/year at the site and we've seen the costs increase about 4%/year over the past five years. If we include product disposal & carbon disposal it would be about $650,000 a year overall.

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
None that I can think of. Just the basic wear & tear replacement items.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Not much. We have worked a lot to maximize the efficiency of this site and I feel that it's running excellently.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
None.

10) Do you have any comments, suggestions, or recommendations regarding the project?
I would like to see an expedited effort to get the site capped as well as fixing the sheet pile wall. We have to treat millions of gallons of rainwater and if we could just get the site capped then we could reduce costs significantly and not have to treat rainwater. Additionally the sheet pile wall needs to be fixed/repaired very soon as has been identified by several reports and subject matter experts. We hope to have another evaluation of the wall done soon with new measurements and projections.

Five-Year Review Interview Record			
Site:	Wyckoff/Eagle Harbor OU-2/OU-4	**EPA ID No:**	WAD009248295

Interview Type: Teleconference
Date: 3/3/2017
Time: 0900

Interviewers		
Name	**Title**	**Organization**
Ben McKenna	Geologist	USACE
Kayla Patten	Environmental Engineer	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Sam Meng	Ecology	Environmental Scientist	360-407-7239	Sam.meng@ecy.wa.gov

Summary of Conversation

1) What is your overall impression of the project?
The groundwater treatment system is working very well. The plant is very clean & well maintained.

2) Is the remedy functioning as expected? How well is the remedy performing?
The system recently underwent its annual summer shutdown for planned maintenance and continues to do its job in pulling contaminants from the soil.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
I have only been working on this site since April of 2016 and do not have a sufficient background on monitoring trends at the site.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
Ch2m has a continuous presence at the site and Stan Warner can best describe that. Ecology visits the site roughly every 2 months with the EPA.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
None that come to mind

6) What are the annual operating costs for your organization's involvement with the site?
Hun Seak Park or Ken Scheffler can best answer that.

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
None that come to mind.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
None that come to mind.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
None that come to mind.

10) Do you have any comments, suggestions, or recommendations regarding the project?
The condition of the Sheet Pile wall is poor. We hope that a remedy/replacement can happen which includes better construction and better materials than the existing wall.

Five-Year Review Interview Record			
Site:	Wyckoff/Eagle Harbor: OU-2/OU-4	**EPA ID No:**	WAD009248295

Interview Type: Teleconference
Date: 3/3/2017
Time: 0900

Interviewers		
Name	**Title**	**Organization**
Ben McKenna	Geologist	USACE
Kayla Patten	Environmental Engineer	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Stan Warner	CH2M	Site Manager	206-780-1711	Stanley.Warner@ch2m.com

Summary of Conversation

1) What is your overall impression of the project?
Overall my impression of the project is very good. The plant is running very good and we are fully funded. We have normal operating issues like any other but overall we are doing very well.

2) Is the remedy functioning as expected? How well is the remedy performing?
The groundwater extraction system is performing very well. We continue to remove contaminants and maintain hydraulic control

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
From what I can see the trending data doesn't show any increasing or decreasing trends. [Editorial note: It was later clarified that trends are viewed only over a one-year interval.]

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
CH2M has staff on site Monday through Friday from approximately 0700 to 1600. Additionally there is a capability for remote operations that operates 24/7. On weekends & holidays the designated operator can log in to the system from home and view the status of the system, monitor the power supply, and restart the system remotely if needed. If there is an emergency the system is equipped with a call out alarm that notifies myself or the other operator 24 hours a day 7 days a week.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
No significant changes.

6) What are the annual operating costs for your organization's involvement with the site?
I don't know what those costs would be.

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
Nothing unexpected. We have an annual shut down in the summer where we perform annual inspections & maintenance of the system. The shutdown is done in the summertime because the seasonal influx of rainwater is minimal and poses a low risk to hydraulic containment to have the system off at that time. The summer of 2015 we shut down but did not perform annual maintenance due to state budget funding issues. But this was known ahead of time and was expected.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Nothing significant. We upgraded the pumps in the extraction wells in 2010. We plan to paint the pipes in the tank farm with Ultraviolet-Proof paint this summer to improve longevity. We will be upgrading the wiring to all the extraction wells this summer as well.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
None that I'm aware of.

10) Do you have any comments, suggestions, or recommendations regarding the project?
CH2M has done several inspections and reports on the sheet pile wall. We previously did daily inspections when the deteriorations were noted. Now we do weekly inspections. The sheet pile wall is severely damaged and in bad shape. We will need to develop some form of repair or replacement plan soon.

OU-3 - EAST HARBOR INTERVIEWS

Five-Year Review Interview Record			
Site:	Wyckoff/Eagle Harbor Superfund Site, OU-3	**EPA ID No:**	WAD009248295

Interview Type: Telephone
Date: March 1, 2017
Time: 2:30 pm

Interviewers

Name	Title	Organization
Kayla Patten	Environmental Engineer	USACE
Ben McKenna	Geologist	USACE

Interviewees

Name	Organization	Title	Telephone	Email
Kevin Bartoy	WSDOT, Ferries Division	Env. and Permitting Mgr, Terminal Engineering	206-515-3856	bartoyk@wsdot.wa.gov

Summary of Conversation

1) What is your overall impression of the project?
The remedy is functioning well. There have been no major issues or any currently emerging issues.

2) Is the remedy functioning as expected? How well is the remedy performing?
There is ongoing maintenance to repair/seal cracks. Staff is very responsive at getting cracks sealed quickly. Doesn't appear that the cracks are very deep, or causing a larger/systemic issue.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
Ask Nancy Adams about this.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
Ask Nancy Adams. Nancy is continuously on-site. May complete informal "walk-arounds" in between formal inspections.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
No. Repairs are regular but not increasing/decreasing in quantity/significance.

6) What are the annual operating costs for your organization's involvement with the site?
Ask Tom Castor for repairs cost. WSDOT spends about $20-30,000/year for Herrera consulting work. Herrera completes monitoring.

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
Tom Castor would know about why the crack sealing method was changed.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.

10) Do you have any comments, suggestions, or recommendations regarding the project?
No other comments/suggestions.

Kevin provided contact information for others that can answer some of these questions in more detail:

- Nancy Adams, adams@wsdot.wa.gov, 206-780-3147; knows data more closely
- Tom Castor, head of maintenance for terminal engineering, castor@wsdot.wa.gov, 206-515-3727; maintenance is completed through his group, will know budget questions
- Rob Zisette, Herrerra, Rzisette@herrerainc.com; has long history with project (20+ yrs), does/oversees stormwater sampling, has history with working with PACCAR.

Five-Year Review Interview Record			
Site:	Wyckoff/Eagle Harbor Superfund Site, OU-3	**EPA ID No:**	WAD009248295
Interview Type: Telephone Date: March 21, 2017 Time: 10:00 AM			

Interviewers		
Name	**Title**	**Organization**
Kayla Patten	Environmental Engineer	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Nancy Adams	WSDOT, Ferries Division	Project Engineer	206-780-3147	Adams@wsdot.wa.gov

Summary of Conversation

Nancy Adams is in charge of the environmental work at the site. This largely includes the industrial stormwater requirements, a lot of which does overlap with the Superfund work.

