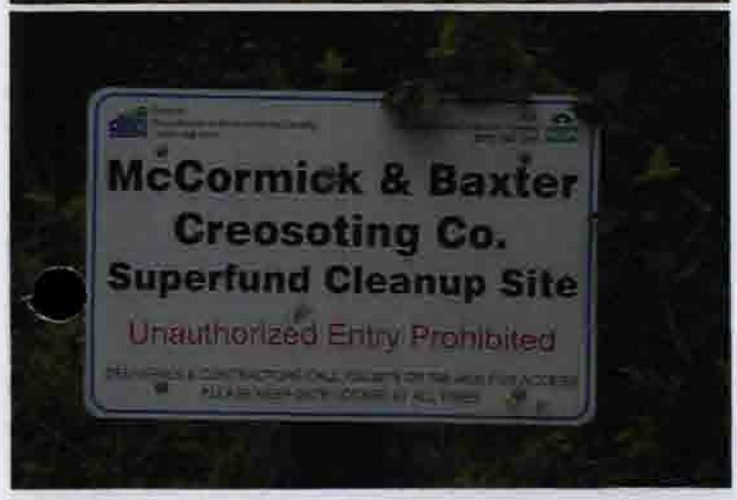

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Operation and Maintenance Report
January 2009 to December 2009
McCormick and Baxter
Superfund Site
Portland, Oregon

Prepared for
Oregon Department of
Environmental Quality

May 25, 2010
15670-05/Task 7

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GSI Water Solutions, Inc.

HARTCROWSER

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Prepared by
GSI Water Solutions, Inc.

Heidi Blischke, RG
Technical Manager

Hart Crowser, Inc.

Richard D. Ernst, RG
Program Manager

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ACRONYMS

ACB	Articulated Concrete Block
ACLs	Alternate Concentration Limits
ARAR	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
BES	Bureau of Environmental Services
BNRR	Burlington Northern Railroad
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Clearwater	Clearwater Environmental Services, Inc
COC	Contaminant of Concern
cPAHs	Carcinogenic Polynuclear Aromatic Hydrocarbons
DEQ	Oregon Department of Environmental Quality
DHS	Oregon Department of Human Services
DNAPL	dense non-aqueous phase liquid
DQO	data quality objectives
DVD	digital video disk
E&E	Ecology and Environment, Inc.
EPA	United States Environmental Protection Agency
FWDA	Former Waste Disposal Area
GC/MS	Gas chromatography/mass spectrometry
GSI	GSI Water Solutions, Inc.
HEM	high hexane extractable
HPAH	high molecular weight PAH
IGA	Intergovernmental Agreement
LNAPL	light non-aqueous phase liquid
LPAH	low molecular weight PAH
McCormick & Baxter	McCormick & Baxter Creosoting Company
MCL	Primary Drinking Water Standard Maximum Contaminant Level
MDL	method detection limit
µg/L	microgram per liter
mg/kg	milligram per kilogram

ACRONYMS (CONTINUED)

MSU	Montana State University
NAPL	non-aqueous phase liquid
NAVD	North American Vertical Datum
NOAA Fisheries	National Oceanic and Atmospheric Marine Fisheries Service
NPDWR	National Primary Drinking Water Regulations
NRWQC	National Recommended Water Quality Criteria
O&M	Operation and Maintenance
PAHs	polynuclear aromatic hydrocarbons
PCP	pentachlorophenol
PSU	Portland State University
RAO	remedial action objective
RCM	reactive core mat
ROD	Record of Decision
Site	McCormick & Baxter Creosoting Company Site
SPME	solid phase micro-extraction
TDS	total dissolved solids
TFA	Tank Farm Area
TPAH	Total petroleum aromatic hydrocarbons
TPH	Total petroleum hydrocarbons
TSS	Total suspended solids
UCL	upper confidence limit
UT	University of Texas
WC	Willamette Cove

OPERATION AND MAINTENANCE REPORT
JANUARY 2009 TO DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE
PORTLAND, OREGON

1.0 INTRODUCTION AND PURPOSE

This Operation and Maintenance (O&M) Report has been prepared for the Oregon Department of Environmental Quality (DEQ) to document the O&M activities implemented at the McCormick and Baxter Superfund Site (Site), located in Portland, Multnomah County, Oregon, between January 1, 2009, and December 31, 2009. The location of the Site is shown on Figure 1. Figure 2 presents the Site layout and features, and Figure 3 presents the Site layout with surface elevations. Figure 4 presents historical non-aqueous phase liquid (NAPL) distribution, Figure 5 presents current Site use restrictions, and Figure 6 presents historical contaminant areas. This report has been prepared by DEQ's contractor team, Hart Crowser, Inc., and GSI Water Solutions, Inc. (GSI).

The DEQ is conducting O&M activities according to the October 2007 *Draft O&M Plan* prepared by the DEQ (DEQ, 2007). The October 2007 *Draft O&M Plan* defines the administrative, financial, and technical details and requirements for inspecting, operating, and maintaining the remedial actions at the Site. The *Revised O&M Manual* (Hart Crowser/GSI, 2008) specifies the sampling and monitoring procedures, quality assurance and quality control, technical information, and data necessary for implementing O&M activities.

This O&M Report documents the operation, monitoring, and maintenance activities that occurred in calendar year 2009. The O&M performance standards and activities are provided in Section 2; the non-sampling O&M activities are summarized in Section 3; and the O&M sampling activities are summarized in Section 4. Section 4.3 summarizes the final results of the ebullition and sheen investigation conducted in 2008/2009, and the sheen characterization study conducted in 2009. Section 5 discusses planned activities for 2010. Detailed presentations of these O&M activities are provided in the following appendices:

- Appendix A - Groundwater and NAPL Monitoring
- Appendix B - Site Observation and Activity Summary
- Appendix C - Vegetation Survival Assessment
- Appendix D - Surface, Inter-Armoring, and Sub-Armoring Water Quality Assessment

- Appendix E - Infiltration Pond MW-59s Groundwater Quality Assessment
- Appendix F - Ebullition and Sheen Investigation and Characterization Summary
- Appendix G - Updated Site-Wide Record Drawings

The O&M Report has been provided to the DEQ in hard copy and in electronic format on digital video disc (DVD). It should be noted that the DVD contains material not provided in the hard copy report including: full laboratory analytical reports, statistical analysis, and diver video images from sampling efforts.

O&M activities were implemented primarily by DEQ's contractor, Hart Crowser, and their teaming partner GSI (under subcontract to Hart Crowser). Hart Crowser also used the following subcontractors for support of site activities including Clearwater Environmental Services, Inc. (Clearwater) for routine operation, monitoring, and maintenance activities including NAPL gauging and extraction, site inspections, and ebullition and sheen investigation assistance; OTAK, Inc. for Site surveying; and Northwest Underwater Construction, LLC, for surface water/inter-armoring/sub-armoring sampling support. The DEQ also maintained intergovernmental agreements with the City of Portland for vegetation planting and maintenance, Portland State University (PSU) for biodegradation studies, the University of Texas (UT) for performance studies on organoclay and specialized porewater sampling, and the University of Montana for biological sheen characterization. Chemical analyses were performed by Pace Analytical Laboratory, under a contract to the DEQ.

Key personnel for implementation of O&M activities include:

- Scott Manzano: Oregon DEQ Project Officer
- Steve Campbell: Oregon DEQ Contract Officer
- Rick Ernst: Hart Crowser Program Manager
- Heidi Blischke: GSI Technical Manager
- Tim Skrotzki: Hart Crowser Site Manager

2.0 OPERATION AND MAINTENANCE PERFORMANCE STANDARDS AND ACTIVITIES

As discussed in Section 1, the DEQ is conducting O&M activities according to a Draft O&M Plan prepared by the DEQ. Performance standards and activities of the October 2007 *Draft O&M Plan* are described below.

2.1 Soil Remedy

The soil remedy consists of contaminated soil removal and construction of an upland soil cap on approximately 40 acres of the Site. The soil cap remedy was complete in September 2005. Long term monitoring is necessary because soils beneath the cap remain contaminated with arsenic, pentachlorophenol (PCP), polynuclear aromatic hydrocarbons (PAHs), dioxins, and NAPL. The performance standards for the soil cap, determined in the Record of Decision (ROD) (EPA, 1996) and specified in the October 2007 *Draft O&M Plan*, are as follows:

- Maintain contaminant concentrations in surface soil below the following risk-based clean-up goals, as specified in the ROD (EPA, 1996):
  - Arsenic – 8 milligrams per kilogram (mg/kg);
  - PCP – 50 mg/kg;
  - Total Carcinogenic PAHs (cPAHs) – 1 mg/kg; and
  - Dioxins/furans – 0.00004 mg/kg.
- Maintain the topsoil layer to within 50 percent of its design specification:
  - Area over impermeable geomembrane cap – maintain thickness of at least 6 inches; and
  - All areas except over impermeable geomembrane cap - maintain thickness of at least 12 inches.
- Minimize infiltration of rainwater within the subsurface barrier wall by maintaining a subsurface stormwater conveyance system.
- Minimize stormwater erosion and surface water ponding by maintaining Site grading, surface stormwater conveyance, and native vegetation.
- Maintain native vegetation within the 6-acre riparian zone for compliance with the National Marine Fisheries Service Biological Opinion (NOAA, 2004).

Monitoring activities for the soil cap (including the riparian zone) include visual inspections of the cap surface, stormwater conveyance system, security fencing, and warning signs. The soil cap is designed to be generally maintenance free, except for maintaining the native vegetation. Routine maintenance includes irrigation of native vegetation during the summer months through 2009, manual removal of invasive plants, and targeted application of herbicides. An additional year of irrigation is recommended in 2010 (Appendix C). Non-routine maintenance may include repairs of the fence, replacement of warning signs, repairs of the gravel roads, filling of potential animal burrows, removal of

sediment from manholes and replanting of unsuccessful trees and shrubs. The scheduled frequency of these activities through 2010 is provided in Table 1.

2.2 Sediment Remedy

The sediment remedy consists of capping 23 acres of contaminated sediments within the Willamette River. The sediment cap remedy was complete in September 2005. Long term monitoring and maintenance is necessary because sediments beneath the cap remain contaminated with arsenic, PCP, PAHs, dioxins, and NAPL. The performance standards for the sediment cap, determined in the ROD (EPA, 1996) and specified in the October 2007 *Draft O&M Plan*, are as follows:

- Maintain contaminant concentrations in surface sediments below the following risk-based cleanup goals, as specified in the ROD (EPA, 1996):
  - Arsenic - 12 mg/kg, dry weight;
  - PCP - 100 mg/kg, dry weight;
  - cPAHs - 2 mg/kg, dry weight;
  - Dioxins/furans - 8×10^{-5} mg/kg, dry weight; and
  - Protection of benthic organisms based on sediment bioassay tests, resulting in impaired survival and growth (i.e., weight).
- Prevent visible discharge of creosote to the Willamette River.
- Minimize releases of contaminants from sediment that might result in contamination of the Willamette River in excess of the following Federal and State ambient water quality criteria (AWQC)[1]:
  - Arsenic (III) - 190 micrograms per liter (µg/L);
  - Chromium (III) - 210 µg/L;
  - Copper - 12 µg/L;
  - Zinc - 110 µg/L;
  - PCP - 13 µg/L;
  - Acenaphthene - 520 µg/L;

[1] One of the Remedial Action Objectives for groundwater in the ROD is to "prevent" groundwater discharges to the Willamette River that contain dissolved contaminants that would result in contaminant concentrations within the river in excess of background concentrations or in excess of water quality criteria for aquatic organisms. The 1996 AWQCs are listed as those were the criteria at the time of the ROD.

- Fluoranthene – 54 µg/L;
- Naphthalene – 620 µg/L;
- Total Carcinogenic PAHs – 0.031 µg/L; and
- Dioxins/furans – 1×10^{-5} nanograms per liter.

- Maintain the armoring layer to within 50 percent of the design specification:
  - 6-inch rock armoring – maintain thickness of at least 6 inches.
  - 12-inch rock armoring – maintain thickness of at least 7.5 inches.
  - 24-inch rock armoring – maintain thickness of at least 12 inches.
- Maintain uniformity and continuity of articulated concrete block armoring (ACB).
- Maintain at least 20 percent excess sorption capacity of the organoclay cap.

The AWQC values listed above are those values in effect at the time of the ROD (EPA, 1996); however, since completion of the ROD, the AWQC values have been updated. During meetings in August 2007 between stakeholders (DEQ, EPA, NOAA, Warm Springs Tribe, and Yakama Tribe), it was agreed that for comparison purposes, five benchmarks would be included in analytical results summary tables in this 2008 O&M Report: (1) two AWQCs in effect at the time the ROD was issued (1996 criteria for chronic effects to aquatic life and for human health based on fish consumption); (2) two current 2007 National Recommended Water Quality Criteria (NRWQCs) (one for chronic effects to aquatic life and one for human health [consumption of organisms]); and (3) current maximum contaminant levels (MCLs). Although these benchmarks have been included in this 2009 O&M Report for comparison purposes, the 1996 AWQC values are the regulatory criteria for the Site unless the ROD is amended.

Monitoring activities for the sediment cap include visual inspections of near shore areas and may include aerial photography of the shoreline during extreme low river stages (late September or early October), multi-beam bathymetric surveys and side-scan sonar surveys of deeper areas, and diver inspections of areas of concern identified from the bathymetry and sonar surveys. Monitoring activities also include collection of samples from surface water, inter-armoring water, sub-armoring water, organoclay cores, and crayfish. Organoclay cores were collected in 2006, 2008, and again in 2009. It is recommended that cores be collected again in 2015 prior to the fourth 5-year review. Although the sediment cap is designed to be generally maintenance free, unplanned or non-routine maintenance may include: the replacement of warning buoys, placement of additional armoring due to erosion, and placement of additional

organoclay if new releases of creosote are discovered or if the existing organoclay becomes saturated with creosote. The frequency of these O&M activities since Fall 2005, post remedy completion, is provided in Table 2.

2.3 Groundwater Remedy

The groundwater remedy consists of NAPL recovery, and a subsurface barrier wall surrounding approximately 18 acres within the upland soil cap. The barrier wall was completed in July 2004. Weekly NAPL recovery is ongoing. Long term monitoring is necessary because groundwater both within and outside of the subsurface barrier wall remains contaminated with metals, PCP, PAHs, dioxins, and NAPL. The performance standards for the subsurface barrier wall and NAPL recovery are as follows.

- Continue to recover NAPL from outside the subsurface barrier wall until recovery rates become minimal, alternative pumping strategies have been examined and/or field tested with poor results, and remaining NAPL does not pose a threat to the Willamette River and its sediments.
- Maintain contaminant concentrations in shallow, downgradient compliance wells (or sediment porewater) below Alternate Concentration Limits (ACLs) set forth in the ROD[2]:
  - Arsenic (III) – 1,000 µg/L;
  - Chromium (III) – 1,000 µg/L;
  - Copper – 1,000 µg/L;
  - Zinc – 1,000 µg/L;
  - Pentachlorophenol – 5,000 µg/L;
  - Total PAHs – 43,000 µg/L; and
  - Dioxins/furans – 0.2 ng/L.
- For reference purposes, groundwater data is compared with current Primary Drinking Water MCLs:

[2] The ROD initially specified site-specific ACLs for the Site. EPA has determined that ACLs are not valid as substitutes for Primary Drinking Water Standard Maximum Contaminant Levels (MCLs) in groundwater. Invalidation of ACLs also affects whether the groundwater RAOs derived from the provisions in CERCLA for using ACLs remain valid for the Site. As a result of this determination, the DEQ and EPA anticipate that: 1) groundwater standards for the Site will be established following a rigorous analysis of Site conditions and all relevant data; and 2) (assuming MCLs cannot be met) the application of a waiver pursuant to Section 122(d)(4) of CERCLA for MCLs to comply with the threshold criterion (meeting ARARs) for all remedies implemented pursuant to any final CERCLA ROD. Issues associated with use of ACLs at this Site are further discussed in Section VIII and IX of the Second Five-Year Review Report.

- Arsenic - 0.01 mg/L;
- Chromium - 0.1 mg/L;
- Copper - 1.30 mg/L;
- Zinc - 5.00 mg/L;
- PCP - 1 µg/L; and
- Benz(a)pyrene - 0.2 µg/L.

- Minimize the transport of NAPL and communication of groundwater zones across the subsurface barrier wall.
- Minimize further vertical migration of creosote to the deep groundwater aquifer.
- Minimize visible discharge of creosote to the Willamette River.
- Maintain contaminant concentrations in the Willamette River below background concentrations or less than the Sediment Cap performance standards for surface water.

Monitoring activities for the groundwater remedy include groundwater elevation monitoring and groundwater sampling. Routine maintenance of equipment and providing for Site utility service are also included as elements of groundwater O&M. The frequency of these O&M activities through September 30, 2011, is provided in Table 3.

3.0 NON-SAMPLING OPERATION AND MAINTENANCE ACTIVITIES SUMMARY

As discussed in Section 1, the DEQ is conducting O&M activities according to a Draft O&M Plan prepared by DEQ. Performance standards and activities of the October 2007 Draft O&M Plan are described below. More detailed presentations of the non-sampling O&M activities are provided in the following appendices:

- Appendix A - Groundwater and NAPL Assessment
- Appendix B - Site Observation and Activity Summary
- Appendix C - Vegetation Survival Assessment

3.1 NAPL Recovery and Thickness Assessment

To assess the performance of the barrier wall and soil cap, periodic well gauging, NAPL measurement, and NAPL extraction were performed. During the

reporting period (January 1 through December 31, 2009), NAPL was monitored weekly in eight wells located outside the barrier wall in the former Waste Disposal Area (FWDA), and quarterly in the remaining wells onsite and offsite (4 wells are located in the Willamette Cove [WC]).

Light non-aqueous phase liquid (LNAPL) was detected in five wells during the reporting period (EW-10s, EW-15s, EW-18s, EW-23s, and MW-56s). Four of the five wells (EW-15s, EW-18s, EW-23s, and MW-56s) are located within the barrier wall; therefore, no LNAPL was extracted from these wells. EW-10s, when bailed, did not produce recoverable LNAPL even though the oil-water interface probe signaled the presence of sufficient product to extract. It appears that pin-sized globules of LNAPL in the upper few feet of the well casing were triggering the probe.

Well MW-56 showed an increase in LNAPL thickness after barrier wall installation, but it has stabilized in thickness in the past 2 years ranging seasonally between 0.3 and 1.5 feet in thickness. The other three wells within the barrier wall that contain LNAPL have remained stable in LNAPL thickness over the same period of time. In all of the wells with regular LNAPL occurrence, the LNAPL thickness is greater when the groundwater elevation is low due to gravity drainage of LNAPL in the vadose zone. This clear consistent pattern is especially evident since NAPL recovery was discontinued within the barrier wall. Although the LNAPL thickness varies cyclically with changes in the groundwater elevation, the accumulated volume of LNAPL remains relatively constant.

Dense non-aqueous phase liquid (DNAPL) was measured in six wells during the reporting period (MW-20i, MW-Ds, MW-Gs, MW-22i, EW-8s, and EW-1s). Three of the wells are located within the barrier wall (MW-22i, EW-8s, and EW-1s). Based on the O&M plan, NAPL is not recovered from the interior wells. However, several feet of DNAPL was observed in EW-1s during the first quarterly gauging event on March 13, 2009, and continues to be detected in this well. EW-1s is central to the location where the upland surface is subsiding (see Appendix B). Subsidence is believed to be related, in part, to degradation of wood debris in the fill material underlying the upland impermeable soil cap. Due to consistent large volumes of DNAPL in EW-1s and concern that the high temperatures (up to 40°C) observed in the well (related to heat from degradation) may increase DNAPL mobility by reducing its viscosity, DEQ determined that weekly NAPL gauging and recovery from this interior well was necessary. DNAPL recovery began on July 6, 2009, and since then, approximately 70 gallons of liquid (water + DNAPL) have been extracted from this location. This accounts for approximately 40% of the NAPL and water extracted in the last 2 quarters of 2009.

Of the three wells located outside the barrier wall, DNAPL was recovered weekly from MW-20i and intermittently from MW-Ds and MW-Gs. A total of approximately 113 gallons of DNAPL (21 gallons of the 113 were extracted from EW-1s) was extracted from the Site in 2009, bringing the total volume of NAPL extracted at the Site to approximately 6,373 gallons.

A significant amount of time is required to manually recover a relatively small volume of NAPL per month at the Site. The NAPL migration assessment contained in the *Post Remedial Action Conceptual Site Model for NAPL Transport* (GSI, 2007) and EPA's review concluded that NAPL outside the barrier wall is not likely migrating to the Willamette River. Based on the high cost of manual NAPL recovery, lack of predictive value of the irregular data derived from manual recovery, and the type of wells from which recovery is occurring (2-inch monitoring wells); the project team should reconsider the need for continued NAPL recovery. If a decision is made to continue, a more effective NAPL recovery system should be installed.

3.2 Groundwater Flow Direction and Gradient Assessment

Manual measurements of static groundwater levels were conducted during low tide on March 13, 2009; June 12, 2009; September 11, 2009; and December 10, 2009. Shallow groundwater elevation and gradient during this reporting period at the Site are consistent with conditions observed during previous reporting periods. Horizontal gradients are the greatest during periods of high precipitation and decrease during periods of low precipitation. Groundwater flow inside the barrier wall remains relatively flat, while outside the wall, shallow groundwater flow is diverted around the barrier wall to the northwest and south.

The barrier wall is clearly isolating the shallow groundwater inside from outside the barrier wall based on the independent groundwater elevations, flow directions, and gradients inside versus outside the barrier wall. With installation of the impermeable soil cap, the elevation differences inside versus outside the barrier wall on the northeastern (bluff) side have further increased indicting a significant decrease in rainwater entering the barrier wall area. The only locations where precipitation can enter the barrier wall area are through the riparian area and between the impermeable soil cap liner and the top of the barrier wall. The groundwater elevation inside the barrier wall continues to decrease in elevation relative to the shallow groundwater elevation upgradient of the barrier wall as it approaches equilibrium with the Willamette River. The interior groundwater elevations approaching equilibrium with the Willamette River is evidenced by the reversal in gradient direction observed inside the barrier wall when the Willamette River was at its peak stage (greater than 15 feet North American Vertical Datum, 1988 [NAVD88]) in June. This was the second

consecutive year that this reversal in gradient occurred and is expected to continue to occur when river stage peaks in the summer months.

Groundwater level data was also collected using pressure transducers that monitored groundwater level fluctuations on a half-hour basis at select monitoring wells surrounding the barrier wall. Hydrographs based on transducer data were prepared for selected monitoring well clusters (MW-36/37, MW40s/41s, MW-44/45, and MW-52/53) inside and outside the barrier wall. Transducers were placed in these wells to monitor the water level differences between inside and outside the barrier wall to assess the barrier wall performance. Under stable river conditions, vertical groundwater gradient figures indicate that gradients are generally downward during low tide and high tide inside the barrier wall in the FWDA and former Tank Farm Area (TFA), with the exception of an upward gradient during high tide in the former TFA.

Transducers were installed in two interior shallow wells (EW-1s and MW-15s) in October 2008 to understand the shallow groundwater table fluctuation within the barrier wall. The transducer data show that these wells are more comparable to interior well MW-52s located on the upgradient side of the barrier wall than interior well MW-36s on the downgradient side in the eastern corner. Collecting transducer data from these wells within the interior area of the barrier wall will allow for the interpretation of precipitation effects on groundwater elevations within the barrier wall.

Frequent irregular water level fluctuations (multiple times per day) of greater than 0.5 feet observed in transducer data for EW-1s and MW-15s are thought to be due to methane gas, generated from the degradation of the wood debris buried at the Site, that is escaping through these wells. A reduction in oscillations was noted after well EW-1s was sealed so that ambient air (with oxygen) was not entering the well. See Appendix B regarding the upland subsidence for further explanation.

Based on the observations made through the 2009 reporting period, the barrier wall and impermeable soil cap are functioning as intended to divert groundwater flow around and prevent rainwater infiltration into NAPL source areas contained within the barrier wall. The thickness of NAPL does not appear to be increasing significantly in any of the monitoring wells inside (with the exception of EW-1s where it is being recovered) or outside the barrier wall. The overall rate of extraction of NAPL outside the barrier wall has remained stable.

A DNAPL recovery system is being considered for the area near MW-20i outside the barrier wall. The objective would be to optimize NAPL recovery, reduce the cost per gallon of NAPL recovered, and collect data that will assist in

understanding NAPL recovery decline so that an informed decision can be made regarding discontinuation of NAPL recovery. Because groundwater flow directions and gradients have been consistent over the past five years, it is expected that the quarterly monitoring program will be reduced to semi-annual monitoring in 2010.

3.3 Site Observation and Activity Summary

Tables 1 and 2 outline the planned inspections for the soil and sediment caps, respectively, through September 2011. In 2009, Hart Crowser subcontracted with Clearwater to perform routine O&M activities, including Site-wide inspections. During the months of July, August, and September 2009, sediment cap inspections were performed on a weekly basis; sediment cap inspections were performed on a monthly basis during the remainder of the reporting period. Soil cap inspections were performed on a monthly basis during the reporting period. Additional Site inspections were performed during monthly Site meetings, sampling events, and other miscellaneous Site visits.

During the reporting period, sheen was observed regularly from approximately late June to October, but not observed during the remainder of the period. A comprehensive effort to identify the origin of the shoreline sheen was conducted in 2008, preliminary results of which are presented in Appendix G of the *2008 O&M Report* (Hart Crowser/GSI, 2009a). In 2009, additional studies were performed to characterize the sheen. This characterization work and results as well as the final results for the 2008 ebullition and sheen investigation are summarized in Section 4.3 and presented in detail in Appendix F of this report.

In general, the sediment cap and the upland soil cap inspections revealed few unexpected changes or areas of concern with the exception of the subsidence occurring in the upland cap. The general vicinity of upland soil cap subsidence is coincidental with subsurface wood debris. It is likely that degradation of the wood debris coupled with the decrease in groundwater elevation inside the barrier wall contribute to the subsidence observed in this vicinity. The stormwater drainage system installed as part of the upland impermeable soil cap continues to flow after rain events indicating that the drainage system continues to operate.

Sand covers the ACB over much of the shoreline, and there are significant amounts of large woody debris that have accumulated to help create wildlife habitat. Wildlife commonly seen at the Site includes Canada geese, blue herons, ospreys, crawfish, squirrels, and rabbits; evidence of coyotes has also been observed. The general public uses the shoreline for recreation, most commonly

walking of dogs. A few instances of vandalism (e.g., meter box damage) and littering have occurred outside the fenced perimeter of the Site.

Site inspections and observations resulted in several non-routine maintenance activities in addition to routine activities. Non-routine activities included fixing the irrigation system, repairing the electrical meter box, and repairing water piping in the office trailer. It is anticipated that Site inspections will be reduced from monthly to every 6 weeks and eventually quarterly. Non-scheduled maintenance activities will continue as needed.

3.4 Vegetation Survival Assessment

The City of Portland, Bureau of Environmental Services (BES) continues to provide planning and vegetation management services at the Site through an Intergovernmental Agreement (IGA) with the DEQ. The initial planting in February 2006 has now completed a third growing season. A full report of site-wide vegetation management is provided in Appendix C.

The Site has five planting areas: (1) upper riparian, (2) lower riparian, (3) natural tree and shrub planting area, (4) swale and pond planting, and (5) the impermeable soil cap. Overall, Site re-vegetation performed above expectations and meets the performance standard of the IGA. The current plant inventories for the five planting areas are as follows:

- In the upper riparian area (3.6 acres), there are currently 1,086 plants per acre of the woody species: 557 shrubs and 529 trees. The site continues to make progress towards achieving the 30% canopy closure by October 2011, the end of the specified 5-year period.
- In the lower riparian area (2.1 acres), there are currently 1,510 plants per acre: 990 shrubs and 520 trees. Herbaceous cover was measured at 84% above the goal of 80% covered by October 2011.
- In the natural tree and shrub planting area (1.1 acres), there are currently 1,557 plants per acre: 1,257 scrubs and 300 trees. Herbaceous cover was measured at 95% above the goal of 90% covered by October 2011.
- In the swale and pond planting area (4.2 acres), five species of shrubs were documented meeting the performance standard set for October 2011. Herbaceous cover was measured at nearly 100% above the goal of 90% covered by October 2011.
- In the impermeable soil cap area (7 acres), no woody species have been planted. Initially hydroseeding in 2005 (DEQ contractor – grass and wildflower species), and subsequent reseeding in 2007 (BES – fescue

species) has maintained adequate ground cover for this area. The noxious weed population has continued to decline over the 2009 growing season.

Noxious weed control remains a problem for the Site. The degree of weed presence will determine the long-term vegetation management requirements more than any other single factor. Establishing a solid herbaceous cover and periodic reseeding will limit the spread of noxious weeds.

Maintenance requirements for the irrigation system have continued over this past season. The battery-operated controllers are not reliable and additional expenses have been incurred to replace malfunctioning controllers in the spring and early summer of 2009. Irrigation system activities for 2009 and 2010 included:

- Drained and winterized the system in fall 2009;
- Inspected entire system to identify, mark, and map any freeze or other types of damage in spring 2010;
- Repair any freeze damage in spring of 2010; and
- Replace and repair all malfunctioning or worn battery-operated irrigation controllers.

3.5 Updated Site-Wide Record Drawings

As a result of the subsidence observed in the upland soil cap, the entire upland portion of the Site was professionally surveyed by OTAK in August 2008 with a more focused survey in the area of subsidence from April through September 2009. The record drawing depicting upland cap features was updated including the Burlington Northern Railroad (BNRR) easement, and is provided as Appendix G to this report. For the upland portion of the map, the topography was extended into the BNRR easement to monitor changes as a result of road building activities conducted by BNRR (see Appendix B). Locations of the wells, buildings and other features are based on the previous survey conducted by David Evans and Associates in 2005.

4.0 SAMPLING ACTIVITIES SUMMARY

This section provides a brief summary of the O&M activities listed in Tables 2 and 3 pertaining to sampling requirements at the Site. These sampling events included sampling: surface water, inter-armoring water, and sub-armoring water from the sediment cap area; and the infiltration pond monitoring well MW-59s. Additional investigation was performed to characterize observed sheen. The

results of the 2008 ebullition and sheen investigation, and the 2009 sheen characterization are included as Appendix F to this report.

More detailed presentations of these O&M activities related to sampling are provided in the following appendices:

- Appendix D – Surface Water, Inter-Armoring Water, and Sub-Armoring Water Quality Assessment
- Appendix E – Infiltration Pond MW-59s Groundwater Quality Assessment
- Appendix F – Ebullition and Sheen Investigation and Characterization Summary

Supplemental information for these activities is provided in electronic format on the O&M Report DVD.

4.1 Surface, Inter-Armoring, and Sub-Armoring Water Assessment

Nine rounds of post cap construction surface, inter-armoring, and sub-armoring water sampling have been conducted since the sediment cap was constructed: Fall 2005 (only surface water and sub-armoring water), Spring 2006, Fall 2006, Spring 2007, Fall 2007, Spring 2008 and Fall 2008, and Spring 2009 and Fall 2009. Pre-cap construction surface water/porewater sampling took place in 2002 and 2003. Appendix D contains the *Surface, Inter-Armoring, and Sub-Armoring Water Assessment*, which describes sampling methodology, sampling results, summaries, and references for the 2009 events, as well as a summary of results from previous sampling events conducted in 2002, 2003, and 2005 through 2009. Beginning in 2005, sampling activities were conducted in the fall and spring of each year to evaluate post sediment cap construction water quality conditions under both low-river discharge and high-river discharge conditions.

Samples taken in and after 2005 included the collection of water contained in the sand layer of the sediment cap (above the original sediments but beneath the overlying armoring layer), hence the term sub-armoring water samples. Samples taken in 2002 and 2003 were collected from the existing sediments and are referred to as porewater samples. Beginning in 2006, a third sampling zone (the armoring layer itself) was included and is referred to as inter-armoring water.

For each sampling event, analytical results obtained from the laboratory were tabulated by location and media. A series of statistical parameters were used to summarize the data and were provided for each media (i.e., surface water, inter-armoring water, and sub-armoring water) and each sampling event (i.e., Fall 2002, Fall 2003, Fall 2005, Spring 2006, Fall 2006, Spring 2007, Fall 2007,

Spring 2008, Fall 2008, Spring 2009, and Fall 2009). The parameters include the following:

- Number of Samples;
- Detection Frequency;
- Maximum Detected Concentration;
- Location of Maximum;
- Mean Concentration;
- Data Distribution; and
- 95% Upper Confidence Limit (UCL) on the Mean (95% UCL).

The summary statistics for each sampling event are provided in Appendix D.

During the 2009 sampling events, samples were analyzed for site contaminants of concern (COCs), including total metals (arsenic, chromium, copper, and zinc), PAHs, and PCP. Total suspended solids (TSS), total dissolved solids (TDS), and dissolved metals were also analyzed. Analytical results were compared against a group of water quality criteria and recommended values including AWQCs referenced in the 1996 ROD, as well as current NRWQCs and National Primary Drinking Regulations (NPDWRs) established by the EPA. These criteria and recommended values are collectively referred to as comparison criteria.

As part of the Fall 2009 sampling event, solid phase micro-extraction (SPME) sampling was conducted in conjunction with porewater sample collection were at 13 of the 22 semi-annual sampling locations, and analyzed for PAHs. Eighteen-inch SPME sampling probes were inserted approximately 1 foot into the sand layer and 6-inches into the armoring layer of the sediment cap. The SPMEs were placed by divers and, extracted one week later by University of Texas graduate students. The sample results are presented in Attachment E to Appendix D of this report.

4.1.1 Surface Water Sampling Results

During the Spring 2009 event, 26 surface water samples were collected from 24 locations including two duplicates and background samples from Location 1 and Location 27 (upstream and downstream, respectively).

Of the 22 locations overlying the sediment cap, eleven had detectable concentrations of PAHs with only one of these locations containing detectable levels of cPAHs. The detected cPAH concentrations were well below

comparison criteria. Naphthalene was detected in five locations (Locations 13, 17, 18, 19, and 21) at concentrations more than 3 orders of magnitude below the comparison criteria. PCP was not detected in any of the samples. Total arsenic was detected and exceeded the comparison criteria of 0.00014 mg/L at all locations. Total copper exceeded the comparison criteria at one location (Location 19). Chromium and zinc did not exceed comparison criteria in any of the locations.

During the Fall 2009 event, 25 surface water samples were collected from 24 locations including one duplicate, MBSW1009-13D, from Location 13. Two of the locations (Locations 1 and 27) are background locations. Of these samples, five samples had detectable PAHs with no detectable cPAHs. Naphthalene was detected in five locations (Locations 4, 5, 17, 19, and 25) at more than 3 orders of magnitude below the comparison criteria. None of the samples had detections of PCP. Sixteen locations had detectable total arsenic, all of which exceeded the comparison criteria of 0.00014 mg/L. Chromium, copper, and zinc did not exceed the comparison criteria in any of the locations.

Trend plots of the mean concentrations (shown in Appendix D) indicate that COC concentrations have not increased since the sediment cap was completed in 2005. In fact, it appears that PAH (both cPAH and TPAH) concentrations have decreased in the sub-armoring layer while the surface water and inter-armoring layers have remained stable (i.e., are not increasing or decreasing).

TPAHs in surface water are consistently higher in the Fall when groundwater discharge is lowest. Because the same pattern is not present in cPAHs, this suggests that low molecular weight PAHs migrate through the sediment cap through lateral discharge of groundwater. The metals concentrations are stable and show no trends since installation of the sediment cap.

4.1.2 Inter-Armoring Water Sampling Results

During the Spring 2009 sampling event, 24 samples were collected from 22 inter-armoring locations, including two duplicates. None of the samples contained detectable amounts of PCP. Three locations (Locations 10, 18, and 25) contained detectable cPAHs below the comparison criteria, and over half of the samples had detectable TPAHs. Arsenic exceeded the comparison criteria at all locations and copper exceeded the comparison criteria at one location. One location exceeded the comparison criteria for copper and no locations exceeded comparison criteria for chromium or zinc.

During the Fall 2009 sampling event there were 23 samples collected from 22 locations, including one duplicate. PCP was not detected in any of the locations.

Ten locations had detectable PAHs; however, none of the cPAH constituents were detected. Although naphthalene was detected in 7 locations these detections were well below the comparison criteria.

Inter-armoring results have remained stable since the sediment cap was installed. The inter-armoring layer typically has the highest concentrations of copper while arsenic and PAH concentrations in the inter-armoring layer are typically lower than the sub-armoring layer. This pattern for copper suggests that it may be related to surface water loads and not related to copper migrating from the Site.

4.1.3 Sub-Armoring Water Sampling Results

In the Spring 2009 sampling event, 24 sub-armoring water samples were collected from 22 locations including two duplicate samples. Of these samples, three had detectable concentrations of cPAHs and 19 of the locations contained detectable low molecular weight polynuclear aromatic hydrocarbons (LPAHs). No sub-armoring samples contained concentrations of PCP above the method detection limit (MDL). Total and dissolved arsenic were detected at all locations and exceeded the comparison criteria of 0.00014 mg/L. Total and dissolved copper exceeded the comparison criteria in 2 of the locations where it was detected. Chromium and zinc, where detected, were all below comparison criteria.

In the Fall 2009 sampling event, 23 samples were collected from 22 locations including two duplicate samples. Of the 22 sample locations, cPAHs were detected at four locations and 19 of the locations contained detectable LPAHs. PCP was not detected at any of the locations. Total and dissolved arsenic with one exception exceeded the comparison criteria of 0.00014 mg/L. Chromium, copper, and zinc, where detected, were all below comparison criteria.

Metals and cPAH concentrations have been stable since the sediment cap was installed (Figures D-21 and D-22). TPAHs appear to be decreasing in concentration (Figure D-23). Sub-armoring concentrations for PAHs and arsenic are higher in the sub-armoring than the surface water and inter-armoring layer, while copper concentrations are lower in the sub-armoring than in the inter-armoring layer.

4.1.4 Solid Phase Micro-extraction Sample Results Summary

In Fall 2009, SPME passive sampling was conducted at 13 of the semi-annual conventional sampling locations to determine its effectiveness as a long-term monitoring strategy. Similar to the regular semi-annual data, the results were compared to surface water quality criteria, analyzed for vertical concentration profiles and intra-site variability. Surface water criteria was only exceeded in one

location; Location 9 at 12-inches into the sediment cap sand layer exceeded the cPAH ROD comparison level of 0.031 µg/L at a concentration of 0.3 µg/L. The two samples closer to the surface at the same sampling location, at 6-inches into the sand cap and within the inter-armoring layer, did not show elevated PAHs suggesting no significant migration to the surface.

The LPAHs compared fairly well with SPME results for the sub-armoring samples. Otherwise, the conventional semi-annual sampling data for HPAHs and for the LPAHs from the inter-armoring were primarily not detected above the standard EPA analytical methods while the SPME achieves much lower detection limits and for the LPAHs in the inter-armoring the SPME appear to be a better representation of the interstitial water within the inter-armoring. The semi-annual sampling methodology for inter-armoring water is very similar to surface water data which is expected due to the large volume of water that is needed to reach the low level detection limits for the PAHs. The SPME results for LPAHs in the inter-armoring layer, although still low, were slightly higher than the conventional method and regularly mimicked the sub-armoring layer pattern at each location. For HPAHs, the SPME achieves a much lower detection limit and will provide significantly better data to monitor sediment cap performance.

In addition, SPME data measure only the freely dissolved concentrations in water which have been shown to correlate well with tissue uptake (Reible et. al., 2008).

4.1.5 Summary

In summary, COC concentrations in surface water and inter-armoring water are generally below comparison criteria with the exception of arsenic, which is present at equivalent background concentrations, and the other exceedences described above. COC concentrations in the sub-armoring water are below comparison criteria with some exceptions. Concentration trends are stable or decreasing or all COCs. Based on water sampling from the surface water, inter-armoring, and sub-armoring, the sediment cap appears to be performing as designed and is protective of surface water.

4.2 Infiltration Pond MW-59s Groundwater Quality Assessment

The soil cap remedy was completed in 2005. A component of the soil cap is the infiltration pond at the southwestern corner of the Site, which was constructed to collect surface water runoff from a portion of the upland cap. A groundwater monitoring well, MW-59s, was installed downgradient from the infiltration pond in 2005 to monitor changes in contaminant levels in groundwater. As specified in the *Draft O&M Plan*, four quarters of groundwater samples were to be collected from MW-59s to evaluate the potential for subsurface contaminants to

be mobilized by the upland cap infiltration pond. A total of six samples have been collected from MW-59s to date, since after four samples it was not clear whether there was an increasing trend present in the data.

During the six sampling events, total arsenic concentrations in three of the four events exceeded the MCL of 0.01 mg/L. All other detections for metals and PAHs were below the corresponding MCLs (where such MCLs exist). No PCP was detected during the five sampling events.

During 2009, concentrations for chromium, copper, and zinc decreased compared to previous sampling events. Arsenic concentrations increased slightly from 2007 levels, but appear to fluctuate based on particulate matter in the samples. Five LPAHs and six high molecular weight polynuclear hydrocarbons (HPAHs) (including four cPAHS) were detected at low levels in August 2009. Total PAHs detected in August 2009 were the highest to date. PAHs were not detected during the first three sampling events; however, the detection limit for PAHs was higher during these events. The results of all sampling to date has not established a clear trend in PAH concentrations.

In the August 2008 Technical Team meeting, a decision was made to sample monitoring well MW-59s on an annual basis in 2009 and 2010. Although metals concentrations have generally decreased compared with 2008 results and total PAHs have been detected more frequently in recent sampling events, there is not enough data to support a clear pattern regarding the potential for subsurface contaminants to be mobilized by the infiltration pond.

Yearly sampling of monitoring well MW-59s will provide a more comprehensive data set and is expected to demonstrate a trend in contaminant concentrations over time.

4.3 Ebullition and Sheen Investigation and Characterization Summary

Sheen has been observed at the Site since the sediment cap was installed in 2004 and completed in 2005. The initial sheen observed were small sheen bursts on the surface water associated with ebullition (ebullition-induced sheen).. Sheen, not associated with ebullition, is observed in late summer/early fall along the shoreward of the organoclay mats in the TFA, overtop of the granular organophilic clay along the WC shoreline, and at the southern end of the Site (Figure F-1).

In 2008, extensive investigative work was conducted to determine whether sheen was caused by creosote migrating through the sediment cap either vertically by tidal pumping or laterally associated with groundwater discharge. The results

indicated that creosote is not migrating through the sediment cap to create the sheen; however, the origin and nature of the sheen were not determined.

In 2009, a sheen characterization study was also conducted with assistance from Montana State University (MSU). The purpose of the additional 2009 characterization was to identify the nature of the sheen with the objective of understanding whether the sheen presence is related to site contamination, hazardous, or just biogenic or metallic sheen associated with groundwater discharge from the site.

Detailed descriptions of the shoreline sheens are provided in the *Operation and Maintenance (O&M) Report October 2005 through December 2006* (E&E, 2007), the *Post Remedial Action Conceptual Site Model for NAPL Transport* (GSI, 2007), the *O&M Report January 2007 through December 2007* (E&E, 2008), and the *O&M Report January 2008 through December 2008* (Hart Crowser/GSI, 2009a).

4.3.1 Ebullition and Sheen Investigation 2008

Extensive investigations were conducted at the site in 2008 to determine whether:

- Creosote or PAH contamination is migrating through the sediment cap resulting in a sheen on surface water;
- Ebullition is a significant pathway for contaminant transport through the sediment cap;
- The Organoclay™ reactive core mats (RCM) are performing as designed;
- The origin of the gas is from methanogenesis within the bulk organophilic clay layer of the sediment cap; and
- The granular bulk organophilic clay is breaking down, and if so, will that adversely affect the longevity of the sediment cap life.

Methodology and preliminary results of the 2008 investigation were reported in Appendix G of the *O&M Report January 2008 through December 2008* (Hart Crowser/GSI, 2009a). Conclusions for the complete 2008 investigation, including the results for analyses completed in 2009 from the 2008 investigation that were not reported in the 2008 annual report, are provided in 4.3.3, below. The final reports for the Portland State University Ebullition Study and University of Texas at Austin organophilic clay/SPME studies are included in Appendix F.

4.3.2 2009 Sheen Characterization Study Objectives

As provided in detail in the *Sheen Characterization Work Plan* (Hart Crowser/GSI, 2009b), the following summarizes the field and sampling elements for the sheen characterization study.

- Sheen Survey: Sheen surveys were conducted along the Site shoreline from mid July through the end of August 2009 to determine the frequency, nature, and extent of sheen observed.
- Sheen Simulation: The DEQ contract laboratory (Pace Analytical) conducted a simulation of creosote sheen and chemical analysis to use as a comparison to sheen and ambient surface water samples collected along the Site shoreline.
- Sheen Sampling: Three separate, one-week sheen sampling events completed on August 6, August 12, and August 27, 2009, including collection of sheen and adjacent ambient surface water using Teflon® nets/pads and C-18 Cartridges for chemical and/or biological analysis. During each event, sheen and adjacent ambient surface water samples was collected from four discrete locations at which sheen has frequently been observed.
- Chemical Analysis: The isolated samples of sheen and ambient surface water were analyzed for total petroleum hydrocarbons (TPH), PAHs, and selected metals to determine the nature of the sheen. The ambient water samples were analyzed for both total and dissolved metals while the sheen samples could only be analyzed for total metals. The gas chromatography/mass spectometry (GC/MS) chromatograms from the sheen samples were also compared to the Site creosote chromatograms to determine if there was a difference between the sheen and creosote from the Site.
- Biological Assessment: A biological assessment of the sheen was conducted by Dr. Anne Camper of MSU. This study was conducted to determine if the sheen was microbiological in origin. The investigation included culturable microbial counts from sheen samples collected on mesh and parallel water samples, and direct microscopic visualization for evidence of bacterial cells.

4.3.3 Ebullition and Sheen Investigation and Characterization Conclusions

The conclusions provided below are based on the data quality objectives (DQOs) presented in the *Ebullition and Sheen Investigation Work Plan* (Hart Crowser/GSI, 2008) (note DQO #5 has been revised to include the 2009 sheen characterization activities). These conclusions consider field observations, data

compiled from the 2008 ebullition and sheen investigation, previous sheen investigations, and the 2009 sheen characterization.

DQO #1: Determine whether the sediment cap is protective of surface water; specifically in the areas of concern. Determine whether the sediment cap is effective in preventing NAPL seeps to the river.

Conclusions for DQO #1: The low PAH concentrations from porewater samples collected in the sediment cap combined with the lack of any evidence of NAPL migration into and through the bulk organophilic clay demonstrate that the sediment cap is protective and that surface water is protected not only broadly across the sediment cap as demonstrated by the semi-annual sampling, but also in the specific areas of concern addressed by these investigations.

Porewater and SPME data collected from the sediment cap sand along the shoreline in the WC are below ROD and risk-based comparison criteria. Porewater samples, collected in 2008 as part of the sheen investigation, from the shoreline of the TFA and south of the TFA were non-detect or below comparison criteria for PAHs, with the exception of some low level cPAH detections exceeding comparison criteria in porewater from two conventionally collected samples located shoreward of the granular bulk organophilic clay. The cPAH concentrations in these samples were 0.0971 µg/L and 0.2154 µg/L, and total PAH concentrations were 0.6749 µg/L and 0.5756 µg/L, respectively. One other porewater sample collected from just outside the southern corner of the Organoclay™ RCM in the TFA contained low level cPAH concentrations (0.115 µg/L). Total PAHs in the porewater samples ranged from not detected to 77 µg/L. Porewater concentrations in the cap sand between the bank and the native sediment in the bank in the TFA would be expected to have significantly higher concentrations of PAHs if sheen were migrating from residual creosote in the bank though the cap sand into surface water. These low level concentrations would not be expected to result in shoreline sheen. In addition, the low level cPAHs detected in the porewater within the cap sand is from 8 to 10 inches into the cap sand which is over 1.5 feet below the surface water interface when the armoring thickness is taken into account.

Sediment cap sand samples, collected in select locations from the WC and TFA were analyzed for PAHs. Sample results were well below ROD sediment cleanup goals and DEQ's sediment bioaccumulation screening level values (DEQ, 2007). Samples collected from the native sediment beneath the sediment cap material were elevated as expected, demonstrating the ability of the sediment cap to attenuate PAHs.

Sheen is frequently observed at the shoreline in areas where residual creosote is known to be present beneath the sediment cap, in areas where there has been no evidence of residual creosote, and along the shoreline of the Triangle Park property, south of the Site. Sheen in each of these areas has common characteristics: metallic luster/iridescent, blocky, and does not re-coalesce when disturbed. The fact that it does not re-coalesce when disturbed suggests that it is not a hydrocarbon sheen. Sheen samples collected in 2009 in the WC and the TFA do not contain elevated PAH concentrations above the adjacent surface water, and are significantly lower than sampling data from pre-cap sheens. In general, observed sheens are odorless. However, there appears to be a naphthalene odor occasionally associated with sheen in WC. This odor is likely associated with upland groundwater discharging over the sediment cap, and not related to observed sheen. This odor is present in late summer when the river levels drop and the upland groundwater levels are still high. Isolated sheen samples collected in 2009 show elevated levels of iron relative to the ambient surface water suggesting that the sheen is related to a concentration of iron in a solid phase.

Dioxin concentrations from crayfish sampling in 2006 and 2008 are below the Oregon Department of Human Services (DHS) health advisory level, and well below the average for Portland Harbor. Prior to installation of the sediment cap, dioxin concentrations in crayfish were well above advisory levels.

An extensive amount and variety of data, as described above and elsewhere in this report, has been collected over the past 5 years, all of which indicate that the sediment cap is protective of surface water, and is performing as designed.

DQO #2: Determine whether or not the degradation is breaking down the organophilic clay, and if so, determine how/whether it significantly affects the life of the organophilic clay as it pertains to the Site.

Conclusions for DQO #2: The high hexane extractable material (HEM) levels in the ET-1 organophilic clay samples suggests that there is a significant amount of organic matter within the organophilic clay that is potentially degradable. This is supported by the reduction in the percent of organic matter within the ET-1 organophilic clay since placement, based on testing by the University of Texas and Portland State University. Degradation of this organic material appears to be contributing to the ebullition noted in the TFA organoclay cap area. Substantial organic matter remains in the ET-1 organophilic clay suggesting that it has adequate capacity to sorb creosote should creosote migrate into the sediment cap. In addition, since creosote migration is arrested by the presence of the barrier wall, reliance on the ET-1 to sorb creosote indefinitely is not expected. Creosote sorption capacity was most important immediately after

remedy implementation when consolidation and redistribution of creosote may have occurred. Finally, any organophilic clay saturated with creosote during these initial stages is likely degrading much more slowly, if at all, due to the negative impact of the NAPL on microbial activity. Thus, there is no evidence that the observed reduction in organic matter in the ET-1 organophilic clay samples will result in creosote release through the sediment cap in the future.

Results from the flux chamber sampling also support the preliminary conclusion that the granular organophilic clay is performing as designed. The PAH concentrations in water from flux chambers located on top of the granular organophilic clay in the TFA were below the comparison criteria with the exception of water from FC-5C where chrysene measured at 0.058 µg/L exceeded the comparison criteria (0.018 µg/L) which is consistent with the determination that the ebullition pathways do allow for limited migration of particulate matter through the sediment cap. No other water samples collected from the 6 flux chambers placed on top of the granular organophilic clay in the TFA exceeded any comparison criteria. The flux chambers in WC were placed just outside of the organophilic clay footprint because of low Willamette River levels; and therefore, did not measure contaminants moving through the granular organophilic clay.

DQO #3: Determine whether the ebullition is a significant contaminant migration pathway through the sediment cap.

Conclusions for DQO #3: Two co-located flux chambers were placed in 10 locations. In each location, one flux chamber was placed over an ebullition pathway and the other adjacent where no ebullition was observed. During the course of the sampling event, one set of flux chambers "washed away" and therefore, water and gas samples were collected from nine co-located chambers.

Gas was only collected from the chambers placed over the ebullition pathways. Generally, gas collected from flux chambers placed over the top of the granular organophilic clay contained high relative concentrations of methane, while gas generated outside the organophilic clay footprint included a lower ratio of methane to other gases. This suggests that methanogenesis is the primary process occurring within the granular organophilic clay, and other degradation processes, including methanogenesis, are occurring elsewhere.

Porewater from each flux chamber was collected daily for four days through an XAD column. Analytical results of porewater collected from flux chambers placed over ebullition locations have higher concentrations of COCs relative to porewater collected from adjacent chambers. However, with the exception of FC-5C where chrysene was measured at 0.058 µg/L, which is slightly above the

comparison criteria, all porewater concentrations are well below comparison criteria. The total cPAHs from FC-01C exceeded the ROD comparison criteria of 0.031µg/L; however, none of the individual cPAHs in that sample exceeded the individual comparison criteria for cPAHs. The results of the water sampling from the flux chambers indicate that ebullition creates a preferential pathway for contaminant migration but not a significant pathway threatening the protectiveness of the sediment cap.

The inability to identify significant contaminant migration through the cap via the cores, conventional porewater, or SPME analyses that exceeds the cleanup goals for the sediment cap suggests that ebullition is not having a dramatic effect on contaminant release. The two SPME samples placed over the top of the granular organophilic clay, where ebullition is prevalent, do not show dissolved PAH concentrations significantly different than elsewhere on the Site and well below Site comparison criteria.

DQO #4: Determine whether gas is passing through the organophilic clay mats or accumulating beneath the mats.

Conclusions for DQO #4: There is no evidence to suggest that gas is not passing through the Organoclay™ RCM. The ebullition survey did not demonstrate that ebullition was significantly greater in water surrounding the mats. The rates of ebullition were relatively low over the top of and surrounding the Organoclay™ mats. Ebullition has been consistently observed from the northeast corner of Organoclay™ Mat #2 suggesting that the RCM in that area may be blocking the movement of gas through the mat. However, when pulling back the corner of the RCM to collect a mat sample, the sand placed over the rock armoring beneath the mat was noticeably missing; the sand had apparently been washed into the rock armoring, providing a higher permeability material directly beneath that area of the mat. Dependent on the extent of this sand washing beneath Mat #2, a preferential pathway for gas to migrate toward the edges of the mat in lieu of migration through the mat is created. Visual inspection of the back side of the pulled back corner of the mat did not reveal any staining or signs that suggest contamination is penetrating the mat. No visual sign of sheens associated with the ebullition surrounding the mats was observed.

Certified testing by CETCO of the RCM after two years in the field (exhumed August 2008) showed that the PM199 Organoclay™ RCM retains sufficient oil capacity and permeability to perform as designed. The adsorption capacity resulted in a capacity of 0.5387 lb creosote/lb Organoclay™ showing no decrease in sorptive capacity from the minimum of 0.5 lb creosote/lb Organoclay™ for fresh Organoclay™. The permeability was measured at 6.3×10^{-2} cm/sec which is greater than the minimum permeability of fresh RCM

of 1 x 10^{-3} cm/sec. Dr. Reible tested the HEM% and found that the PM-199 Organoclay™ exhibited an HEM of 1.25 +/- 0.77% (95% confidence interval) for fresh material and 1.25 +/- 0.28% (standard deviation) for material removed from the RCM.

DQO #5: Determine nature and origin of sheen and whether sheen poses a threat to the environment.

Conclusions for DQO #5: The resulting data from the samples collected for DQO#1 support a strong argument that the periodically observed shoreline sheen is not the result of PAH migration through the sediment cap at the site. Porewater results from samples collected within the sediment cap sand in multiple locations in the TFA and the WC riverbank, downgradient from the most likely source of a potential residual creosote source, do not support the suggestion that the origin and nature of the sheen is associated with contamination from the Site.

PAH concentrations in the four surface water samples collected in July 2008 are significantly lower than concentrations that would be indicative of, or produce, sheen. Concentrations of the surface water with sheen were similar to the adjacent surface water without sheen and, in one case, the concentration in the surface water without sheen was higher than the concentration of the surface water with sheen. There were no detections of TPH in the sheen samples or adjacent surface water samples.

Sheen-inducing contaminant migration was not observed in samples collected or collection locations in the 2008 and 2009 investigations. In addition, NAPL was not observed in core samples in locations where SPME samplers were placed, which was generally where sheens had been observed or suspected.

The results from the biogenic evaluation by MSU of the sheen samples from the site do not support a role for bacteria/bacterial biofilms in the creation of the sheens. There was no substantial difference in colony morphologies between the water and sheen associated bacteria, no evidence for biofilm formation or iron oxidizing bacteria in the direct microscopy images, and no major differences in the microbial ecology between the water and sheen samples were seen.

The analytical chemistry of the sheen samples show that the sheen is not related to creosote migration through the cap but more probably a composite film composed of metals, including iron with low concentrations of PAHs and relatively low bacteria counts. Observation of the sheens at the Site suggested that this may be the case because the material fractured and did not re-coalesce on the water surface. Sheens on the bank sands looked metallic as they dried.

The material also had a sharp, metallic odor. Other evidence is elevated level of iron in the material collected on the mesh. Collection of iron on the mesh suggests that the metals were in a solid form since ions should not be retained by the Teflon®. The oxidation state of the metals in the sheens is unknown (iron in the ambient surface water is Fe^{+2}), and it is also unknown if the iron is chelated with organics.

The signature of the chromatograms of sheen collected at the Site mimic the Teflon® blank chromatogram signature. The chromatograms of simulated creosote sheen from the Site show numerous peaks forming a distinctive mound from 6 to 20 minutes elution. The analytical chemistry results show that the laboratory simulated sheen samples contains a high mass of PAHs in all but one of the analyzed PAHs represented in the sheen, while the actual sheen from the Site contains few PAHs at levels and ratios compared to the laboratory simulated sheen samples, and are therefore not indicative of creosote product. PAHs in the field-sampled sheen contain similar PAHs at similar levels to what is detected in ambient surface water samples. The data clearly demonstrate that the sheen does not contain PAH concentrations indicative of a sheen resulting from a surficial film of creosote migrating through the sediment cap as the surface water moves upward through the residual creosote contamination or entrained on gas bubbles.

The elevated iron levels relative to other metals in the sheen as compared to the surface water coupled with the field observations suggestive of metallic characteristics strongly suggest that the sheen is related to iron and not contaminant migration through the sediment cap.

Overall Conclusion Regarding Sediment Cap Protectiveness: Extensive investigations and studies have been conducted related to the protectiveness of the sediment cap since its construction completion in 2005. As described above in the conclusions to individual DQOs, the sediment cap is functioning as designed and is protective of surface water quality.

4.3.4 Recommendations

All data evaluated to date suggests a lack of direct microbial contribution to the production of the sheen. Chemical results are highly indicative of the presence of metals, particularly iron, in the observed sheen film at the Site. Extensive study of the Site demonstrates that the sheen is not related to Site contaminants migrating through the sediment cap. Further characterization of the nature of the sheens would require highly sophisticated analytical methods and are not likely to provide conclusive evidence of their composition. Hence, additional characterization of the sheen film is not recommended.

Specific additional monitoring of the sediment cap remedy is recommended to include:

- Additional, periodic monitoring of the dissolved contamination in and above the cap layers to ensure that contaminant migration does not lead to unacceptable levels of contaminant in the near surface environment. Profiling SPME can be used to replace or supplement conventional porewater extraction methods and can provide an indication of not only current concentrations but gradients in concentration that may be early warning indicators of contaminant migration; and
- Additional, periodic evaluation of ET-1 organophilic clay to ensure that the degradable or extractible organic matter fraction does not compromise the ability of the organophilic clay to retain NAPL and dissolved contaminants. HEM and organic matter content evaluations should be the primary tools to assess the change of ET-1 organophilic clay over time.

5.0 SUMMARY AND PLANNED ACTIVITIES FOR 2010

Table 4 summarizes the planned O&M activities for 2010. Tasks correspond to O&M activities outlined in Tables 1, 2, and 3. Since 2006, inspection of habitat enhancement features has been added to the inspection task for the sediment cap.

Sediment cap multi-beam bathymetric, side-scan sonar survey, and, as necessary, a diver inspection of sediment cap anomolies based on the bathymetry and side-scan sonar images, are scheduled for 2010. However, it is likely existing bathymetry and side scan sonar completed, as part of the Portland Harbor Investigation in 2009, will be used to assess the Site sediment cap conditions as part of the 5-Year Review process.

Groundwater from MW-59s will be sampled in August 2010 to provide further information regarding potential mobilization of contaminants from the infiltration pond.

The ebullition and sheen investigation demonstrated that the sheen is not related to the residual creosote remaining beneath the sediment cap or in the upland, and the sheen characterization demonstrated that the sheen is related to increased concentrations in iron. The characterization also demonstrated that the sheen is not the result of creosote or bacteria caused film. No further sheen investigations are anticipated or recommended to determine the nature of the sheen film. However, shoreline inspections will be conducted quarterly through

September 2010 with monthly inspections continuing between June and October 2010.

6.0 REFERENCES

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Tables

Table 1: Description and Frequency of Soil Cap O&M Activities through September 30, 2011	
O&M Activity	**Frequency**
Inspections: • Cap surface • Stormwater conveyance system • Security fencing • Warning signs	 • Monthly • Monthly • Monthly • Monthly
Routine Maintenance: • Irrigation of Native Vegetation • Manual removal of invasive plants • Targeted application of herbicides	 • Summer 2010 (if needed irrigation will continue beyond 2010) • Annually, if necessary • Biannually (April and September), if necessary
Non-Routine Maintenance – such as: • Repairs of fence • Replacement of warning signs • Repairs of gravel roads • Filling of potential animal burrow into the earthen cap • Remove sediment from manholes • Replanting unsuccessful trees and shrubs • Subsidence Observations	 • As needed • As needed • As needed • As needed • As needed • As needed • As needed

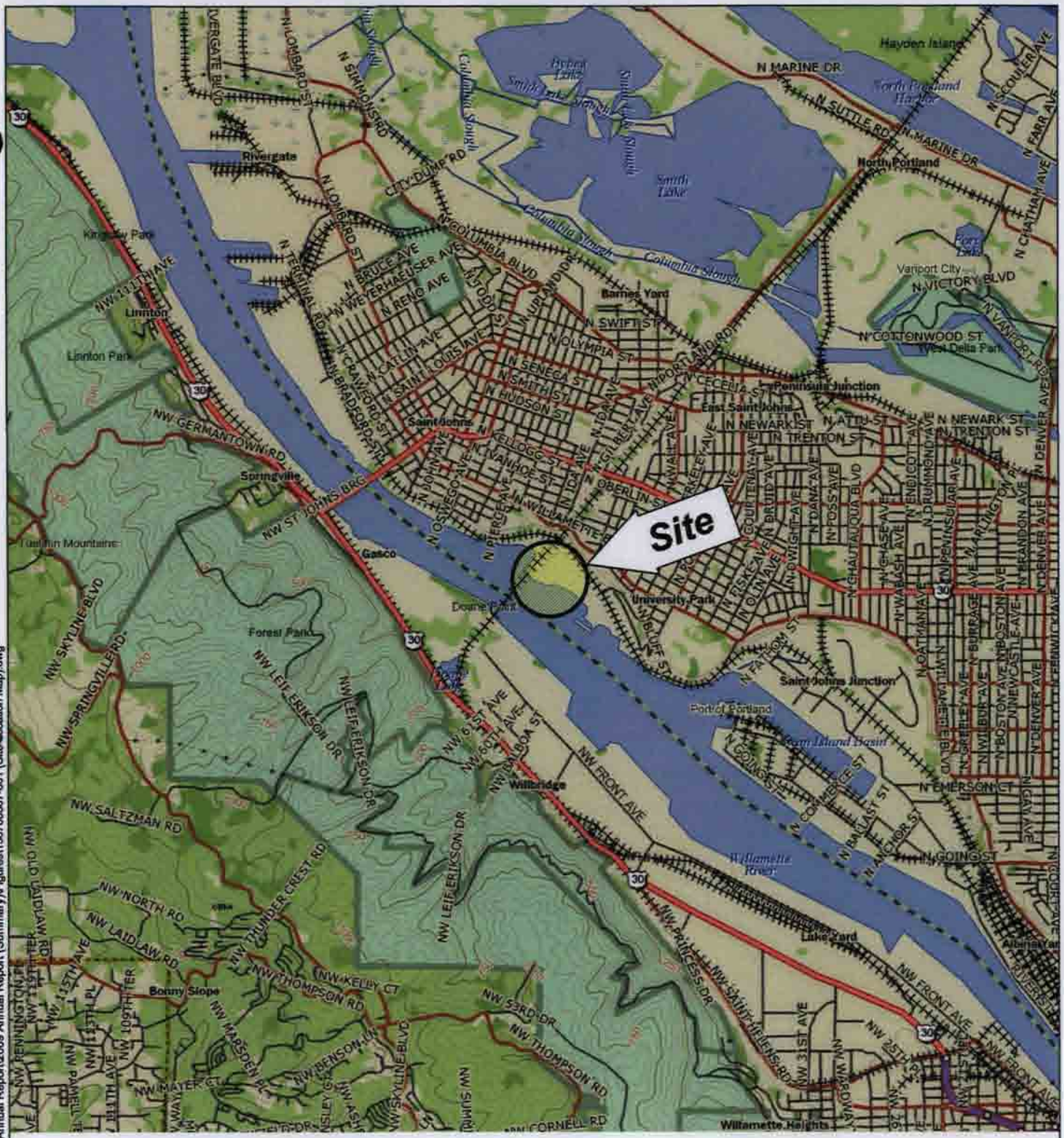
Table 2: Description and Frequency of Sediment Cap O&M Activities through September 30, 2011	
O&M Activity	**Frequency**
Inspections:	
• Warning buoys	• Monthly
• Near shore areas	• Weekly (August - October) otherwise monthly
• Habitat enhancement features	• Yearly
• Multibeam bathymetric surveys	• Spring 2010 or as needed
• Side-scan sonar surveys	• Spring 2010 or as needed
• Diver inspections of deep water	• Spring 2010 or as needed
Sampling:	
• Surface water, inter-armoring water, and sub-armoring water	• Semiannually (March and September each year through 2010)
• Organoclay cores	• October 2010*
Non-Routine Maintenance – such as:	
• Replacement of buoys	• As needed
• Additional armoring placement	• As needed
• Additional organoclay capping	• As needed

* Organoclay cores were collected in 2006, 2008, and 2009. It is not expected that they will be collected again in 2010.

Table 3: Description and Frequency of Groundwater O&M Activities through September 30, 2011	
O&M Activity	**Frequency**
NAPL Recovery: • Gauging and extraction of exterior wells • Gauging of interior wells	• Weekly, until otherwise determined • Quarterly
Groundwater Monitoring: • Downloading continuous water level data loggers • Manual water level measurements	• Quarterly • Quarterly
Groundwater Sampling: • Site-wide	• Spring 2010
Routine Maintenance of Equipment: • Interface probes, pumps, vehicle, data loggers/transducers, etc.	• As needed
Utility Services: • Water, electric, communication, security, solid waste, sanitary	• Continuous

Table 4: Schedule of Activities for January 2010 through December 2010	
Task	**Schedule**
Soil and Sediment Cap inspections. (contractor)	Monthly January 2010 through July 2010, weekly August 2010 through October 2010, monthly November 2010 and December 2010.
Sediment Cap multi-beam bathymetric and side-scan sonar surveys; diver inspections of deep water.	Spring 2010, if necessary. Will likely use Portland Harbor investigation bathymetry survey data.
Irrigation of native vegetation.	Summer 2010
Manual removal of invasive plants.	If necessary to suppress invasive plant growth.
Targeted application of herbicides.	April and September 2010, if necessary to suppress invasive plant growth.
Maintenance of equipment.	Ongoing as needed.
Non-routine maintenance.	As needed
Surface/Inter-Armoring/Sub-Armoring Water Sampling.	March and September 2010
MW-59s Sampling.	August 2010
NAPL recovery exterior wells.	Gauged weekly, recovery as criterion is met.
NAPL recovery interior wells.	Gauged quarterly, no recovery.
Groundwater elevation monitoring.	March, June, September, and December 2010
Utility Services.	Continuous

Figures



0 4,000 8,000

Scale in Feet

N

McCormick and Baxter Superfund Site
Portland, Oregon

Site Location Map

2/10

HARTCROWSER

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Figure
1

Source: DeLorme Topo USA®.

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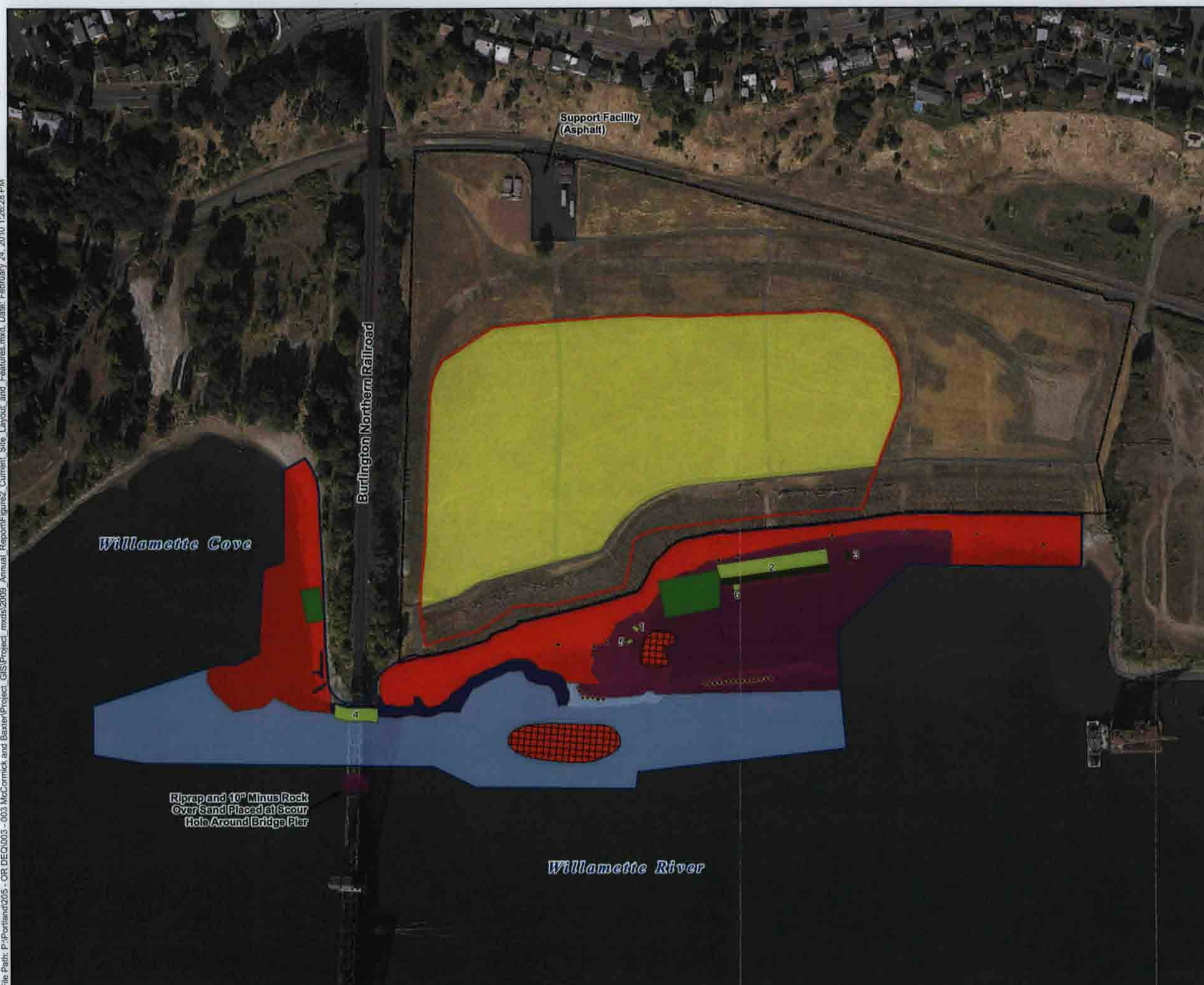

LEGEND

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Riprap Armor
- Articulated Concrete Block
- 6-inch Minus Rock Armor
- 10-inch Minus Rock Armor
- Impermeable Cap
- Earthen Soil Cap Boundary

NOTE: Aerial photo taken on September 22, 2006

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Current Site Layout and Features

2/10

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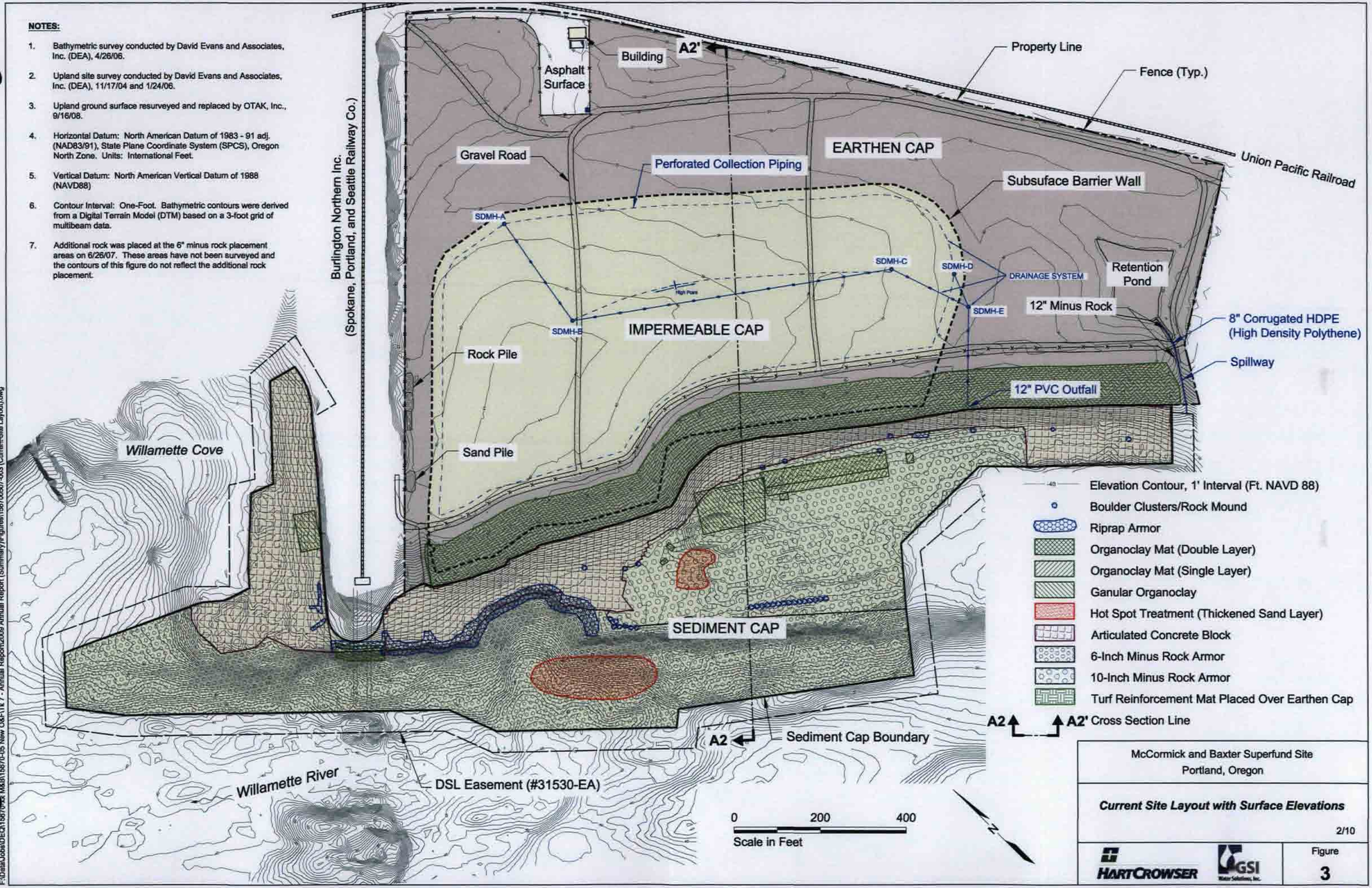
Figure
2

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\Figure2_Current_Site_Layout_and_Features.mxd, Date: February 24, 2010 1:26:28 PM

NOTES:

1. Bathymetric survey conducted by David Evans and Associates, Inc. (DEA), 4/26/06.
2. Upland site survey conducted by David Evans and Associates, Inc. (DEA), 11/17/04 and 1/24/06.
3. Upland ground surface resurveyed and replaced by OTAK, Inc., 9/16/08.
4. Horizontal Datum: North American Datum of 1983 - 91 adj. (NAD83/91), State Plane Coordinate System (SPCS), Oregon North Zone. Units: International Feet.
5. Vertical Datum: North American Vertical Datum of 1988 (NAVD88)
6. Contour Interval: One-Foot. Bathymetric contours were derived from a Digital Terrain Model (DTM) based on a 3-foot grid of multibeam data.
7. Additional rock was placed at the 6" minus rock placement areas on 6/26/07. These areas have not been surveyed and the contours of this figure do not reflect the additional rock placement.



McCormick and Baxter Superfund Site
Portland, Oregon

Current Site Layout with Surface Elevations

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure
3

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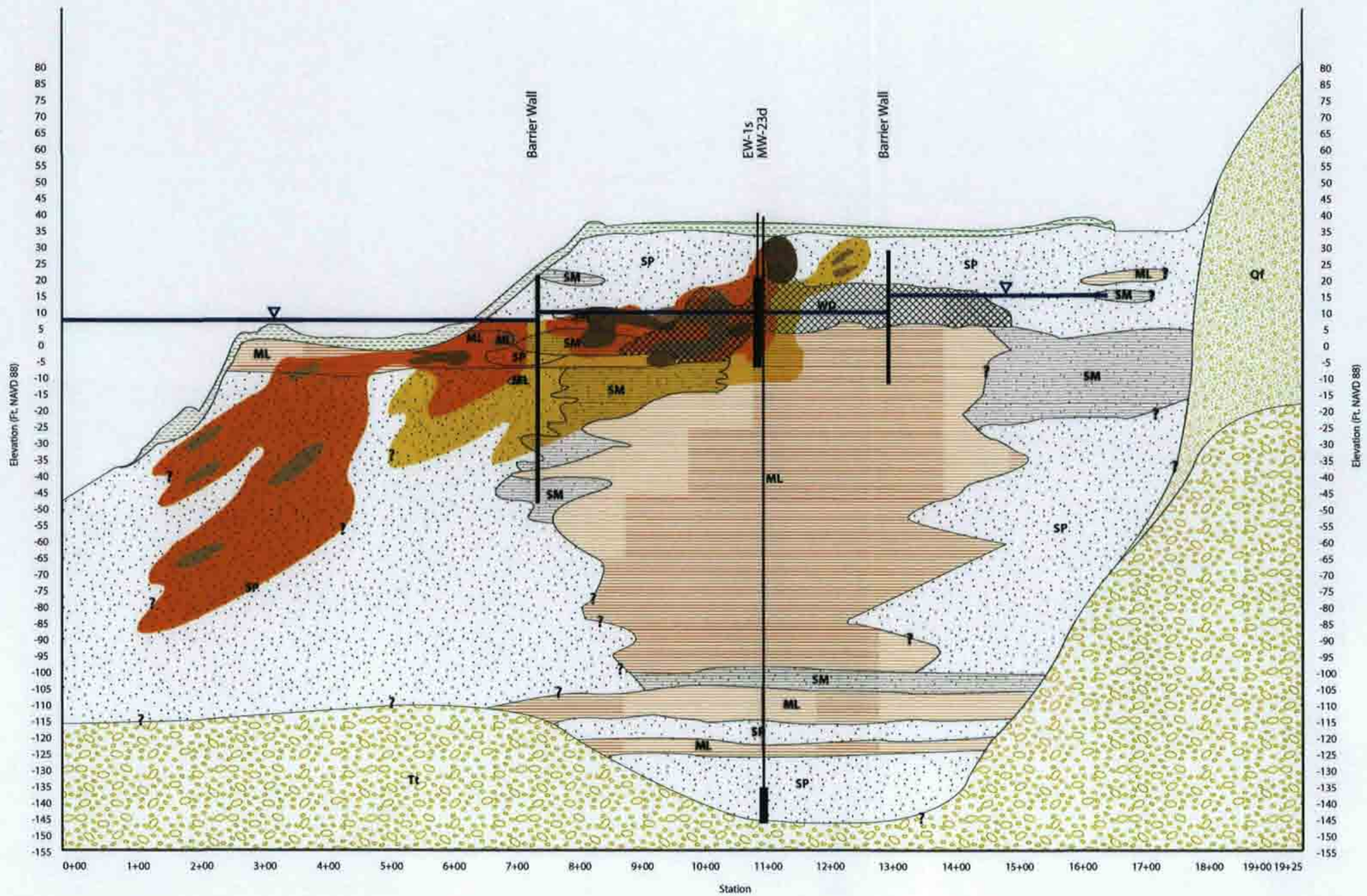


LEGEND

- SP- Sand, Fine to Medium, Poorly Graded
- SM- Silt Sand, or Thin Interbeds of Silt and Sand
- ML- Clayey Silt or Silty Clay
- WD- Wood Debris, Chips or Sawdust Occasionally
- Qf- Catastrophic Flood Deposits Consisteing of Gravels and Sands
- Tt-Troutdale Formation
- Sediment/Soil Cap
- Approximate Average Water Level 2008
- Creosote Odor
- Strong Creosote Odor
- Heavy Sheen
- Saturated

Horizontal Scale in Feet
0 200 400
0 40 80
Vertical Scale in Feet
Vertical Exaggeration = 5x

McCormick and Baxter Superfund Site
Portland, Oregon

Historic NAPL Distribution Cross Section A2-A2'

02/10

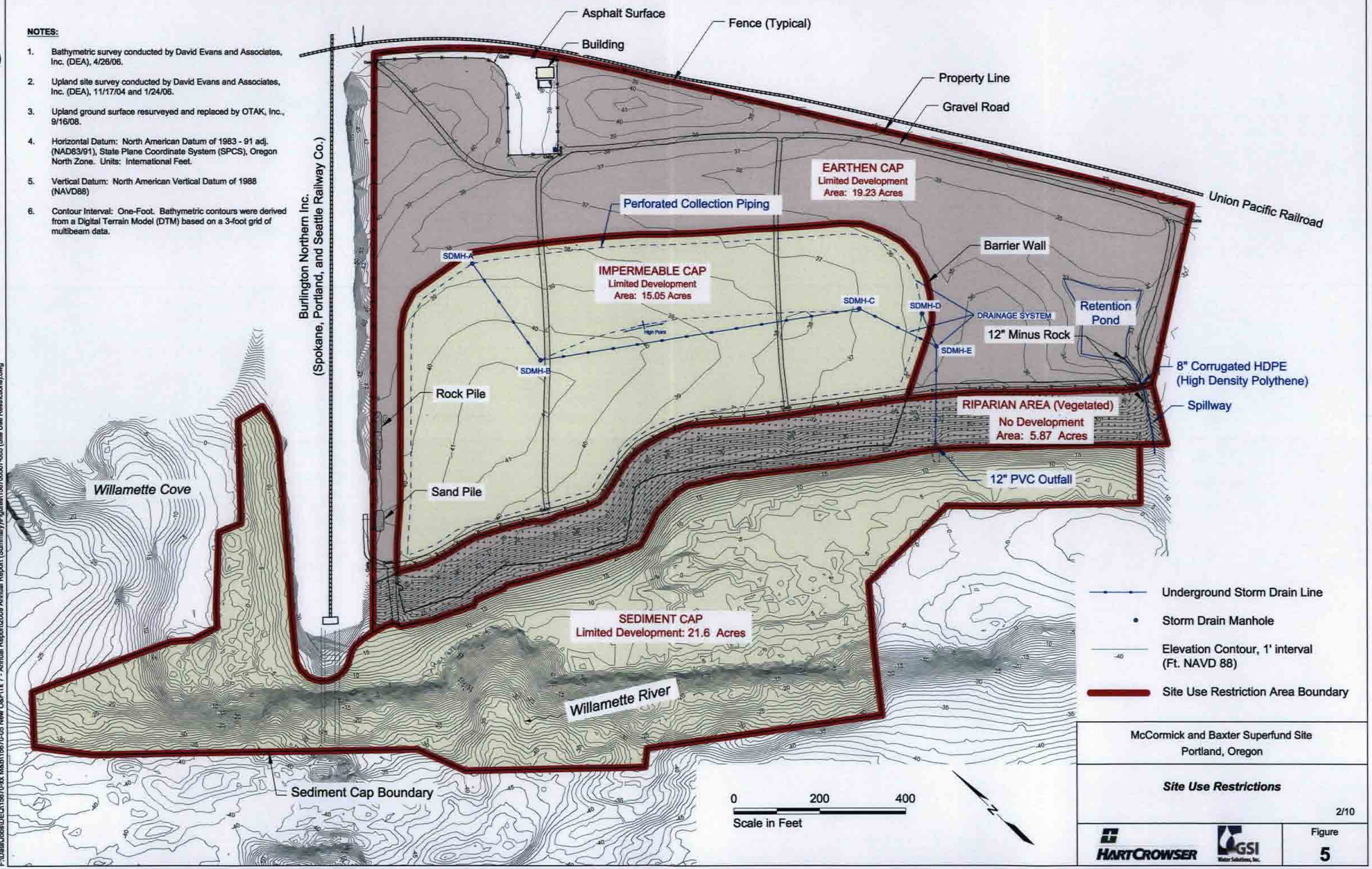
HARTCROWSER GSI Water Solutions, Inc.

Figure
4

W:\Projects\205 - OR DEQ\003 - 003 McCormick and Baxter\Figures

NOTES:

1. Bathymetric survey conducted by David Evans and Associates, Inc. (DEA), 4/26/06.
2. Upland site survey conducted by David Evans and Associates, Inc. (DEA), 11/17/04 and 1/24/06.
3. Upland ground surface resurveyed and replaced by OTAK, Inc., 9/16/08.
4. Horizontal Datum: North American Datum of 1983 - 91 adj. (NAD83/91), State Plane Coordinate System (SPCS), Oregon North Zone. Units: International Feet.
5. Vertical Datum: North American Vertical Datum of 1988 (NAVD88)
6. Contour Interval: One-Foot. Bathymetric contours were derived from a Digital Terrain Model (DTM) based on a 3-foot grid of multibeam data.