1) What is your overall impression of the project?
Going fine. Some things are starting to wear/fail. We're seeing more cracks in the asphalt.

2) Is the remedy functioning as expected? How well is the remedy performing?
Yes. Remedy is largely performing well. Some issues they're seeing: cracks in asphalt, quarry spalls are falling off exposing concrete matting, outfalls don't have valves to keep tide water out of the oil water separators (OWS). OWS #2 has a crack in the outfall pipe, is getting larger and may need to be fixed soon.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
Stormwater data has gotten better. Changed housekeep practices; now cover lots of the material in the maintenance yard to keep stormwater off. Data is typically highest in the winter after snow. This is because of the salt and sand used for deicing/traction. The sand is often recycled which means it is high in zinc and copper. Their personnel vehicles track in the salt and sand to the maintenance yard, which eventually ends up in stormwater.

This year seeing more cracking and "alligatoring" of the asphalt, more than in past years. Nancy is hoping the replacement of the asphalt has been put in the budget for this coming year, but won't know until June.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
Yes. Nancy is at the site every day. Does weekly walks of the site for the industrial permit; documents with a standardized form. Checks for how water is flowing/ponding on the asphalt surface. Change filter socks regularly (as part of industrial permit). May is yearly Superfund inspection for asphalt, shoreline, and wet weather components. Cracks are reported yearly (in May), but is aware of them all year round. In past cracks have been repaired by the WSDOT northwest regional repair group. They often define "cracks" differently because they aren't used to Superfund needs. This has been a challenge.

Recently did clean out of the OWSs and stormwater system. Nancy had the contractors take photographs of the inside of the piping and system to understand the current conditions better. Nancy is very conscious of leaking vehicles due to the very stringent requirements for the industrial permit. Because of this, they don't see much oil in the OWS and outfalls.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
No changes to monitoring needs. Did change the type of stormwater filters used in catch basins (Nancy is not yet convinced the new kind show an improvement). Inspections of OWS used to use camera, now use sludge judge which seems to be working well and is easier.

6) What are the annual operating costs for your organization's involvement with the site?
N/A

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
In past have had issues with the vendor who does the OWS cleaning. Used to just pump but not actually clean, as the State contractor they often didn't have time/capacity to do a full cleaning. Now Nancy does inspection and requires a full cleaning. OWS are cleaned every other year (two small one year, large the next year). Now are doing a much better job. In recent cleaning, did discover that the outfall pipe to the large OWS is lower than in plans. This impacts cleaning activities since they need to be done at very low tide.

Currently concerned about the quarry spalls that have eroded and exposed the concrete lining. Generally, there is mixed feelings about how much of a concern this is. Nancy is looking to get this fixed this year.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
No; things are pretty easy. In the future would like a better infrastructure (better OWS and valves on outfalls).

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
Only on industrial side, not Superfund side.

10) Do you have any comments, suggestions, or recommendations regarding the project?
No.

Five-Year Review Interview Record			
Site:	Wyckoff/Eagle Harbor Superfund Site, OU-3	**EPA ID No:**	WAD009248295
Interview Type: Telephone Date: March 16, 2017 Time: 3:00 PM			

Interviewers		
Name	**Title**	**Organization**
Kayla Patten	Environmental Engineer	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Rob Zisette	Herrera	Principal Scientist	206-787-8262	rzisette@herrerainc.com

Summary of Conversation

1) What is your overall impression of the project?
Going well. Little is changing in the last five years.

2) Is the remedy functioning as expected? How well is the remedy performing?
Yes. The asphalt cap and the shoreline caps are working well. For the northern cutoff drainage it's hard to tell if it is capturing water from the adjacent slope or just the asphalt pathway.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
The seepage data did show an increase in zinc in 2016 (last sampled in 2011) – the 2016 monitoring report will be submitted to EPA soon. The 2016 data was still within the limits, but not by a large margin. Seeps are continuing across the whole shoreline; but these are normal seeps from saltwater entering/exiting the shoreline.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
Nancy Adams is on site all the time. She monitors the site and does the regular inspections and data collection.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
No. Rob is beginning to develop the new OMMP for the site but doesn't foresee many changes. He thinks sampling frequency is appropriate, but may try to find ways to streamline the reporting process.

6) What are the annual operating costs for your organization's involvement with the site?
N/A

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
No. The subsidence repair was the only unexpected repair need. The final repair completed was robust. In general, WSDOT staff often forget that this is a Superfund site, so they must keep up training and education about what can/can't be done on site. This extends to contractors at the site as well.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Don't see many opportunities for optimizations.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
N/A

10) Do you have any comments, suggestions, or recommendations regarding the project?
No.

Additional Site-Specific Questions

Rob described each part of the monitoring program in detail. This is a summary of that discussion:

- The first OMMP was prepared 20 years ago. An update was completed in 2008. Rob is getting ready to develop a new OMMP
- OMMP needs are mostly just inspections of the site. Water quality data is collected at less frequent intervals.
- Nancy Adams at WSDOT completes the inspections and is good about keeping an eye on the site. She manages the industrial stormwater permit and pollution prevention efforts.
- The inspections are broken down into three sections: upland, shoreline, and wet weather (stormwater)
- Upland inspections:
    - Check the asphalt cap for cracks, depressions, etc.
    - There are many small cracks in the cap, but don't think they are leading to much (if any) infiltration. The soil below is concrete stabilized anyway, so certainly don't think there is leaching.
    - A pavement engineer looked at it a few years ago and recommended crack sealing. Another pavement engineer looked at it in 2016 and suggested a full overlay. It might be economical in the long run to do the full overlay/replacement.
    - The northern cutoff drainage does show flow. Hard to tell if this is drainage from the slope or pathway. Could be getting seawater into pipe during high tides.
- Shoreline inspections
    - The tidal barrier extends from the cutoff drainage, under the footbridge, down to Outfall #1. Consists of a concrete filled geotextile mat.
    - Historically, there had been issues with seepage under the toe of the barrier and around the southern end. Design engineer had said they were not aware of other contaminated backfill that was in that area south of Outfall #1.
    - Designed a Seep Remediation Cap to solve this issue. It extends further south to cover the contaminated fill area. 3 feet of sand was added over everything.
    - Seep samples are collected once every five years, last done in 2011 and 2016. Zinc did increase but still within limits but not by much. The 2016 report will go to EPA soon. Sampling every five years does still seem appropriate going forward because interim annual visual inspections for rust-colored sediment is done. This should catch any major increases in metals concentrations.
    - Four seeps >1 gpm are sampled; location often varies. Have identified around 45 seeps of varying sizes. Samples are analyzed for copper, lead, zinc, and mercury, and field parameters
    - Seep salinity analysis does indicate they are mostly saltwater (drainage after high tide), with some freshwater mixed in.
    - Some erosion is being seen on the rockery and quarry spall; this is being noted in the 2016 report. On the northern edge the concrete mat has been exposed. This was likely from a high creek flow during a big storm mixed with low tide. There is a liner under the mat so not concerned about exposure.
    - Erosion causing mat exposure has occurred before and it was repaired.
    - On the southern end there was a large slump/subsidence near the pier. The first repair attempt was minimal, but the second was robust. Ecology blocks were placed at the toe. Erosion stakes were added, which haven't showed erosion since. Cause of this failure is unclear.
- Stormwater inspections
    - Nancy conducts inspections to make sure catchment and piping are all functioning.
    - Sediment level in oil water separators is measured. Nancy has sediment removed if build up is sufficient. Cleaning does occur somewhat more frequently now than previously.
    - The new NPDES stormwater permit required full flushing of the system. This was done twice in 2015 and once in 2016. The stormwater system is now very clean.
    - WSDOT has gotten much better about source control in recent years. They cover any galvanized material and have instituted twice monthly street sweeping. Have removed excess junk in the yard.