McCormick and Baxter Superfund Site
Portland, Oregon

Site Use Restrictions

2/10

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Figure
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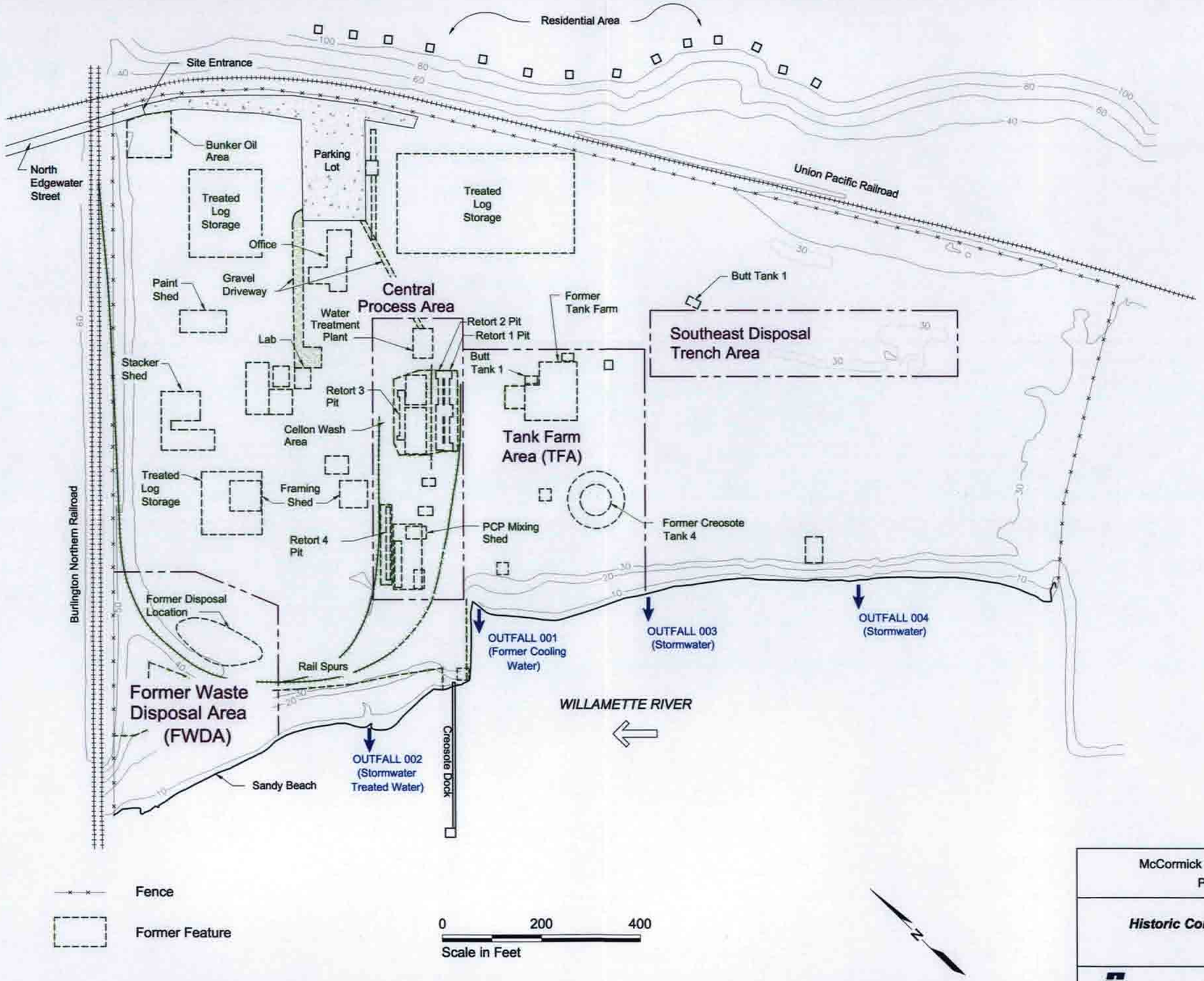

McCormick and Baxter Superfund Site
Portland, Oregon

Historic Contaminant Source Areas

2/10

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Figure
6

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Appendix A

APPENDIX A
GROUNDWATER AND NAPL MONITORING

OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009

Hart Crowser/GSI
15670-05/Task 7 May 25, 2010

APPENDIX A
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ACRONYMS

Clearwater	Clearwater Environmental Services, Inc.
DEQ	Oregon Department of Environmental Quality
DNAPL	dense nonaqueous phase liquid
E&E	Ecology and Environment, Inc.
ft/ft	feet per foot
FWDA	Former Waste Disposal Area
IDW	investigation-derived waste
LNAPL	light nonaqueous phase liquid
NAPL	nonaqueous phase liquid
NAVD	North American Vertical Datum
O&M	Operation and Maintenance
RCRA	Resource Conservation and Recovery Act
RM	Willamette River Mile
Site	McCormick and Baxter Superfund Site
TFA	Tank Farm Area
USGS	U.S. Geological Survey

APPENDIX A
GROUNDWATER AND NAPL MONITORING
OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE

1.0 INTRODUCTION

Appendix A to the *January 2009 through December 2009 Operation and Maintenance (O&M) Report* (O&M Report) presents the nonaqueous phase liquid (NAPL) measurement and extraction results and groundwater elevation and gradient information collected at the McCormick and Baxter Superfund Site (Site) for the period from January 1, 2009, through December 31, 2009. The location of the Site, Site layout, and surface elevations are presented on Figures 1 through 3 in the O&M Report.

2.0 NAPL MEASUREMENTS AND EXTRACTIONS

NAPL monitoring at the Site is used to evaluate the functional performance of the barrier wall and soil cap, and to document NAPL removal relative to the groundwater remedial action objective: to contain the NAPL plumes, prevent ongoing discharges of NAPL to the Willamette River, and minimize further contamination of the intermediate and deep aquifers.

2.1 Field Activities

Clearwater Environmental Services (Clearwater), under subcontract to Hart Crowser, conducts NAPL gauging weekly at eight monitoring wells in the Former Waste Disposal Area (FWDA) including: EW-2s, EW-9s, EW-10s, EW-19s, MW-20i, MW-34i, MW-Ds, and MW-Gs. These eight wells are located outside the barrier wall, and have historically contained NAPL. Due to dense nonaqueous phase liquid (DNAPL) volume and high temperature measurements in well EW-1s within the barrier wall, the DEQ instructed Clearwater to include this interior well in their weekly NAPL gauging and recovery routine beginning July 6, 2009. DNAPL extraction from this well was initiated to address potential vertical mobility due to decreased viscosity under high subterraneous temperatures in this area.

NAPL gauging is also conducted quarterly in conjunction with water level measurements on the 74 onsite wells and 5 offsite wells on the adjacent Burlington Northern and Metro (Willamette Cove area) properties (Figure A-1).

Quarterly NAPL gauging events were conducted on March 13, 2009; June 12, 2009; September 11, 2009; and December 10, 2009.

During 2009, NAPL was detected in five (EW-1s, EW-10s, MW-20i, MW-Ds, and MW-Gs) of the nine wells gauged weekly, and seven (EW-8s, EW-15s, EW-18s, EW-23s, MW-10r, MW-22i, and MW-56s) of the remaining Site wells gauged quarterly. Figures A-2 through A-5 show the locations of wells that contained light nonaqueous phase liquid (LNAPL) and/or DNAPL and NAPL thickness for the first through fourth quarters, respectively. Tables A-1 through A-4 provide quarterly NAPL gauging measurements. Figures A-6 through A-16 show the NAPL thickness in individual wells that routinely contain NAPL over time.

During the weekly NAPL gauging event, if individual wells meet the NAPL extraction criteria, then NAPL extraction is conducted. NAPL extraction criteria are:

- Minimum of 0.4 foot thickness of LNAPL;
- Minimum of 1.5 feet thickness of DNAPL; and
- The well is located outside the barrier wall (with the exception of EW-1s).

LNAPL is extracted using a bailer, and DNAPL is extracted using a submersible pump. With the exception of EW-1s, extraction is not conducted at wells located within the barrier wall that contain NAPL.

Tables A-5 through A-8 list, for the first through fourth quarters, the weekly NAPL thickness measurements and the estimated extraction volumes including water and NAPL (based on depth in a 5-gallon bucket) for wells meeting the extraction criteria. In some instances, NAPL extraction was not successful because the NAPL was present in recovered liquids as speck sized globules rather than distinct layers.

2.2 *LNAPL Observations*

Outside the Barrier Wall. During the weekly NAPL gauging outside the barrier wall, the thickness of LNAPL was measured in well EW-10s at 0.03 foot to 1.55 feet; recovery was periodically attempted when the measured LNAPL thickness was greater than 0.4 feet. However, when recovery was attempted, water within the bailer collected from the top of the water column in the well had speck-sized globules of LNAPL dispersed throughout with no discrete layer of LNAPL product. The recorded LNAPL measurements in EW-10s likely reflect a distinct zone of groundwater with floating LNAPL globules rather than a distinct layer of LNAPL product. The non-cohesive nature of the LNAPL at the Site

suggests a specific gravity only slightly less than that of groundwater. Figure A-6 shows a plot of NAPL thickness since 1999 in EW-10s. The measured LNAPL thickness is fairly consistent over time at less than 0.5 foot with periodic variances. In general, LNAPL does not appear to be increasing in thickness or accumulating in the well in significant volumes.

Although trace LNAPL was measured in wells EW-9s and MW-Ds during the second quarter of 2008, no LNAPL was detected in these wells during any 2009 monitoring events. The 2009 data are consistent with historical data, which demonstrate that there is virtually no LNAPL accumulation in these wells over time, as shown on Figures A-7 and A-8.

Inside the Barrier Wall. During quarterly monitoring in 2009, LNAPL was routinely detected in the following wells within the barrier wall: EW-15s (0.83 foot to 3.16 feet), EW-18s (0.15 foot to 0.45 foot), EW-23s (2.29 foot to 4.46 feet), and MW-56s (0.33 foot to 1.44 feet). Figures A-9 through A-12 show the thickness of LNAPL in these wells versus time. In all wells where LNAPL was consistently measured, its thickness was generally greater when the groundwater elevation was low. This is the result of gravity drainage of LNAPL through the vadose zone when the water table drops. This pattern is consistent from mid-2006 through the end of 2009 because LNAPL was not recovered inside of the barrier wall in this time-frame (i.e., LNAPL thickness was not disturbed by recovery). Although the LNAPL thickness varies cyclically with changes in the groundwater elevation, the overall LNAPL thickness in wells has remained relatively constant. LNAPL shows no evidence of migration through the subsurface barrier wall.

2.3 DNAPL Observations

Outside the Barrier Wall. DNAPL was regularly detected during weekly gauging of three FWDA wells (MW-20i, MW-Ds, and MW-Gs) outside the barrier wall. In the first quarter of 2009, DNAPL thickness was measured from a minimum of 0.06 foot in well MW-Gs to 7.88 feet in well MW-Gs. In 2009, extraction was conducted 98 percent of the time for well MW-20i, 58 percent for well MW-Ds, and 36 percent for well MW-Gs. Figures A-8, A-13, and A-14 show DNAPL thickness versus time for MW-Ds, MW-20i, and MW-Gs, respectively. The DNAPL thickness present in each of these three wells is fairly consistent. Well MW-20i recovers sufficiently on a weekly basis, while wells MW-Ds and MW-Gs occasionally take two or more weeks for the DNAPL to recover to the extraction criteria thickness. The volume of recovered DNAPL from MW-20i increased each quarter of 2009. In contrast, the volumes recovered from wells MW-Ds and MW-Gs were greatest during the second quarter of 2009.

Both DNAPL and LNAPL have been measured in wells EW-10s and EW-9s (Figures A-6 and A-7, respectively). Well EW-10s had a short lived accumulation of DNAPL (up to 2 feet) in 2005, and no detection since. DNAPL was measured in well EW-9s until May 2009.

Inside the Barrier Wall. DNAPL was detected each quarter in 2009 within the barrier wall near the former Tank Farm Area (TFA) in wells EW-1s, MW-22i, and EW-8s.

DNAPL was first observed in EW-1s during the first quarterly monitoring event on March 13, 2009, and has been detected in this well ever since. The DNAPL thickness was recorded at 3.12 feet, 1.46 feet, 3.39 feet, and 2.95 feet during the first through fourth quarter 2009 sampling events, respectively (Figures A-2 to A-5). As previously provided, weekly NAPL gauging and recovery from EW-1s began on July 6, 2009. Since then, DNAPL thicknesses in the well have been measured from 2.66 to 6.81 feet during weekly monitoring. Approximately 70 gallons of liquid (water and DNAPL) were extracted from EW-1s since the weekly monitoring activities began.

Figure A-15 shows the DNAPL thickness versus time for MW-22i. DNAPL was measured in well MW-22i at 5.83 feet, 6.63 feet, 6.00 feet, and 6.82 feet during the first through fourth quarters of 2009, respectively. With one exception, DNAPL has been detected each quarter in MW-22i since the beginning of 2007. DNAPL was also consistently reported in MW-22i from 1997 to 2000. During monitoring in July 2007, Clearwater used a bailer to extract liquid from the well because of a petroleum hydrocarbon odor within the well (instead of creosote). The extracted liquid contained speck sized globules of DNAPL rather than a distinct DNAPL layer. Because the thickness of DNAPL in MW-22i was consistently measured at thicknesses greater than 5 feet, recovery was attempted again in 2008. Approximately five gallons of liquid was bailed from the bottom of the well and allowed to settle. After settling, the liquid was observed to be primarily water with limited speck-sized DNAPL globules, rather than a distinct layer of DNAPL. Therefore, we conclude that the observations since 2007 do not accurately reflect the volume of DNAPL in the well. Because MW-22i is within the barrier wall, no further extractions have been conducted.

Figure A-16 presents the DNAPL thickness versus time for EW-8s. In 2009, the thickness of DNAPL in EW-8s fluctuated between zero to approximately 10 feet; the prevalent thickness of DNAPL measured in this well is approximately 2 feet. DNAPL measured at 13.51 feet thick on June 18, 2008, and at 9.97 feet thick on June 12, 2009, may be erroneous measurements since the measurements before and after were consistent with the measurement of approximately 2 feet.

The suspect DNAPL measurements in EW-8s, as in MW-22i, may be attributed to the non-uniform characteristics of the DNAPL and its tendency to be disseminated into speck-sized globules rather than a distinct layer.

2.4 NAPL Extraction Summary

LNAPL was not recovered from any wells at the Site in 2009. Although the thickness of LNAPL varies with groundwater elevation, the accumulated volume does not appear to be increasing, either inside or outside the barrier wall. In instances where the LNAPL extraction criteria was exceeded in exterior well EW-10s, extraction was periodically attempted but was unsuccessful given the unconsolidated nature of the LNAPL, which occurs as speck-sized globules floating near the top of the water column, rather than as a distinct NAPL layer.

Based on periodic investigation-derived waste (IDW) drum measurements of extracted liquid (water and NAPL), approximately 113 gallons of NAPL were extracted from the Site between November 2008 and January 2010. This calculation assumes that the extracted liquid contains 38% water and 62% NAPL. These percentages were based on percent present as water and NAPL after freezing NAPL/water mixtures removed from wells. Freezing was performed twice in 2007 and is reported in two technical memoranda presented in Appendix A of the *Operation and Maintenance Report January 2007 through December 2007* (E&E, 2008). The extraction volumes determined in this manner do not always correspond to the extraction volumes estimated during the weekly NAPL gauging and recovery events. During the weekly events, the quantity of extracted liquid (water + NAPL) from each well is estimated by noting the amount of liquid in a 5-gallon bucket. These measurements are often coarse approximations and tend to overestimate the amount of extracted liquid in comparison with the direct IDW drum measurements. Extraction volumes based on IDW drum measurements are thought to be more representative of actual extraction volumes than the weekly extraction estimates and are thus used to quantify the extraction volumes discussed in this section.

Historical cumulative NAPL extraction (based on drum gauging) is presented in Table A-9, and shown graphically on Figure A-17. Between February 1993 and January 10, 2010, approximately 6,373 gallons of NAPL have been extracted from Site wells. Based on the weekly NAPL recovery measurements, approximately 40% of the third and fourth quarter 2009 extraction volume can be attributed to interior well EW-1s (approximately 21 gallons total). Approximately 92 gallons of NAPL were recovered from wells outside the barrier wall in 2009, which is roughly 7.7 gallons per month. Previously, an estimated 6.3 gallons per month were recovered in 2008 (57 gallons over a 9

month timeframe). While it appears that more NAPL was recovered in 2009 compared to 2008, the actual recovery rate may be equivalent due to numerous uncertainties involved in quantifying the extraction volumes based on the current gauging methodology. The bulk of the DNAPL outside the barrier wall was recovered from MW-20i. Relatively small amounts of DNAPL were extracted from MW-Ds and MW-Gs.

3.0 QUARTERLY GROUNDWATER MONITORING

Quarterly groundwater monitoring generally consists of (1) manual water level gauging from 79 monitoring wells located at the Site and on the adjacent Burlington Northern and Metro (Willamette Cove area) properties, and (2) collecting continuous automated transducer data from a subset of the wells. Groundwater monitoring data can be utilized to gain insight on groundwater flow conditions inside and outside of the barrier wall. This information is evaluated to determine whether the barrier wall and impermeable RCRA type soil cap are functioning as designed.

3.1 Water Level Measurements

Quarterly manual measurements of static groundwater levels were conducted on March 13, 2009; June 12, 2009; September 11, 2009; and December 10, 2009. These measurements were typically collected during or immediately following low tide corresponding to the low Willamette River elevation. Shallow groundwater elevation contour maps were developed for each of the four quarters (Figures A-18 through A-21, respectively). The groundwater elevation data for each quarterly monitoring event are included in Tables A-1 through A-4, respectively.

In addition to the 79 monitoring wells at the Site, groundwater elevations were collected from 10 monitoring wells on the adjacent Triangle Park property during the December 10, 2009, event. The 10 wells were monitored at the request of EPA in order to understand low groundwater elevation measurements in well MW-2s, located at the southeast boundary of the Site. Unfortunately, data from only six of the Triangle Park wells could be utilized in conjunction with the Site data to evaluate groundwater elevations between the two properties. Wells located on the northeast portion of the Triangle Park property, near the M&B Site's MW-2s, did not have reliable survey information, so the groundwater elevation in this area could not be determined. Therefore, the reason for the lower shallow groundwater elevation in MW-2s has not been determined. There is no information available regarding a pumping center in the area.

Groundwater elevation data were also collected on a 30-minute basis using pressure transducers at select monitoring wells surrounding the barrier wall. Fourteen wells with transducers are located along the riverfront portion of the barrier wall, in the shallow, intermediate, and deep wells in well clusters MW-36, MW-37, MW-44, and MW-45, and in the shallow wells MW-40s and MW-41s. Transducers also monitored upland wells MW-52s and MW-53s. On October 1, 2008, transducers were installed in wells EW-1s and EW-15s to help understand the behavior of shallow groundwater within the interior of the barrier wall containment area as other transducers within the barrier wall are located adjacent to the barrier wall where the effects of precipitation are present.

Hydrographs were prepared using the transducer data for monitoring wells inside and outside the barrier wall as shown on Figures A-22 through A-31. The hydrographs compare water-level elevations inside the barrier wall versus water-level elevations outside the barrier wall, river stage elevation, and precipitation data.

Multiple hydrographs were prepared for the paired well clusters MW-36/MW-37 and MW-44/MW-45. Figure A-22 shows a comprehensive hydrograph of groundwater for well clusters MW-36 and MW-37 and river elevations from October 2003, when transducers initially were installed after construction of the barrier wall, to December 10, 2009. Additional detail is provided in Figures A-23 and A-24, which show the 2009 data and a subset of data for a 15-day period in May 2009. Similarly, historic and annual hydrographs for well clusters MW-44 and MW-45 are presented on Figures A-25 and A-26, respectively. To show more detail and compare trends between the high and low flow conditions, Figures A-27 and A-28 were created to present select 9- to 15-day periods during the months of April (high flow) and February (low flow) 2009.

Historical hydrographs have been prepared for the shallow well pairs MW-40/MW-41, MW-52s/MW-53s, and EW-1s/EW-15s, and are presented on Figures A-29, A-30, and A-31, respectively.

River stage data were recorded on a 30-minute basis from U.S. Geological Survey (USGS) station number 14211720, located on the upstream side of the Morrison Bridge (River Mile [RM] 12.8). River stage elevation data reported by the USGS are relative to the Portland River Datum at this location. The river stage data are corrected to North American Vertical Datum, 1988, (NAVD88) at the Site (approximately RM 7) by adding 5 feet to the USGS reading.

3.2 Shallow Groundwater Flow Direction and Horizontal Gradients

As shown in the shallow groundwater contour maps (Figures A-18 through A-21), the shallow horizontal groundwater gradient within the barrier wall is independent of the gradient outside the barrier wall demonstrating that the barrier wall has effectively cut off the connection between the shallow groundwater zone inside the barrier wall and the shallow groundwater zone outside the barrier wall. Shallow groundwater elevations at the bluff side of the barrier wall are lower inside the barrier wall while shallow groundwater elevations toward the river are lower outside the barrier wall than inside the barrier wall.

Since the installation of the barrier wall in 2003, the upland (easterly) groundwater elevations are higher outside of the barrier wall than inside it due to the impediment, which deflects groundwater flow horizontally around the barrier wall from upland areas. Prior to the barrier wall construction, the groundwater gradient was directly from the bluff to the Willamette River. After the barrier wall construction and prior to installation of the impermeable soil cap, the elevation differences between the exterior upland shallow well MW-53s, and its interior counterpart MW-52s fluctuated from approximately 0.25 foot to 2 feet (Figure A-30). After construction of the impermeable Resource Conservation and Recovery Act (RCRA) style soil cap in late 2005, the elevation difference inside versus outside the barrier wall increased to a range of 2 to 6 feet. The average separation in 2009 was 3.6 feet with the highest separation (about 4.5 feet) observed during the March 13, 2009, sampling event. This indicates a significant reduction in rainwater entering the barrier wall. The only areas where precipitation can enter the interior area within the barrier wall are through the 3 acres of riparian area and a small amount of precipitation that infiltrates between the edge of the impermeable soil cap liner and the top of the barrier wall.

The shallow groundwater horizontal gradient inside the barrier wall is typically flat (approximately 0.002 foot/foot [ft/ft]) compared to the shallow horizontal gradient (ranging from 0.002 ft/ft to 0.02 ft/ft) outside the barrier wall. Outside the barrier wall, shallow groundwater flow is diverted around the barrier wall toward Willamette Cove and the Willamette River. This is consistent with previous reporting periods. Generally, under low flow conditions in the Willamette River, the horizontal groundwater gradient inside the barrier wall is west, toward the FWDA. The groundwater contour maps for the first, third, and fourth quarters (Figures A-18, A-20, and A-21, respectively) confirm the westerly groundwater gradient. Transducers were installed in two interior shallow wells (EW-1s and MW-15s) in October 2008. The transducer data, presented on Figure A-31 confirm that, on average, the water level in EW-1s is approximately 0.7 feet higher than that in MW-15s. This corresponds to an average westerly gradient of

approximately 0.001 ft/ft toward MW-15s, which is slightly flatter than the average gradient within the barrier wall (which often steepens west of well MW-15s).

Although the barrier wall penetrates a confining silt layer in most locations, the conditions in the northwestern corner (near the FWDA) of the barrier wall are less confining. In this area, the barrier wall is completed in silt and sand layers rather than the confining massive silt layer found elsewhere along the barrier wall. Due to the nature of this material there is a hydraulic connection between the deep strata within the barrier wall and the deep strata outside the barrier wall in this location. This location can be thought of as a drain in a bathtub. Limited quantities of deep groundwater can both leave and enter the barrier wall through this connection; however the shallow groundwater zones are thought to be hydraulically disconnected from the area outside of the barrier wall.

When the Willamette River reaches peak stage (greater than about 15 feet NAVD88), as it did in June 2009, it can induce a partial reversal of gradient in the northwest corner of land within the barrier wall (adjacent to the Willamette River). Due to the deep hydraulic connection through sands in this area and the change in hydraulic head that the high river level induces, groundwater elevations in the northwest corner within the barrier wall increase in response to the River and the groundwater gradient changes to an easterly direction. This gradient reversal is contrary to the primarily westerly gradient direction typically observed within the barrier wall. This explains the bilateral gradient directions that can occur at peak river stage as evidenced on the June 12, 2009, groundwater contour map (Figure A-19). Once the river stage subsides, the groundwater levels within the barrier wall return to their typical flat westerly gradient patterns.

The frequent fluctuations in EW-1s and MW-15s, as shown on Figure A-31, are thought to be caused by methane gas produced from the degradation of the wood debris buried at the site escaping through these wells. A reduction in oscillations was noted after well EW-1s was sealed such that ambient air (with oxygen) was not entering the well. See Appendix B regarding the upland subsidence in this area for further explanation.

3.3 Vertical Gradients

Vertical gradients inside and outside the barrier wall along the Willamette River are best observed in monitoring well clusters MW-36/MW-37 and MW-44/ MW-45. The hydrographs for these wells (Figures A-22 through A-28) indicate that the intermediate and deep zones of the aquifer are highly influenced by fluctuations in the river levels. The intermediate and deep zones both inside and outside of the barrier wall closely mimic the river stage both in elevation and

timing with a small vertical gradient that varies between upward and downward with the tidal changes. The exterior shallow wells experience about a quarter cycle delay from river fluctuations and have dampened amplitude in comparison with the deeper wells.

Closer inspection of Figure A-24 and A-28, for monitoring well clusters MW-36/ MW-37 and MW-44/MW-45, reveals that there is a reversal in the vertical hydraulic gradient outside the barrier wall every time the tide advances or retreats and the river levels change. Because the shallow exterior wells have a higher groundwater elevation during low tide and low river stage events, there is a downward vertical gradient during this time. In contrast, the gradient is upward during high tide. This indicates that groundwater gradient outside the barrier wall switches between an upward and downward gradient about two times per day during the low flow season. However, as the river stage increases, the intermediate and deeper water levels in exterior well cluster MW-37 and MW-45 (Figure A-24 and A-27) raise faster than the shallow zone and the gradient in this vicinity is primarily upward until the river reaches a peak stage of about 14 feet NAVD88 and the oscillations return to their normal cyclic behavior.

The fact that the response of the interior shallow wells on Figures A-24, A-27, and A-28, is either muted or non-existent in comparison with the intermediate and deep zone wells suggests a clear hydraulic disconnect between the shallow aquifer within the barrier wall and the deeper strata. The muted response in MW-36s (Figure A-24) is likely due to the presence of a hydraulic connection between the deeper units inside and outside the barrier wall, which is completed in silt and sand layers rather than a massive silt in this area that then induces an upward gradient within the semi-confined aquifer in this area. In contrast to the muted response of MW-36s to changes in river stage elevation, water levels in the shallow interior well MW-44s (Figure A-27 and A-28) are virtually non-responsive to the cyclic changes in Willamette River stage. This indicates the presence of a confining layer between the shallow and intermediate zones in the vicinity of MW-44. Given the apparent discontinuity (low vertical hydraulic conductivity) between the shallow and deeper zones, the relatively strong downward gradient within the barrier wall is not indicative of groundwater flow to the deeper zones. Similarly an apparent upward gradient may result from semi-confined conditions at depth rather than the upwelling of water under unconfined conditions. Figures A-22 to A-29 show that the shallow reversal in gradient within the barrier wall occurs only when the Willamette River experiences stage peaks at an elevation greater than approximately 12 feet NAVD88.

Although precipitation in the Willamette River watershed ultimately affects the stage of the river, direct precipitation near the Site appears to play a minor role in determining the water levels of wells within the barrier wall and along the

river. The RCRA style soil cap was designed to divert precipitation so that little infiltration occurs within the barrier wall. Although some infiltration occurs along the fringes of the soil cap, the amount of infiltration is minimal. Downgradient of the soil cap precipitation inputs are vastly overshadowed by the response of groundwater to variations in river stage. The shallow zone upgradient or cross-gradient from the barrier wall appears to react subtly to precipitation and is less connected to the river because of its distance from the river and the presence of barrier wall downgradient, which is sealed into the underlying silt. One location where infiltration may influence groundwater elevations and flow paths is in the infiltration pond that receives diverted runoff from the soil cap. Figures A-18 through A-21 show that the groundwater gradient in this area is very flat, and that there may be a slight groundwater mound in this area east of the soil cap.

The net vertical gradients between the shallow and intermediate, intermediate and deep, and shallow and deep zones have been calculated using the transducer data for 2009, and are presented in Table A-10. In all wells, the net annual vertical gradient is downward between the shallow zone and the intermediate and deep zones. As would be expected, the downward gradient is greater inside the barrier wall (MW-36 and MW-44 clusters) since the shallow groundwater elevation inside the barrier wall continues to be slightly elevated as compared to the river elevation. The net vertical gradient outside the barrier wall is smaller while still downward between the shallow zone and intermediate and deep zones. The net vertical gradient is upward between the intermediate and deep zone in wells MW-37, MW-44, and MW-45, which likely indicates that these deeper zones are under confining pressures. The net vertical gradients in 2009 were very comparable (in both direction and magnitude) to the gradients calculated in 2008.

4.0 SUMMARY

With the exception of EW-10s, there was not sufficient accumulation of LNAPL during the monitoring period to warrant extraction from wells outside the barrier wall. DNAPL was extracted from three wells located outside the barrier wall in the FWDA and one well (EW-1s) located within the barrier wall. Approximately 113 gallons of DNAPL were extracted from the Site between November 2008 and January 2010. Approximately 40% of the third and fourth quarter 2009 extraction volumes (21 gallons) can be attributed to interior well EW-1s. The remaining 92 gallons, corresponding to approximately 7.7 gallons per month, were extracted from exterior wells MW-20i, MW-Ds, and MW-Gs. These calculations indicate that the monthly recovery rates from wells outside the barrier wall was approximately 21% greater during the 2009 monitoring period

(November 2008 to January 2010) than the 2008 monitoring period (December 2007 to November 2008). While it appears that there is a slight increase in extraction rates from MW-20i, the actual rates may be the same given the uncertainty in the recovery methods. Weekly manual measurements and periodic drum measurements have a lot of uncertainty associated with them and result in non-quantifiable data that is relatively expensive to collect (about $1,000/gallon). An automated NAPL monitoring and recovery system would allow for more accurate measurements than can be provided by the current manual monitoring method.

Shallow groundwater elevations and gradients during the 2009 reporting period at the Site are generally consistent with conditions observed during previous reporting periods. Horizontal gradients outside the barrier wall are the greatest during periods of high precipitation and decrease during periods of low precipitation. Groundwater gradients inside the barrier wall remain flat and generally to the west (except when peak river stage causes a reversal in gradient), while outside and upgradient of the wall, shallow groundwater flow is diverted around the barrier wall to the northwest and south. While most of the monitoring wells mimic the stage variations in the Willamette River, the oscillations in the shallow interior walls are delayed and muted and likely due to changes in pressure at depth rather than a hydraulic connection to the river. Under stable river conditions, vertical groundwater gradient figures indicate that gradients are generally downward inside the barrier wall in the FWDA and former TFA, with the exception of an upward gradient during high tide in the former TFA.

Based on the observations made through the 2009 reporting period, it appears that the barrier wall and impermeable soil cap are functioning as designed: groundwater flow and rainwater infiltration are diverted around source areas contained within the barrier wall, and NAPL contained within the barrier wall is prohibited from migrating to the Willamette River.

Uncertainties in the weekly manual extraction methodology make it difficult to quantify the volume of NAPL accumulation. Although NAPL does not appear to be increasing in most of the monitoring wells, with the possible exception of MW-20i, the overall rate of extraction in 2009 appears to have increased over the 2008 measurements. It should be noted that NAPL collection approaches have changed over time, in terms of pumping approaches and the number of wells from which NAPL is extracted. To better quantify NAPL accumulation and recovery rates we suggest that the overall strategy for collecting NAPL from the Site be re-evaluated. As mentioned previously, an automated system would make quantification of NAPL accumulation at the Site and NAPL extraction volumes more reliable.

At this time, it is anticipated that future O&M activities will be conducted in accordance with the *Draft Final Operation and Maintenance Plan* (DEQ, 2007), including groundwater gauging and NAPL extraction activities.

5.0 REFERENCES

DEQ, 2007. *Draft Final Operation and Maintenance Plan, McCormick & Baxter Creosoting Company Superfund Site Portland, Oregon, ORD00020603.* March 2007.

E&E, 2008. *Operation and Maintenance Report January through December 2007, McCormick and Baxter Creosoting Company Superfund Site, Portland, Oregon.* Prepared for Oregon Department of Environmental Quality. May 2008.

Table A-1 - Groundwater and NAPL Elevations: March 13, 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Well ID	Time	Measuring Point Elevation (ft NAVD88)	Depth to LNAPL (ft)	Depth to water (ft)	Depth to DNAPL (ft)	Well TD Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
EW-1s	14:26	40.34	ND	27.53	43.79	-6.57		3.12	12.81
EW-2s	13:50	42.37	ND	32.65	ND	-4.24			9.72
EW-8s	14:13	40.48	ND	27.96	53.75	-14.23		0.96	12.52
EW-9s	13:42	40.75	ND	31.19	ND	-5.62			9.56
EW-10s*	13:34	29.43	20.67	21.25	ND	-13.2	0.58		8.75
EW-15s	14:07	43.01	32.00	34.00	ND	-5.55	2.00		10.97
EW-18s	14:18	40.74	28.23	28.41	ND	-3.92	0.18		12.51
EW-19s	13:31	25.94	ND	16.08	ND	-4.19			9.86
EW-23s	14:04	37.61	26.98	29.38	ND	-1.67	2.40		10.59
MW-1r	13:21	37.63	ND	26.34	ND	-14.2			11.29
MW-2s	15:25	38.26	ND	26.35	ND	0.19			11.91
MW-3s	14:59	30.61	ND	15.45	ND	-0.18			15.16
MW-7 WC	13:37	36.69	ND	25.18	ND	-0.31			11.51
MW-10r	15:05	41.85	29.5	29.52	ND	1.46	0.02		12.33
MW-15s	14:40	43.25	ND	30.05	ND	5.02			13.20
MW-17s	14:49	41.25	ND	29.27	ND	1.21			11.98
MW-18s	13:42	43.14	ND	33.43	ND	-3.28			9.71
MW-20i	13:47	41.44	ND	33.08	69.25	-33.25		5.44	8.36
MW-22i**	14:37	42.28	ND	33.43	53.13	-16.68		5.83	8.85
MW-23d	15:10	41.06	ND	32.58	ND	-147.26			8.48
MW-32i	16:06	39.34	ND	27.99	ND	-23.24			11.35
MW-34i	15:01	32.66	ND	24.74	ND	-52.47			7.92
MW-35r	13:45	32.27	ND	DRY	DRY				
MW-36d	13:50	30.45	ND	22.14	ND	-57.25			8.31
MW-36i	13:48	30.18	ND	21.82	ND	-23.16			8.36
MW-36s	13:46	30.74	ND	20.02	ND	1.7			10.72
MW-37d	13:52	26.05	ND	17.79	ND	-57.31			8.26
MW-37i	13:54	25.88	ND	17.61	ND	-22.22			8.27
MW-37s	13:56	24.86	ND	15.99	ND	-4.04			8.87
MW-38d	13:58	31.84	ND	23.50	ND	-56.8			8.34
MW-38i	14:00	32.06	ND	23.51	ND	-21.81			8.55
MW-38s	14:02	32.31	ND	21.41	ND	1.08			10.90
MW-39d	14:08	29.83	ND	21.55	ND	-57.27			8.28
MW-39i	14:06	30.08	ND	21.86	ND	-22.54			8.22
MW-39s	14:04	29.75	ND	20.69	ND	0.1			9.06
MW-40d	14:16	28.67	ND	20.37	ND	-58.56			8.30
MW-40i	14:14	28.73	ND	20.06	ND	-22.47			8.67
MW-40s	14:12	28.33	ND	17.00	ND	1.56			11.33
MW-41d	14:18	27.43	ND	19.15	ND	-57.89			8.28
MW-41i	14:20	27.10	ND	18.75	ND	-23.85			8.35
MW-41s	14:22	27.78	ND	18.80	ND	0.39			8.98
MW-42d	14:25	32.20	ND	23.92	ND	-56.68			8.28
MW-42i	14:27	32.67	ND	24.34	ND	-21.2			8.33
MW-42s	14:21	32.37	ND	20.04	ND	5.35			12.33
MW-43d	14:35	28.33	ND	20.07	ND	-57.45			8.26
MW-43i	14:33	30.31	ND	21.98	ND	-22.37			8.33
MW-43s	14:31	31.05	ND	22.21	ND	4.07			8.84
MW-44d	14:40	29.64	ND	21.00	ND	-57.59			8.64
MW-44i	14:38	29.31	ND	20.65	ND	-22.69			8.66
MW-44s	14:37	29.57	ND	17.10	ND	0.54			12.47
MW-45d	14:44	27.88	ND	19.67	ND	-58.59			8.21
MW-45i	14:45	27.99	ND	19.55	ND	-22.56			8.44
MW-45s	14:42	28.17	ND	19.18	ND	-0.1			8.99
MW-46s	14:51	35.51	ND	22.92	ND	3.83			12.59
MW-47s	14:49	35.50	ND	25.56	ND	4.43			9.94
MW-48s	15:32	38.68	ND	25.40	ND	2.55			13.28
MW-49s	15:29	37.55	ND	19.95	ND	1.86			17.60
MW-50s	15:23	39.25	ND	26.32	ND	3.82			12.93

Table A-1 - Groundwater and NAPL Elevations: March 13, 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Well ID	Time	Measuring Point Elevation (ft NAVD88)	Depth to LNAPL (ft)	Depth to water (ft)	Depth to DNAPL (ft)	Well TD Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
MW-51s	15:30	39.53	ND	21.92	ND	4.37			17.61
MW-52s	16:00	40.70	ND	24.05	ND	-0.3			16.65
MW-53s	15:53	40.44	ND	28.3	ND	-0.43			12.14
MW-54s	14:33	41.78	ND	29.43	ND	5.48			12.35
MW-55s	14:30	41.04	ND	27.75	ND	5.21			13.29
MW-56s	13:59	43.49	32.17	32.50	ND	6.2	0.33		11.31
MW-57s	14:36	42.04	ND	31.84	ND	5.92			10.20
MW-58d	14:01	41.43	ND	33.03	ND				8.40
MW-58i	13:57	40.99	ND	32.73	ND				8.26
MW-58s	13:52	41.51	ND	31.94	ND				9.57
MW-59s	15:20	35.90	ND	21.04	ND				14.86
MW-60d	13:38	40.05	ND	31.65	ND	-80.3			8.40
MW-61s	14:22	43.61	ND	29.98	ND	2.3			13.63
MW-62i	14:50	42.61	ND	34.6	ND	-21.3			8.01
MW-As	16:11	39.27	ND	21.78	ND	9.81			17.49
MW-Ds	13:53	42.90	ND	33.25	37.39	4.24		1.27	9.65
MW-Gs	13:40	40.17	ND	30.84	44.09	-4.52		0.60	9.33
MW-Ks	14:14	44.14	ND	30.08	ND	1.96			14.06
MW-Os	15:55	40.93	ND	23.32	ND	-4.42			17.61
PW-1d	15:50	44.02	ND	32.7	ND	-93.45			11.32
PW-2d	15:31	41.79	ND	30.45	ND	-58.98			11.34

ND = not detected NM = not measured LNAPL specific gravity estimated as 0.981 g/cm^3

*LNAPL recovery periodically attempted in EW-1s when LNAPL thickness was observed to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.

**DNAPL recovery was attempted in MW-22i in July 2007 but the extracted liquid appeared to be water with speck sized globules of DNAPL (with a creosote odor), rather than a distinct layer, suggesting that the DNAPL thicknesses measured may not accurately reflect the amount of DNAPL in the well.