Five-Year Review Interview Record			
Site:	Wyckoff/Eagle Harbor Superfund Site, OU-3	**EPA ID No:**	WAD009248295
Interview Type: Telephone Date: March 2, 2017 Time: about 10:00 am (unscheduled call)			

Interviewers		
Name	**Title**	**Organization**
Kayla Patten	Environmental Engineer	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Tom Castor	WSDOT, Ferries Division	Marine Project Engineer	206-515-3727	tom.castor@wsdot.wa.gov

Summary of Conversation

Tom Castor oversees the ferry terminal maintenance for al WSDOT Ferry terminals. This includes construction projects and the inspection program. Tom isn't involved in actual inspection but does manage the budget. Individual terminals request money from him for maintenance/repair work. He figures out what priorities are and what budget is available. Repairs for the Eagle Harbor site has been coming out of his budget for about 8 years now.

1) What is your overall impression of the project?
Compared to the other Ferry terminal faculties, this one gets the most work. But this is probably due to the fact that small cracks seem like a really big deal to the terminal managers, compared to other facilities where a small crack wouldn't be a big deal. Tom has to prioritize where his team does repairs and can be hard to understand what is really a legitimate need at Eagle Harbor.

2) Is the remedy functioning as expected? How well is the remedy performing?
Only small cracks so far. Seems to be performing fine. No large issues.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
Question for Nancy Adams. Tom does receive an annual report. He asks a member of his group to read. No major issues that have stood out. Mostly it just says that the whole site needs to be repaved, which he is aware of and trying to determine how to fit that in the budget.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
Nancy Adams is out at the site all the time. Tom is in the Seattle office.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
Most of the repairs at Eagle Harbor have occurred in about the last five years. Tom thinks this is just due to normal aging of the asphalt, doesn't think anything is really changing. The asphalt is about 15 years old.

6) What are the annual operating costs for your organization's involvement with the site?
Tom will send follow-up email with this information.

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
Nothing in particular has been difficult. In general, since he wasn't around for the actual construction of the facility and cap, there are lots of questions about where exactly contamination is. Don't have good as-builts for it. This makes O&M difficult because he doesn't know exactly where exposure might happen.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

None.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No new laws/regs. Do have to get permits for work just outside of the facility. Recently they had rocks falling into the stream they wanted to move back, had to get City permits. That can be difficult.

10) Do you have any comments, suggestions, or recommendations regarding the project?
Would like information on how long they will need to continue monitoring.

Additional Site-Specific Questions

11) Recently, the method for sealing cracks was changed. Why was this? Is the new method better?
The original method didn't seem to be holding well; not sure why. They contacted the regional WSDOT maintenance group and asked to use their crack sealing equipment but it wasn't available. So they worked with a vendor to do the work. The vendor suggested the new method. Tom said the new method seemed much more intense then they would normally use at other projects. He hasn't been back out since then to see if it is holding better than before. Back in contact with the regional WSDOT maintenance group to do additional repairs, since equipment should be available soon. They suggested doing repairs in the winter when it is cold.

APPENDIX H – PUBLIC NOTIFICATIONS

January 6, 2017 email to the Wyckoff/Eagle Harbor distribution list

Bottcher, Helen

From: U.S. Environmental Protection Agency <usaepa@service.govdelivery.com>
Sent: Friday, January 06, 2017 9:39 AM
To: Bottcher, Helen
Subject: EPA to Review Wyckoff/Eagle Harbor Cleanup

EPA to Review Wyckoff/Eagle Harbor Cleanup

We Invite Your Input by February 10, 2017

Cleanup Plan Is Being Revised

Wyckoff/Eagle Harbor was listed as a Superfund site in 1987. Over the past 30 years, the U.S. Environmental Protection Agency (EPA) has made significant progress in cleaning up this site to make it a healthier place for people, fish, and shellfish. However, creosote and related chemicals still present some risk. The EPA recommended additional cleanup actions in April 2016, and accepted public comments on our draft cleanup plan through June 2016. We are now revising the cleanup plan to address the comments received, and will issue a final cleanup decision, which will include responses to public comments, this spring.

Asking for Community Input

In the meantime, the EPA is beginning its fourth Five-Year Review of the site. We are required to review Superfund cleanups at least every five years at sites where contaminants remain in place. The EPA uses the review to ensure that cleanup actions are protecting people's health and the environment. You may have information and ideas to share about the site that will assist us with this review.

We encourage you to send your input by **February 10, 2017 to Helen Bottcher, EPA, 206-553-6069 or bottcher.helen@epa.gov.**

visit the site page: **www.epa.gov/superfund/wyckoff-eagle-harbor**

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Post cards mailed in December 2016

EPA United States Environmental Protection Agency

Wyckoff/Eagle Harbor Site – EPA to Review Cleanup Status

Wyckoff/Eagle Harbor Superfund Site | Bainbridge Island, WA | December 2016

We Invite Your Input by February 10, 2017

Wyckoff/Eagle Harbor was listed as a Superfund site in 1987. Over the past 30 years, the U.S. Environmental Protection Agency (EPA) has made significant progress in cleaning up this site to make it a healthier place for people, fish, and shellfish. However, creosote and related chemicals still present some risk. The EPA recommended additional cleanup actions in April 2016, and accepted public comments on our draft cleanup plan through June 2016. We are now revising the cleanup plan to address the comments received, and will issue a final cleanup decision, which will include responses to public comments, later this spring.

In the meantime, the EPA is beginning its fourth Five-Year Review of the site. We are required to review Superfund cleanups at least every five years at sites where contaminants remain in place. The EPA uses the review to ensure that cleanup actions are protecting people's health and the environment. You may have information and ideas to share about the site that will assist us with this review. We encourage you to send your input by **February 10, 2017** to Helen Bottcher, EPA, 206-553-6069 or bottcher.helen@epa.gov.

*TDD/TYY users please call the Federal Relay Service at 1-800-877-8339 and give the operator **Debra Sherbina's** phone number: 206-553-0247.*

EPA United States Environmental Protection Agency

Wyckoff/Eagle Harbor Site: EPA to Review Cleanup Status

Wyckoff/Eagle Harbor Superfund Site | Bainbridge Island, WA | December 2016

We Invite Your Input by February 10, 2017

Wyckoff/Eagle Harbor was listed as a Superfund site in 1987. Over the past 30 years, the U.S. Environmental Protection Agency (EPA) has made significant progress in cleaning up this site to make it a healthier place for people, fish, and shellfish. However, creosote and related chemicals still present some risk. The EPA recommended additional cleanup actions in April 2016, and accepted public comments on our draft cleanup plan through June 2016. We are now revising the cleanup plan to address the comments received, and will issue a final cleanup decision, which will include responses to public comments, later this spring.

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EPA United States Environmental Protection Agency

Region 10
1200 Sixth Avenue, Suite 900, RAD-202
Seattle, Washington 98101-3140

December 2016

Pre-Sorted Standard
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U.S. EPA
Permit No. G-35
Seattle, WA

Wyckoff/Eagle Harbor Site – EPA to Review Cleanup Status

People Walk on East Beach at Low Tide

EPA United States Environmental Protection Agency

Region 10
1200 Sixth Avenue, Suite 900, RAD-202
Seattle, Washington 98101-3140

December 2016

Pre-Sorted Standard
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Seattle, WA

Wyckoff/Eagle Harbor Site: EPA to Review Cleanup Status

People Walk on East Beach at Low Tide

Public Notice placed in the *Bainbridge Islander* on January 6, 2017

EPA to Review Wyckoff/Eagle Harbor Cleanup
We Invite Your Input by February 10, 2017

Cleanup Plan Is Being Revised

Wyckoff/Eagle Harbor was listed as a Superfund site in 1987. Over the past 30 years, the U.S. Environmental Protection Agency (EPA) has made significant progress in cleaning up this site to make it a healthier place for people, fish, and shellfish. However, creosote and related chemicals still present some risk. The EPA recommended additional cleanup actions in April 2016, and accepted public comments on our draft cleanup plan through June 2016. We are now revising the cleanup plan to address the comments received, and will issue a final cleanup decision, which will include responses to public comments, this spring.

Asking for Community Input

In the meantime, the EPA is beginning its fourth Five-Year Review of the site. We are required to review Superfund cleanups at least every five years at sites where contaminants remain in place. The EPA uses the review to ensure that cleanup actions are protecting people's health and the environment. You may have information and ideas to share about the site that will assist us with this review. We encourage you to send your input by **February 10, 2017 to Helen Bottcher, EPA, 206-553-6069 or bottcher.helen@epa.gov.**

TDD and/or TTY users please call the Federal Relay Service at 800-877-8339 and give the operator Debra Sherbina's phone number: 206-553-0247.

Bainbridge Islander

Notice of the Five-Year Review public kick-off meeting included in the "City Manager Report" (see third page)

Bottcher, Helen

From: City of Bainbridge Island <dschulze@bainbridgewa.ccsend.com> on behalf of City of Bainbridge Island <dschulze@bainbridgewa.gov>
Sent: Friday, January 06, 2017 2:04 PM
To: Bottcher, Helen
Subject: City Manager's Report for 1/7/2017

Bainbridge Island Washington

CITY OF BAINBRIDGE ISLAND

City Manager's Report

January 6, 2017

Message from the City Manager

Dear Bainbridge Island Residents,

I hope the new year finds you well and already having success fulfilling your New Year's resolutions. There is much in store for the City of Bainbridge Island in 2017. I look forward to sharing our priorities with you after the Council meets for their annual Council Advance on January 26. I mentioned in last week's City Manager's report that one of our goals is to be recognized as a leader in emergency preparedness within Washington state. To be a leader in the state, we need to have prepared residents. I challenge you to complete at least one of the items this month, and join us on our path to preparedness.

- Watch this video from the Rotary Club on how you can be prepared at home,
- Build your basic disaster kit.
- Make sure your vehicle is ready for inclement weather.
- Sign-up for emergency alerts from the City of Bainbridge Island and the Bainbridge Island Fire Department by texting 98110 to 888777.
- View the Federal Emergency Management Association's Earthquake Preparedness List.
- Visit the Bainbridge Prepares website and find out if there are classes on the island that might help your family get even more prepared.

1

I hope you will join us on our journey to be a recognized leader in preparedness in Washington. For more information on how you can get prepared visit our website.

I wish you a happy and healthy 2017.

Best wishes,

Doug Schulze
City Manager, Bainbridge Island

Planning Update

Public Hearing on Comprehensive Plan Update Scheduled for January 10 Written Comments Accepted Until January 17

The Bainbridge Island City Council will conduct a public hearing to receive public comment on the City's Comprehensive Plan Update proposal during their regularly scheduled meeting at 7:00 p.m. on Tuesday, January 10.

In addition to providing comment in-person at the public hearing, written comments will also be accepted until 4:00 p.m., Tuesday, January 17 (this deadline has been extended) at City Hall, 280 Madison Ave N, or via email to pcd@bainbridgewa.gov. The ordinances and other supporting materials of the City Council's 2016 DRAFT Comprehensive Plan Update proposal, dated December 16, 2016, may be found at http://bit.ly/DRAFTCompPlan. More information on the work that had been completed to-date can be found on the Navigate Bainbridge page on the City website.

This public hearing signals that the City is nearing completion of the Comprehensive Plan Update process. For more than two years City staff, members of the Planning Commission, members of the Navigate Bainbridge Steering Committee, and hundreds of community members have worked to update this long range planning document.

NAVIGATE BAINBRIDGE
charting our future together

For questions about the Comprehensive Plan Update contact Jennifer Sutton, Senior Planner at 206.780.3772.

Police Update

Criminal Mass Casualty Incident Exercise Scheduled at Rolling Bay Presbyterian for Saturday January 7

On Saturday, January 7, 2017 the Bainbridge Island Fire and Police Departments will be conducting a criminal mass casualty incident exercise at the Rolling Bay Presbyterian Church located at 11042 Sunrise Drive.

The purpose of the exercise to is prepare emergency responders to work together to mitigate the effects of a criminal mass casualty event anywhere in Kitsap County. The exercise will take place between 9:30 a.m. and 1:30 p.m. During Saturday's event, police and fire agencies will exercise responding to a simulated shooting at Rolling Bay Presbyterian Church. Community members can expect

to see numerous fire and police vehicles, and may hear simulated gunfire as part of the exercise. Additionally, actors will be using make-up to simulate injuries associated with this type of event. Members of the Bainbridge Island Community Emergency Response Team (CERT) will act as victims and bystanders.

Law enforcement has stringent safety measures in place to ensure the safety of the public and all personnel involved in the training. The area around the church property will be secured, and we ask that all bystanders respect the security lines so that the exercise can proceed safely and on-time.

In May of 2016, Kitsap County fire and law officials agreed upon a common operating procedure for an event of this type in Kitsap County. A criminal mass casualty incident, such as a shooting in a shopping mall or other large gathering area, will require responders from all over the County to work together to mitigate the issue. Training opportunities and a common operating procedure are key to the effective response to such an event.
If citizens have any questions concerning this training event, they are encouraged to contact the Bainbridge Island Fire Department at 206-451-2033.

Upcoming Events

- **City Hall will be closed January 16 to observe Rev. Dr. Martin Luther King Jr. Day.**

- City Hall is still collecting socks for individuals experiencing homelessness. Please drop off new or laundered used socks at City Hall or Buckley and Buckley Real Estate at 168 Winslow Way W. For more information contact Kellie Stickney, Communications Manager at kstickney@bainbridgewa.gov.