Table A-2 - Groundwater and NAPL Elevations: June 12, 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Well ID	Time	Measuring Point Elevation (ft NAVD88)	Depth to LNAPL (ft)	Depth to water (ft)	Depth to DNAPL (ft)	Well TD Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
EW-1s	15:23	40.34	ND	27.08	45.45	-6.57		1.46	13.26
EW-2s	14:40	42.37	ND	28.12	ND	-4.24			14.25
EW-8s	15:05	40.48	ND	27.39	44.74	-14.23		9.97	13.09
EW-9s	14:37	40.75	ND	26.8	ND	-5.62			13.95
EW-10s*	14:26	29.43	16.59	17.27	ND	-13.2	0.68		12.83
EW-15s	14:58	43.01	29.72	30.55	ND	-5.55	0.83		13.27
EW-18s	15:16	40.74	27.68	27.83	ND	-3.92	0.15		13.06
EW-19s	14:22	25.94	ND	12.3	ND	-4.19			13.64
EW-23s	14:54	37.61	24.40	26.69	ND	-1.67	2.29		13.17
MW-1r	14:15	37.63	ND	24.37	ND	-14.2			13.26
MW-2s	15:48	38.26	ND	24.8	ND	0.19			13.46
MW-3s	15:28	30.61	ND	14.64	ND	-0.18			15.97
MW-7 WC	1:22	36.69	ND	22.18	ND	-0.31			14.51
MW-10r	15:17	41.85	ND	28.86	ND	1.46			12.99
MW-15s	14:50	43.25	ND	30.15	ND	5.02			13.10
MW-17s	15:08	41.25	ND	28.14	ND	1.21			13.11
MW-18s	14:00	43.14	ND	29.11	ND	-3.28			14.03
MW-20i	14:34	41.44	ND	29.20	69.59	-33.25		5.10	12.24
MW-22i**	15:30	42.28	ND	29.71	52.33	-16.68		6.63	12.57
MW-23d	15:26	41.06	ND	28.61	ND	-147.26			12.45
MW-32i	15:52	39.34	ND	26.08	ND	-23.24			13.26
MW-34i	14:58	32.66	ND	20.52	ND	-52.47			12.14
MW-35r	14:17		ND	18.55	ND				-18.55
MW-36d	14:18	30.45	ND	18.14	ND	-57.25			12.31
MW-36i	14:16	30.18	ND	17.84	ND	-23.16			12.34
MW-36s	14:14	30.74	ND	17.25	ND	-1.7			13.49
MW-37d	14:24	26.05	ND	13.81	ND	-57.31			12.24
MW-37i	14:22	25.88	ND	13.61	ND	-22.22			12.27
MW-37s	14:20	24.86	ND	11.81	ND	-4.04			13.05
MW-38d	14:37	31.84	ND	18.55	ND	-56.8			13.29
MW-38i	14:35	32.06	ND	19.63	ND	-21.81			12.43
MW-38s	14:33	32.31	ND	19.08	ND	1.08			13.23
MW-39d	14:27	29.83	ND	17.5	ND	-57.27			12.33
MW-39i	14:29	30.08	ND	17.79	ND	-22.54			12.29
MW-39s	14:31	29.75	ND	16.19	ND	0.1			13.56
MW-40d	14:45	28.67	ND	16.35	ND	-58.56			12.32
MW-40i	14:43	28.73	ND	16.24	ND	-22.47			12.49
MW-40s	14:41	28.33	ND	15.19	ND	1.56			13.14
MW-41d	14:51	27.43	ND	15.14	ND	-57.89			12.29
MW-41i	14:49	27.1	ND	14.75	ND	-23.85			12.35
MW-41s	14:47	27.78	ND	14.04	ND	0.39			13.74
MW-42d	14:53	32.2	ND	19.91	ND	-56.68			12.29
MW-42i	14:55	32.67	ND	20.36	ND	-21.2			12.31
MW-42s	15:57	32.37	ND	9.23	ND	5.35			23.14
MW-43d	15:00	28.33	ND	16.03	ND	-57.45			12.30
MW-43i	14:57	30.31	ND	18.1	ND	-22.37			12.21
MW-43s	14:55	31.05	ND	18.1	ND	4.07			12.95
MW-44d	14:45	29.64	ND	16.96	ND	-57.59			12.68
MW-44i	15:07	29.31	ND	16.93	ND	-22.69			12.38

Table A-2 - Groundwater and NAPL Elevations: June 12, 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Well ID	Time	Measuring Point Elevation (ft NAVD88)	Depth to LNAPL (ft)	Depth to water (ft)	Depth to DNAPL (ft)	Well TD Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
MW-44s	15:09	29.57	ND	16.59	ND	0.54			12.98
MW-45d	15:15	27.88	ND	15.54	ND	-58.59			12.34
MW-45i	15:13	27.99	ND	15.57	ND	-22.56			12.42
MW-45s	15:11	28.17	ND	14.98	ND	-0.1			13.19
MW-46s	15:20	35.51	ND	22.44	ND	3.83			13.07
MW-47s	15:24	35.5	ND	21.52	ND	4.43			13.98
MW-48s	15:55	38.68	ND	25.4	ND	2.55			13.28
MW-49s	15:52	37.55	ND	20.2	ND	1.86			17.35
MW-50s	15:28	39.25	ND	26.2	ND	3.82			13.05
MW-51s	15:33	39.53	ND	22.44	ND	4.37			17.09
MW-52s	15:47	40.7	ND	27.74	ND	-0.3			12.96
MW-53s	15:49	40.44	ND	23.98	ND	-0.43			16.46
MW-54s	14:41	41.78	ND	28.69	ND	5.48			13.09
MW-55s	14:39	41.04	ND	25.8	ND	5.21			15.24
MW-56s	15:11	43.49	ND	30.1	ND	6.2			13.39
MW-57s	14:47	42.04	ND	27.87	ND	5.92			14.17
MW-58d	14:03	41.43	ND	29.22	ND				12.21
MW-58i	14:05	40.99	ND	28.78	ND				12.21
MW-58s	14:04	41.51	ND	28.28	ND				13.23
MW-59s	15:44	35.9	ND	20.08	ND				15.82
MW-60d	14:10	40.05	ND	27.71	ND	-80.3			12.34
MW-61s	14:29	43.61	ND	28.55	ND	2.3			15.06
MW-62i	14:53	42.61	ND	30.44	ND	-21.3			12.17
MW-As	15:54	39.27	ND	22.15	ND	9.81			17.12
MW-Ds	14:45	42.9	ND	28.71	37.50	4.24		1.16	14.19
MW-Gs	14:30	40.17	ND	26.30	43.46	-4.52		1.23	13.87
MW-Ks	14:34	44.14	ND	28.9	ND	1.96			15.24
MW-Os	15:38	40.93	ND	23.73	ND	-4.42			17.20
PW-1d	15:42	44.02	ND	30.79	ND	-93.45			13.23
PW-2d	15:35	41.79	ND	28.51	ND	-58.98			13.28

ND = not detected NM = not measured LNAPL specific gravity estimated as 0.981 g/cm^3

*LNAPL recovery periodically attempted in EW-1s when LNAPL thickness was observed to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.

**DNAPL recovery was attempted in MW-22i in July 2007 but the extracted liquid appeared to be water with speck sized globules of DNAPL (with a creosote odor), rather than a distinct layer, suggesting that the DNAPL thicknesses measured may not accurately reflect the amount of DNAPL in the well.

Table A-3 - Groundwater and NAPL Elevations: September 11, 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Well ID	Time	Measuring Point Elevation (ft NAVD88)	Depth to LNAPL (ft)	Depth to water (ft)	Depth to DNAPL (ft)	Well TD Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
EW-1s	10:35	40.34	ND	27.83	43.52	-6.57		3.39	12.51
EW-2s	9:53	42.37	ND	34.54	ND	-4.24			7.83
EW-8s	10:14	40.48	ND	28.35	53.39	-14.23		1.32	12.13
EW-9s	9:49	40.75	ND	32.89	ND	-5.62			7.86
EW-10s*	9:37	29.43	ND	22.67	ND	-13.2			6.76
EW-15s	10:06	43.01	33.47	36.63	ND	-5.55	3.16		9.48
EW-18s	10:29	40.74	28.59	29.04	ND	-3.92	0.45		12.14
EW-19s	9:34	25.94	ND	18.64	ND	-4.19			7.30
EW-23s	10:02	37.61	28.17	32.63	ND	-1.67	4.46		9.36
MW-1r	9:18	37.63	Trace	27.34	ND	-14.2			10.29
MW-2s	11:06	38.26	ND	27.32	ND	0.19			10.94
MW-3s	10:51	30.61	ND	17.4	ND	-0.18			13.21
MW-7 WC	9:49	36.69	ND	26.64	ND	-0.31			10.05
MW-10r	10:42	41.85	ND	29.82	ND	1.46			12.03
MW-15s	10:22	43.25	ND	31.55	ND	5.02			11.70
MW-17s	10:38	41.25	ND	29.84	ND	1.21			11.41
MW-18s	9:20	43.14	ND	35.13	ND	-3.28			8.01
MW-20i	9:45	41.44	ND	35.09	70.82	-33.25		3.87	6.35
MW-22i**	10:46	42.28	ND	35.52	52.96	-16.68		6.00	6.76
MW-23d	10:50	41.06	ND	33.66	ND	-147.26			7.40
MW-32i	11:30	39.34	ND	23.06	ND	-23.24			16.28
MW-34i	10:34	32.66	ND	25.80	ND	-52.47			6.86
MW-35r	9:40	32.27	ND	24.21	ND				8.06
MW-36d	9:35	30.45	ND	24.07	ND	-57.25			6.38
MW-36i	9:30	30.18	ND	23.83	ND	-23.16			6.35
MW-36s	9:28	30.74	ND	21.07	ND	1.7			9.67
MW-37d	9:42	26.05	ND	19.64	ND	-57.31			6.41
MW-37i	9:40	25.88	ND	19.48	ND	-22.22			6.40
MW-37s	9:38	24.86	ND	17.86	ND	-4.04			7.00
MW-38d	9:51	31.84	ND	25.26	ND	-56.8			6.58
MW-38i	9:48	32.06	ND	25.76	ND	-21.81			6.30
MW-38s	9:44	32.31	ND	22.50	ND	1.08			9.81
MW-39d	9:57	29.83	ND	23.21	ND	-57.27			6.62
MW-39i	9:55	30.08	ND	23.60	ND	-22.54			6.48
MW-39s	9:53	29.75	ND	22.50	ND	0.1			7.25
MW-40d	10:04	28.67	ND	21.98	ND	-58.56			6.69
MW-40i	10:01	28.73	ND	22.36	ND	-22.47			6.37
MW-40s	9:59	28.33	ND	18.61	ND	1.56			9.72
MW-41d	10:08	27.43	ND	20.71	ND	-57.89			6.72
MW-41i	10:10	27.10	ND	20.57	ND	-23.85			6.53
MW-41s	10:06	27.78	ND	20.5	ND	0.39			7.28
MW-42d	10:16	32.20	ND	25.41	ND	-56.68			6.79
MW-42i	10:14	32.67	ND	25.91	ND	-21.2			6.76
MW-42s	10:12	32.37	ND	20.62	ND	5.35			11.75
MW-43d	10:23	28.33	ND	21.65	ND	-57.45			6.68
MW-43i	10:21	30.31	ND	23.60	ND	-22.37			6.71
MW-43s	10:20	31.05	ND	24.18	ND	4.07			6.87
MW-44d	10:29	29.64	ND	22.34	ND	-57.59			7.30
MW-44i	10:26	29.31	ND	22.69	ND	-22.69			6.62
MW-44s	10:24	29.57	ND	17.53	ND	0.54			12.04
MW-45d	10:37	27.88	ND	20.88	ND	-58.59			7.00
MW-45i	10:34	27.99	ND	21.14	ND	-22.56			6.85
MW-45s	10:30	28.17	ND	20.92	ND	-0.1			7.25
MW-46s	10:41	35.51	ND	23.33	ND	3.83			12.18
MW-47s	10:45	35.50	ND	27.91	ND	4.43			7.59
MW-48s	11:35	38.68	ND	25.80	ND	2.55			12.88
MW-49s	11:19	37.55	ND	21.79	ND	1.86			15.76

Table A-3 - Groundwater and NAPL Elevations: September 11, 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Well ID	Time	Measuring Point Elevation (ft NAVD88)	Depth to LNAPL (ft)	Depth to water (ft)	Depth to DNAPL (ft)	Well TD Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
MW-50s	10:53	39.25	ND	26.65	ND	3.82			12.60
MW-51s	10:58	39.53	ND	23.69	ND	4.37			15.84
MW-52s	11:21	40.70	ND	28.66	ND	-0.3			12.04
MW-53s	11:15	40.44	ND	25.45	ND	-0.43			14.99
MW-54s	10:14	41.78	ND	29.83	ND	5.48			11.95
MW-55s	10:10	41.04	ND	29.14	ND	5.21			11.90
MW-56s	10:22	43.49	33.02	34.46	ND	6.2	1.44		10.44
MW-57s	10:17	42.04	ND	33.49	ND	5.92			8.55
MW-58d	9:26	41.43	ND	35.02	ND				6.41
MW-58i	9:32	40.99	ND	34.69	ND				6.30
MW-58s	9:30	41.51	ND	33.78	ND				7.73
MW-59s	10:48	35.90	ND	23.21	ND				12.69
MW-60d	9:24	40.05	ND	33.72	ND	-80.3			6.33
MW-61s	9:55	43.61	ND	31.60	ND	2.3			12.01
MW-62i	10:30	42.61	ND	36.76	ND	-21.3			5.85
MW-As	11:24	39.27	ND	28.96	ND	9.81			10.31
MW-Ds	9:56	42.90	ND	34.92	37.67	4.24		0.99	7.98
MW-Gs	9:41	40.17	ND	32.58	43.82	-4.52		0.87	7.59
MW-Ks	10:00	44.14	ND	31.82	ND	1.96			12.32
MW-Os	11:05	40.93	ND	24.99	ND	-4.42			15.94
PW-1d	11:10	44.02	ND	33.71	ND	-93.45			10.31
PW-2d	11:00	41.79	ND	31.44	ND	-58.98			10.35

ND = not detected NM = not measured LNAPL specific gravity estimated as 0.981 g/cm^3

*LNAPL recovery periodically attempted in EW-1s when LNAPL thickness was observed to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.

**DNAPL recovery was attempted in MW-22i in July 2007 but the extracted liquid appeared to be water with speck sized globules of DNAPL (with a creosote odor), rather than a distinct layer, suggesting that the DNAPL thicknesses measured may not accurately reflect the amount of DNAPL in the well.

Table A-4 - Groundwater and NAPL Elevations: December 10, 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Well ID	Time	Measuring Point Elevation (ft NAVD88)	Depth to LNAPL (ft)	Depth to water (ft)	Depth to DNAPL (ft)	Well TD Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
EW-1s	10:45	40.10	ND	28.71	43.96	-6.81		2.95	11.39
EW-2s	10:02	42.37	ND	32.32	ND	-4.24			10.05
EW-8s	10:23	40.48	ND	29.13	53.46	-14.23		1.25	11.36
EW-9s	10:00	40.75	ND	31.74	ND	-5.62			9.01
EW-10s*	9:50	29.43	21.08	22.19	ND	-13.2	1.10		8.33
EW-15s	10:15	43.01	32.94	35.33	ND	-5.55	2.40		10.03
EW-18s	10:37	40.74	29.42	29.76	ND	-3.92	0.34		11.32
EW-19s	9:47	25.94	ND	17.36	ND	-4.19			8.58
EW-23s	10:11	37.61	27.88	32.08	ND	-1.67	4.21		9.66
MW-1r		37.63	ND	0.00	ND	-14.2			37.63
MW-2s	10:48	38.26	ND	27.22	ND	0.19			11.04
MW-3s	10:38	30.61	ND	16.79	ND	-0.18			13.82
MW-7 WC	12:15	36.69	ND	26.5	ND	-0.31			10.19
MW-10r	NA	41.85	ND	NA	ND	1.46			NA
MW-15s	10:58	43.25	ND	32.21	ND	5.02			11.04
MW-17s	10:15	41.25	ND	30.41	ND	1.21			10.84
MW-18s	9:17	43.14	ND	34.08	ND	-3.28			9.06
MW-20i	9:57	41.44	ND	33.19	69.19	-33.25		5.50	8.25
MW-22i**	10:50	42.28	ND	33.94	52.14	-16.68		6.82	8.34
MW-23d	11:15	41.06	ND	31.19	ND	-147.26			9.87
MW-32i	12:00	39.34	ND	29.14	ND	-23.24			10.20
MW-34i	10:50	32.66	ND	23.43	ND	-52.47			9.23
MW-35r	NA	32.27	ND	NA	ND				NA
MW-36d	9:34	30.45	ND	22.32	ND	-57.25			8.13
MW-36i	9:31	30.18	ND	22.15	ND	-23.16			8.03
MW-36s	9:29	30.74	ND	20.85	ND	1.7			9.89
MW-37d	9:40	26.05	ND	17.89	ND	-57.31			8.16
MW-37i	9:38	25.88	ND	17.74	ND	-22.22			8.14
MW-37s	9:36	24.86	ND	16.54	ND	-4.04			8.32
MW-38d	9:48	31.84	ND	23.54	ND	-56.8			8.30
MW-38i	9:47	32.06	ND	24.12	ND	-21.81			7.94
MW-38s	9:46	32.31	ND	22.50	ND	1.08			9.81
MW-39d	9:53	29.83	ND	21.62	ND	-57.27			8.21
MW-39i	9:51	30.08	ND	21.95	ND	-22.54			8.13
MW-39s	9:50	29.75	ND	21.55	ND	0.1			8.20
MW-40d	9:57	28.67	ND	20.35	ND	-58.56			8.32
MW-40i	9:56	28.73	ND	20.77	ND	-22.47			7.96
MW-40s	9:55	28.33	ND	18.16	ND	1.56			10.17
MW-41d	9:58	27.43	ND	19.12	ND	-57.89			8.31
MW-41i	9:59	27.10	ND	18.93	ND	-23.85			8.17
MW-41s	10:00	27.78	ND	19.30	ND	0.39			8.48
MW-42d	10:02	32.20	ND	23.85	ND	-56.68			8.35
MW-42i	10:03	32.67	ND	24.36	ND	-21.2			8.31
MW-42s	10:04	32.37	ND	21.25	ND	5.35			11.12
MW-43d	10:08	28.33	ND	19.86	ND	-57.45			8.47
MW-43i	10:07	30.31	ND	22.02	ND	-22.37			8.29
MW-43s	10:06	31.05	ND	22.77	ND	4.07			8.28
MW-44d	10:18	29.64	ND	20.64	ND	-57.59			9.00
MW-44i	10:19	29.31	ND	21.28	ND	-22.69			8.03
MW-44s	10:17	29.57	ND	18.26	ND	0.54			11.31
MW-45d	10:22	27.88	ND	19.17	ND	-58.59			8.71
MW-45i	10:23	27.99	ND	19.50	ND	-22.56			8.49
MW-45s	10:24	28.17	ND	19.65	ND	-0.1			8.52
MW-46s	10:29	35.51	ND	24.05	ND	3.83			11.46
MW-47s	10:31	35.50	ND	26.16	ND	4.43			9.34
MW-48s	10:59	38.68	ND	26.36	ND	2.55			12.32
MW-49s	10:55	37.55	ND	21.75	ND	1.86			15.80

Table A-4 - Groundwater and NAPL Elevations: December 10, 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Well ID	Time	Measuring Point Elevation (ft NAVD88)	Depth to LNAPL (ft)	Depth to water (ft)	Depth to DNAPL (ft)	Well TD Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
MW-50s	11:30	39.25	ND	27.22	ND	3.82			12.03
MW-51s	11:40	39.53	ND	23.92	ND	4.37			15.61
MW-52s	11:55	40.70	ND	29.45	ND	-0.3			11.25
MW-53s	11:59	40.44	ND	25.75	ND	-0.43			14.69
MW-54s	9:45	41.78	ND	30.60	ND	5.48			11.18
MW-55s	9:40	41.04	ND	29.25	ND	5.21			11.79
MW-56s	10:29	43.49	33.18	33.51	ND	6.2	0.33		10.31
MW-57s	10:00	42.04	ND	32.50	ND	5.92			9.54
MW-58d	9:10	41.43	ND	33.40	ND				8.03
MW-58i	9:00	40.99	ND	32.97	ND				8.02
MW-58s	9:00	41.51	ND	32.67	ND				8.84
MW-59s		35.90	ND		ND				35.90
MW-60d	9:22	40.05	ND	32.05	ND	-80.3			8.00
MW-61s	10:15	43.61	ND	32.33	ND	2.3			11.28
MW-62i	10:30	42.61	ND	33.44	ND	-21.3			9.17
MW-As	12:06	39.27	ND	27.30	ND	9.81			11.97
MW-Ds	10:06	42.90	ND	33.77	37.34	4.24		1.32	9.13
MW-Gs	9:53	40.17	ND	31.33	43.82	-4.52		0.87	8.84
MW-Ks	9:20	44.14	ND	32.7	ND	1.96			11.44
MW-Os	11:50	40.93	ND	23.35	ND	-4.42			17.58
PW-1d	11:52	44.02	ND	33.84	ND	-93.45			10.18
PW-2d	11:45	41.79	ND	31.59	ND	-58.98			10.20

ND = not detected NM = not measured LNAPL specific gravity estimated as 0.981 g/cm^3

*LNAPL recovery periodically attempted in EW-1s when LNAPL thickness was observed to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.

**DNAPL recovery was attempted in MW-22i in July 2007 but the extracted liquid appeared to be water with speck sized globules of DNAPL (with a creosote odor), rather than a distinct layer, suggesting that the DNAPL thicknesses measured may not accurately reflect the amount of DNAPL in the well.

Table A-5 - LNAPL and DNAPL Measurement Summary: First Quarter 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Date Measured	Well Number	Thickness (feet)	Extracted (Gallons) Based on Visual Observation (water + NAPL)[a]
LNAPL			
1/5/2009	EW-10s	**1.0**[b,c]	NR
1/12/2009	EW-10s	0.33	NR
1/21/2009	EW-10s	0.32	NR
1/28/2009	EW-10s	0.25	NR
2/2/2009	EW-10s	0.30	NR
2/9/2009	EW-10s	**0.42**[c]	NR
2/18/2009	EW-10s	0.27	NR
2/27/2009	EW-10s	0.37	NR
3/3/2009	EW-10s	0.24	NR
3/11/2009	EW-10s	0.15	NR
3/19/2009	EW-10s	0.41	NR
3/23/2009	EW-10s	**0.58**[c]	NR
DNAPL			
1/5/2009	MW-20i	**7.20**[b]	2.5
1/12/2009	MW-20i	**2.92**	1.0
1/21/2009	MW-20i	**3.18**	3.25
1/28/2009	MW-20i	**4.11**	2.75
2/2/2009	MW-20i	**4.07**	2.75
2/9/2009	MW-20i	**4.56**	2.75
2/18/2009	MW-20i	**4.91**	3.25
2/27/2009	MW-20i	**4.02**	3.5
3/3/2009	MW-20i	**4.11**	3.0
3/11/2009	MW-20i	**4.59**	3.25
3/19/2009	MW-20i	**5.31**	3.75
3/23/2009	MW-20i	**5.44**	3.25
1/5/2009	MW-Ds	1.39[b]	NR
1/12/2009	MW-Ds	**1.91**	NR
1/21/2009	MW-Ds	0.97	NR
1/28/2009	MW-Ds	1.15	NR
2/2/2009	MW-Ds	**1.86**	NR
2/9/2009	MW-Ds	1.36	NR
2/18/2009	MW-Ds	**2.15**	2.25
2/27/2009	MW-Ds	1.22	NR
3/3/2009	MW-Ds	1.28	NR
3/11/2009	MW-Ds	0.84	NR
3/19/2009	MW-Ds	1.03	NR
3/23/2009	MW-Ds	1.41	1.5
1/5/2009	MW-Gs	**7.88**[b]	0.5
1/12/2009	MW-Gs	1.48	NR
1/21/2009	MW-Gs	0.06	NR
1/28/2009	MW-Gs	0.61	NR
2/2/2009	MW-Gs	1.39	1.0
2/9/2009	MW-Gs	1.36	0.75
2/18/2009	MW-Gs	1.22	NR

Table A-5 - LNAPL and DNAPL Measurement Summary: First Quarter 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Date Measured	Well Number	Thickness (feet)	Extracted (Gallons) Based on Visual Observation (water + NAPL)[a]
2/27/2009	MW-Gs	**4.30**	1.75
3/3/2009	MW-Gs	0.51	NR
3/11/2009	MW-Gs	0.43	NR
3/19/2009	MW-Gs	0.50	NR
3/23/2009	MW-Gs	**1.68**	NR
Total Water and NAPL Extracted			**42.75**

Notes:

Bold values indicate the Extraction Criteria have been met: minimum of 0.4 feet for LNAPL and 1.5 feet for DNAPL.

NR = No Recovery

[a] Extracted volume based on visual observations at time of extraction for water + NAPL.

[b] The gauging for thickness was measured on 12/29/2008 and was extracted on 1/5/2009.

[c] LNAPL recovery periodically attempted when LNAPL thickness appears to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.

Table A-6 - LNAPL and DNAPL Measurement Summary: Second Quarter 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Date Measured	Well Number	Thickness (feet)	Extracted (Gallons) Based on Visual Observation (water + NAPL)[a]
LNAPL			
4/3/2009	EW-10s	**0.67**[b]	NR
4/10/2009	EW-10s	0.29	NR
4/20/2009	EW-10s	0.03	NR
4/27/2009	EW-10s	0.16	NR
5/5/2009	EW-10s	0.33	NR
5/12/2009	EW-10s	0.32	NR
5/21/2009	EW-10s	**1.34**[b]	NR
5/27/2009	EW-10s	**0.44**[b]	NR
6/4/2009	EW-10s	**0.59**[b]	NR
6/8/2009	EW-10s	**0.66**[b]	NR
6/15/2009	EW-10s	**0.67**[b]	NR
6/25/2009	EW-10s	**0.81**[b]	NR
DNAPL			
4/3/2009	MW-20i	**4.68**	2.5
4/10/2009	MW-20i	**5.57**	2.75
4/20/2009	MW-20i	**4.49**	3.25
4/27/2009	MW-20i	**5.56**	3.25
5/5/2009	MW-20i	**5.27**	3.0
5/12/2009	MW-20i	**4.41**	3.0
5/21/2009	MW-20i	**5.23**	3.3
5/27/2009	MW-20i	**5.02**	3.25
6/4/2009	MW-20i	**5.20**	2.75
6/8/2009	MW-20i	0.11	3.0
6/15/2009	MW-20i	**6.47**	3.25
6/25/2009	MW-20i	**5.01**	3.0
4/3/2009	MW-Ds	**2.44**	1.5
4/10/2009	MW-Ds	**2.57**	1.5
4/20/2009	MW-Ds	**2.40**	1.75
4/27/2009	MW-Ds	**2.43**	1.25
5/5/2009	MW-Ds	**2.23**	1.0
5/12/2009	MW-Ds	**2.23**	1.25
5/21/2009	MW-Ds	**2.15**	1.75
5/27/2009	MW-Ds	**2.22**	1.25
6/4/2009	MW-Ds	0.97	NR
6/8/2009	MW-Ds	1.19	NR
6/15/2009	MW-Ds	**2.40**	1.25
6/25/2009	MW-Ds	1.07	NR
4/3/2009	MW-Gs	0.51	NR
4/10/2009	MW-Gs	1.35	1.0
4/20/2009	MW-Gs	**1.69**	1.0
4/27/2009	MW-Gs	**6.69**	1.0
5/5/2009	MW-Gs	**1.94**	1.25
5/12/2009	MW-Gs	1.17	NR

Table A-6 - LNAPL and DNAPL Measurement Summary: Second Quarter 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Date Measured	Well Number	Thickness (feet)	Extracted (Gallons) Based on Visual Observation (water + NAPL)[a]
5/21/2009	MW-Gs	**2.90**	1.0
5/27/2009	MW-Gs	1.40	1.25
6/4/2009	MW-Gs	**6.00**	1.75
6/8/2009	MW-Gs	**5.55**	1.5
6/15/2009	MW-Gs	**1.51**	1.0
6/25/2009	MW-Gs	**5.87**	1.75
Total Water and NAPL Extracted			**61.25**

Notes:

Bold values indicate the Extraction Criteria have been met: minimum of 0.4 feet for LNAPL and 1.5 feet for DNAPL.

NR = No Recovery

[a] Extracted volume based on visual observations at time of extraction for water + NAPL.

[b] LNAPL recovery periodically attempted when LNAPL thickness appears to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.

Table A-7 - LNAPL and DNAPL Measurement Summary: Third Quarter 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Date Measured	Well Number	Thickness (feet)	Extracted (Gallons) Based on Visual Observation (water + NAPL)[a]
LNAPL			
7/2/2009	EW-10s	**1.00**[b]	NR
7/6/2009	EW-10s	0.23	NR
7/13/2009	EW-10s	0.37	NR
7/22/2009	EW-10s	0.15	NR
7/28/2009	EW-10s	0.31	NR
8/4/2009	EW-10s	**1.55**[b]	NR
8/11/2009	EW-10s	**1.00**[b]	NR
8/24/2009	EW-10s	**0.51**[b]	NR
8/31/2009	EW-10s	0.26	NR
DNAPL			
7/2/2009	MW-20i	**5.93**	3.25
7/6/2009	MW-20i	**5.94**	2.75
7/13/2009	MW-20i	**4.68**	3.0
7/22/2009	MW-20i	**4.52**	3.25
7/28/2009	MW-20i	**4.36**	3.25
8/4/2009	MW-20i	**3.69**	2.75
8/11/2009	MW-20i	**3.89**	3.25
8/24/2009	MW-20i	**4.19**	3.0
8/31/2009	MW-20i	**4.19**	3.0
9/9/2009	MW-20i	**4.44**	2.75
9/16/2009	MW-20i	**4.05**	3.0
9/22/2009	MW-20i	**5.07**	3.25
9/28/2009	MW-20i	**4.30**	3.0
7/2/2009	MW-Ds	1.22	NR
7/6/2009	MW-Ds	1.45	NR
7/13/2009	MW-Ds	**2.40**	1.25
7/22/2009	MW-Ds	**2.23**	1.0
7/28/2009	MW-Ds	**2.40**	1.5
8/4/2009	MW-Ds	1.45	NR
8/11/2009	MW-Ds	0.53	1.5
8/24/2009	MW-Ds	**2.15**	1.45
8/31/2009	MW-Ds	1.39	NR
9/9/2009	MW-Ds	1.41	NR
9/16/2009	MW-Ds	1.01	NR
9/22/2009	MW-Ds	1.00	NR
9/28/2009	MW-Ds	**2.23**	1.25
7/2/2009	MW-Gs	**1.56**	1.25
7/6/2009	MW-Gs	**1.67**	1.25
7/13/2009	MW-Gs	**1.69**	1.25
7/22/2009	MW-Gs	0.44	NR
7/28/2009	MW-Gs	0.44	NR
8/4/2009	MW-Gs	1.40	1.5
8/11/2009	MW-Gs	0.08	1.25
8/24/2009	MW-Gs	1.01	NR
8/31/2009	MW-Gs	1.36	1.25

Table A-7 - LNAPL and DNAPL Measurement Summary: Third Quarter 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Date Measured	Well Number	Thickness (feet)	Extracted (Gallons) Based on Visual Observation (water + NAPL)[a]
9/9/2009	MW-Gs	1.43	1.25
9/16/2009	MW-Gs	1.48	1.0
9/22/2009	MW-Gs	**3.56**	NR
9/28/2009	MW-Gs	0.99	1.25
7/6/2009	EW-1s	**2.66**	4.0
7/13/2009	EW-1s	**3.66**	NR
7/22/2009	EW-1s	**6.18**	NR
7/28/2009	EW-1s	**2.75**	4.25
8/4/2009	EW-1s	**3.74**	3.75
8/12/2009	EW-1s	**5.01**	2.75
8/24/2009	EW-1s	**3.67**	4.25
8/31/2009	EW-1s	**3.83**	NR
9/9/2009	EW-1s	**3.13**	3.75
9/16/2009	EW-1s	**3.00**	4.25
9/22/2009	EW-1s	**4.03**	3.75
9/28/2009	EW-1s	**3.15**	3.75
Total Water and NAPL Extracted			**93.20**

Notes:

Bold values indicate the Extraction Criteria have been met: minimum of 0.4 feet for LNAPL and 1.5 feet for DNAPL.

NR = No Recovery

[a] Extracted volume based on visual observations at time of extraction for water + NAPL.

[b] LNAPL recovery periodically attempted when LNAPL thickness appears to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.

Table A-8 - LNAPL and DNAPL Measurement Summary: Fourth Quarter 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Date Measured	Well Number	Thickness (feet)	Extracted (Gallons) Based on Visual Observation (water + NAPL)[a]
LNAPL			
12/9/2009	EW-10s	0.17	NR
12/15/2009	EW-10s	0.21	NR
12/21/2009	EW-10s	0.30	NR
12/28/2009	EW-10s	0.25	NR
DNAPL			
10/5/2009	MW-20i	**4.24**	2.5
10/13/2009	MW-20i	**4.47**	3.0
10/23/2009	MW-20i	**4.56**	3.65
10/30/2009	MW-20i	**5.61**	3.25
11/2/2009	MW-20i	**4.34**	3.0
11/9/2009	MW-20i	**4.66**	2.25
11/16/2009	MW-20i	**4.94**	2.5
11/24/2009	MW-20i	**5.01**	3.5
12/2/2009	MW-20i	**4.99**	3.45
12/9/2009	MW-20i	**5.16**	3.0
12/15/2009	MW-20i	**5.37**	3.25
12/21/2009	MW-20i	**5.06**	2.75
12/28/2009	MW-20i	**5.05**	3.3
10/5/2009	MW-Ds	**2.40**	1.0
10/13/2009	MW-Ds	**1.90**	NR
10/23/2009	MW-Ds	**2.14**	1.25
10/30/2009	MW-Ds	**2.07**	NR
11/2/2009	MW-Ds	**1.91**	1.25
11/9/2009	MW-Ds	**2.32**	NR
11/16/2009	MW-Ds	**2.04**	NR
11/24/2009	MW-Ds	**1.70**	NR
12/9/2009	MW-Ds	**1.78**	NR
12/15/2009	MW-Ds	**1.57**	NR
12/21/2009	MW-Ds	**2.25**	1.2
12/28/2009	MW-Ds	**2.08**	NR
10/5/2009	MW-Gs	1.33	NR
10/13/2009	MW-Gs	0.89	NR
10/23/2009	MW-Gs	0.93	NR
10/30/2009	MW-Gs	0.87	NR
11/2/2009	MW-Gs	0.50	NR
11/9/2009	MW-Gs	1.01	NR
11/16/2009	MW-Gs	**3.18**	1.75
11/24/2009	MW-Gs	0.58	NR
12/2/2009	MW-Gs	0.98	NR
12/9/2009	MW-Gs	**1.69**	NR
12/15/2009	MW-Gs	**1.65**	1.2
12/21/2009	MW-Gs	0.91	NR
12/28/2009	MW-Gs	1.23	NR
10/5/2009	EW-1s	**3.34**	3.25
10/13/2009	EW-1s	**4.02**	3.75
10/23/2009	EW-1s	**3.96**	3.55

Table A-8 - LNAPL and DNAPL Measurement Summary: Fourth Quarter 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Date Measured	Well Number	Thickness (feet)	Extracted (Gallons) Based on Visual Observation (water + NAPL)[a]
10/30/2009	EW-1s	**3.90**	3.5
11/2/2009	EW-1s	**4.83**	3.45
11/9/2009	EW-1s	**5.42**	2.5
11/16/2009	EW-1s	**4.08**	NR
11/24/2009	EW-1s	**4.19**	3.25
12/2/2009	EW-1s	**5.86**	2.25
12/9/2009	EW-1s	**5.13**	2.45
12/15/2009	EW-1s	**4.67**	2.45
12/21/2009	EW-1s	**4.51**	2.45
12/28/2009	EW-1s	**4.58**	2.75
Total Water and NAPL Extracted			**82.65**

Notes:

Bold values indicate the Extraction Criteria have been met: minimum of 0.4 feet for LNAPL and 1.5 feet for DNAPL.

NR = No Recovery

[a] Extracted volume based on visual observations at time of extraction for water + NAPL.

Table A-9 - Cumulative NAPL Extraction Summary
McCormick and Baxter Superfund Site
Portland, Oregon

Date	Manual NAPL Extracted (DNAPL + LNAPL)	Total Monthly Treatment System NAPL Extracted (DNAPL & LNAPL)	Monthly Total NAPL Extracted (gallons)	Total NAPL Extracted (gallons)
Pre-Barrier Wall Extraction Volumes				
Jun-89			0	0
Feb-93			1097	1097
Feb-95			1021	2118
Dec-95	31.03	0	31.03	2149
Jan-96	20.8	0	20.8	2170
Feb-96	52.4	0	52.4	2222
Mar-96	66.05	0	66.05	2288
Apr-96	35.87	0	35.87	2324
May-96	23.36	0	23.36	2348
Jun-96	31.68	0	31.68	2379
Jul-96	29.8	0	29.8	2409
Aug-96	73.02	0	73.02	2482
Sep-96	33.5	0	33.5	2516
Oct-96	43.8	0	43.8	2559
Nov-96	39	0	39	2598
Dec-96	25.3	0	25.3	2624
Jan-97	40.36	0	40.36	2664
Feb-97	31.04	0	31.04	2695
Mar-97	34.18	0	34.18	2729
Apr-97	32.04	0	32.04	2761
May-97	8.64	0	8.64	2770
Jun-97	11.6	0	11.6	2781
Jul-97	28.29	0	28.29	2810
Aug-97	52.33	0	52.33	2862
Sep-97	38.9	0	38.9	2901
Oct-97	32.3	0	32.3	2933
Nov-97	53.8	0	53.8	2987
Dec-97	53.3	0	53.3	3040
Jan-98	33.17	112.32	145.49	3186
Feb-98	27.05	5.9	32.95	3219
Mar-98	51.1	3.83	54.93	3274
Apr-98	33.37	7.67	41.04	3315
May-98	31.45	7.67	39.12	3354
Jun-98	12.08	7.67	19.75	3374
Jul-98	9.34	8.11	17.45	3391
Aug-98	14.95	8.11	23.06	3414
Sep-98	14.17	8.11	22.28	3436
Oct-98	16	8.11	24.11	3461
Nov-98	11.3	8.11	19.41	3480
Dec-98	5.2	16.15	21.35	3501
Jan-99	15.28	0	15.28	3517
Feb-99	14.12	0	14.12	3531
Mar-99	47.74	0	47.74	3578
Apr-99	7.44	0	7.44	3586
May-99	12.82	0	12.82	3599
Jun-99	10.7	0	10.7	3609

Table A-9 - Cumulative NAPL Extraction Summary
McCormick and Baxter Superfund Site
Portland, Oregon

Date	Manual NAPL Extracted (DNAPL + LNAPL)	Total Monthly Treatment System NAPL Extracted (DNAPL & LNAPL)	Monthly Total NAPL Extracted (gallons)	Total NAPL Extracted (gallons)
Jul-99	6.6	7.85	14.45	3624
Aug-99	13.84	7.85	21.69	3646
Sep-99	35.88	7.85	43.73	3689
Oct-99	6.85	7.85	14.7	3704
Nov-99	7.47	7.85	15.32	3719
Dec-99	2.15	7.85	10	3729
Jan-00	3.46	21.17	24.63	3754
Feb-00	1.75	21.17	22.92	3777
Mar-00	0.98	21.17	22.15	3799
Apr-00	1.05	21.17	22.22	3821
May-00	1.9	21.17	23.07	3844
Jun-00	0.41	21.17	21.58	3866
Jul-00	14.5	21.7	36.2	3902
Aug-00	25.36	21.7	47.06	3949
Sep-00	21.83	21.6	43.43	3993
Oct-00	18.63	0	18.63	4011
Nov-00	17.38	0	17.38	4029
Dec-00	1.53	0	1.53	4030
Jan-01	4.09	0	4.09	4034
Feb-01	0.56	0	0.56	4035
Mar-01	2.64	0	2.64	4037
Apr-01	4.19	0	4.19	4042
May-01	1.36	0	1.36	4043
Jun-01	0.41	0	0.41	4043
Jul-01	0.64	0	0.64	4044
Aug-01	1.15	0	1.15	4045
Sep-01	0	0	0	4045
Oct-01	0	0	0	4045
Nov-01	5.98	0	5.98	4051
Dec-01	0.519	0	0.519	4052
Jan-02	0.46	0	0.46	4052
Feb-02	19.28	0	19.28	4071
Mar-02	18.66	0	18.66	4090
Apr-02	0.31	0	0.31	4090
May-02	5.065	0	5.065	4095
Jun-02	0	0	0	4095
Jul-02	13.81	0	13.81	4109
Aug-02	11.59	0	11.59	4121
Sep-02	8.76	0	8.76	4130
Oct-02	12.34	0	12.34	4142
Nov-02	10.19	0	10.19	4152
Dec-02	0.851	0	0.851	4153
Jan-03	1.514	0	1.514	4154
Feb-03	7.45	0	7.45	4162
Mar-03	1.73	0	1.73	4164
Apr-03	0	0	0	4164
May-03	0	0	0	4164

Table A-9 - Cumulative NAPL Extraction Summary
McCormick and Baxter Superfund Site
Portland, Oregon

Date	Manual NAPL Extracted (DNAPL + LNAPL)	Total Monthly Treatment System NAPL Extracted (DNAPL & LNAPL)	Monthly Total NAPL Extracted (gallons)	Total NAPL Extracted (gallons)
Jun-03	0	0	0	4164
Jul-03	0	0	0	4164
Aug-03	0	0	0	4164
Sep-03	0	0	0	4164
Oct-03	0	0	0	4164
Nov-03	10	0	10	4174
Feb-04	79.5	0	79.5	4253
Mar-04	94.5	0	94.5	4348
Post Barrier Wall Extraction Volume				
Apr-04	118.33	0	118.33	4466
May-04	163.6	0	163.6	4630
Jun-04	165.6	0	165.6	4795
Jul-04	103.3	0	103.3	4898
Aug-04	127	34.1	161.1	5060
Sep-04	98.4	32.84	131.24	5191
Oct-04	50.2	28.76	78.96	5270
Nov-04	61.44	34.3	95.74	5366
Dec-04	59.12	23.51	82.63	5448
Jan-05	49.1	24.1	73.2	5521
Feb-05	83.86	0	83.86	5605
Mar-05	132.7	1	133.7	5739
Apr-05	131.2	0	131.2	5870
May-05	66.2	0	66.2	5936
Oct-05	45	0	45	5981
Nov-05	5.16	0	5.16	5986
Dec-05	12.33	0	12.33	5999
Jan-06	13.43	0	13.43	6012
Feb-06	14.68	0	14.68	6027
Mar-06	17.17	0	17.17	6044
Apr-06	13.24	0	13.24	6057
May-06	19.43	0	19.43	6076
Jun-06	16.72	0	16.72	6092
Jul-06	14.98	0	14.98	6107
Aug-06	27.37	0	27.37	6135
Sep-06	12.19	0	12.19	6147
Dec-06	9.93	0	9.93	6157
Mar-07	10.5	0	10.5	6167
Jun-07	14.86	0	14.86	6182
Sep-07	10.08	0	10.08	6192
Dec-07	9.93	0	9.93	6202
Feb-08	4.5	0	4.5	6207
Jun-08	19.7	0	19.7	6227
Jul-08	13.9	0	13.9	6240
Nov-08	19.2	0	19.2	6260
Mar-09	31	0	31	6291
Jun-09	29.76	0	29.76	6320
Sep-09	23.56	0	23.56	6344

Table A-9 - Cumulative NAPL Extraction Summary
McCormick and Baxter Superfund Site
Portland, Oregon

Date	Manual NAPL Extracted (DNAPL + LNAPL)	Total Monthly Treatment System NAPL Extracted (DNAPL & LNAPL)	Monthly Total NAPL Extracted (gallons)	Total NAPL Extracted (gallons)
Nov-09	12.4	0	12.4	6356
Jan-10	16.74	0	16.74	6373
Total Extracted Volume				6373

Note:

NAPL volume was estimated as 62% of the drum volume each measuring period. This calculation assumes that water comprises 38% of the drum volume, although the actual quantity varies from about 10% to over 50%.

Table A-10 - Net Annual Vertical Gradients in Monitoring Well Clusters: 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Monitoring Well Cluster ID	2009 Net Annual Gradient		
	From shallow to intermediate zone	From intermediate to deep zone	From shallow to deep zone
MW-36 (Interior)	-0.0434	-0.0020 [a]	-0.191 [a]
MW-37 (Exterior)	-0.0070	0.0022	-0.0015
MW-44 (Interior)	-0.0841 [b]	0.0165 [c]	-0.0290 [b,c]
MW-45 (Exterior)	-0.0066 [d]	0.0017	-0.0018 [d]

Note:

Negative values indicate a net downward hydraulic gradient and positive values indicate a net upward hydraulic gradient.

[a] MW-36s was not functioning from 9/3/09 to present. Net Gradient calculations exclude this period.

[b] MW-44s was not functioning from 9/3/09 to present. Net Gradient calculations exclude this period.

[c] MW-44d is missing data between 9/3/09 and 9/24/09. Net Gradient calculations exclude this period.

[d] MW-45s is missing data between 9/3/09 and 9/24/09. Net Gradient calculations exclude this period.

LEGEND

- Groundwater Monitoring Wells with Transducers
- All Other Groundwater Monitoring Wells
- Subsurface Barrier Wall

NOTE: Aerial photo taken on September 22, 2006

0 200 400

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Groundwater Monitoring Well Location Map

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure
A-1

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureA-1_Monitoring_Well_Location_Map.mxd, Date: February 26, 2010 1:28:16 PM

LEGEND

Groundwater Monitoring Wells (Depth to LNAPL or DNAPL)

- Wells with LNAPL
- Wells with DNAPL
- Wells without LNAPL or DNAPL
- Subsurface Barrier Wall

NOTES:

1) Aerial photo taken on September 22, 2006.
2) *LNAPL recovery periodically attempted when LNAPL thickness appears to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.
3) **DNAPL recovery was attempted in July 2007 but the extracted liquid appeared to be water with speck sized globules of DNAPL (with a creosote odor), rather than a distinct layer, suggesting that the DNAPL thicknesses measured may not accurately reflect the amount of DNAPL in the well. Because MW-22i is located within the barrier wall, no further extraction has been conducted.