- The Bainbridge Island City Council will conduct a **public hearing to receive public comment on the City's Comprehensive Plan Update** proposal during their regularly scheduled meeting on **Tuesday, January 10.**

- On **Thursday, January 12** from 9:00 a.m. to 11:00 a.m. the EPA is hosting the **Wyckoff/Eagle Harbor Fourth Five-Year Review - Kick-off Meeting** at Waterfront Park Community Center.

- The **City Council annual Advance** will be held on the second floor of the Bainbridge Island Museum of Art from 8:30 to 4:30 p.m., **Thursday, January 26**.

City of Bainbridge Island, 280 Madison Avenue North, Bainbridge Island, WA 98110

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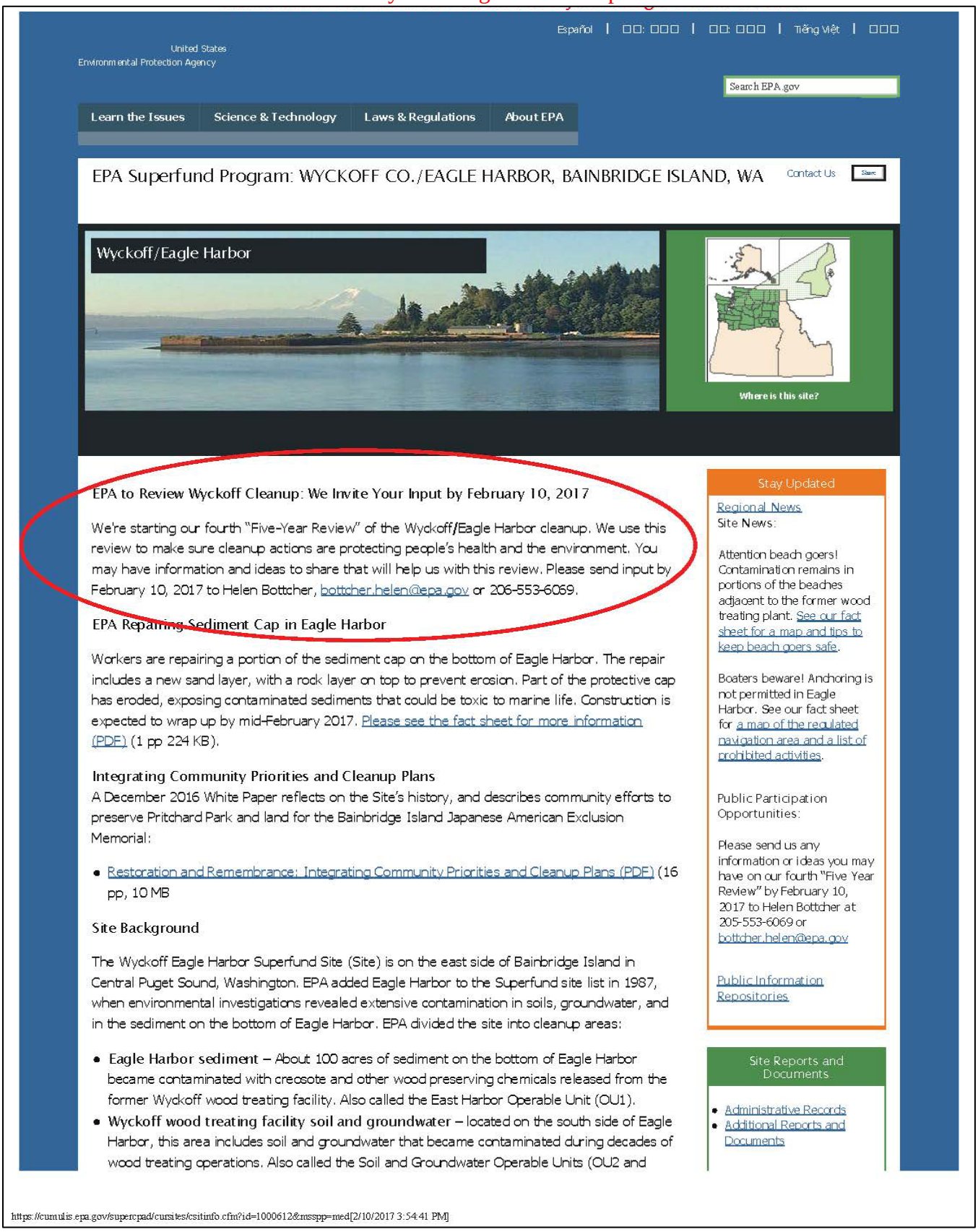
4

Notice of the Five-Year Review on the Wyckoff/Eagle Harbor Superfund Website



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EPA Superfund Program: WYCKOFF CO./EAGLE HARBOR, BAINBRIDGE ISLAND, WA

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Wyckoff/Eagle Harbor

Where is this site?

EPA to Review Wyckoff Cleanup: We Invite Your Input by February 10, 2017

We're starting our fourth "Five-Year Review" of the Wyckoff/Eagle Harbor cleanup. We use this review to make sure cleanup actions are protecting people's health and the environment. You may have information and ideas to share that will help us with this review. Please send input by February 10, 2017 to Helen Bottcher, bottcher.helen@epa.gov or 206-553-6069.

EPA Repairing Sediment Cap in Eagle Harbor

Workers are repairing a portion of the sediment cap on the bottom of Eagle Harbor. The repair includes a new sand layer, with a rock layer on top to prevent erosion. Part of the protective cap has eroded, exposing contaminated sediments that could be toxic to marine life. Construction is expected to wrap up by mid-February 2017. Please see the fact sheet for more information (PDF) (1 pp 224 KB).

Integrating Community Priorities and Cleanup Plans

A December 2016 White Paper reflects on the Site's history, and describes community efforts to preserve Pritchard Park and land for the Bainbridge Island Japanese American Exclusion Memorial:

- Restoration and Remembrance: Integrating Community Priorities and Cleanup Plans (PDF) (16 pp, 10 MB

Site Background

The Wyckoff Eagle Harbor Superfund Site (Site) is on the east side of Bainbridge Island in Central Puget Sound, Washington. EPA added Eagle Harbor to the Superfund site list in 1987, when environmental investigations revealed extensive contamination in soils, groundwater, and in the sediment on the bottom of Eagle Harbor. EPA divided the site into cleanup areas:

- **Eagle Harbor sediment** – About 100 acres of sediment on the bottom of Eagle Harbor became contaminated with creosote and other wood preserving chemicals released from the former Wyckoff wood treating facility. Also called the East Harbor Operable Unit (OU1).
- **Wyckoff wood treating facility soil and groundwater** – located on the south side of Eagle Harbor, this area includes soil and groundwater that became contaminated during decades of wood treating operations. Also called the Soil and Groundwater Operable Units (OU2 and

Stay Updated

Regional News

Site News:

Attention beach goers! Contamination remains in portions of the beaches adjacent to the former wood treating plant. See our fact sheet for a map and tips to keep beach goers safe.

Boaters beware! Anchoring is not permitted in Eagle Harbor. See our fact sheet for a map of the regulated navigation area and a list of prohibited activities.