0 200 400

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

LNAPL and DNAPL Distribution Map for March 13, 2009 Sampling Event

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **A-2**

File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureA-2_LNAPL_and_DNAPL_Map_March13_2009.mxd, Date: February 15, 2010 3:11:37 PM

LEGEND

Groundwater Monitoring Wells (Depth to LNAPL or DNAPL)

- Wells with LNAPL
- Wells with DNAPL
- Wells without LNAPL or DNAPL
- Subsurface Barrier Wall

NOTES:

1) Aerial photo taken on September 22, 2006.
2) *LNAPL recovery periodically attempted when LNAPL thickness appears to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.
3) **DNAPL recovery was attempted in July 2007 but the extracted liquid appeared to be water with speck sized globules of DNAPL (with a creosote odor), rather than a distinct layer, suggesting that the DNAPL thicknesses measured may not accurately reflect the amount of DNAPL in the well. Because MW-22i is located within the barrier wall, no further extraction has been conducted.

0 200 400

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

LNAPL and DNAPL Distribution Map for June 12, 2009 Sampling Event

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure
A-3

File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureA-3_LNAPL_and_DNAPL_Map_June12_2009.mxd, Date: February 15, 2010 3:15:08 PM

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LEGEND

Groundwater Monitoring Wells (Depth to LNAPL or DNAPL)

- Wells with LNAPL
- Wells with DNAPL
- Wells without LNAPL or DNAPL
- Subsurface Barrier Wall

NOTES:

1) Aerial photo taken on September 22, 2006.
2) **DNAPL recovery was attempted in July 2007 but the extracted liquid appeared to be water with speck sized globules of DNAPL (with a creosote odor), rather than a distinct layer, suggesting that the DNAPL thicknesses measured may not accurately reflect the amount of DNAPL in the well. Because MW-22i is located within the barrier wall, no further extraction has been conducted.

0 200 400

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

LNAPL and DNAPL Distribution Map for September 11, 2009 Sampling Event

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure
A-4

LEGEND

Groundwater Monitoring Wells (Depth to LNAPL or DNAPL)

- Wells with LNAPL
- Wells with DNAPL
- Wells without LNAPL or DNAPL
- Subsurface Barrier Wall

NOTES:

1) Aerial photo taken on September 22, 2006.
2) *LNAPL recovery periodically attempted when LNAPL thickness appears to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck sized globules of product dispersed through the water column indicating that no discrete layer of product is present.
3) **DNAPL recovery was attempted in July 2007 but the extracted liquid appeared to be water with speck sized globules of DNAPL (with a creosote odor), rather than a distinct layer, suggesting that the DNAPL thicknesses measured may not accurately reflect the amount of DNAPL in the well. Because MW-22i is located within the barrier wall, no further extraction has been conducted.

0 200 400

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

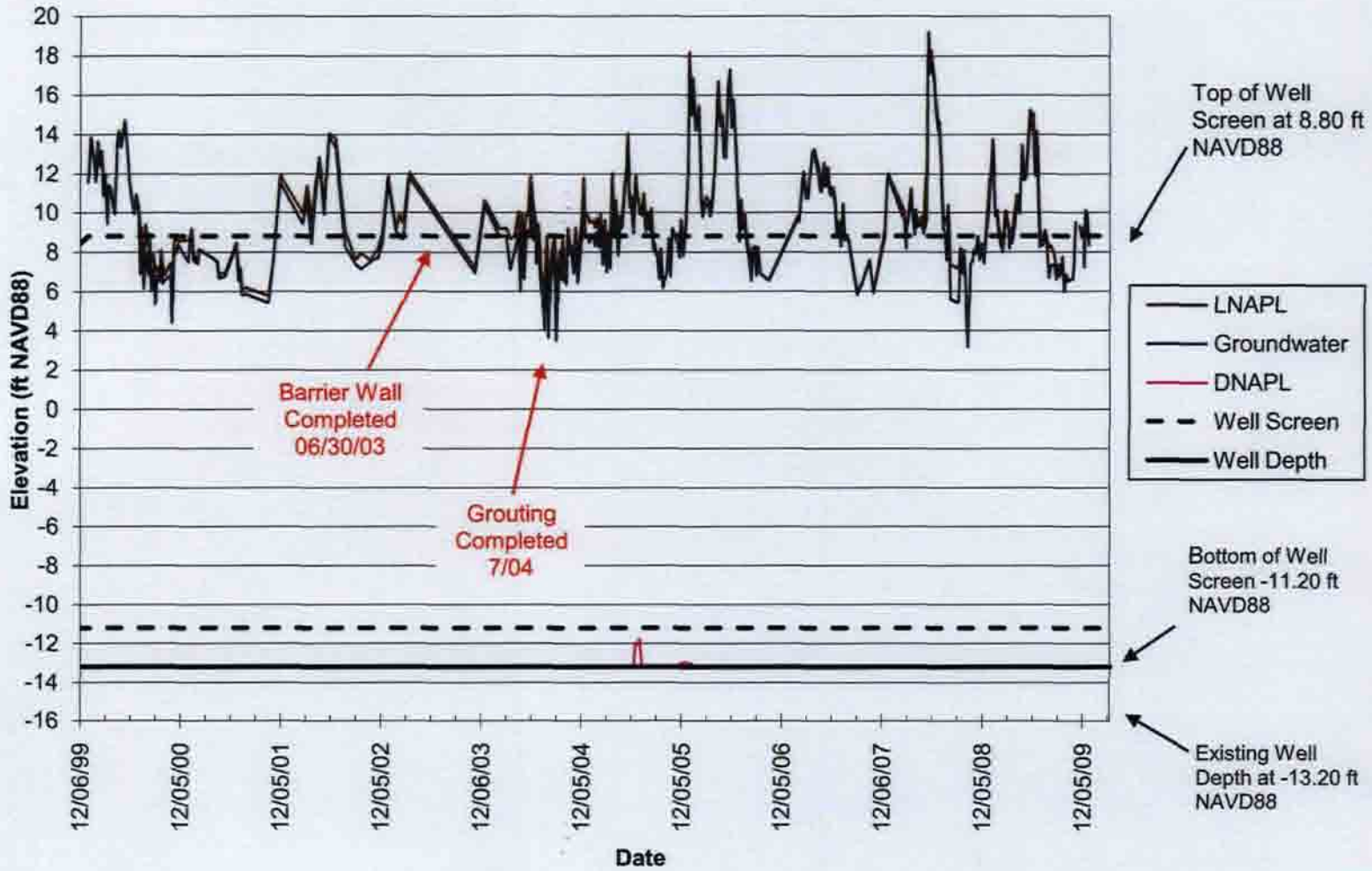
LNAPL and DNAPL Distribution Map for December 10, 2009 Sampling Event

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **A-5**

File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureA-5_LNAPL_and_DNAPL_Map_Dec10_2009.mxd, Date: February 15, 2010 3:20:04 PM



McCormick and Baxter Superfund Site
Portland, Oregon

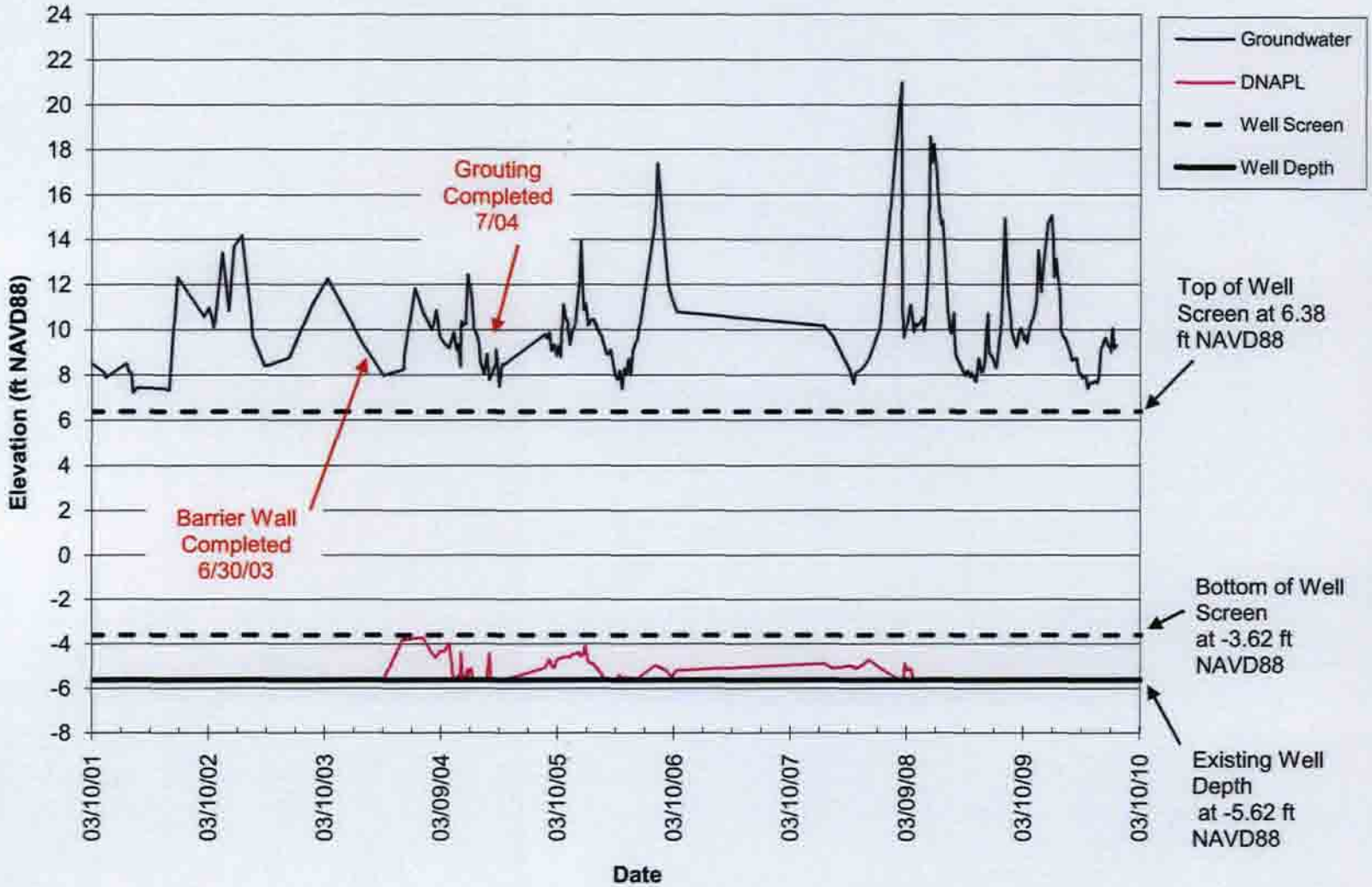
NAPL Thickness Plot for Well EW-10s

1/10

Figure **A-6**

HARTCROWSER

GSI Water Solutions, Inc.



McCormick and Baxter Superfund Site
Portland, Oregon

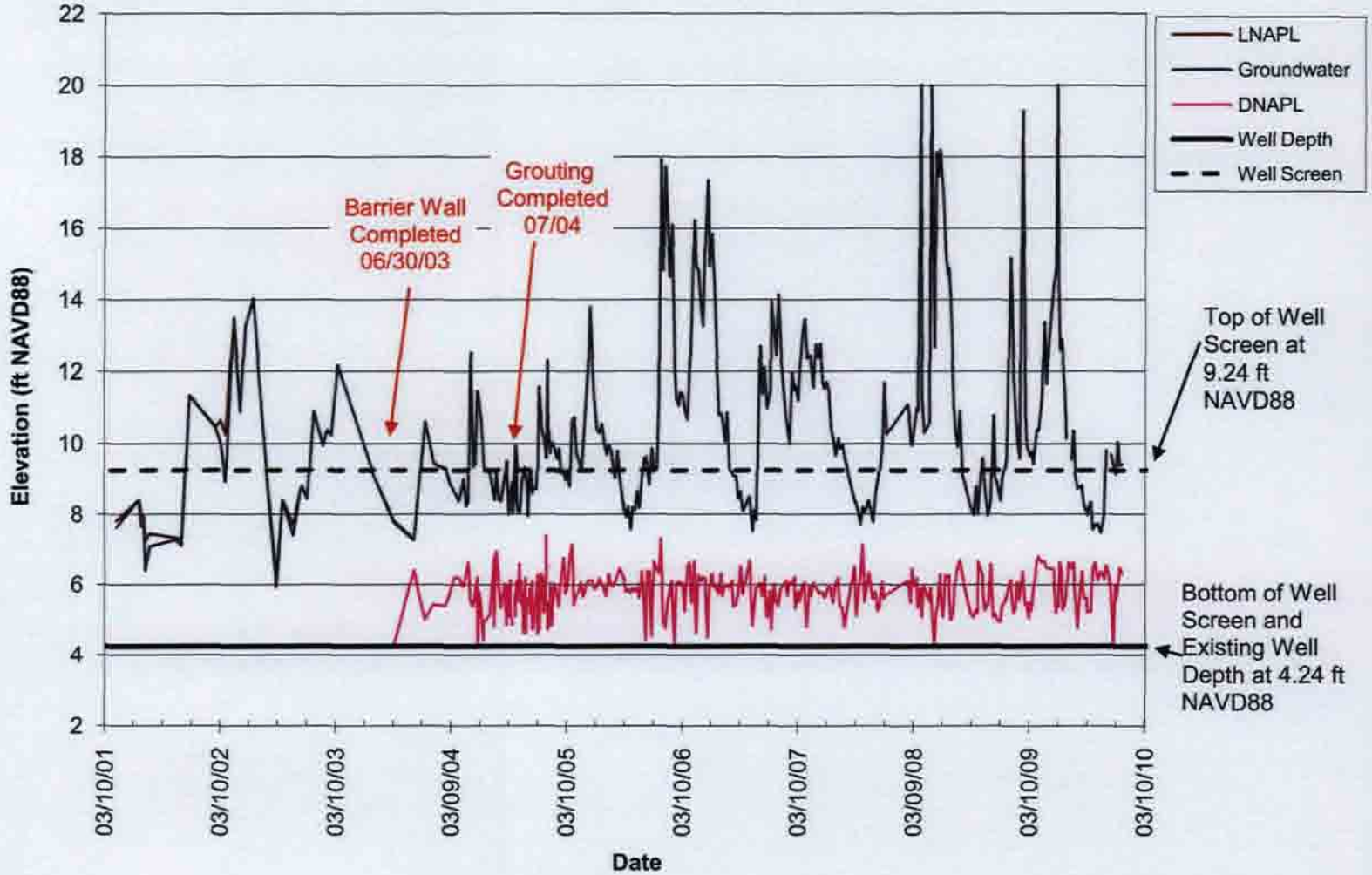
NAPL Thickness Plot for Well EW-9s

1/10

Figure **A-7**

HARTCROWSER

GSI Water Solutions, Inc.



McCormick and Baxter Superfund Site
Portland, Oregon

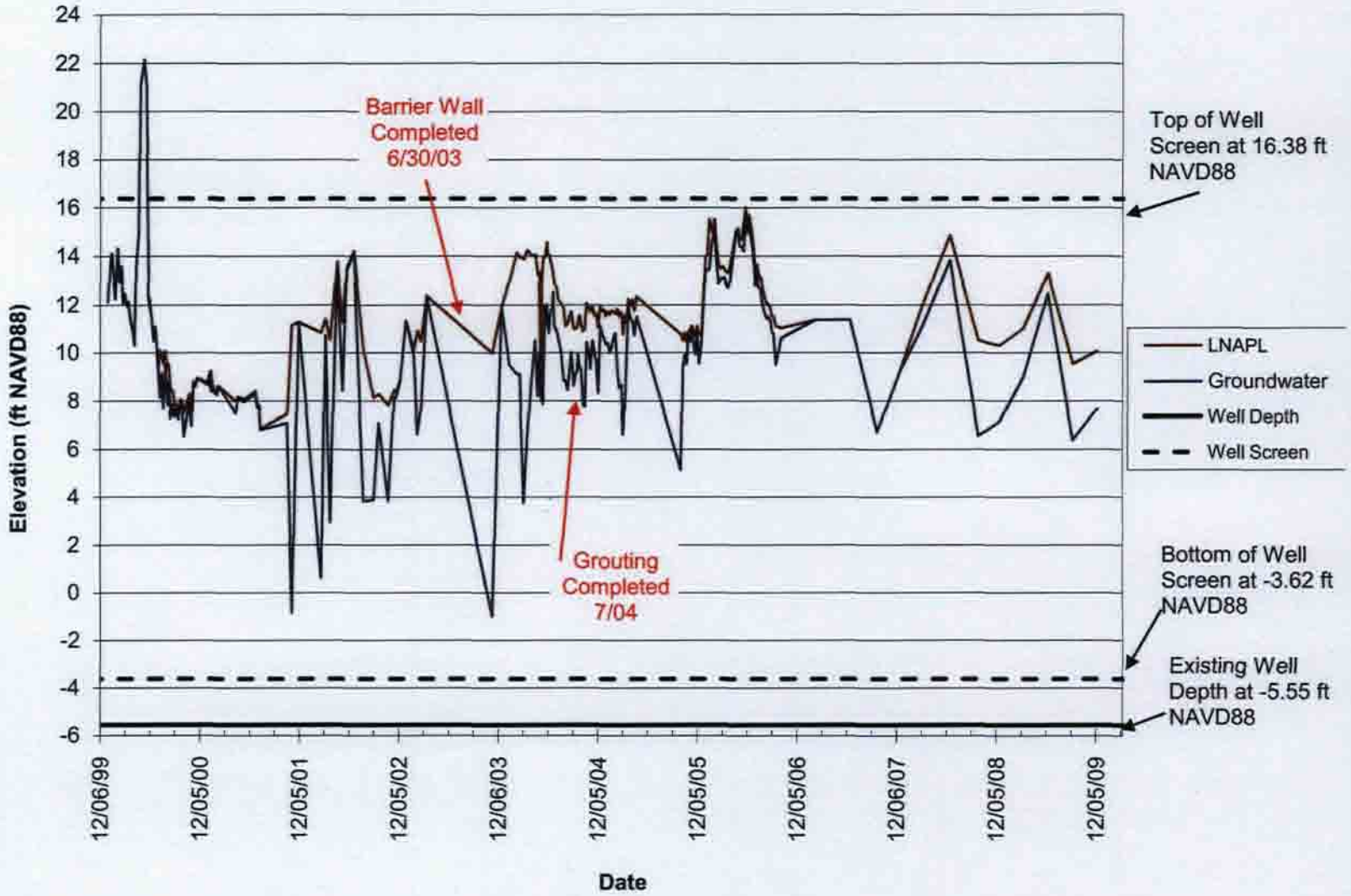
NAPL Thickness Plot for Well MW-Ds

1/10

Figure **A-8**

HARTCROWSER

GSI Water Solutions, Inc.



McCormick and Baxter Superfund Site
Portland, Oregon

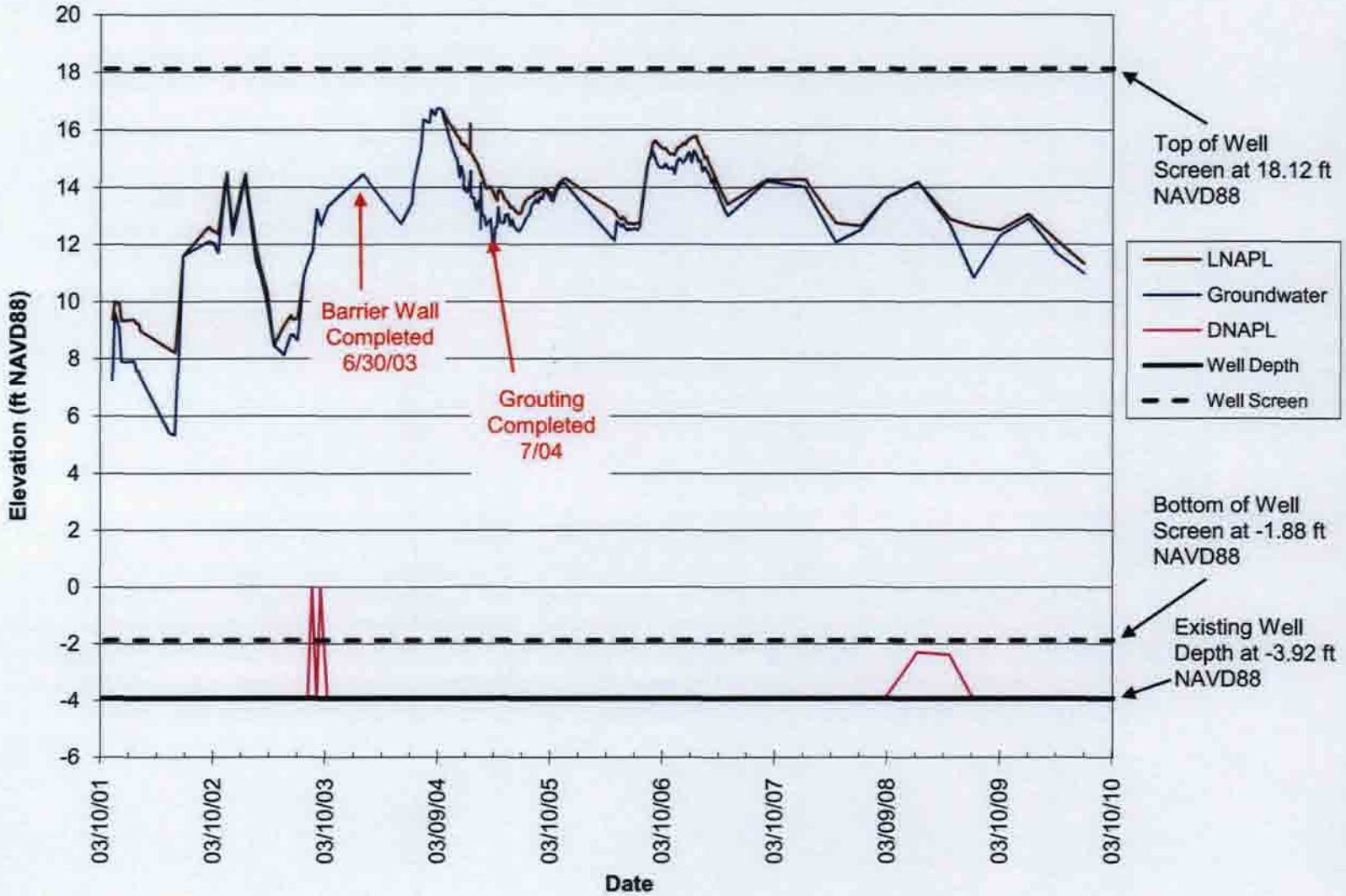
NAPL Thickness Plot for Well EW-15s

1/10

Figure **A-9**

HARTCROWSER

GSI Water Solutions, Inc.



McCormick and Baxter Superfund Site
Portland, Oregon

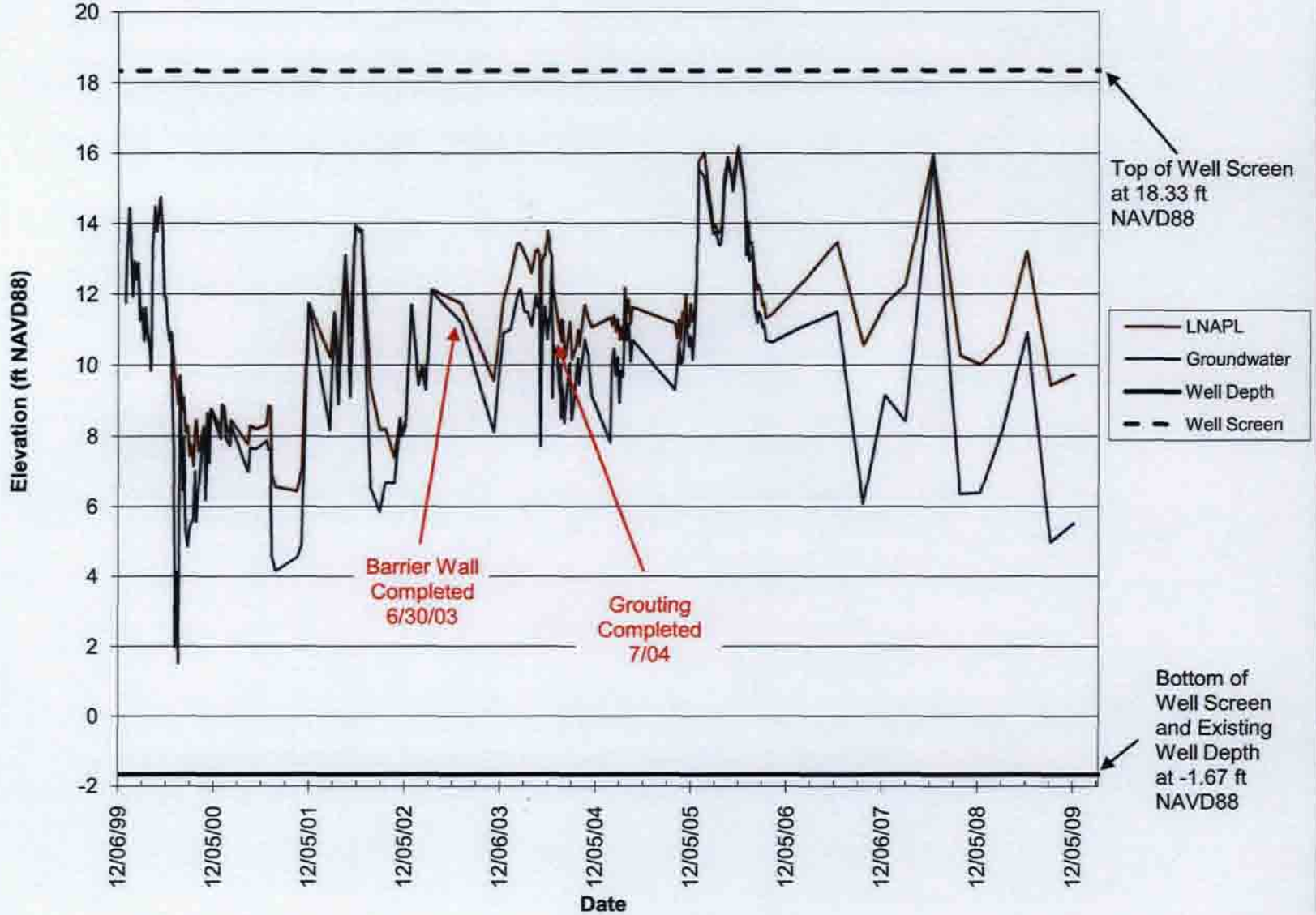
NAPL Thickness Plot for Well EW-18s

1/10

Figure **A-10**

HARTCROWSER

GSI Water Solutions, Inc.



McCormick and Baxter Superfund Site
Portland, Oregon

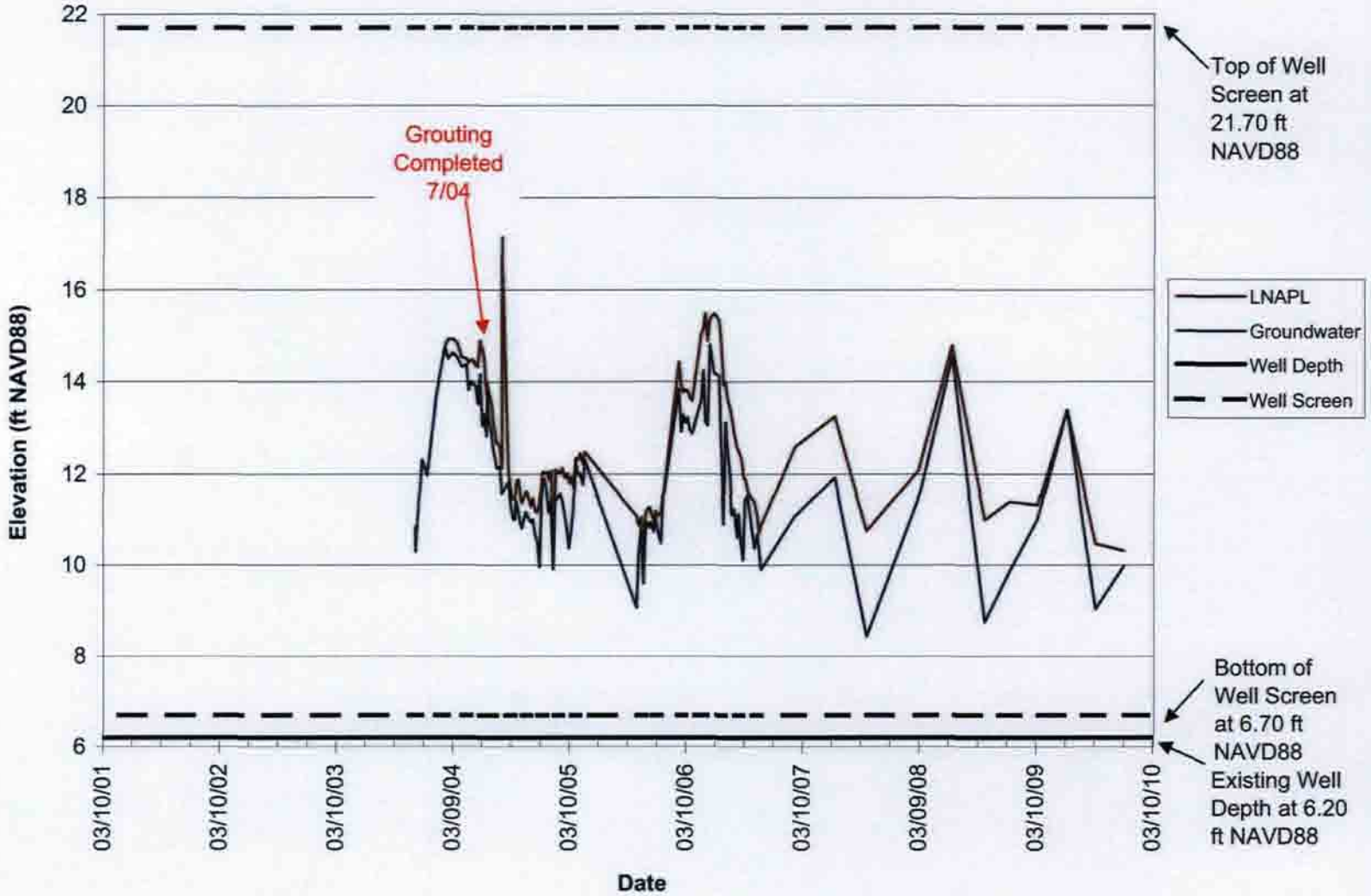
NAPL Thickness Plot for Well EW-23s

1/10

Figure **A-11**

HARTCROWSER

GSI Water Solutions, Inc.



McCormick and Baxter Superfund Site
Portland, Oregon

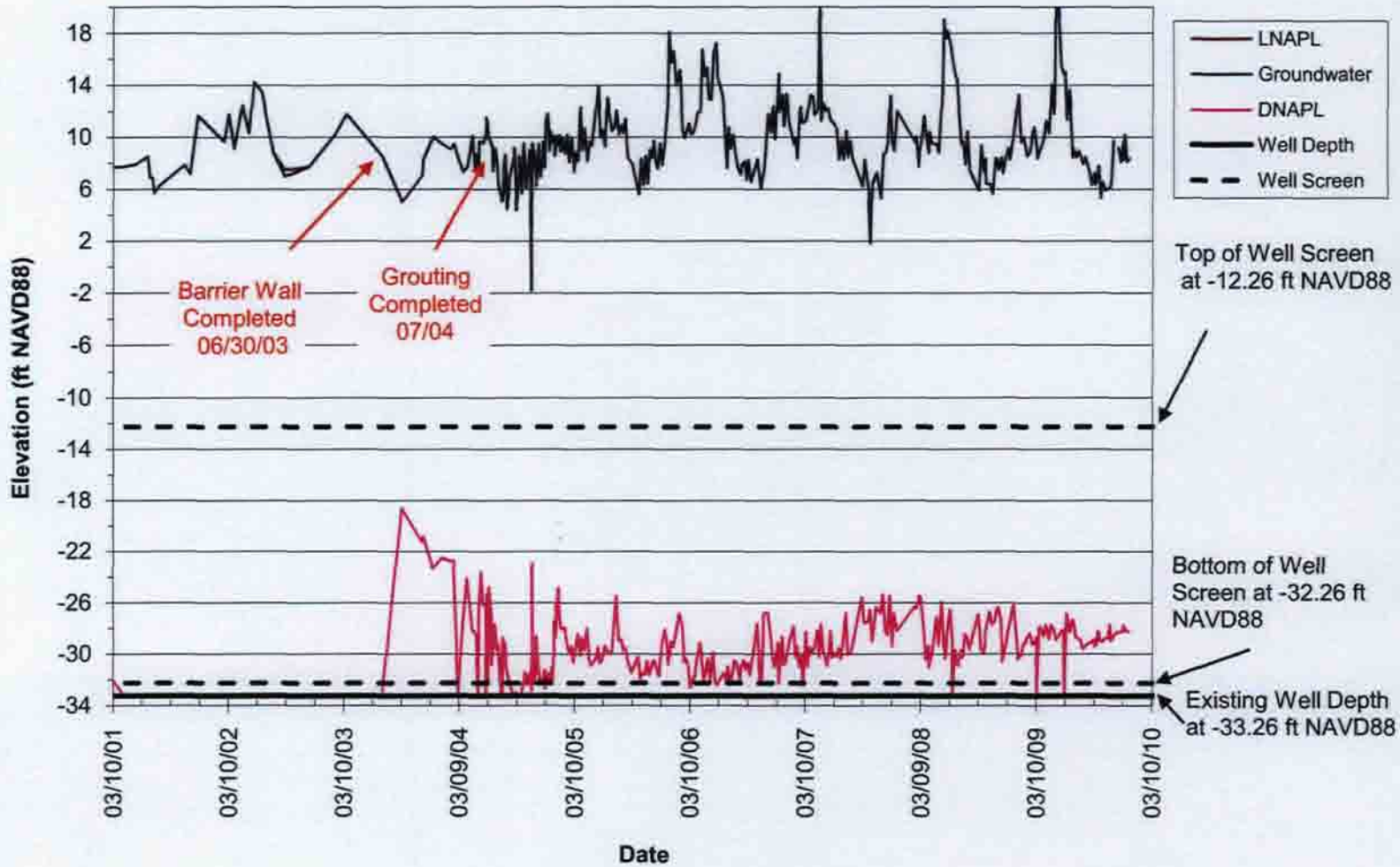
NAPL Thickness Plot for Well MW-56s

1/10

Figure **A-12**

HARTCROWSER

GSI Water Solutions, Inc.



Note: DNAPL recovery was attempted in July 2007 but the extracted liquid appeared to be water with speck sized globules of DNAPL (with a creosote odor), rather than a distinct layer, suggesting that the DNAPL thicknesses measured may not accurately reflect the amount of DNAPL in the well.

HARTCROWSER

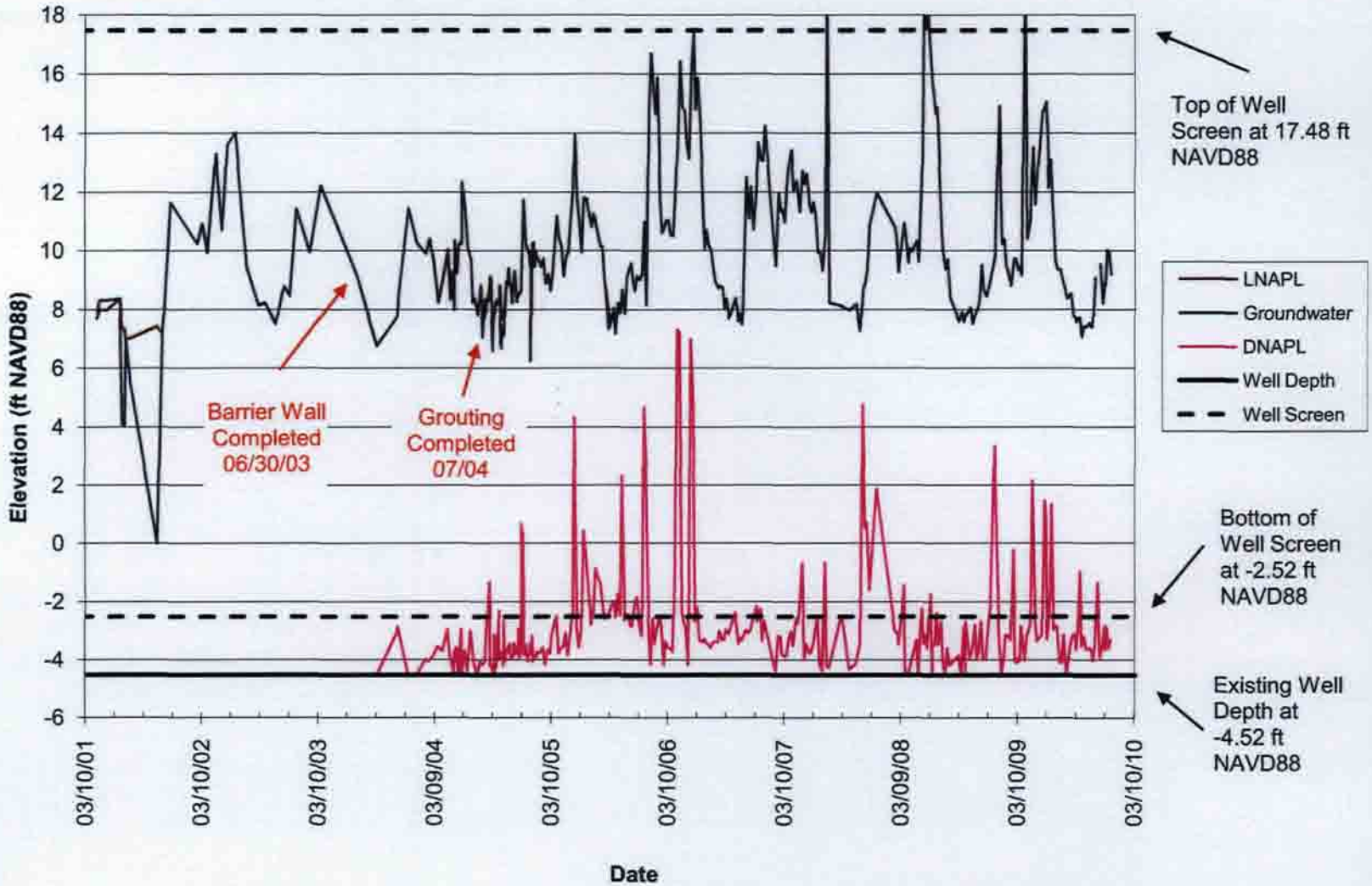
GSI Water Solutions, Inc.

NAPL Thickness Plot for Well MW-20I

1/10

McCormick and Baxter Superfund Site
Portland, Oregon

Figure **A-13**



McCormick and Baxter Superfund Site
Portland, Oregon

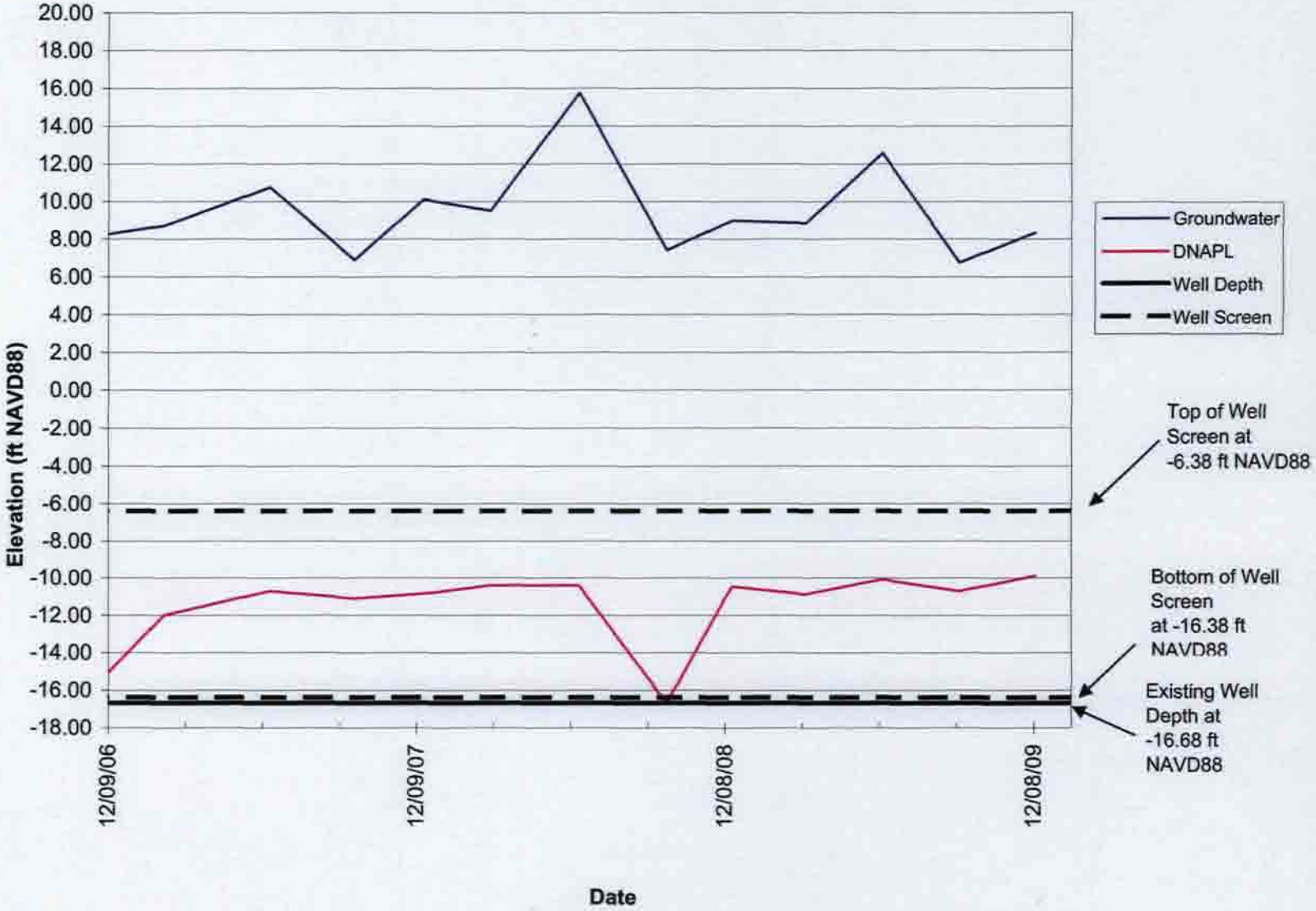
NAPL Thickness Plot for Well MW-Gs

1/10

Figure **A-14**

HARTCROWSER

GSI Water Solutions, Inc.



Note: LNAPL recovery periodically attempted when LNAPL thickness appears to be greater than 0.4 feet. However, the water recovered with the bailer from the top of the water column has speck-sized globules of product dispersed through the water column indicating that no discrete layer of product is present.

McCormick and Baxter Superfund Site
Portland, Oregon

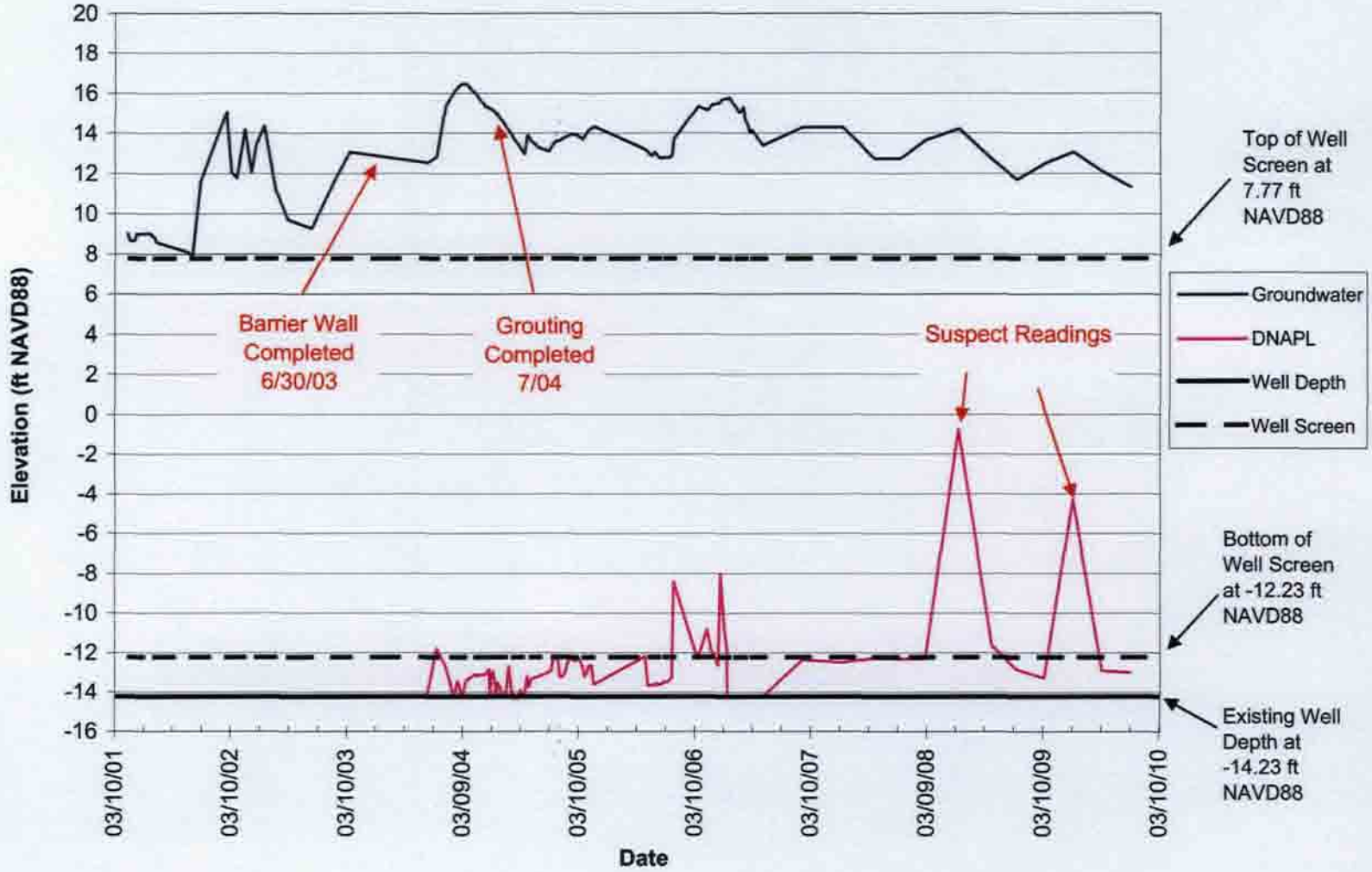
NAPL Thickness Plot for Well MW-22i

1/10

Figure **A-15**

HARTCROWSER

GSI Water Solutions, Inc.



McCormick and Baxter Superfund Site
Portland, Oregon

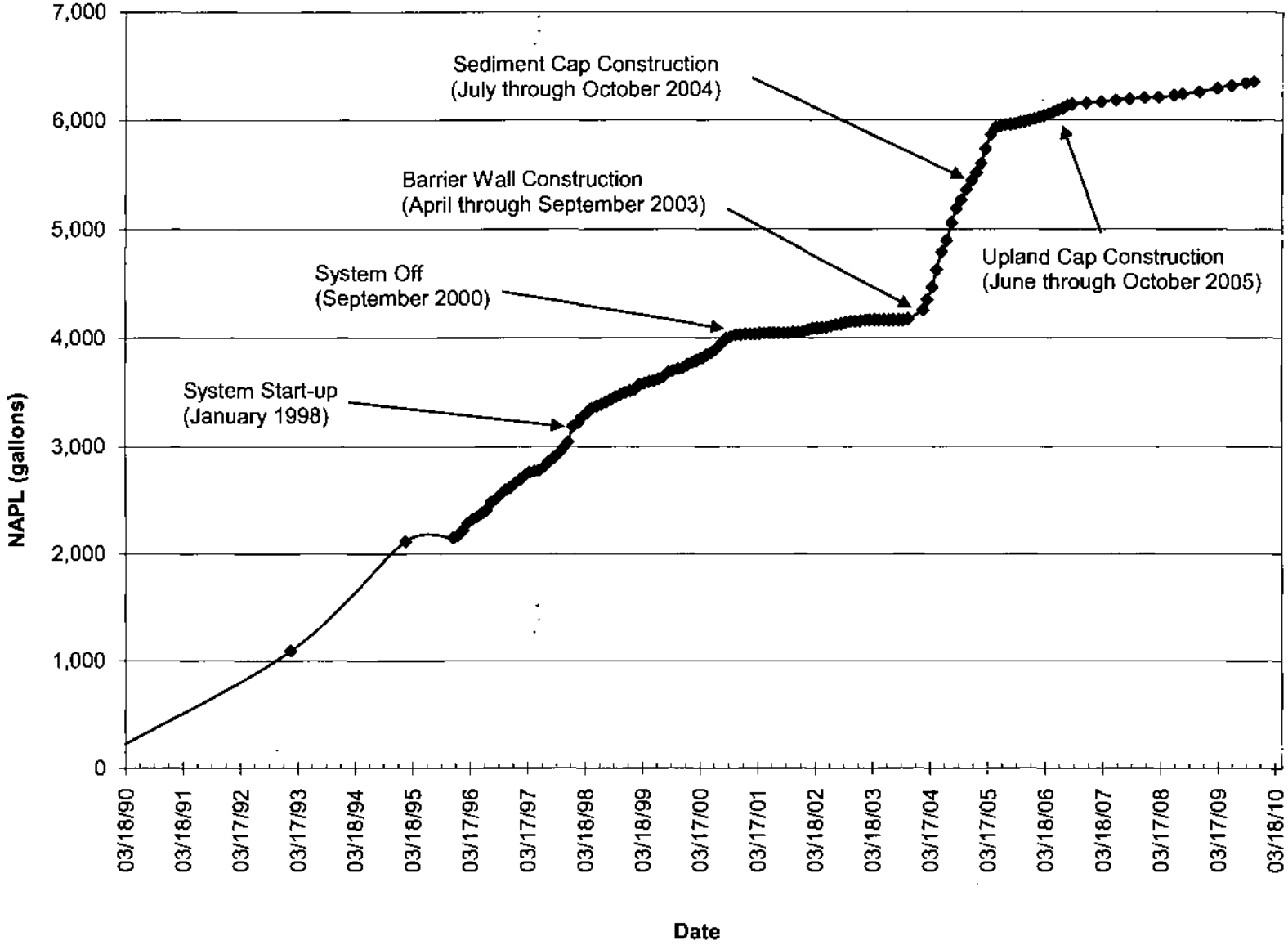
NAPL Thickness Plot for Well EW-8s

1/10

Figure **A-16**

HARTCROWSER

GSI Water Solutions, Inc.



McCormick and Baxter Superfund Site
Portland, Oregon

Cumulative NAPL Recovery

5/09

HARTCROWSER

GSI Water Solutions, Inc.

Figure A-17

LEGEND

- Groundwater Monitoring Wells (Groundwater Elevation)
- Groundwater Elevation Contours (dashed where inferred)
- Willamette River Level During Sampling Event (7.301 feet)
- Subsurface Barrier Wall

NOTES:

1) All elevations shown exist in NAVD 88.
2) Aerial photo taken on September 22, 2006.
3) Water levels measured between 13:21 and 16:11.
4) Willamette River low tide at 16:30 at 7.301 feet NAVD 88.
5) The transducer reading was used for the elevation of groundwater in MW-15s due to a suspect field measurement.

0 200 400

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Groundwater Contour Map for March 13, 2009 Sampling Event

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **A-18**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\Figure\A-18_GW_Contour_Map_March13_2009.mxd, Date: February 15, 2010 10:19:29 AM

LEGEND

- Groundwater Monitoring Wells (Groundwater Elevation)
- Groundwater Elevation Contours (dashed where inferred)
- Willamette River Level During Sampling Event (13.00 feet)
- Subsurface Barrier Wall

NOTES:

1) All elevations shown exist in NAVD 88.
2) Aerial photo taken on September 22, 2006.
3) Water levels measured between 14:00 and 16:00.
4) Willamette River low tide at 15:15 at 13.00 feet NAVD 88.
5) To better demonstrate groundwater flow patterns inside the barrier wall, ground water contours of 0.1 feet were utilized.

0 200 400
Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Groundwater Contour Map for June 12, 2009 Sampling Event

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **A-19**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureA-19_GW_Contour_Map_June12_2009.mxd, Date: February 15, 2010 10:26:20 AM

LEGEND

- Groundwater Monitoring Wells (Groundwater Elevation)
- Groundwater Elevation Contours (dashed where inferred)
- Willamette River Level During Sampling Event (5.71 feet)
- Subsurface Barrier Wall

NOTES:

1) All elevations shown exist in NAVD 88.
2) Aerial photo taken on September 22, 2006.
3) Water levels measured between 09:34 and 11:35.
4) Willamette River low tide at 08:00 at 5.71 feet NAVD 88.

0 200 400

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Groundwater Contour Map for September 11, 2009 Sampling Event

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **A-20**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureA-20_GW_Contour_Map_Sept11_2009.mxd, Date: February 15, 2010 11:12:20 AM

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LEGEND

- Groundwater Monitoring Wells (Groundwater Elevation)
- Groundwater Elevation Contours (dashed where inferred)
- Willamette River Level During Sampling Event (7.561 feet)
- Subsurface Barrier Wall

NOTES:

1) All elevations shown exist in NAVD 88.
2) Aerial photo taken on September 22, 2006.
3) Water levels measured between 09:00 and 12:15.
4) Willamette River low tide at 08:00 at 7.56 feet NAVD 88
5) EW-2s field measurement not included due to suspected error.

0 300 600

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Groundwater Contour Map for December 10, 2009 Sampling Event

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **A-21**

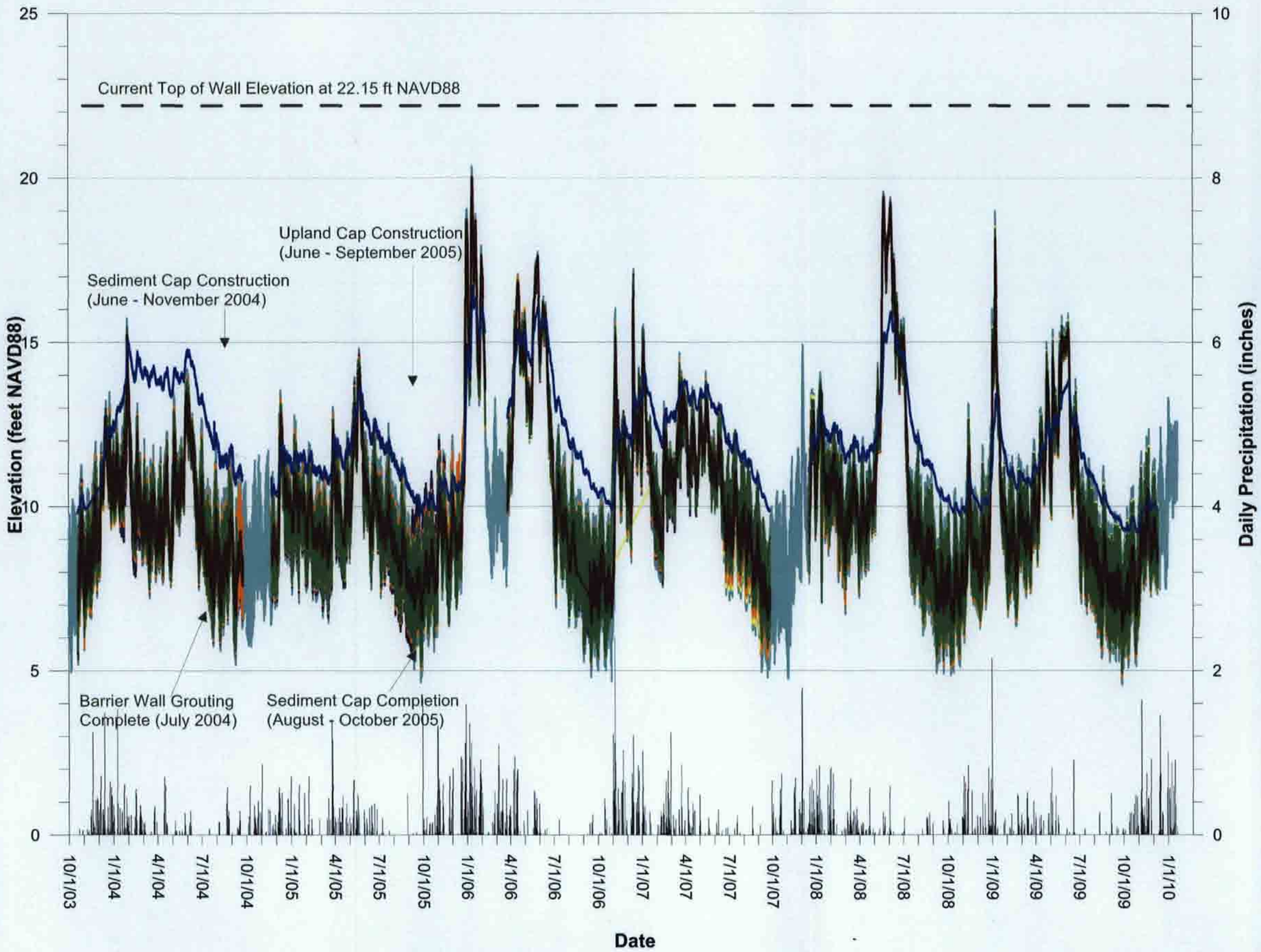

Figure A-22:
Post-Barrier Wall Groundwater Elevations in Monitoring Wells MW-36 and MW-37
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- MW-36s (Interior)
- MW-36i (Interior)
- MW-36d (Interior)
- MW-37s (Exterior)
- MW-37i (Exterior)
- MW-37d (Exterior)
- River
- Precipitation Data

Notes:
MW-36 wells are located inside the barrier wall and MW-37 wells are located outside the barrier wall.

Breaks in transducer data are the result of removal for calibration, removal for well modification, or a damaged transducer was not collecting accurate pressure readings.

HARTCROWSER

GSI Water Solutions, Inc.

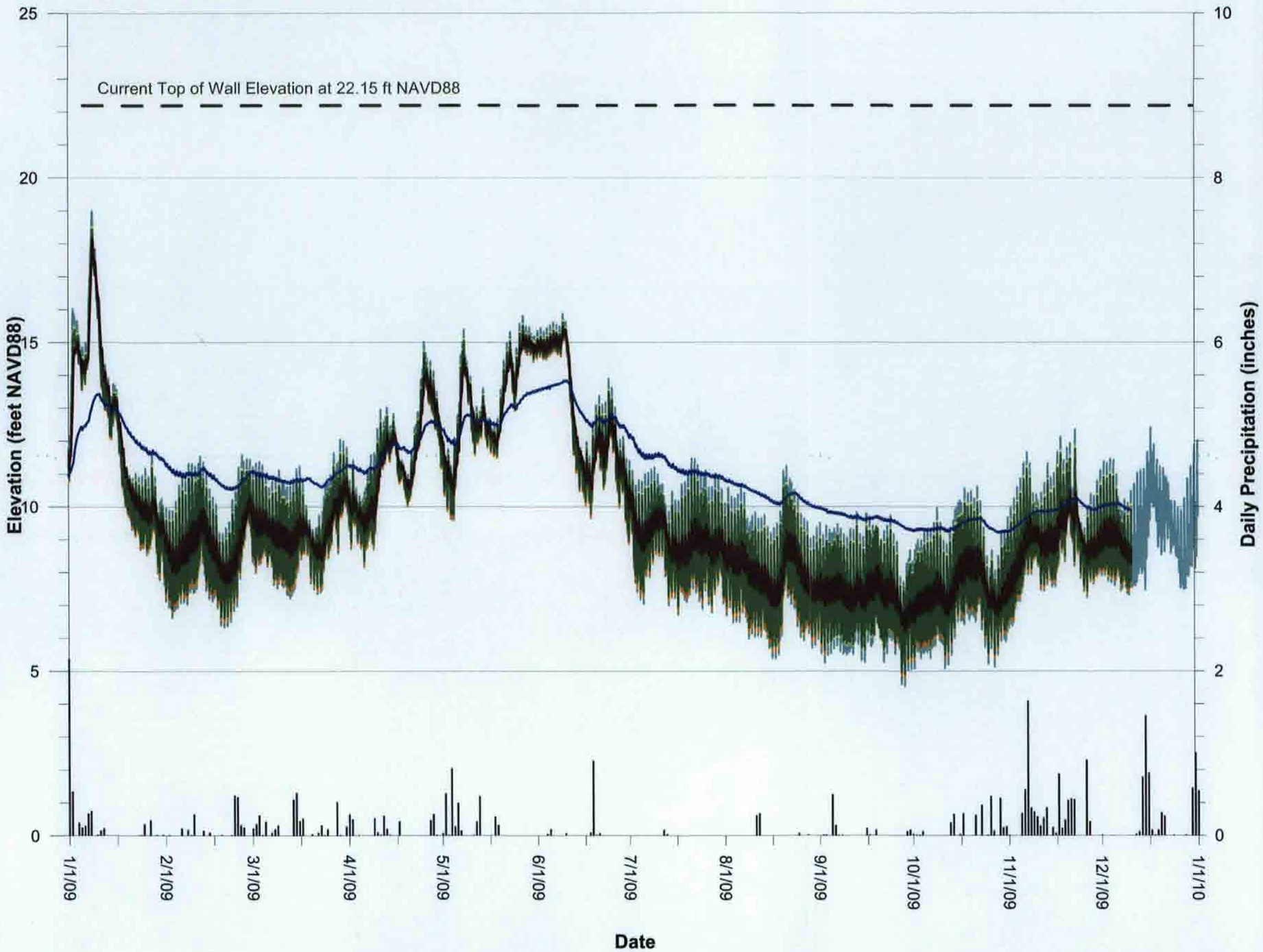

Figure A-23:
2009 Groundwater Elevations in Monitoring Wells MW-36 and MW-37
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- MW-36s (Interior)
- MW-36i (Interior)
- MW-36d (Interior)
- MW-37s (Exterior)
- MW-37i (Exterior)
- MW-37d (Exterior)
- River
- Precipitation Data

Notes:
MW-36 wells are located inside the barrier wall and MW-37 wells are located outside the barrier wall.

Breaks in transducer data are the result of removal for calibration, removal for well modification, or a damaged transducer was not collecting accurate pressure readings.

HARTCROWSER

GSI Water Solutions, Inc.

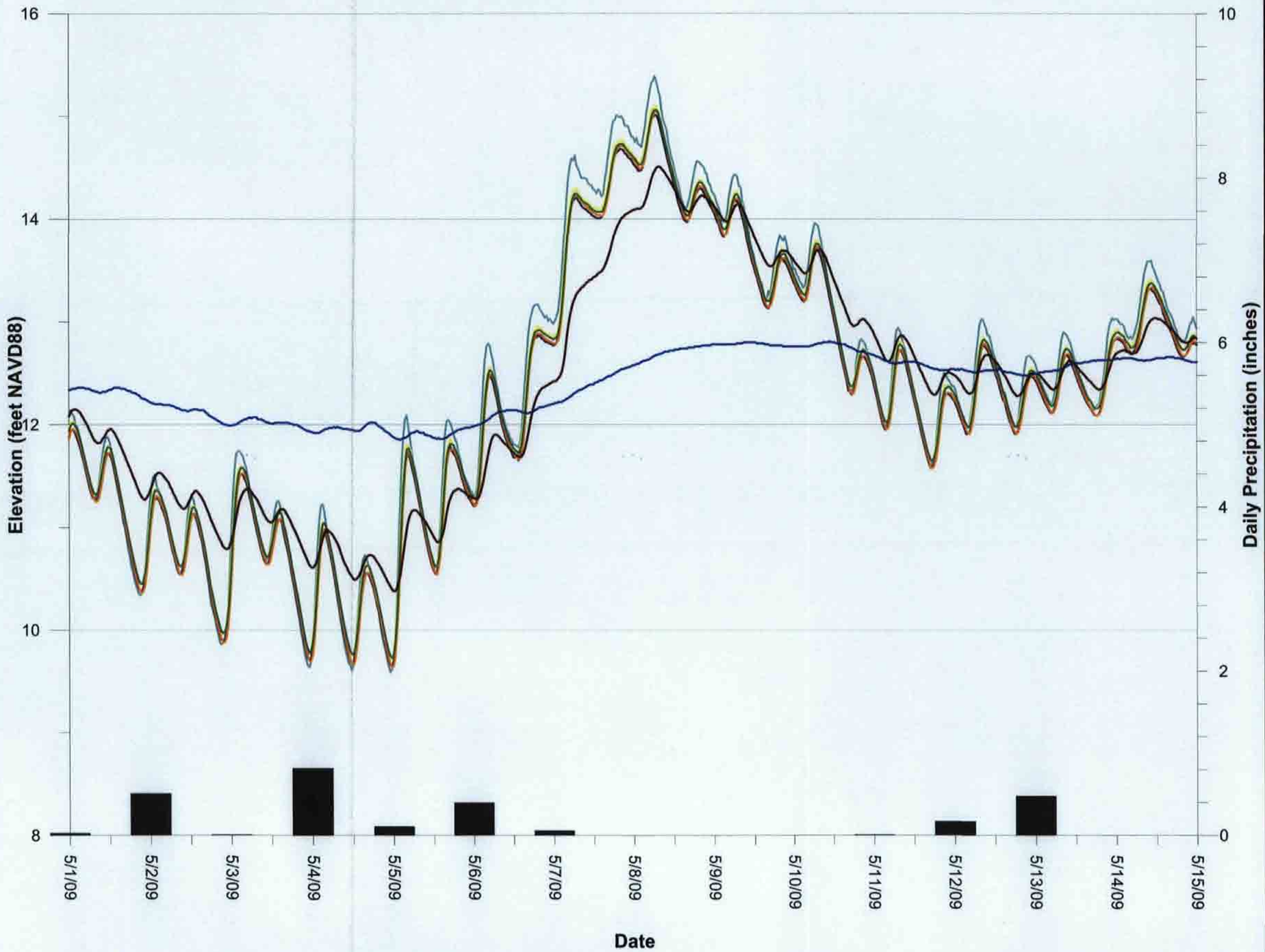

Figure A-24:
May 2009 - Groundwater Elevations in Monitoring Wells MW-36 and MW-37
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- MW-36s (Interior)
- MW-36i (Interior)
- MW-36d (Interior)
- MW-37s (Exterior)
- MW-37i (Exterior)
- MW-37d (Exterior)
- River
- Precipitation Data

Notes:
MW-36 wells are located inside the barrier wall and MW-37 wells are located outside the barrier wall.

HARTCROWSER

GSI Water Solutions, Inc.

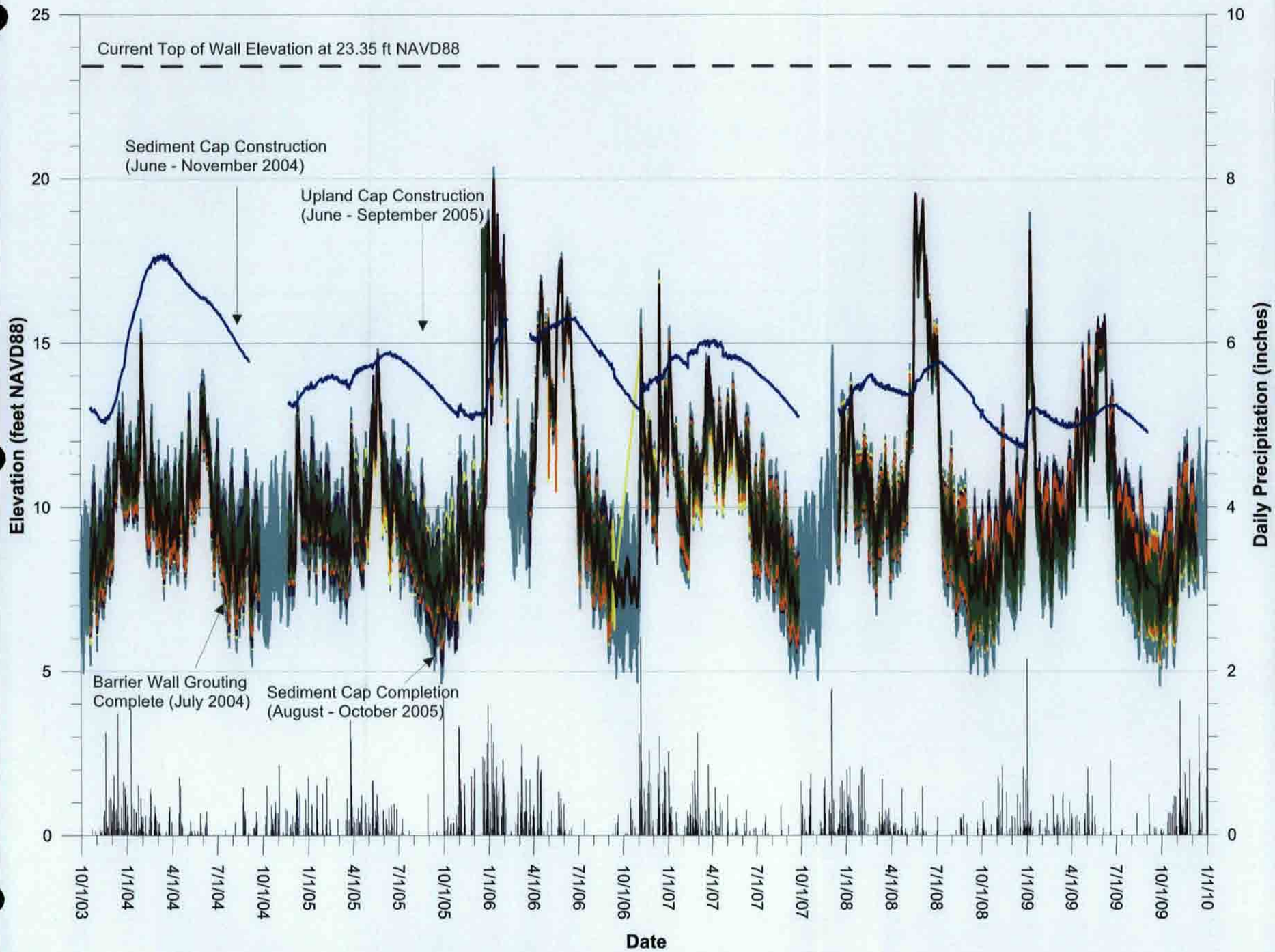

Figure A-25:
Post-Barrier Wall Groundwater Elevations in Monitoring Wells MW-44 and MW-45
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- MW-44s (Interior)
- MW-44i (Interior)
- MW-44d (Interior)
- MW-45s (Exterior)
- MW-45i (Exterior)
- MW-45d (Exterior)
- River
- Precipitation Data

Notes: MW-44 well cluster is located inside the barrier wall and MW-45 well cluster is located outside the barrier wall.

Breaks in transducer data are the result of removal for calibration, removal for well modification, or a damaged transducer was not collecting accurate pressure readings.

HARTCROWSER

GSI Water Solutions, Inc.

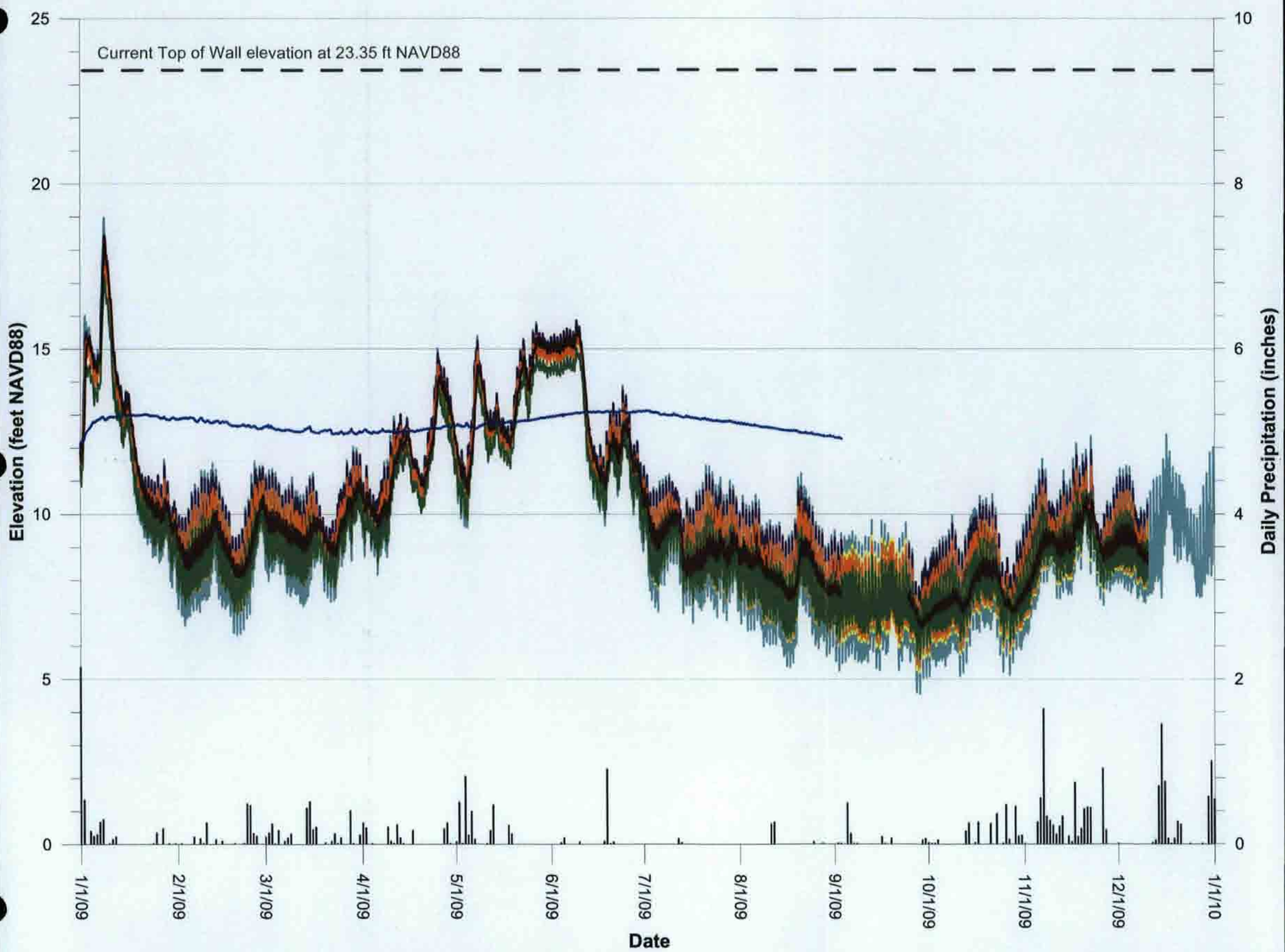

Figure A-26:
2009 Groundwater Elevations in Monitoring Wells MW-44 and MW-45
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- MW-44s (Interior)
- MW-44i (Interior)
- MW-44d (Interior)
- MW-45s (Exterior)
- MW-45i (Exterior)
- MW-45d (Exterior)
- River 2008
- Precipitation Data

Notes: MW-44 well cluster is located inside the barrier wall and MW-45 well cluster is located outside the barrier wall.

Breaks in transducer data are the result of removal for calibration, removal for well modification, or a damaged transducer was not collecting accurate pressure readings.

HARTCROWSER

GSI Water Solutions, Inc.

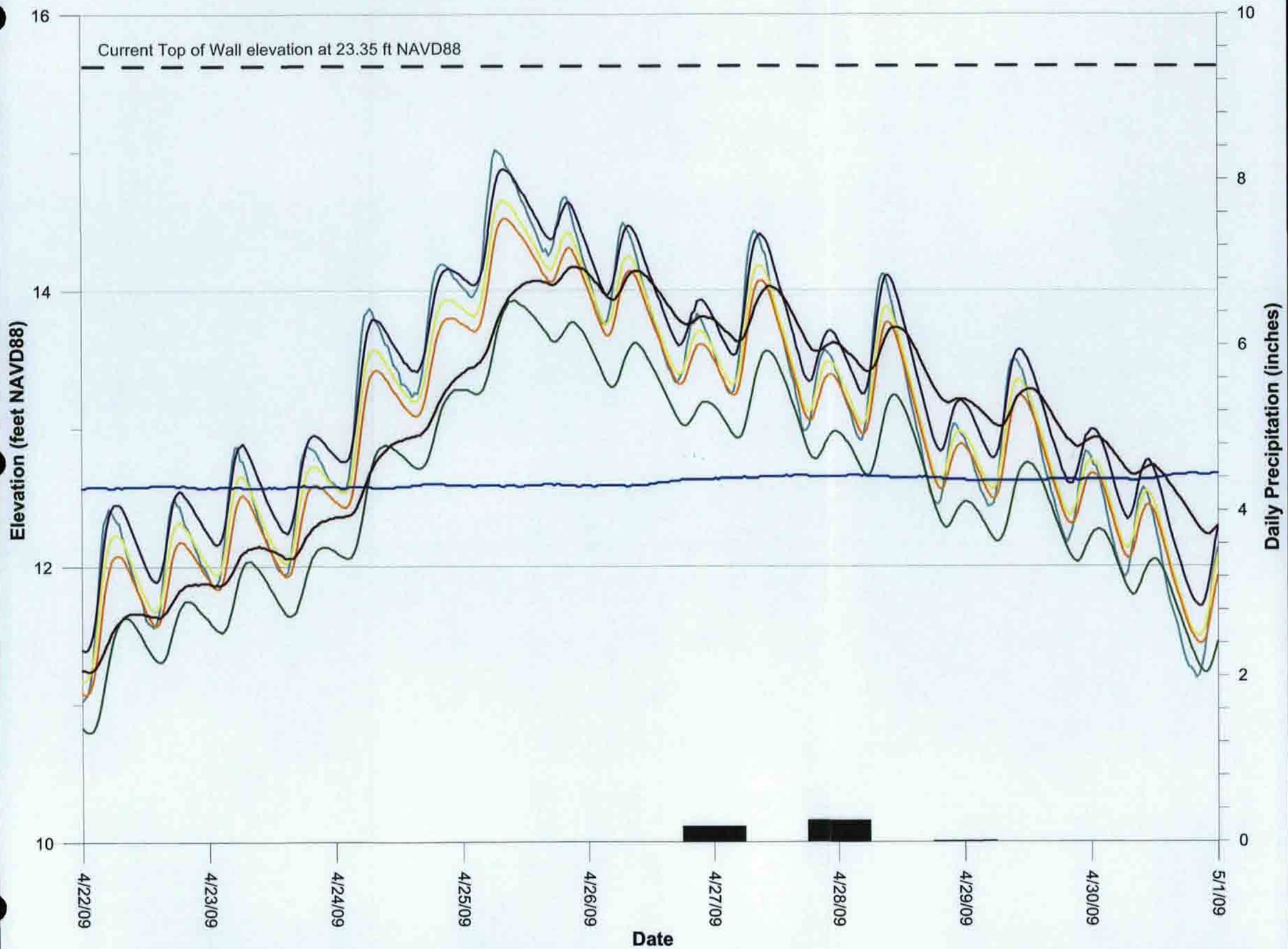

Figure A-27: High Flow Detail
2009 Groundwater Elevations
in Monitoring Wells MW-44 and MW-45
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- MW-44s (Interior)
- MW-44i (Interior)
- MW-44d (Interior)
- MW-45s (Exterior)
- MW-45i (Exterior)
- MW-45d (Exterior)
- River
- Precipitation Data

Notes: MW-44 well cluster is located inside the barrier wall and MW-45 well cluster is located outside the barrier wall.

HARTCROWSER

GSI Water Solutions, Inc.

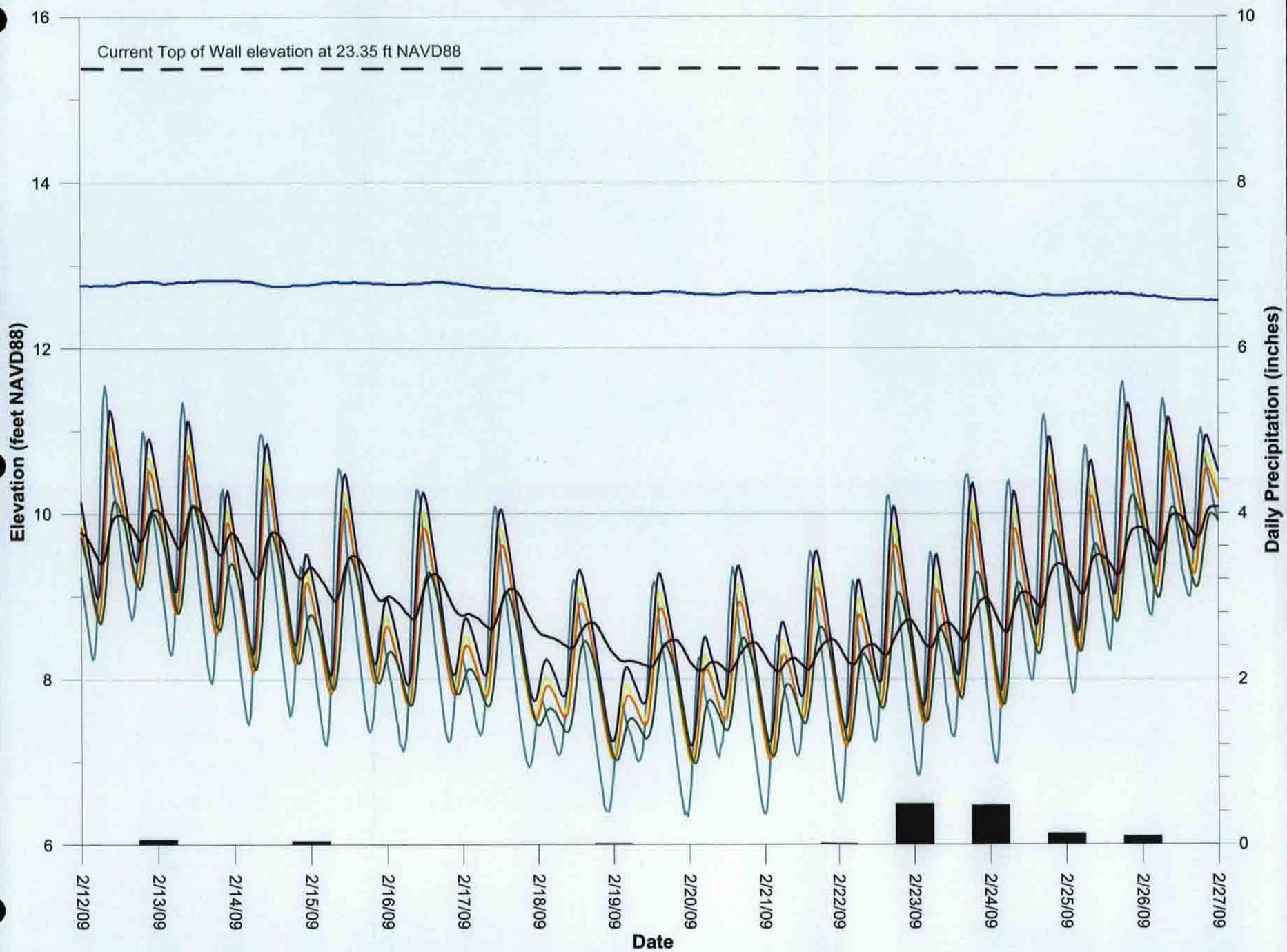

Figure A-28: Low Flow Detail
2009 Groundwater Elevations
in Monitoring Wells MW-44 and MW-45
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- MW-44s (Interior)
- MW-44i (Interior)
- MW-44d (Interior)
- MW-45s (Exterior)
- MW-45i (Exterior)
- MW-45d (Exterior)
- River
- Precipitation Data

Notes: MW-44 well cluster is located inside the barrier wall and MW-45 well cluster is located outside the barrier wall.