Public Participation Opportunities:

Please send us any information or ideas you may have on our fourth "Five Year Review" by February 10, 2017 to Helen Bottcher at 205-553-6069 or bottcher.helen@epa.gov

Public Information Repositories

Site Reports and Documents

- Administrative Records
- Additional Reports and Documents

https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=1000612&msspp=med[2/10/2017 3:54:41 PM]

OU4).

- West Harbor soil and sediment – the site of a former shipyard, this area became contaminated with mercury and other metals. Also called the West Harbor Operable Unit (OU-3).

Extensive cleanup actions have been completed in all three areas. The remedy in West Harbor is functioning as designed. No further work is needed at this time.

Additional cleanup actions are needed in the soil and groundwater at the former Wyckoff wood treating facility, and in the adjacent beach sediments. EPA released its Proposed Plan, which describes the agency's preferred cleanup alternatives, in April 2016. The public comment period on the Proposed Plan closed June 30, 2016. After we carefully consider all of the public comments received, the EPA will issue a cleanup plan in late 2016.

TOPICS IN FOCUS

EPA's Dive Team has been conducting underwater investigation work at the Wyckoff/Eagle Harbor site for decades. Watch our YouTube video to learn more.

- EPA's Involvement at this Site
- What is the current site status?
- What's being done to protect human health and the environment?
- Staying Informed and Involved
- What are the risks at the site?
- Community Resources
- Redevelopment Activity

SITE VIDEO

Site Facts

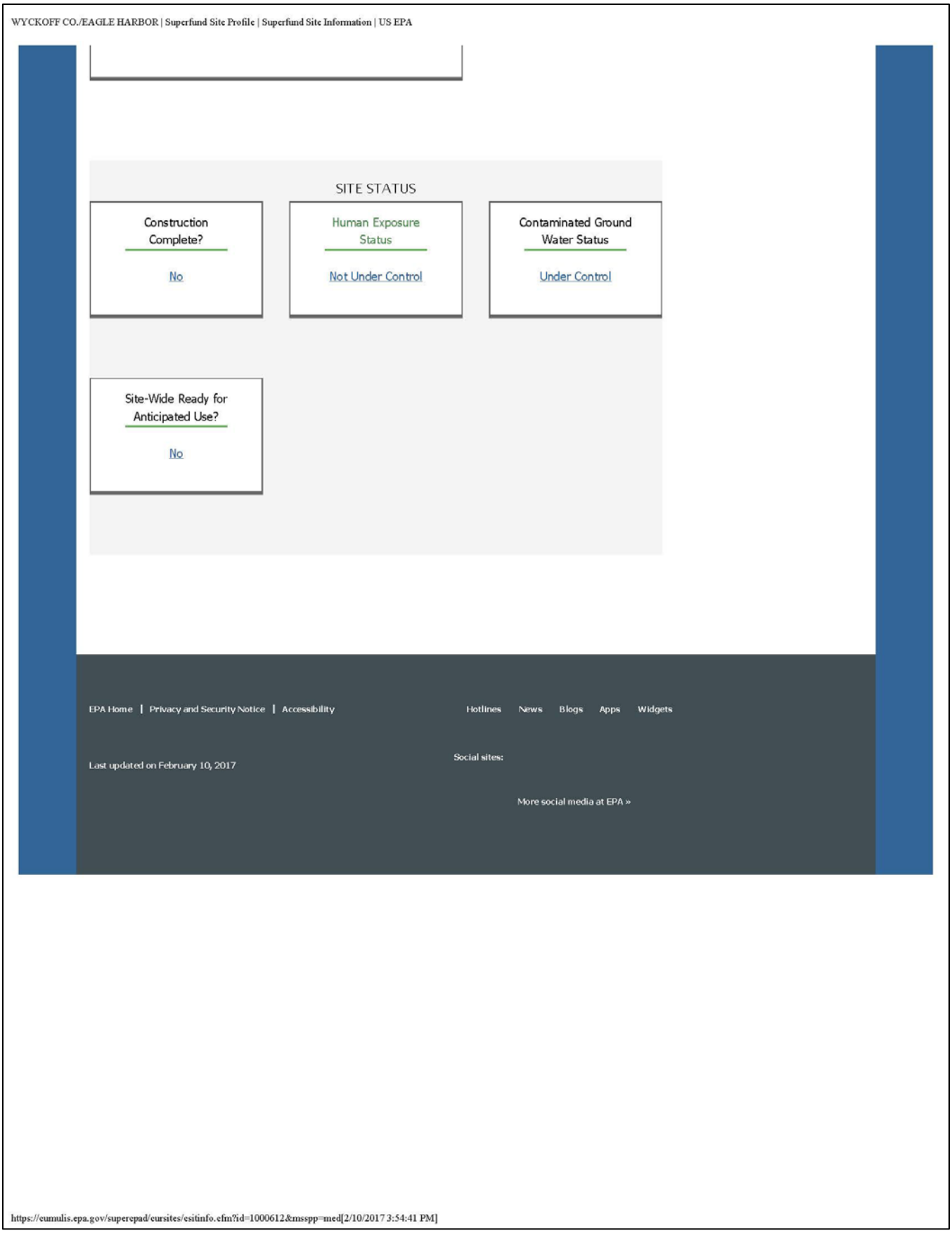
NPL Status: Final
Street Address:
5350 CREOSOTE PL NE, BAINBRIDGE ISLAND, WA 98110
Congressional District: 06
EPA ID: WAD009248295
Contaminant Information

Site Contacts:

- Remedial Project Manager (RPM):
  Helen Bottcher
  (206) 553-6069
- Additional Site Contact(s):

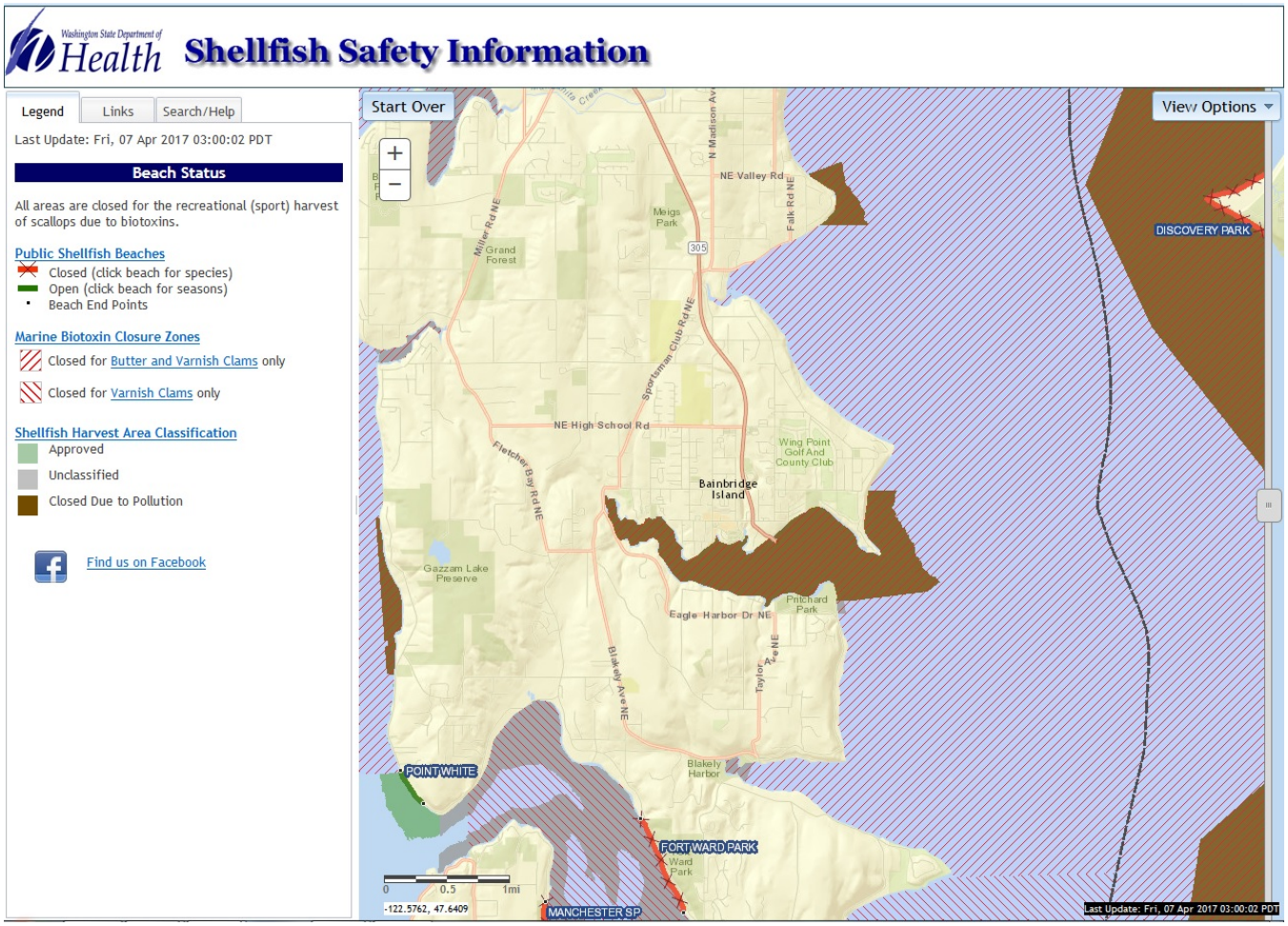
  EPA Community Involvement Coordinator:
  Debra Sherbina
  Sherbina.debra@epa.gov
  (206) 553-0247

  Washington Department of Ecology Project Manager:
  Hun Seak Park
  hpar461@ecy.wa.gov
  (360) 407-7189


WYCKOFF CO./EAGLE HARBOR | Superfund Site Profile | Superfund Site Information | US EPA
SITE STATUS
Construction Complete?
No
Human Exposure Status
Not Under Control
Contaminated Ground Water Status
Under Control
Site-Wide Ready for Anticipated Use?
No
EPA Home | Privacy and Security Notice | Accessibility
Hotlines News Blogs Apps Widgets
Last updated on February 10, 2017
Social sites:
More social media at EPA »
https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=1000612&msspp=med[2/10/2017 3:54:41 PM]

APPENDIX I – EAGLE HARBOR SHELLFISH ADVISORIES

The Kitsap Public Health District implements the shellfish harvest advisories for Eagle Harbor. They maintain an interactive map will all shellfish advisories, available at <http://www.kitsappublichealth.org/environment/shellfish_advisories.php>. Eagle Harbor is shown as "Closed Due to Pollution."



There are also several warning signs around Prichard Park (the Wyckoff Facility), prohibiting collection and eating of fish and shellfish from Eagle Harbor.

★ = Location of signs

APPENDIX J – BEACH CLOSURE NOTIFICATIONS

EPA has posted signs throughout the Wyckoff beach areas and Prichard Park notifying the public of the beach areas closed due to contamination. North Shoal and East Beach remain closed to the public.

2017 Beach Updated mailed to area residents

EPA United States Environmental Protection Agency

Beaches at Wyckoff still contaminated

Bainbridge Island, Washington — May 2017

Summer is quickly approaching and with it, sunny weather and low tides during daylight hours. The U.S. Environmental Protection Agency and the Washington Department of Ecology want to remind the local community around the Wyckoff / Eagle Harbor Superfund site that portions of the beaches east and north of "the Point," the site's former processing area, are still contaminated. This fact sheet provides information that will help you stay safe this summer.

Where is the contamination?

The East Beach and North Shoal are still contaminated. These areas are shown in the map on Page 3.

What is the contamination and what does it look like?

The beaches are contaminated with creosote, a chemical used to treat wooden rail road ties, utility poles and pier pilings. Creosote is an oily petroleum-based product with a distinctive odor. The creosote that remains on the beaches today is in long, thin layers. The contamination is patchy – it shows up in small spots here and there, usually during falling low tides. Heat makes the creosote thinner, so it moves more readily. As a result, we tend to see spots of it on the beach on warm, sunny days. It looks like motor oil – brown liquid thicker than water. It almost always produces a rainbow sheen, similar to what you see when oil drips from a car onto wet pavement. The photos below provide two examples of creosote seen on East Beach.

Creosote seep on East Beach with boot for scale

Be safe around creosote on the beach – follow guidelines in this fact sheet

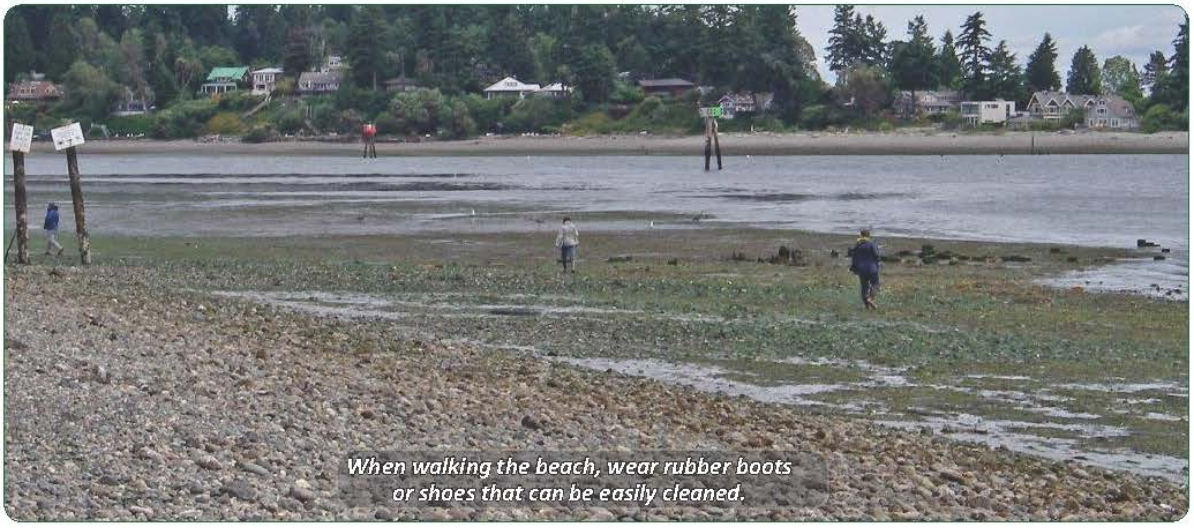
How could contaminants on the beaches affect me and my family?