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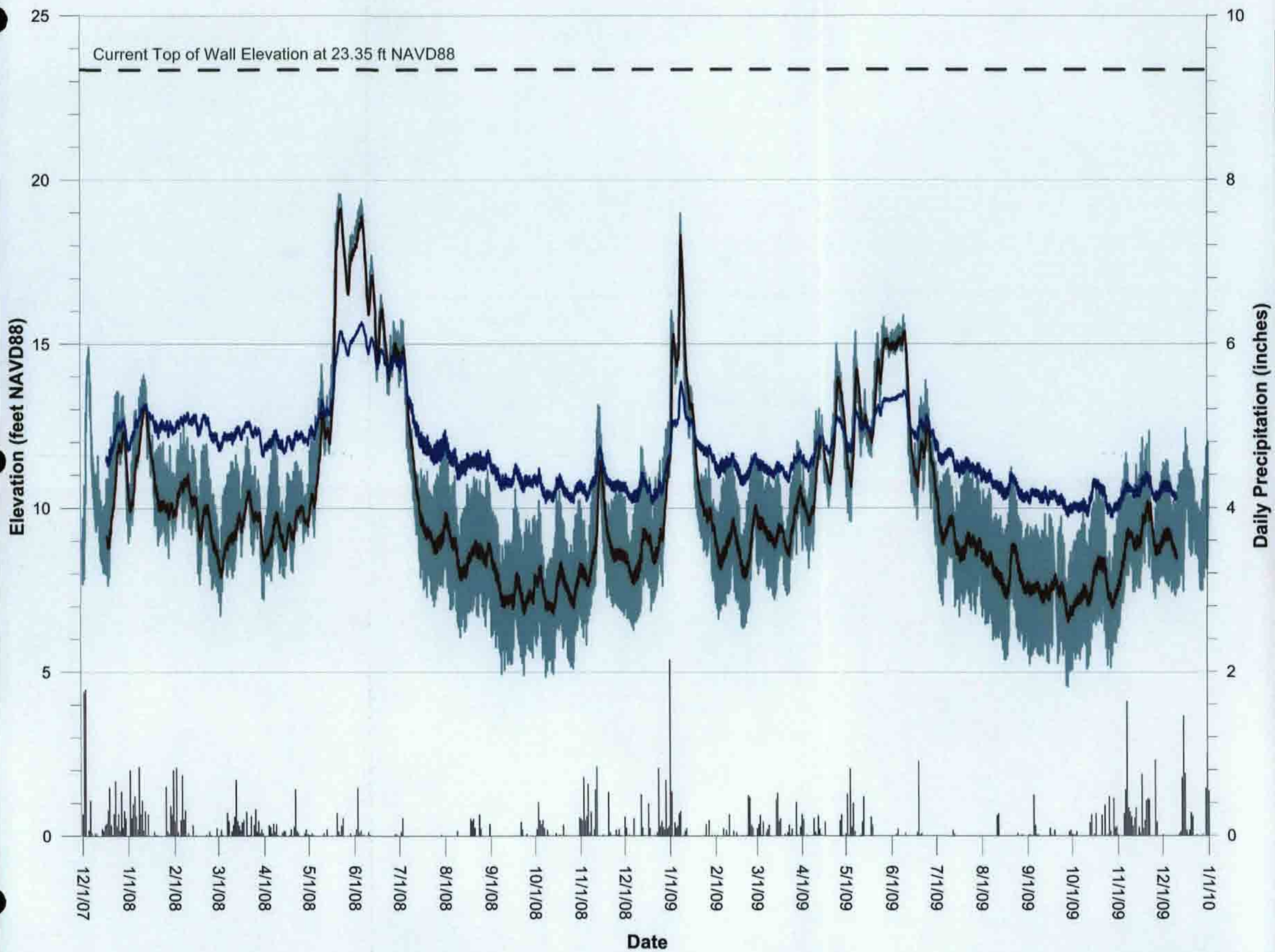

Figure A-29:
Post-Barrier Wall Groundwater Elevations
Monitoring Wells MW-40s and MW-41s
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- MW-40s (Interior)
- MW-41s (Exterior)
- River
- Precipitation Data

Note: MW-40s is located inside the barrier wall and MW-37s is located outside the barrier wall.

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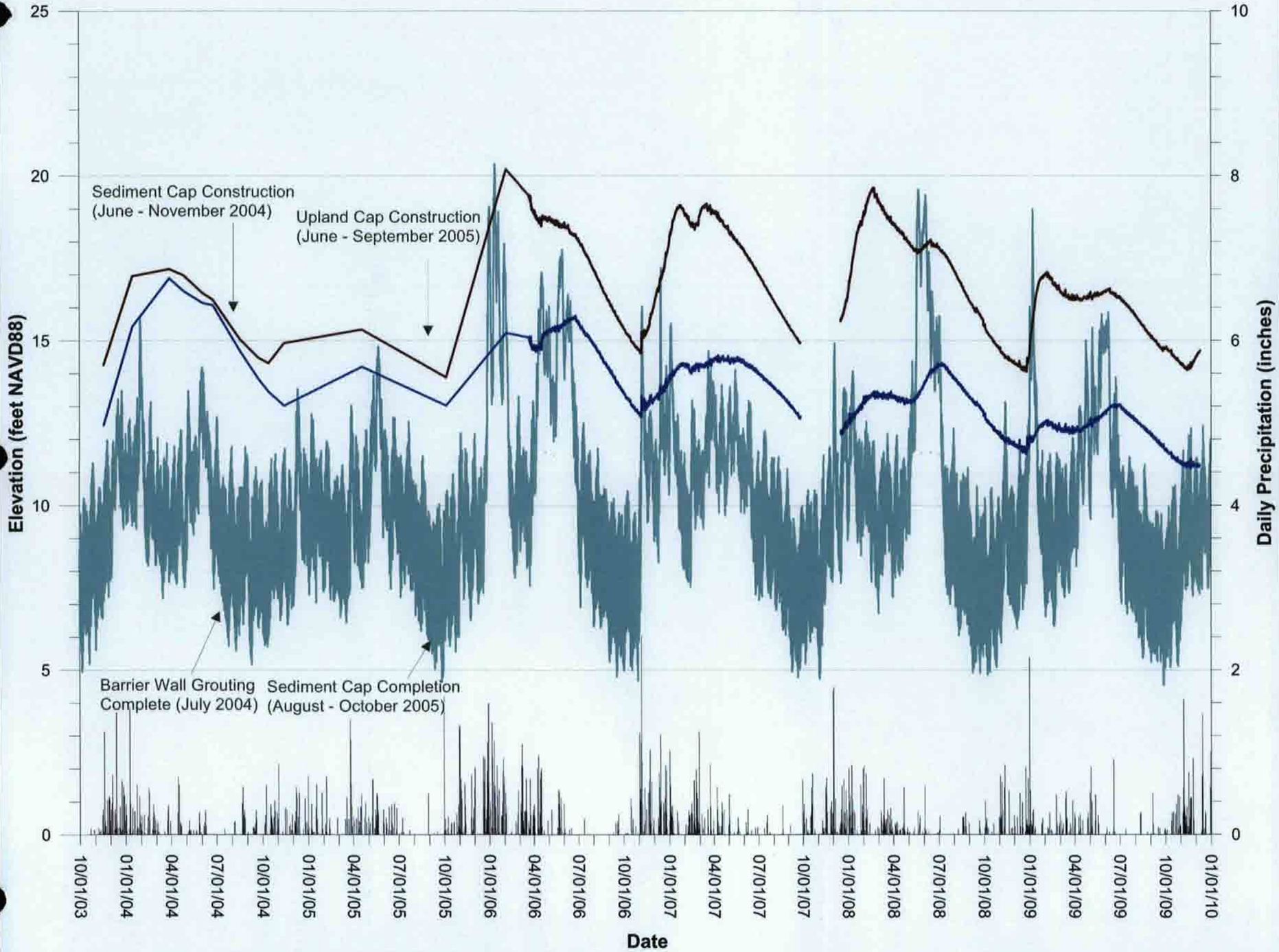

Figure A-30:
Post-Barrier Wall Groundwater Elevations
Monitoring Wells MW-52s and MW-53s
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- MW-52s (Interior)
- MW-53s (Exterior)
- River
- Precipitation Data

Notes:
MW-52s is located inside the barrier wall and MW-53s is located outside the barrier wall.

Top of Barrier wall (not shown) is about 31 ft NAVD.

Prior to March 23, 2006 water level measurements are manual and intermittent.

Breaks in transducer data are the result of removal for calibration, removal for well modification, or a damaged transducer was not collecting accurate pressure readings.

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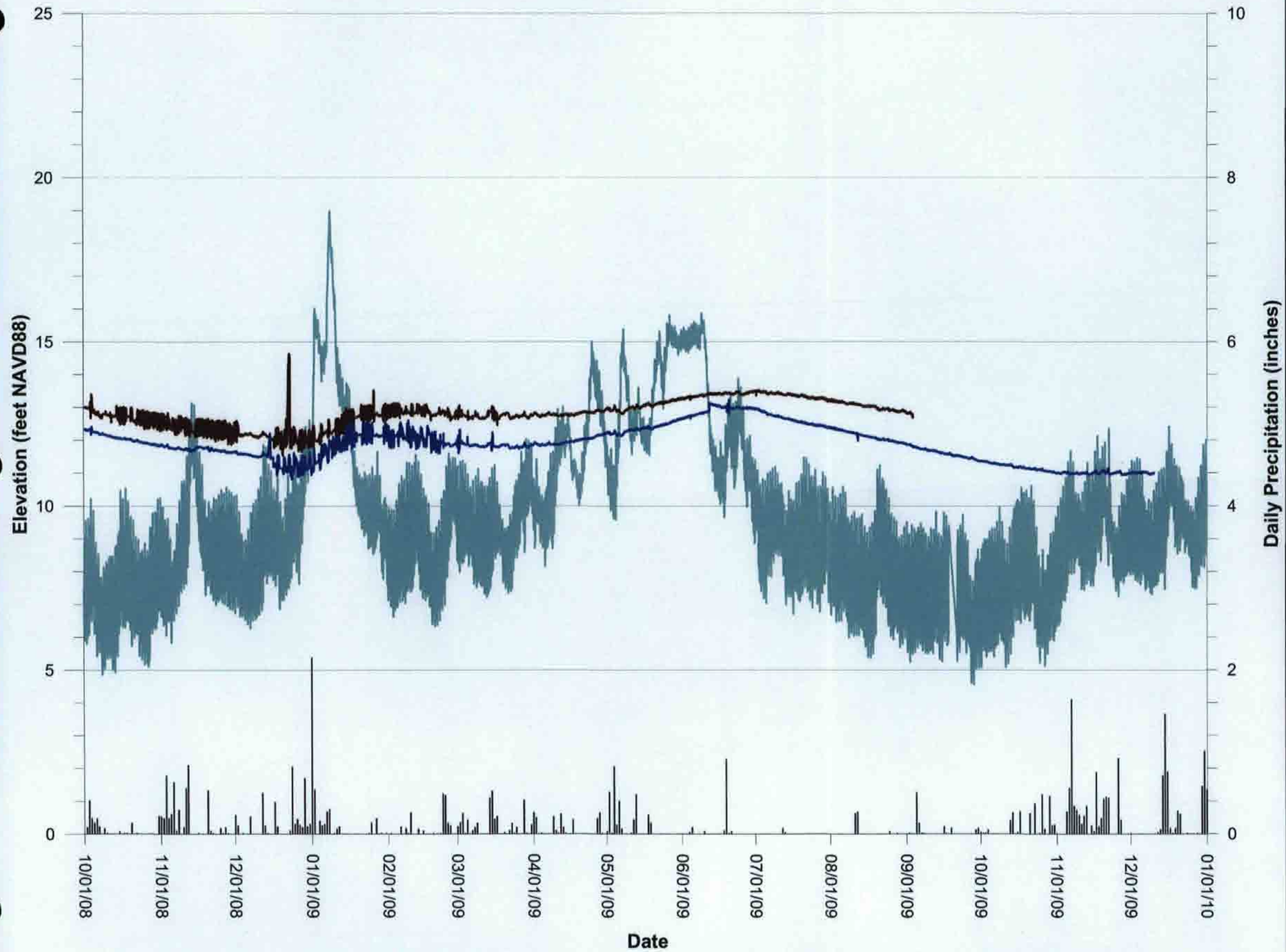

Figure A-31:
2008/2009 Groundwater Elevations
Monitoring Wells MW-15s and EW-1s
McCormick and Baxter Superfund Site
Portland, OR

LEGEND

- EW-1s (Interior)
- MW-15s (Interior)
- River
- Precipitation Data

Note: Monitoring wells EW-1s and MW-15s are located inside the barrier wall.

Breaks in transducer data are the result of removal for calibration, removal for well modification, or a damaged transducer was not collecting accurate pressure readings.

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Appendix B

APPENDIX B
SITE OPERATION AND ACTIVITY SUMMARY

OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009

Hart Crowser/GSI
15670-05/Task 7 May 25, 2010

APPENDIX B
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ATTACHMENTS

A Site Activity Log (DVD)
B Soil Cap Observations (DVD)
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D Monthly Meeting Summaries (DVD)
E Photograph Documentation
F Addtional Subsidence Monitoring Memorandum (DVD)
G Waste Disposal Documentation (DVD)

ACRONYMS

ACB	articulated concrete block
BNRR	Burlington Northern Railroad
Clearwater	Clearwater Environmental Services, Inc.
COP	City of Portland
DEQ	Oregon Department of Environmental Quality
NAPL	nonaqueous phase liquid
O&M	Operation and Maintenance
P&B	Parsons and Brinkerhoff
PGE	Portland General Electric
Site	McCormick & Baxter Superfund Site
TFA	Tank Farm Area

APPENDIX B
SITE OBSERVATION AND ACTIVITY SUMMARY
OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE

1.0 INTRODUCTION

Appendix B to the *January 2009 through December 2009 Operation and Maintenance (O&M) Report* (O&M Report) presents a summary of observation and maintenance activities at the McCormick & Baxter Superfund Site (Site) for the reporting period from January 1, 2009, through December 31, 2009. Attachments A through G provide detailed information about the activities.

2.0 SITE OBSERVATIONS

Site observations and maintenance activities were conducted according to the *Draft Final Operation and Maintenance Plan* (DEQ, 2007). Soils and sediment cap inspections were conducted monthly at the Site in 2009. From mid July through October 2009, additional sediment cap inspections were conducted weekly. These weekly and monthly inspections are considered routine inspections, and are documented in observation forms developed and recorded for the Site. Attachments pertinent to site activity and observations are:

- Attachment A: Site Activity Log;
- Attachments B: Soil Cap Observations;
- Attachment C: Sediment Cap Observations;
- Attachment D: Monthly Meeting Summaries;
- Attachment E: Photograph documentation;
- Attachment F: Additional Subsidence Monitoring Memorandum; and
- Attachment G: Waste Disposal Documentation.

Routine inspections were performed by Clearwater Environmental Services, Inc. (Clearwater), the O&M subcontractor to Hart Crowser for the Site. Site inspections also were performed during monthly Site meetings and miscellaneous Site visits. Observations of interest from the routine inspections and monthly site meetings are summarized on Figure B-1. Miscellaneous Site

inspection observations of interest were documented in field notes and are summarized in this report.

2.1 Sediment Cap Observations

The sediment cap was inspected 25 times in 2009. The inspections were conducted in conjunction with routine inspections during monthly Site meetings, sheen investigation activities, and surface, inter-armoring, and sub-armoring water sampling. Inspections were conducted weekly during the low-water period from mid July through October 2009. Routine monthly and weekly sheen (July through October) sediment cap inspection documentation is included in Attachment B. Sections 2.1.1 through 2.1.4 below describe sediment cap observations regarding sheen, habitat enhancement features and wildlife, sediment cap features, and vandalism and/or trespassing.

2.1.1 Sheen Observations

Sheen was periodically observed during Site inspections from July 23, 2009, through September 28, 2009. The frequency of Site inspections during this period was increased to record the frequency and description of visible shoreline sheen in conjunction with the Ebullition and Sheen Investigation, and Sheen Characterization studies. Though no sheen was observed with or appeared to be caused by ebullition, ebullition was most frequently observed in the former Tank Farm Area (TFA) and the Willamette Cove where granular bulk organoclay has been placed as part of the sediment cap (Attachment E, Photograph 1). Observation details are included in Appendix F - Ebullition and Sheen Investigation Summary in section 4.3 Additional Sheen Investigation of the O&M Annual Report including the date, location, and description of the sheen for each sheen occurrence. Locations of sheen observed in 2009 are presented on Figure B-1. Photographs 2, 3, and 4 (Attachment E) show sheen along the south shoreline, former TFA, and in Willamette Cove, respectively.

2.1.2 Habitat Enhancement Features and Wildlife

Habitat enhancement features, such as boulder clusters and sand cover as a biotic layer, are design elements of the sediment cap. This section provides observations regarding the condition of these features, as well as additional enhancement features (i.e., large woody debris) along the shoreline and in the riparian area above the shoreline. A habitat enhancement survey was conducted by Hart Crowser on November 4, 2009. Figure B-2 shows the distribution of sand and woody debris observed along the shoreline, the location of boulder clusters, and the location of wildlife paths placed on the shoreline in late September 2007.

Generally, the distribution of sand is similar to previous years with sand in place over a large portion of the Site. An approximate 120-foot long "sand-gap" exists where sand was originally placed on the articulated concrete block (ACB) in 2005 along the northern location of the Site shoreline. Sand was placed along the entire length of the shoreline during the 2005 Sediment Cap construction activities. ACB is also exposed toward the southern end of the Site where the bank slope is steeper and in Willamette Cove. A Sediment Stability Assessment prepared by Parsons and Brinkerhoff (P&B) Ports and Marine Inc. (P&B Ports and Marine, 2003) indicated sand washes away along steep sloped portions of the Site and becomes deposited in preferential locations such as flat areas with low velocity. Shoreline sand erosion in 2009 generally follows the predicted Two-Dimensional Hydraulic Model results from the 2003 Sediment Stability Assessment. Similar to what was observed in 2007 and 2008, sand appears to be accumulating on the eastern side of the reef that forms the embayment near the TFA. Sand deposition is also occurring at the northern end of the shoreline near the Burlington Northern Railroad (BNRR) bridge abutment.

Large woody debris has accumulated along the entire length of the shoreline (Attachment E, Photograph 5). Most was deposited near the top of the ACB in early January 2009 following heavy rain and substantial snow melt, and high river levels. Three areas of the shoreline appear to accumulate woody debris at a greater rate then others: at the south end of the shoreline near the City of Portland (COP) outfall, along the shoreline near the TFA, and at the north end of the Site near the BNRR bridge. Boulder clusters placed during original cap construction remain in place, as shown on Figure B-2.

Numerous wildlife species were observed at the Site in 2009. Most frequently observed were various birds, including Canada geese, gulls, pigeons, blue herons, and ospreys (Attachment E, Photograph 6). In the Willamette River, juvenile fish, clams, and crayfish were often observed.

A small animal burrow was identified at the top of the ACB near the southern end of the Site in 2007 and has been monitored through December 2009; no increase in burrow depth or use has been observed.

2.1.3 Sediment Cap Features

The general condition of the sediment cap remains unchanged. Several broken or cracked ACBs have been observed, likely the result of damage from impacting logs during high water events. During routine inspections in conjunction with monthly meetings, several gaps between ACB mat seams were noted where sand has been washed away (Attachment E, Photograph 7).

Additionally during low river levels in September 2009, broken ACB and uneven ACB surface was exposed in Willamette Cove (Attachment E, Photographs 8, 9, and 10). The river level was at a lower elevation than it had been since the installation of the sediment cap, resulting in exposure of an area not previously exposed. It is possible that either the sediment cap was placed over uneven sediments including debris or piling or differential settling within the Willamette Cove has created an uneven cap surface. The cause of this settling will be further investigated in Spring 2010.

Five temporary buoys were placed to mark the outer boundary of the sediment cap to warn of potential underwater hazards after the cap was constructed; two located in Willamette Cove, and three located south of the BNRR bridge. In 2008/2009, two were no longer present, possibly destroyed by high river levels and debris contact with anchor lines. The three remaining buoys currently mark the outer boundary. Permanent buoy replacement is planned for Summer 2010.

2.1.4 Vandalism and Trespassing

The shoreline along the Site and in Willamette Cove is accessible, and is often used by public for various forms of recreation. Throughout 2009, various amounts of shoreline trash and graffiti were observed. In the summer of 2009, transient use was common along the sandy shoreline; however, no full time occupants were observed.

2.2 Soil Cap Observations

The soil cap was inspected 12 times in 2009. The inspections were conducted in conjunction with routine inspections during monthly Site meetings, subsidence survey activity, and miscellaneous Site visits for maintenance purposes (Photographs 11 and 12). Soil cap observation documentation is included in Attachment C. Sections 2.2.1 and 2.2.2 below describe soil cap observations regarding wildlife and vandalism and/or trespassing.

2.2.1 Wildlife

The upland soil cap provides habitat for rabbits, ground squirrels, Canada geese, several species of birds, and coyotes (likely). Despite gravel placement in 2008 to fill the gap beneath Site fencing, evidence of burrowing has been observed under the southwest fence along the perimeter road to enter the Site (Attachment E, Photograph 13). These burrows are filled in with gravel.

Increased ground squirrel activity was observed at several locations south of the Site trailers and various areas throughout the upland soil cap (Attachment E,

Photograph 14). Ground squirrels are common to the general vicinity of the area, and their burrows typically extend from 1 to 3 feet underground. There are unconfirmed instances of burrowing deeper where large colonies inhabit a burrow network (Larson, 2007). Ground squirrels prefer hillsides and low earth banks, sometimes using structures such as trees and boulders for cover. It appears the ground squirrels are using the surplus ACB stockpiled at the site, paved roadway, and concrete well monuments as habitat. There are no indications that any of the borrows exist below the depth of the soil cap, and therefore do not pose a concern that the integrity of the soil cap has been compromised. Continued monitoring of the burrows is recommended; no action to remove burrowing animals or to fill in the burrows is planned at this time.

2.2.2 Vandalism and Trespassing

A gate at the top of North Edgewater Road marks the entrance to the Site and Willamette Cove property. The gate is locked with a series of locks and chain to provide access to two railroads, DEQ, and other agencies that require access to this area. The locks and chain on the gate were cut numerous times in 2009 by other agency and railroad personnel or by people who wanted to gain vehicle access to Willamette Cove (assumed). Although an ongoing nuisance, these breaches of North Edgewater Road gate did not affect the security of the Site because of the surrounding fence, lighting, and alarm system.

On September 17, 2009, Phillips Alarm Company notified Hart Crowser of a power outage at the Site trailers. Tim Skrotzki of Hart Crowser and Newt Linn of Clearwater inspected the area of the site trailers then notified Portland General Electric (PGE). A PGE technician inspected the Site electric meter box and determined that vandals had apparently attempted to remove some wiring. The technician determined that the system was active, nothing was removed from the box, and repaired minor damage. A certified electrician was contracted to inspect and reconnect the electricity. No other apparent damage to the Site was observed.

2.3 Soil Cap Subsidence

In June 2008, the MW-23d inner casing was observed to be protruding approximately 4 inches above the outer casing monument. Subsequent upland survey results confirmed that ground surface elevation subsidence had occurred in the vicinity of MW-23d. A *Subsidence in Upland Cap Memorandum* (Hart Crowser, 2008) was prepared for DEQ by Hart Crowser in 2008 to present activities to determine vicinity subsidence and recommended actions. Additional subsidence monitoring was completed during the 2009 reporting period, including stormwater conveyance system inspection, upland hub and well

surveying (July through September 2009), EW-1s groundwater and vapor sampling, and data interpretation. A detailed description of these activities with additional recommendations is presented in the *Additional Subsidence Monitoring Memorandum* (Attachment F). Subsidence monitoring activities and results are described below.

Storm Drain. On March 27, 2009, Pacific Int-R-Tech videotaped the inside of stormwater piping extending from Manhole B to Manhole C, from Manhole C to Manhole E, and from Manhole E to the outfall. Two conveyance line sags were noted in the line between Manhole B and Manhole C. Although sagging is present, the video tape did not reveal any signs of pipe stress, failure, or leaking. Based on the results of the video, elevation measurement, and stormwater discharge monitoring, the stormwater piping system continues to function properly.

Survey Results. As part of the broader site surface evaluation, survey hubs were placed to monitor the ground elevation in 16 locations on the upland soil cap, and at several points along the storm drain line. The results of the survey show the most significant area of subsidence is near wells MW-23d and EW-1s and decreases with distance from these wells.

Elevation data was also collected for the top of inner and outer casing of MW-23d and EW-1s. Between July and September 2009, the MW-23d monument (outer casing) elevation declined by 0.013 foot, or 0.006 foot per month. In contrast, the well casing (inner casing) declined by 0.034 foot between September 2008 and September 2009 or approximately 0.003 foot per month. This suggests that the ground surface/monument was subsiding at approximately twice the rate of the well casing. The casing elevation for shallow EW-1s well has also been declining. The EW-1s well casing dropped 0.027 foot in elevation between July and September 2009, or approximately 0.013 foot per month.

EW-1s Gas Sampling. During a site visit in November 2008, a significant amount of vapor was observed when the lid to EW-1s was opened. Ebullition from water in the well was also noted. Transducer data showed pressure head reading variation by as much as 0.7 foot between 30 minute intervals. Pressure induced by the periodic release of gas is likely the cause for the observed, temporary changes in groundwater elevation in EW-1s. On May 18, 2009, an air-tight well seal was placed on the well in preparation for gas sampling and analysis to determine the composition of gas within the well. Following an equalization period, both vapor (gas) and groundwater samples were collected on July 1, 2009. The samples were analyzed for carbon dioxide, carbon monoxide, oxygen, and methane.

The sample results indicate near homogenous mixing of in-well gases in an anoxic environment consisting of 44 percent carbon dioxide and 29 percent methane. The balance of gas is assumed to be nitrogen based on composition of atmospheric gases as the source of vadose zone oxygen. Results of dissolved gas in groundwater samples reflect similar conditions - anoxic environment with elevated carbon dioxide and methane concentrations.

EW-1s Groundwater Sampling. Groundwater samples collected near the top and bottom of the saturated interval were also analyzed for site contaminants and indicators of reductive activity. Analytical results were similar for both intervals. Significant concentrations of dissolved total organic carbon were present in both samples, ranging up to 45.5 mg/L. Both sample intervals contained detectable arsenic, iron, and zinc. Detected iron was essentially present only as the ferrous species, consistent with strong iron reducing and methanogenic conditions. Groundwater chemistry results confirmed that groundwater in the vicinity of EW-1s was highly reductive.

Conclusions. The recent survey results confirm that the upland cap is settling in the vicinity of wells MW-23d and EW-1s. A review of previous subsurface investigations in this area, indicate the presence of significant subsurface wood debris. Survey data collected from September 2008 through September 2009 suggests that upland cap ground settling is occurring at a rate of up to 0.015 foot per month.

Evaluation of vapor and dissolved gas results suggest that oxygen was continually being introduced into the vadose zone in the vicinity of EW-1s. This oxygen was then rapidly and energetically utilized to microbiologically degrade organic carbon (wood debris) to produce carbon dioxide. This carbon dioxide then diffuses to lower elevations and is subsequently being utilized to further degrade organic carbon through the much slower and less energetic process of methanogenesis. There is no evidence that a compromise to cap integrity (i.e., the boot seal around EW-1s) is a source of the oxygen to stimulate this degradation process.

A contributing factor to the settling in the wood waste area is believed to be declining water levels. Depending on the rate of water level declines, this compression can be relatively fast and seemingly abrupt. Because shallow groundwater levels within the cap are approaching equilibrium with the Willamette River, additional changes in overburden pressure within the landfill mass are likely to slow. Due to the large mass of residual wood waste in the vicinity of MW-23d and EW-1s, it is likely that further settling will occur over time. The degree and rate at which settling occurs is dependent on groundwater elevations, weight of overlying unsaturated soils, compaction of

subsurface wood waste, and the availability of electron acceptors, such as oxygen and carbon dioxide, to facilitate degradation. While the evaluation did not find evidence of soil cap failure, further significant settling in the future may stress cap features (i.e., stormwater conveyance and well boots), potentially resulting in some degree of failure of the stormwater conveyance system.

2.4 Burlington Northern Railroad Road Right of Way Construction

In early October 2009, a contractor (Nutter Corporation) for BNRR began building a road in the right of way between the McCormick and Baxter Site northwest property boundary and BNRR south embankment. The road extends from the underpass west to the elevated railroad tracks. Exposed orange plastic fencing was observed by DEQ during excavation activities to prepare a base for the road. The exposed orange fencing was placed during the upland soil cap placement at the Site to define the final elevation (sub-grade) and areal extent of potentially contaminated soil remaining beneath the upland soil cap. The orange fencing was visible because part of the upland soil cap soil had been removed in the right of way along with resident soil and vegetation. Nutter Corporation was also observed excavating, and removing soil and railroad ties from the slope of the railroad embankment for offsite disposal.

3.0 MAINTENANCE ACTIVITIES

Maintenance activities in 2009 at the Site were performed by Clearwater. Activities ranged from weekly maintenance of pumps and regulators to non-routine tasks such as bathroom pipe repairs and ACB replacement. In addition to activities performed by Clearwater, non-routine maintenance activities were performed by Moen Machinery Company, the COP, PGE, Instrumentation Northwest, and Waste Watch. The following section discusses routine maintenance tasks and non-routine tasks performed in 2009. Site support services, such as phone, alarm, solid waste, and wastewater were provided by Qwest, Phillips, Trashco Services, and Schulz-Clearwater Sanitation, respectively.

3.1 Routine Maintenance

Clearwater performed routine maintenance on the pumps, compressor, regulators, lines, oil interface meter (used to perform nonaqueous phase liquid [NAPL] gauging and extraction), and the Site vehicle (Kubota). Routine maintenance is crucial for keeping the equipment in proper working order to avoid activity delays. Three transducer well data loggers were sent to Instrumentation Northwest for repairs in 2009. The Site vehicle received

recommended annual inspection and maintenance by Moen Machinery Company.

Routine maintenance was also provided for the Site vegetation management plan, conducted by the COP. Prior to the winter of 2008-2009, the irrigation system was turned off and drained to prevent freeze damage, which also required removal of the pressure reducing valve from the site fire hydrant. In June 2009, the pressure reducing valve was re-installed by Clearwater and the irrigation system was re-commissioned. The COP performed inspections along the system to check for freeze or other damage, repaired any damage, and began operating the system when weather conditions warranted irrigation. In November 2009, the irrigation system was de-commissioned again and the pressure reducing valve was removed.

NAPL extracted from wells, wastewater generated during groundwater monitoring, and solid waste generated during NAPL collection and measurement activities were removed for offsite disposal by Waste Watch on November 18, 2009. Seven, 55-gallon drums of NAPL and purged wastewater, three totes, and one drum of soil were removed for disposal as hazardous waste. Documentation for this activity is provided in Attachment G.

3.2 Non-Routine Maintenance Activities

Clearwater and other service providers also performed non-routine maintenance activities that are typically action items from monthly meetings or in response to Site observations (e.g., meter box vandalism).

An extended cold event in late December 2008 caused a water pipe in the Site bathroom trailer to break and flood the trailer with approximately 4 inches of water. Clearwater repaired the broken pipe, and was able to remove the water and use fans to dry the trailer during the week of January 16, 2009. No other damage to the Site trailers were observed in 2009.

4.0 SUMMARY

In 2009, sheen was frequently observed in several locations along the shoreline at the Site from approximately late July to October 2009. Shoreline sheen was not observed at the Site at any other time in 2009. A comprehensive effort to identify the source and mechanism of the sheen were conducted as part of the Additional Sheen Investigation (results of which are presented in Appendix F of this report).

In general, the sediment cap and the upland soil cap inspections revealed few unexpected changes or areas of concern with the exception of the subsidence occurring in the upland cap. The general vicinity of upland soil cap subsidence is coincidental with subsurface wood debris. It is likely that degradation of the wood debris coupled with the decrease in groundwater level inside the barrier wall are contributing to the subsidence in this vicinity. Recommended activities include continued transducer monitoring in MW-15s and EW-1s, elevation differencing measurement at well MW-23d, continued periodic upland cap surveying to determine longer-term settling rates, and periodic collection of vapor and dissolved gas samples from EW-1s.

Sand covers the ACB over much of the shoreline, and there are significant amounts of large woody debris that have accumulated to help create wildlife habitat. Wildlife commonly seen at the Site includes Canada geese, blue herons, ospreys, crawfish, squirrels, and rabbits; evidence of coyotes has also been observed. The general public frequents the shoreline for recreation, most commonly walking dogs. A few instances of vandalism to the Site (e.g., meter box damage), and littering have occurred.

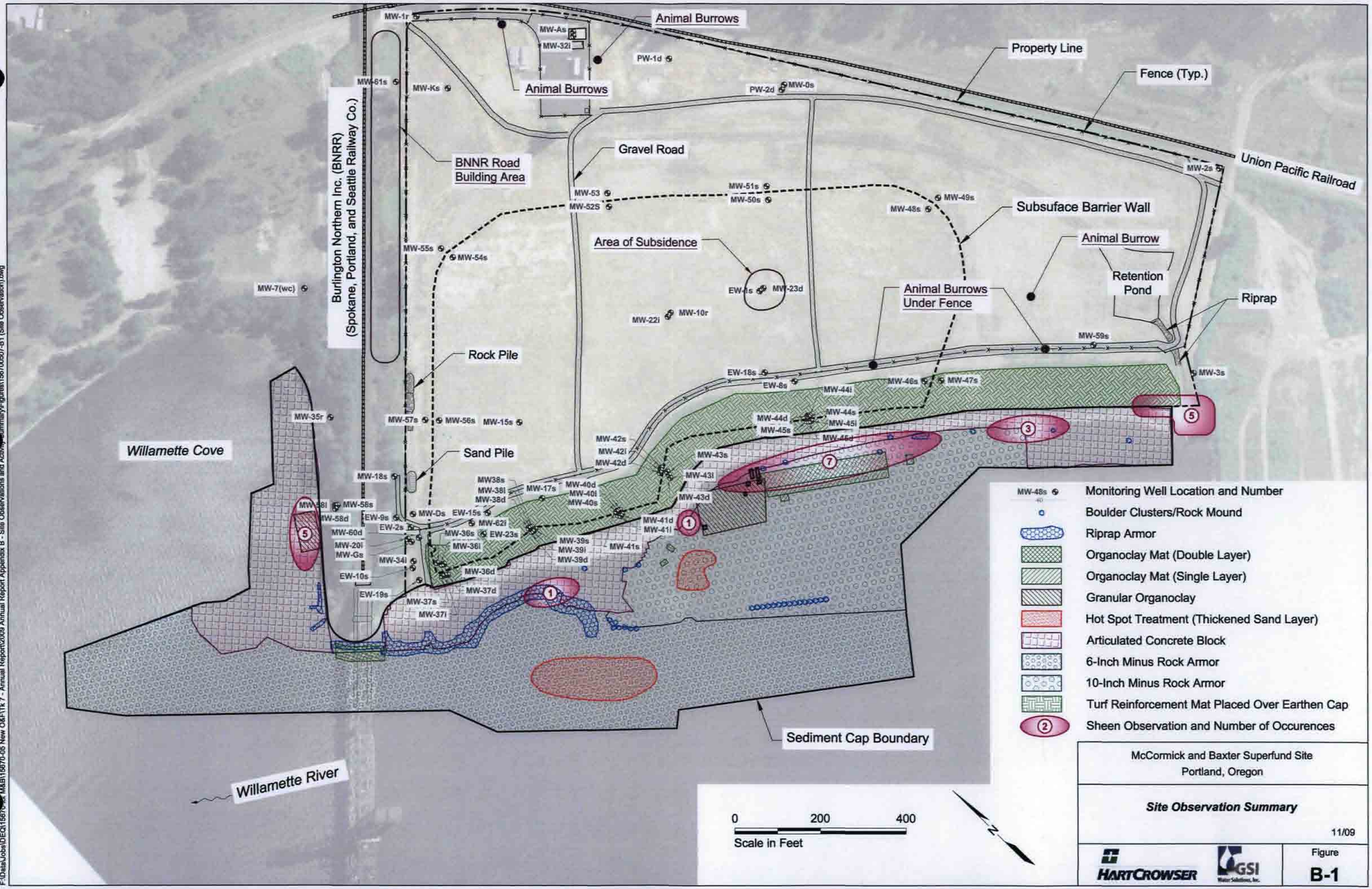
Site inspections and observations resulted in several non-routine maintenance activities in addition to routine activities. Non-routine activities included operating the irrigation system, repairing the electrical meter box, and repairing water piping in the office trailer. It is anticipated that Site inspections and maintenance activities will continue as described in the *Draft Final Operation and Maintenance Plan.*

5.0 REFERENCES

Hart Crowser, 2008. *Subsidence in Upland Cap Memorandum, McCormick and Baxter Superfund Site Portland, Oregon.* December 15, 2008.

Parsons and Brinckerhoff (P&B) Ports and Marine, 2003. *Sediment Stability within the Proposed Sediment Cap and River Bankline Areas, McCormick & Baxter Creosoting Company Superfund Site Portland, Oregon.* February 2003.

DEQ, 2007. *Draft Final Operation and Maintenance Plan, McCormick and Baxter Creosoting Company Superfund Site Portland, Oregon.* March 2007.



McCormick and Baxter Superfund Site
Portland, Oregon

Site Observation Summary

11/09

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GSI Water Solutions, Inc.

Figure
B-1

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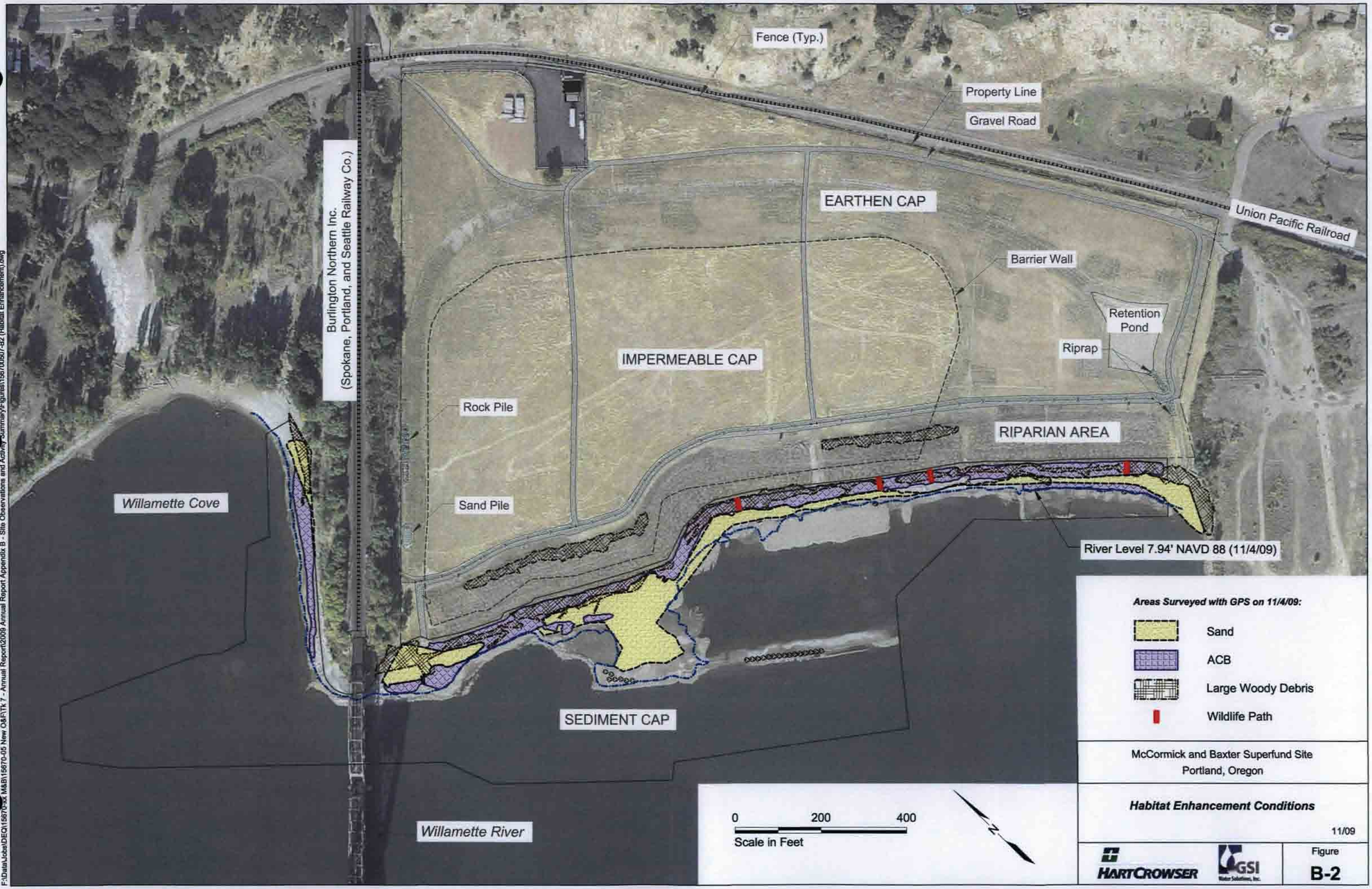

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ATTACHMENT A
SITE ACTIVITY LOG

Included only on the O&M Report DVD

ATTACHMENT B
SOIL CAP OBSERVATIONS

Included only on the O&M Report DVD

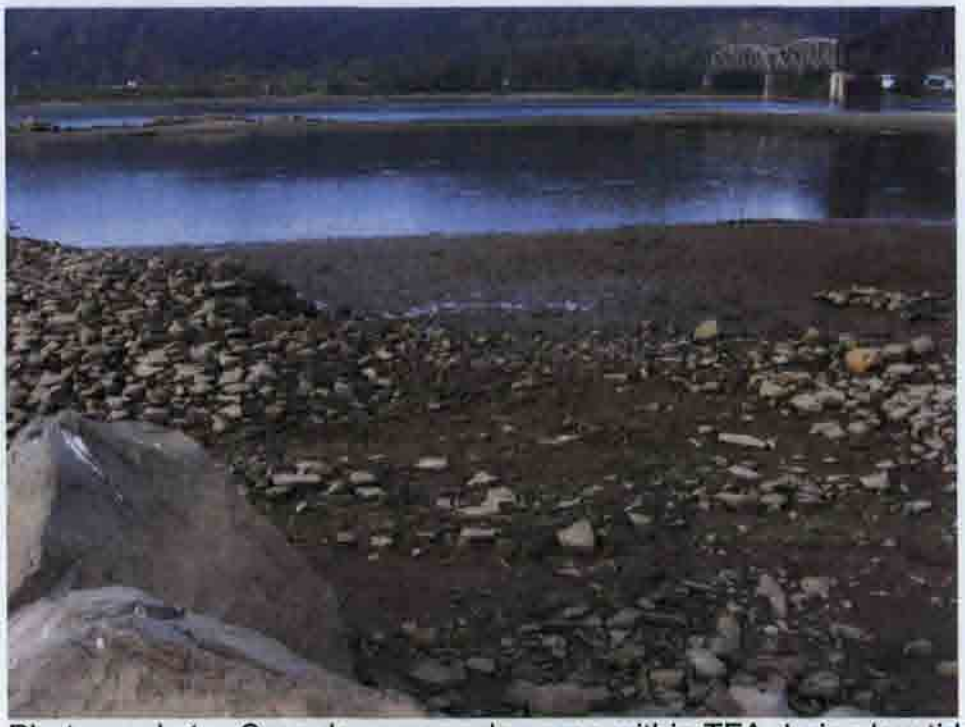
ATTACHMENT C
SEDIMENT CAP OBSERVATIONS

Included only on the O&M Report DVD

ATTACHMENT D
MONTHLY MEETING SUMMARIES

Included only on the O&M Report DVD

ATTACHMENT E
PHOTOGRAPH DOCUMENTATION



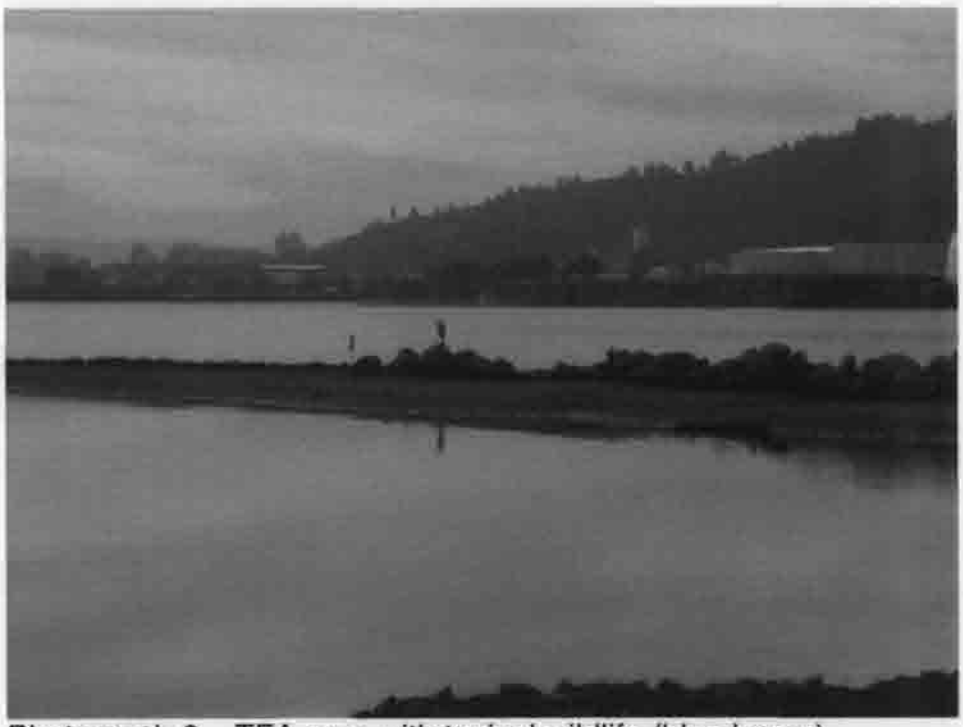
Photograph 1 – Granular organoclay area within TFA during low tide. Note: Ebullition in organoclay area. Photograph taken looking west (September 2009).