On bare skin, creosote can cause chemical burns. Creosote contains polycyclic aromatic hydrocarbons (PAHs), which are chemicals found in oil, coal and tar. Some of the PAHs found in creosote can cause cancer.

Is it safe to enjoy the beaches?

Because of the risk of encountering contamination, the EPA and Ecology recommend that people avoid the East Beach and North Shoal areas until they are cleaned up. However, we know that many people will choose to walk around the Point during low tide, despite the warning signs. If you are one of those people, here are some things to keep in mind:

- Wear rubber boots or shoes that can be easily cleaned. Do not walk on these beaches with bare feet.
- Be on the lookout for creosote or oily sheens and avoid contact with visible contamination.
- Don't take young children out on the beaches. Kids may be attracted to the rainbow sheen of the contamination and they are more sensitive than adults to the chemicals in creosote.
- Leave the canine members of your family at home or restrict them to the clean portion of the beach. Dogs could track contaminants back to your home. Grooming could make dogs sick if they become contaminated, then lick creosote from their fur or paws and swallow it.
- Do not dig on the beaches — you are more likely to encounter contamination below the surface of the beach.
- Do not eat shellfish from these beaches.
- When you leave the beach, wash your hands. Be especially careful to wash your hands before eating.
- If there is any visible contamination on your boots or shoes, wash it off with soap and water before entering your house.
- It is safe to swim offshore of the facility – contaminant concentrations in the water are well below risk thresholds. Be careful not to wade through contaminated areas on your way in or out of the water.



When walking the beach, wear rubber boots or shoes that can be easily cleaned.

Update on Beaches at Wyckoff

Background

The Wyckoff/Eagle Harbor Superfund Site is on the east side of Bainbridge Island, Washington, in central Puget Sound. It encompasses the former Wyckoff wood-treating facility (operated from 1903-1988) and a former shipyard. In the past, creosote, oil, and other wood-treatment chemicals were used at the site. Decades of wood treating operations left high levels of polycyclic aromatic hydrocarbons and pentachlorophenol in the soil and groundwater.

The most severe contamination is found in the shallow aquifer groundwater beneath the site's former processing area. The metal sheet pile wall around the upland portion of the site helps prevent the transport of contaminants to Eagle Harbor. To further limit the movement of contamination, groundwater is pumped from the shallow aquifer and treated to remove contaminants. After treatment, the clean water is released to Puget Sound.

Sediments on the sea floor in Eagle Harbor were also polluted with chemicals from the wood treating operations. Approximately 76 acres of the harbor, including the beach west of the former wood-treatment facility, have been capped with a thick layer of clean sand. The sand protects fish and other aquatic life from coming into contact with the contamination.

For more information

For general information

Debra Sherbina, EPA Community Involvement
800-424-4372, ext. 0247
sherbina.debra@epa.gov

Dawn Hooper, Ecology Community Involvement
360-407-7182
dhoo461@ecy.wa.gov

For technical information

Helen Bottcher, EPA Project Manager
800-424-4372, ext. 6069
bottcher.helen@epa.gov

Hun Seak Park, Ecology Project Manager
360-407-7189
Hpar461@ecy.wa.gov

Find site documents online

View technical documents, fact sheets, and other documents related to the cleanup on our web sites

EPA: http://www.epa.gov/superfund/wyckoff-eagle-harbor

Ecology: https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=2683

If you need materials in an alternative format, please contact Debra Sherbina at 800-424-4372, ext. 0247.

***TTY users:** please call the Federal Relay Service: 800-877-8339 and ask for Debra Sherbina*

3

EPA United States Environmental Protection Agency
Region 10

1200 Sixth Avenue, Suite 900, RAD-202
Seattle, Washington 98101-3140
May 2017

Beaches at Wyckoff still contaminated

Look inside for

- Information on creosote
- Tips for staying safe on beaches this summer
- Beach cleanup to date

APPENDIX K – "NO ANCHOR" AREA NOTIFICATIONS

To protect the subtidal cap, EPA restricts anchoring in the area. The following show the buoys used and the posted notifications regarding the no anchor area.

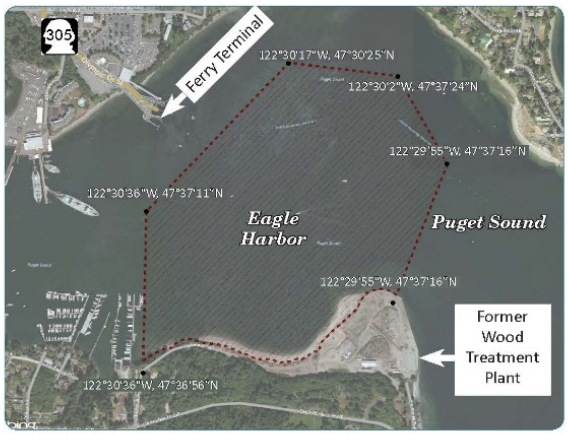
EPA United States Environmental Protection Agency
Region 10
Bainbridge Island, Washington

Attention Boaters!

'No Anchor' area in Eagle Harbor

June 2016

Anchoring is prohibited over a large area in the eastern part of Eagle Harbor. The map shows the boundaries of the "Regulated Navigation Area."



The "Regulated Navigation Area" within Eagle Harbor. Boaters are prohibited from anchoring, dredging, and other activities within its boundaries.

Why the 'No Anchor' restriction?

The sea floor in Eagle Harbor became heavily contaminated with creosote released from a former wood treating facility on the south side of the harbor. Creosote is a thick, oily, toxic liquid used to preserve rail road ties, utility poles and pier pilings. In the mid-1990s, to protect fish and other marine life, the EPA "capped" portions of Eagle Harbor by burying the contamination under a layer of clean sand. Anchoring could penetrate the sand cap, bringing contamination to the surface. It could also contaminate anchors and lines, exposing boaters to the contamination.

What activities are prohibited?

The regulation, which can be found in the Coast Pilot and at 33 CFR 165.1307, states: "All vessels and persons are prohibited from **anchoring, dredging, laying cable, dragging, seining, bottom fishing, conducting salvage operations**, or any other activity which could potentially **disturb the seabed** in the designated area. Vessels may otherwise transit or navigate within this area without reservation."

To learn more about the Wyckoff site, visit: www.epa.gov/superfund/wyckoff-eagle-harbor

For questions about the Regulated Navigation Area, or other mooring options in Eagle Harbor, contact **Tami Allen,** Harbormaster, tallen@bainbridgewa.gov 206-780-3733.

For Information, Contact:

Helen Bottcher, Project Manager
bottcher.helen@epa.gov
800-424-4372, extension 6069

Debra Sherbina, Community Involvement Coordinator,
sherbina.debra@epa.gov
800-424-4372, extension 0247

This document can be made available in other languages by request.
If you need this document in an alternative format, contact **Debra Sherbina** at 800-424-4372, extension 0247.
TDD users please call the Federal Relay Service: 800-877-8339 and give the operator Debra Sherbina's phone number.