Photograph 2 – Sheen observed in TFA. Note: blocky structure and does not coalesce after disturbed. (July 2009).

Photograph 3 – Sheen observed along southern shoreline. (August 2009).

Photograph 4 – Sheen observed on sediment in Willamette Cove. (August 2009).

Photograph 5 – Wood debris accumulated along south shoreline.
Photograph taken looking north (June 2009).



Photograph 6 – TFA area with typical wildlife (blue heron).
Photograph taken looking south (September 2009).

Photograph 7 – Typical gap formed in ACB in TFA area. Photograph taken looking west (June 2008).

Photograph 8 – Willamette Cove ACB settling. Photograph taken looking east (September 2009).

Photograph 9 – Willamette Cove ACB settling. Photograph taken looking east (September 2009).

Photograph 10 – Willamette Cove ACB settling. Photograph taken looking northeast (September 2009).

Photograph 11 – Drainage swale with vegetation. Photograph taken looking south (September 2009).

Photograph 12 – Upland soil cap vegetation. Photograph taken looking northwest (September 2009).

Photograph 13 – Burrow underneath west perimeter fence from a Coyote-like animal (August 2009).

Photograph 14 – Typical ground squirrel burrow bellow irrigation piping (March 2009).

Photograph 15 – Well cap and transducer box placed on EW-1s. Photograph taken looking south (June 2009).

Photograph 16 – Wells EW-1s and MW-23d and hub location1006 within the area of known subsidence. Photograph taken looking north (September 2009).

Photograph 17 – Upland cap discharge (March 2009).

ATTACHMENT F
ADDITIONAL SUBSIDENCE MONITORING MEMORANDUM

Included only on the O&M Report DVD

ATTACHMENT G
WASTE DISPOSAL DOCUMENTATION

Included only on the O&M Report DVD

APPENDIX C
VEGETATION SURVIVAL ASSESSMENT

OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009

Hart Crowser/GSI
15670-05/Task 7 May 25, 2010

CITY OF PORTLAND
ENVIRONMENTAL SERVICES
1120 SW Fifth Avenue, Room 1000, Portland, Oregon 97204 ▪ Dan Saltzman, Commissioner ▪ Dean Marriott, Director

Background

The City of Portland, Bureau of Environmental Services (BES) entered into an Intergovernmental Agreement (IGA) with the Oregon Department of Environmental Quality (DEQ) to provide vegetation planning and vegetation management services at the McCormick and Baxter Superfund site located in North Portland. The revegetation project planning was completed in fall 2005'the site was then planted in February 2006'. The installed plant materials have now completed their forth growing season. In February 2008' the lower riparian component was inter-planted with an additional 500 alder trees, irrigation was also extended to this portion of the property.

Management Approach and Treatments

The potential for noxious weeds problems continues to remain very high for this property. The degree of noxious weed presence will determine the longer term vegetation management requirements more than any other single factor. Many of the adjacent off-site areas have severe noxious weed problems, including scotch broom on the rail road grade and butterfly bush from the Triangle Park industrial property. Both of these properties have recently undergone major disturbances, this will only increase the potential for even greater off-site noxious weed pressures. In addition spotted and diffuse knapweeds were detected last year and are now being actively managed.

We continue to use a preventative noxious weed control approach, this is part of an ongoing effort to control the spread of noxious weed species on this property. Establishment of a solid herbaceous cover is another part of this approach to limit establishment and spread of noxious weeds. Additional seeding (see list below of species seeded) has been applied to build and maintain a full vegetative cover on the project site, especially in the areas that did not have any woody plant material specified in the IGA.

Site Component	Treatment Acres	Festuca rubra commutata	Collomia grandiflora	Coreopsis atkinsoniana	Eriophyllum lanatum	Gilia capitata	Grindelia integrifolia	Iris tenax	Lotus pursh	Lupinus polyphyllus	Prunella vulgaris	Sisyrinchium angustifolium	Total lbs.
M & B 2006 - swales & Natural Tree/Shrub	15	300	5	25	9	2	50	2	8	10	20	1	432
M & B 2007 - Impermeable Soil Cap	10	125	0	0	0	1	0	0	10		0	0	136
TOTALS:		425	5	25	9	3	50	2	18	10	20	1	568

In November 2007' Festuca romeri and a few selected wildflower species were sown on a portion of the impermeable soil cap in part as a test to compare these two Fescues side by side. Monitoring in the spring of 2008' did not indicate that the more expensive Festuca romeri is any more successful than the Festuca Rubra 'commutate'. It should be noted that Festuca rubra commutata is not a true native but functionally and genetically it is nearly identical to the Festuca romeri and the native Festuca rubra. Overall diversity and

density of the grasses on this droughty component continues to improve. No additional seeding was needed on the other vegetative components, all other areas have very good grass and herbaceous plant establishment.

Soils are another area of concern; the organic mater is very low in much of the imported top soils present on this site. In the summer of 2008' we added a bone-meal based product, Nutri-fiber, as a mulch on a large portion of the swale plantings, to attempt to determine if this would help build soil nutrition. Compaction is another factor that can negatively affect plant growth. In general the establishment of vegetation is better in areas where the soil appears to be less compacted, and or has deeper fills, examples include east of the maintenance road and just south of the office. These areas have taller stands of grasses, and better growth rates for the woody plantings.

Mice or voles also are a concern but with the exception of some targeted damage to the grand fir seedlings, there continues to have been only moderate damage to the other plantings, fortunately during this past growing season there was less activity from voles. Effective rodent control measures are limited to monitoring and inter-planting if necessary. We have also continued to monitor for beaver damage, very little has been detected. Wire beaver guard caging can be installed if it is determined necessary.

Management Approach for the Next Growing Season

Assess plant survival in fall 2010'
Determine if additional planting and seeding is necessary.
Respond to the level of landscape management that DEQ is required to provide.

Vegetative Components

Upper Riparian 18.7 to 30.0 NGDV (3.6 acres)

General Observations

In the last two vegetation assessments we noted the greater size and vigor of woody plants that were planted adjacent to the driftwood that was placed at the top of the Upper Riparian slope. It was also noted that these alder grew much faster than any of the other types of trees on any other portion of the project. Based on those findings we planted 500 additional alder trees on the lower riparian in response to the previous success of this tree species. Knapweeds, thistles and yellow mustard will continue to need to be managed; a combination of herbicide spot spraying and manual pulling has been effective to date. Clover, native and non-native grasses have continued to increase replacing the lupine and wildflower mix that dominated originally. The groundcover component continues to shift towards both native and non-native grasses and clover; most of these species are not invasive or overly-competitive and are doing a good job of preventing erosion and invasive species encroachment. The percent of bare ground has been reduced to only 2%.

Performance Standards per IGA

- Plant 820 trees and 829 shrubs per acre
- 80% survival after one year, at the end of the initial growing season. Achieved as recorded in 2006 Monitoring Report.
- Invasive species less than 10% of all plants by year five; 2011.
- 80% herbaceous and shrub cover after five years; October 2011.

- 30% canopy closure after five years; October 2011.
- Minimum of 8 shrub species and 3 tree species present, no species to exceed 50% of the total stem count.

Monitored Status and Recommendations as of November 2008'

- Woody species; currently there are 1086 plants per acre, 557 shrubs and 529 trees per acre. We have met the original goals for this component, 8 species of shrubs and 3 species of trees.
- The site continues to make progress towards achieving the 30% canopy closure by October 2011, the end of the specified 5 year period.
- Herbaceous; knapweeds and thistle are somewhat of a concern but they will continue to be closely monitored and controlled, a steady progression from native grasses to non invasive non native grasses continues to occur.
- Yellow mustard has been nearly eliminated from the site.
- Monitor and continue spot treat small infestations of noxious weeds before they spread.

Volunteer Planting Area (1-2 acres)

This area is monitored as part of the Upper Riparian Component, there is no significant difference between this area and the adjacent Riparian area. The upper riparian goals have been met as applied to this component.

Lower Riparian 16.6 to 18.7 NGDV (2.1 acres)

General Observations

The vegetated area for this component becomes droughty very quickly in early to mid summer. There has been an increase in bare ground and generally a less vigorous herbaceous ground cover than the adjacent Upper Riparian component. The higher percentage of bare ground increases the potential for invasive weed species to affect this area. Several responses are being applied to this area, proactive weed control; continued irrigation for at least another year and over-seeding the more open areas with an appropriate combination of grasses and herbaceous seed. The original irrigation system that was proposed and installed does not adequately supplement the moisture needed. The irrigation system on the northern end of this component was extended in winter 2008' to provide addition coverage. This is the same area that we also installed 500 additional alder trees. The quick growth typical of this species and the shade that they provide should help ensure that we meet our performance standards for this component.

The groundcovers have shifted from herbaceous species towards clover and both native and non-native grasses. Most of the non-natives are not invasive; the weed species of concern are the same as the Upper Riparian component - knapweeds, and thistles, with the addition of butterfly bush. The combination of herbicide spot spraying and manual pulling has again been effective on this portion of the site. The shrub species that were planted, particularly the Nootka rose have begun to vigorously expand, sending out new rhizomatous shoots, this significantly increased the number of monitored stems per acre for this component.

Performance Standards per IGA

- Plant 540 trees and 1,100 shrubs per acre.
- 80% survival after one year. Achieved, and provided in 2006 monitoring report.
- Invasive species less than 10% of all plants by year five; Fall 2011.
- 80% herbaceous and shrub cover after five years; Fall 2011.
- Minimum of 9 shrub species and 3 tree species, no species to exceed 50% of the total stem count.
- 30% canopy closure after five years; fall 2011.

Monitored Status and Recommendations as of November 2009:

- Currently there are 1510 plants per acre, 990 shrubs and 520 trees.
- Monitor and protect both planted and natural seedlings to encourage 30% canopy closure by the end of five years; fall 2011.
- Herbaceous cover was measured at 84%. There is 16% of the area that was classified as bare ground.
- Knapweeds, scotch broom, and thistle are a concern but have been successfully controlled. Continue to monitor and spot treat these relatively small infestations to prevent spread and reduce cover.

Natural Tree and Shrub Planting Area (1.1 acres)

General Observations

Survival of the madrone, oak, ponderosa pine and hawthorn are all performing very well. Invasive weed control has been excellent due in part to a heavy cover of herbaceous species and grass thatch. Grindelia and Canada goldenrod are both providing some herbaceous diversity to this component.

Performance Standards per IGA

- Plant a total of 625 plants per acre.
- 70% survival after one year, Achieved, and provided in 2006 monitoring report.
- Invasive species less than 10% of all plants by year five; Fall 2011.
- 90% herbaceous and shrub cover after five years; Fall 2011.

Monitored Status and Recommendations as of October 2007:

- Woody plant survival rate was greater than 100% of the original planted density. There were 300 trees and 1257 shrubs recorded in this monitoring cycle.
- Final planting density was increased to over 2,000 plants per acre in anticipation of high mortality in this component, survival has been better than initially expected.
- Herbaceous cover is 95% with an only 5% of exposed bare ground.
- Monitor and spot treat small infestations of noxious weeds before they can spread. Thistle and some tansy ragweed are the weeds of greatest concern.

Swale and Pond Planting (4.2 acres)

General Observations

In the previous reports, herbaceous species, notably Spanish clover and birdsfoot trefoil were taller than many of the smaller planted shrubs, but the shrubs are establishing well and might even benefit from the shade and nitrogen fixation provided by theses species. Once again both of these species have declined and other desirable species including native lupines, grindelia and epilobium have increased. The white clover in the Swale and Pond Planting are also contributing to soil fertility with little or no adverse effect on the woody plant material establishment. Thistles are a concern but under control, Scotch broom and butterfly bush continue to be held at very low levels. Alder and cottonwood seedlings are naturally regenerating in this area, neither of which fell within this years monitoring sample however.

Performance Standards per IGA

- Plant 1,640 shrubs per acre including willow live stakes. (Piper & Sitka willow constituted the bulk of the live stakes in addition to 250 red osier dogwood.)
- 80% survival after one year, fall 2006. Achieved as recorded in 2006 monitoring report.
- Invasive species less than 10% of all plants by 2011.
- 90% herbaceous and shrub cover after five years, 2011.
- A total of 5 shrub species (no tree species); no species to exceed 50% of the total stem count.

Monitored Status and Recommendations as of October 2007:

- Woody shrubs, five species of shrubs are present and doing well
- Live stake (the willows) survival was not as successful as the bare-root component, but will be more than adequate to establish a good willow shrub cover.
- In the pond portion of this component the live stakes survived exceptionally well but the herbaceous cover is poor due to sandy soil.
- Herbaceous cover was measured at nearly 100%, very little bare ground is present. Additional wildflowers have been sown in this part of the project.
- Monitor and perform preventive noxious weed control

Impermeable Soil Cap (7 acres)

General Observations

This area has not been part of the BES formally monitored components for this project because no woody species were designated for this area, only grasses and wildflower or herbaceous species were planted. However, BES has been maintaining this area from the time that the rest of the site was planted. Additional sowing of grasses including the test of Festuca rubra 'commutata' verses Festuca romeri has been applied to this area as well.

Initially the hydro-seeded, (by DEQ contractors) grass and wildflower species survived very well on this component. Invasive or noxious weeds were not a

problem during the first growing period in fall 2005. At the end of the second growing period in fall 2006, BES staff observed a rapid decline in the vigor of the hydro-seeded species, especially the slender hairgrass. Soil pH, soil nutrition, and species selection could all be factors in this trend. The active drainage system may also hasten the drought period for this area, which is extremely dry by early to mid summer.

As the grasses have declined, invasive weed species have started to colonize this area including: sweet clover (*Melilotus alba*), various knapweeds, scotch broom, thistles and skeletonweed. BES has continued to actively control these highly invasive species with a combination of herbicide applications and mechanical removal. This effort continues to be very successful to date.

BES reseeded this component in fall 2007 with *Festuca rubra* v. commutata (chewings fescue) and *Festuca roemerii* (Roemer's fescue) as replacement species for the original hydro-seeded species. BES will continue to monitor this area for species shift and invasive weed encroachment. The noxious weed population has continued to decline over the 2009' growing season. Additional grass and herbaceous species will be sown in this area if needed.

Irrigation System Status

Maintenance requirements for the irrigation system have increased significantly over this past two seasons. The battery operated controllers are not as reliable as the electrical equivalent, and additional expenses have been incurred to replace malfunctioning controllers in the spring and early summer of 2008' and 2009'. The most recent irrigation system activities and 20010' plans include:

- System was drained and winterized the system in fall 2009'
- Annual inspection of entire system to identify, mark and map any freeze or other types of damage in spring 2010'.
- Repair any freeze damage in spring of 2010'
- Replace and repair any malfunctioning or worn battery operated irrigation controllers.

McCormick & Baxter Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Upper Riparian** CompontAc: **3.60** MonitorYr: **Yr4** Date: **11/3/2009**

Observations

Upper Riparian Performance Standard: 80% survival of planted species after on year and 80% herbaceous cover after five years. 1640 plants per acre (planned). At the end the fourth growing season there are 1086 plants per acre (557 trees and 529 shrubs) surviving. 66% survival rate of initial densities has been achieved. Herbaceous species cover is 98%, it is dominated by grass thatch. Exotic species are 51%, native species comprise about 17% & bare ground is just 2%. Alder nearest to large woody debris continue to grow faster than others species on this site. The larger alder are starting to modify the site by providing shade and organic matter to adjacent plantings. Some late summer burn to alder trunks & grand fir foliage occurred during the extreme heat wave this past summer. Thistle & knapweed are the biggest weed concerns. Some black mustard is present as well. The Volunteer Component was included as part of the Upper Riparian Component.

Recommendations

This component would benefit from an additional year of irrigation. Thistle, blk mustard & knapweed need to treated aggressively, flag areas w/ mustard & knapweed to help treat it more effectively.

Woody Species Plants Per Acre

of Plots = 7

Species	CommonName	PlantType	Alive	Natural	Total	Mortality
Cornus sericea	Red-Osier Dogwood	SHRUB	71	0	71	0
Holodiscus discolor	Ocean-spray	SHRUB	14	0	14	0
Lonicera involucrata	Black Twinberry	SHRUB	14	0	14	0
Philadelphus lewisii	Mockorange	SHRUB	14	0	14	0
Physocarpus capitatus	Pacific Ninebark	SHRUB	71	0	71	0
Ribes sanguineum	Red Currant	SHRUB	86	0	86	0
Rosa nutkana var.	Nootka Rose	SHRUB	157	0	157	0
Sambucus cerulea	Blue Elderberry	SHRUB	29	0	29	0
Symphoricarpos albus	Common Snowberry	SHRUB	100	0	100	0
		TOTALS	**557**	**0**	**557**	**0**

Species	CommonName	PlantType	Alive	Natural	Total	Mortality
Abies grandis	Grand Fir	TREE	100	0	100	0
Acer macrophyllum	Big-leaf Maple	TREE	43	0	43	0
Alnus rubra	Red Alder	TREE	43	0	43	0
Arbutus menziesii	Madrone	TREE	43	0	43	0
Fraxinus latifolia	Oregon Ash	TREE	157	0	157	0
Quercus garryana	Garry Oak	TREE	114	0	114	0
Thuja plicata	Western Red Cedar	TREE	29	0	29	0
		TOTALS	**529**	**0**	**529**	**0**
	GRAND		**1086**	**0**	**1086**	**0**

Ground Cover Summary

of Plots = 7

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Upper Riparian** CompontAc: **3.60** MonitorYr: **Yr4** Date: **11/3/2009**

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Agrostis stolonifera	Creeping Bent Grass	EXOTIC	21%	13%	100%
Festuca rubra var.	Red Fescue-grass	EXOTIC	18%	11%	100%
Holcus lanatus	Velvet Grass	EXOTIC	7%	4%	57%
Cirsium arvense	Canada Thistle	EXOTIC	5%	3%	57%
		EXOTIC TOTAL	**51%**	**30%**	

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Lupinus polyphyllus	Large-leaved Lupine	NATIVE	7%	4%	57%
Epilobium ciliatum	Common Willow-weed	NATIVE	5%	3%	43%
Elymus glaucus	Blue Wildrye	NATIVE	3%	2%	43%
Grindelia integrifolia	Entire-leafed Gumweed	NATIVE	2%	1%	14%
Bromus carinatus	California Brome-grass	NATIVE	0%	0%	14%
		NATIVE TOTAL	**17%**	**10%**	

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Grass Thatch	Grass Thatch	OTHER	71%	42%	86%
Coarse Woody Debris	Coarse Woody Debris	OTHER	21%	12%	71%
Leaf Litter	Leaf Litter	OTHER	2%	1%	71%
Bare Ground	Bare Ground	OTHER	2%	1%	71%
		OTHER TOTAL	**96%**	**56%**	

Completed Treats

Treatment	Qnty	Units	Completion Date
Monitor	6	hr	11/20/2009
Monitor	6	hr	11/3/2009
Labor WRP	4	hr	11/3/2009
Labor WRP	8	hr	11/2/2009
Spray Reimbursement	1	ea	9/23/2009
Spray Hourly	42	Hr	9/23/2009
Cut Hourly	14	hr	7/1/2009
Spray WRP	40	hr	7/1/2009
Labor WRP	37	hr	7/1/2009
Spray WRP	36	hr	6/30/2009
Spray WRP	8	hr	5/28/2009
Spray WRP	8	hr	5/11/2009
Spray WRP	4	hr	5/6/2009
Spray WRP	4	hr	3/13/2009
Spray WRP	4	hr	3/13/2009
Spray WRP	5	hr	2/4/2009
Labor WRP	12	hr	10/14/2008
Spray Hourly	24	Hr	7/28/2008
Spray WRP	25	hr	7/1/2008
Manual Labor	24	Hr	5/8/2008

Scheduled Treats

Treatment	Qnty	Units	Scheduled Date
Note	1	ea	12/1/2009
Spray WRP	8	hr	4/1/2010
Spray Hourly	48	hr	5/1/2010
Proj Mngt WRP	8	hr	5/1/2010
Labor WRP	48	hr	6/1/2010
Proj Mngt WRP	8	hr	7/1/2010
Spray Hourly	48	hr	7/1/2010

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Upper Riparian** CompontAc: **3.60** MonitorYr: **Yr4** Date: **11/3/2009**

[illegible]erials	1.5	tons	5/8/2008
[illegible]y Hourly	43	Hr	5/5/2008
Manual Labor	36	Hr	4/16/2008
Bamboo Lg (Mtrl)	4	thous	4/16/2008
Bamboo Lg (Mtrl)	0.5	thous	2/14/2008
Bamboo Sm (Mtrl)	0.5	thous	2/14/2008
Tubes (Mtrl)	0.5	thous	2/14/2008
Native Plants (Mtrl)	0.5	thous	2/14/2008
Hourly Planting	21	Hr	2/14/2008
Seed - Native Upland	2	ac	11/14/2007
Seed - Cover (Mtrl)	8	ac	11/14/2007
Seed Appl	10	Ac	11/14/2007
Labor WRP	0	Hr	9/30/2007
Labor WRP	8	Hr	8/31/2007
Labor WRP	33	Hr	7/31/2007
Spray WRP	4	hr	6/30/2007
Labor WRP	20	hr	6/30/2007
Labor WRP	30	hr	6/30/2007
Labor WRP	69	hr	5/31/2007
Spray Reimbursement	1.5	gal	5/22/2007
Cut Hourly	12	Hr	3/12/2007
Manual Labor	73	Hr	3/12/2007
Labor WRP	12	hr	3/12/2007
Seed Appl	15	Ac	11/9/2006
Seed - Native Upland	15	ac	11/9/2006
[illegible] Hourly	25	Hr	11/9/2006
[illegible]or WRP	16	hr	10/30/2006
Monitor	18	ea	10/25/2006
Labor WRP	6	ea	9/15/2006
Spray WRP	16	hr	9/12/2006
Seed - Native Upland	2	ac	9/11/2006
Seed WRP	8	hr	9/11/2006
Labor Volunteer	64	hr	9/2/2006
Labor WRP	8	hr	8/23/2006
Mulch Wood (Mtrl)	20.5333	thous	3/22/2006
Manual Labor	122	Hr	3/22/2006
Staking	1.86	Thous	2/21/2006
Bamboo Lg (Mtrl)	2.74	thous	2/21/2006
Bamboo Sm (Mtrl)	0.88	thous	2/21/2006
Tubing	0.88	Thous	2/21/2006
Tubes (Mtrl)	0.88	thous	2/21/2006
Bare Root Inst	2.74	Thous	2/21/2006
Native Plants (Mtrl)	2.74	thous	2/21/2006

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Upper Riparian** CompontAc: **3.60** MonitorYr: **Yr4** Date: **11/3/2009**

Hourly Planting	135	Hr	2/14/2006
Staking	7.44	Thous	2/14/2006
Pole Cuttings (Mtrl)	3.63	thous	2/14/2006
Tubes (Mtrl)	4.172	thous	2/14/2006
Tubing	4.172	Thous	2/14/2006
Bamboo Sm (Mtrl)	4.172	thous	2/14/2006
Bamboo Lg (Mtrl)	11.612	thous	2/14/2006
Bare Root Inst	16.212	Thous	2/14/2006
Native Plants (Mtrl)	14.016	thous	2/14/2006

McCormick & Baxter Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Lower Riparian** CompontAc: **2.10** MonitorYr: **Yr4** Date: **11/3/2009**

Observations

Lower Riparian Performance Standard: 80% survival of planted species after on year and 80% herbaceous cover after five years. 1640 plants per acre (planned). 1510 plants per acre (520 trees and 990 shrubs) have survived. Herbaceous species cover is 84%, dominated by 40% grass thatch. The bare ground was measured at 16%. Overall the Lower Riparian Component is much drier than upper riparian area, there is very little woody debris & less alder, no measurable canopy yet. Alder and additional irrigation was added before this past growing season. Nootka rose stem counts have increased from the original numbers as a result of new shoots that are included in the count. Thistle is present throughout the knapweed is spotty.

Recommendations

Continue irrigation for one more year. No interplant needed. Focus weed control on thistle and knapweed.

Woody Species Plants Per Acre

of Plots = 10

Species	CommonName	PlantType	Alive	Natural	Total	Mortality
Cornus sericea	Red-Osier Dogwood	SHRUB	170	0	170	0
Lonicera involucrata	Black Twinberry	SHRUB	90	0	90	0
Physocarpus capitatus	Pacific Ninebark	SHRUB	60	0	60	0
Rosa nutkana var.	Nootka Rose	SHRUB	340	0	340	0
Salix General	Willow (General)	SHRUB	20	0	20	0
Spiraea douglasii	Douglas's Spiraea	SHRUB	240	0	240	0
mphoricarpos albus	Common Snowberry	SHRUB	70	0	70	0
		TOTALS	990	0	990	0

Species	CommonName	PlantType	Alive	Natural	Total	Mortality
Abies grandis	Grand Fir	TREE	60	0	60	0
Crataegus suksdorfii	Black Hawthorn	TREE	210	0	210	0
Fraxinus latifolia	Oregon Ash	TREE	110	0	110	0
Quercus garryana	Garry Oak	TREE	50	0	50	0
Rhamnus purshiana	Cascara	TREE	50	0	50	0
Thuja plicata	Western Red Cedar	TREE	40	0	40	0
		TOTALS	520	0	520	0
	GRAND		1510	0	1510	0

Ground Cover Summary

of Plots = 10

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Cirsium arvense	Canada Thistle	EXOTIC	17%	11%	100%
Holcus lanatus	Velvet Grass	EXOTIC	14%	9%	70%
Thlaspi arvense	Field Pennycress	EXOTIC	12%	8%	20%
Festuca rubra var.	Red Fescue-grass	EXOTIC	11%	7%	100%
Plantago major	Common Plantain	EXOTIC	5%	3%	50%
Centaurea diffusa	Diffuse Knapweed	EXOTIC	3%	2%	30%

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Lower Riparian** CompontAc: **2.10** MonitorYr: **Yr4** Date: **11/3/2009**

Dactylis glomerata	Orchard Grass	EXOTIC	3%	2%	20%
Trifolium repens	White Clover	EXOTIC	1%	0%	20%
		EXOTIC TOTAL	**66%**	**44%**	

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Deschampsia elongata	Slender Hairgrass	NATIVE	5%	3%	50%
Lupinus polyphyllus	Large-leaved Lupine	NATIVE	5%	3%	30%
Epilobium ciliatum	Common Willow-weed	NATIVE	4%	2%	50%
Phacelia nemoralis	Shade Phacelia	NATIVE	3%	2%	30%
Solidago canadensis	Canada Goldenrod	NATIVE	2%	1%	20%
		NATIVE TOTAL	**18%**	**12%**	

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Grass Thatch	Grass Thatch	OTHER	40%	26%	80%
Bare Ground	Bare Ground	OTHER	16%	10%	100%
Agrostis sp.	Agrostic grass sp.	OTHER	11%	7%	90%
		OTHER TOTAL	**67%**	**44%**	

Completed Treats

Treatment	Qnty	Units	Completion Date
Monitor	6	hr	11/20/2009
Monitor	6	hr	11/3/2009
Labor WRP	4	hr	11/3/2009
Labor WRP	8	hr	11/2/2009
Spray Reimbursement	1	ea	9/23/2009
Spray Hourly	42	Hr	9/23/2009
Cut Hourly	14	hr	7/1/2009
Spray WRP	40	hr	7/1/2009
Labor WRP	37	hr	7/1/2009
Spray WRP	36	hr	6/30/2009
Spray WRP	8	hr	5/28/2009
Spray WRP	8	hr	5/11/2009
Spray WRP	4	hr	5/6/2009
Spray WRP	4	hr	3/13/2009
Spray WRP	4	hr	3/13/2009
Spray WRP	5	hr	2/4/2009
Labor WRP	12	hr	10/14/2008
Spray Hourly	24	Hr	7/28/2008
Spray WRP	25	hr	7/1/2008
Manual Labor	24	Hr	5/8/2008
Materials	1.5	tons	5/8/2008
Spray Hourly	43	Hr	5/5/2008
Manual Labor	36	Hr	4/16/2008

Scheduled Treats

Treatment	Qnty	Units	Scheduled Date
Note	1	ea	12/1/2009
Spray WRP	8	hr	4/1/2010
Spray Hourly	48	hr	5/1/2010
Proj Mngt WRP	8	hr	5/1/2010
Labor WRP	48	hr	6/1/2010
Proj Mngt WRP	8	hr	7/1/2010
Spray Hourly	48	hr	7/1/2010

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Lower Riparian** CompontAc: **2.10** MonitorYr: **Yr4** Date: **11/3/2009**

[illegible]boo Lg (Mtrl)	4	thous	4/16/2008
[illegible]mboo Lg (Mtrl)	0.5	thous	2/14/2008
Bamboo Sm (Mtrl)	0.5	thous	2/14/2008
Tubes (Mtrl)	0.5	thous	2/14/2008
Native Plants (Mtrl)	0.5	thous	2/14/2008
Hourly Planting	21	Hr	2/14/2008
Seed - Native Upland	2	ac	11/14/2007
Seed - Cover (Mtrl)	8	ac	11/14/2007
Seed Appl	10	Ac	11/14/2007
Labor WRP	0	Hr	9/30/2007
Labor WRP	8	Hr	8/31/2007
Labor WRP	33	Hr	7/31/2007
Spray WRP	4	hr	6/30/2007
Labor WRP	20	hr	6/30/2007
Labor WRP	30	hr	6/30/2007
Labor WRP	69	hr	5/31/2007
Spray Reimbursement	1.5	gal	5/22/2007
Cut Hourly	12	Hr	3/12/2007
Manual Labor	73	Hr	3/12/2007
Labor WRP	12	hr	3/12/2007
Seed Appl	15	Ac	11/9/2006
Seed - Native Upland	15	ac	11/9/2006
Cut Hourly	25	Hr	11/9/2006
Labor WRP	16	hr	10/30/2006
Monitor	18	ea	10/25/2006
[illegible]bor WRP	6	ea	9/15/2006
[illegible]ray WRP	16	hr	9/12/2006
Seed - Native Upland	2	ac	9/11/2006
Seed WRP	8	hr	9/11/2006
Labor Volunteer	64	hr	9/2/2006
Labor WRP	8	hr	8/23/2006
Mulch Wood (Mtrl)	20.5333	thous	3/22/2006
Manual Labor	122	Hr	3/22/2006
Staking	1.86	Thous	2/21/2006
Bamboo Lg (Mtrl)	2.74	thous	2/21/2006
Bamboo Sm (Mtrl)	0.88	thous	2/21/2006
Tubing	0.88	Thous	2/21/2006
Tubes (Mtrl)	0.88	thous	2/21/2006
Bare Root Inst	2.74	Thous	2/21/2006
Native Plants (Mtrl)	2.74	thous	2/21/2006
Hourly Planting	135	Hr	2/14/2006
Staking	7.44	Thous	2/14/2006
Pole Cuttings (Mtrl)	3.63	thous	2/14/2006

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Lower Riparian** CompontAc: **2.10** MonitorYr: **Yr4** Date: **11/3/2009**

Tubes (Mtrl)	4.172	thous	2/14/2006
Tubing	4.172	Thous	2/14/2006
Bamboo Sm (Mtrl)	4.172	thous	2/14/2006
Bamboo Lg (Mtrl)	11.612	thous	2/14/2006
Bare Root Inst	16.212	Thous	2/14/2006
Native Plants (Mtrl)	14.016	thous	2/14/2006

McCormick & Baxter Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Natural Tree and** CompontAc: **1.10** MonitorYr: **Yr4** Date: **11/3/2009**

Observations

Natural Tree/Shrub Area Performance Standard: 70% survival of planted species after five years and 90% herbaceous cover after one year. 625 plants per acre (planned). Currently 1557 (300 trees and 1257 shrubs) have survived resulting in 100% survival rate of planned densities have been achieved. Native herbaceous species cover is 29%, this includes a combination of both native grasses and wildflower species. Exotic species are 67% but of that total 28% is Festuca rubra commutata, it has been sown as a functional replacement for the native red fescue. Exposed bare ground is down to 5%. Grass thatch has continued to increased to 57% & will likely stay at this

Recommendations

Continue invasive weed control, thistle, Scotch broom & knap weeds could be problems if current level of preventative spot spray not adhered to. Irrigation needed for a minimum of one more year. Stake trees as needed.

Plants Per Acre

Trees= **Shrubs =** **Total=** **# of Plots= 7**

Woody Species Plants Per Acre

# of Plots = 7

Species	CommonName	PlantType	Alive	Natural	Total	Mortality
Cornus sericea	Red-Osier Dogwood	SHRUB	29	0	29	0
Mahonia aquifolium	Oregon Grape	SHRUB	214	0	214	0
Philadelphus lewisii	Mockorange	SHRUB	43	0	43	0
Ribes sanguineum	Red Currant	SHRUB	114	0	114	0
Rosa nutkana var.	Nootka Rose	SHRUB	543	0	543	0
Symphoricarpos albus	Common Snowberry	SHRUB	314	0	314	0
		TOTALS	**1257**	**0**	**1257**	**0**

Species	CommonName	PlantType	Alive	Natural	Total	Mortality
Arbutus menziesii	Madrone	TREE	86	0	86	0
Betula pendula	European White	TREE	14	0	14	0
Crataegus suksdorfii	Black Hawthorn	TREE	43	0	43	0
Pinus ponderosa	Ponderosa Pine	TREE	71	0	71	0
Quercus garryana	Garry Oak	TREE	86	0	86	0
		TOTALS	**300**	**0**	**300**	**0**
		GRAND	**1557**	**0**	**1557**	**0**

Ground Cover Summary

# of Plots = 7

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Festuca rubra var.	Red Fescue-grass	EXOTIC	28%	18%	100%
Agrostis stolonifera	Creeping Bent Grass	EXOTIC	28%	17%	86%
Holcus lanatus	Velvet Grass	EXOTIC	8%	5%	57%
Trifolium repens	White Clover	EXOTIC	3%	2%	43%

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Natural Tree and** CompontAc: **1.10** MonitorYr: **Yr4** Date: **11/3/2009**

		EXOTIC TOTAL	67%	42%	
Species	**CommonName:**	**Origins:**	**SpeciesCove**	**SpeciesComp:**	**SpeciesFrequenc**
Grindelia integrifolia	Entire-leafed Gumweed	NATIVE	10%	6%	57%
Deschampsia elongata	Slender Hairgrass	NATIVE	7%	4%	71%
Solidago canadensis	Canada Goldenrod	NATIVE	7%	4%	57%
Prunella vulgaris	Heal-all	NATIVE	3%	2%	57%
Lupinus polyphyllus	Large-leaved Lupine	NATIVE	1%	1%	43%
Bromus carinatus	California Brome-grass	NATIVE	1%	0%	29%
		NATIVE TOTAL	29%	18%	
Species	**CommonName:**	**Origins:**	**SpeciesCove**	**SpeciesComp:**	**SpeciesFrequenc**
Grass Thatch	Grass Thatch	OTHER	57%	36%	100%
Bare Ground	Bare Ground	OTHER	5%	3%	43%
Leaf Litter	Leaf Litter	OTHER	2%	1%	71%
		OTHER TOTAL	64%	40%	

Completed Treats

Treatment	Qnty	Units	Completion Date
Monitor	6	hr	11/20/2009
Monitor	6	hr	11/3/2009
Labor WRP	4	hr	11/3/2009
Labor WRP	8	hr	11/2/2009
Spray Reimbursement	1	ea	9/23/2009
Spray Hourly	42	Hr	9/23/2009
Cut Hourly	14	hr	7/1/2009
Spray WRP	40	hr	7/1/2009
Labor WRP	37	hr	7/1/2009
Spray WRP	36	hr	6/30/2009
Spray WRP	8	hr	5/28/2009
Spray WRP	8	hr	5/11/2009
Spray WRP	4	hr	5/6/2009
Spray WRP	4	hr	3/13/2009
Spray WRP	4	hr	3/13/2009
Spray WRP	5	hr	2/4/2009
Labor WRP	12	hr	10/14/2008
Spray Hourly	24	Hr	7/28/2008
Spray WRP	25	hr	7/1/2008
Manual Labor	24	Hr	5/8/2008
Materials	1.5	tons	5/8/2008
Spray Hourly	43	Hr	5/5/2008
Manual Labor	36	Hr	4/16/2008
Bamboo Lg (Mtrl)	4	thous	4/16/2008

Scheduled Treats

Treatment	Qnty	Units	Scheduled Date
Note	1	ea	12/1/2009
Spray WRP	8	hr	4/1/2010
Spray Hourly	48	hr	5/1/2010
Proj Mngt WRP	8	hr	5/1/2010
Labor WRP	48	hr	6/1/2010
Proj Mngt WRP	8	hr	7/1/2010
Spray Hourly	48	hr	7/1/2010

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Natural Tree and** CompontAc: **1.10** MonitorYr: **Yr4** Date: **11/3/2009**

boo Lg (Mtrl)	0.5	thous	2/14/2008
nboo Sm (Mtrl)	0.5	thous	2/14/2008
Tubes (Mtrl)	0.5	thous	2/14/2008
Native Plants (Mtrl)	0.5	thous	2/14/2008
Hourly Planting	21	Hr	2/14/2008
Seed - Native Upland	2	ac	11/14/2007
Seed - Cover (Mtrl)	8	ac	11/14/2007
Seed Appl	10	Ac	11/14/2007
Labor WRP	0	Hr	9/30/2007
Labor WRP	8	Hr	8/31/2007
Labor WRP	33	Hr	7/31/2007
Spray WRP	4	hr	6/30/2007
Labor WRP	20	hr	6/30/2007
Labor WRP	30	hr	6/30/2007
Labor WRP	69	hr	5/31/2007
Spray Reimbursement	1.5	gal	5/22/2007
Cut Hourly	12	Hr	3/12/2007
Manual Labor	73	Hr	3/12/2007
Labor WRP	12	hr	3/12/2007
Seed Appl	15	Ac	11/9/2006
Seed - Native Upland	15	ac	11/9/2006
Cut Hourly	25	Hr	11/9/2006
Labor WRP	16	hr	10/30/2006
Monitor	18	ea	10/25/2006
Labor WRP	6	ea	9/15/2006
ay WRP	16	hr	9/12/2006
ed - Native Upland	2	ac	9/11/2006
Seed WRP	8	hr	9/11/2006
Labor Volunteer	64	hr	9/2/2006
Labor WRP	8	hr	8/23/2006
Mulch Wood (Mtrl)	20.5333	thous	3/22/2006
Manual Labor	122	Hr	3/22/2006
Staking	1.86	Thous	2/21/2006
Bamboo Lg (Mtrl)	2.74	thous	2/21/2006
Bamboo Sm (Mtrl)	0.88	thous	2/21/2006
Tubing	0.88	Thous	2/21/2006
Tubes (Mtrl)	0.88	thous	2/21/2006
Bare Root Inst	2.74	Thous	2/21/2006
Native Plants (Mtrl)	2.74	thous	2/21/2006
Hourly Planting	135	Hr	2/14/2006
Staking	7.44	Thous	2/14/2006
Pole Cuttings (Mtrl)	3.63	thous	2/14/2006
Tubes (Mtrl)	4.172	thous	2/14/2006

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Natural Tree and** CompontAc: **1.10** MonitorYr: **Yr4** Date: **11/3/2009**

Tubing	4.172	Thous	2/14/2006
Bamboo Sm (Mtrl)	4.172	thous	2/14/2006
Bamboo Lg (Mtrl)	11.612	thous	2/14/2006
Bare Root Inst	16.212	Thous	2/14/2006
Native Plants (Mtrl)	14.016	thous	2/14/2006

McCormick & Baxter Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Swale and Pond** CompontAc: **4.20** MonitorYr: **Yr4** Date: **11/3/2009**

Observations

Swale and Pond Performance Standard: 90% herbaceous cover after one year. 1640 plants per acre (planned/amended). 1057 plants per acre were recorded. Planned density of 625 plants per acre or 70% survival rate has been exceed. Native herbaceous species cover is 50%, dominated by 29% Deschampsia grasses. Exotic species are 36%, Festuca rubra commutata was sown to provide the same function as native red fesce and is included in the Exotic species total. Bare ground is only 3%. Grass thatch has increased over the past year. The native lupines, grindelia & epilobium are providing increased herbaceous species divirsity.

Recommendations

Thistle, butterfly bush and Scotch broom will need to be monitored and treated. One additional year of irrigation is needed, especially for the willow cuttings. The additional shade & leaf litter produced as these species grow will also be very helpful to future survival of the other species in this component.

Woody Species Plants Per Acre

of Plots = 7

Species	CommonName	PlantType	Alive	Natural	Total	Mortality
Cornus sericea	Red-Osier Dogwood	SHRUB	229	0	229	0
Rosa nutkana var.	Nootka Rose	SHRUB	57	0	57	0
Salix General	Willow (General)	SHRUB	371	0	371	0
Spiraea douglasii	Douglas's Spiraea	SHRUB	71	0	71	0
Symphoricarpos albus	Common Snowberry	SHRUB	129	0	129	0
		TOTALS	**857**	**0**	**857**	**0**

Species	CommonName	PlantType	Alive	Natural	Total	Mortality
Betula pendula	European White	TREE	43	0	43	0
Populus balsamifera	Black Cottonwood	TREE	157	0	157	0
		TOTALS	**200**	**0**	**200**	**0**
	GRAND		**1057**	**0**	**1057**	**0**

Ground Cover Summary

of Plots = 7

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Agrostis stolonifera	Creeping Bent Grass	EXOTIC	18%	10%	86%
Festuca rubra var.	Red Fescue-grass	EXOTIC	11%	6%	71%
Trifolium repens	White Clover	EXOTIC	3%	2%	57%
Cirsium arvense	Canada Thistle	EXOTIC	2%	1%	14%
Holcus lanatus	Velvet Grass	EXOTIC	1%	1%	43%
Lotus corniculatus	Bird's Foot Trefoil	EXOTIC	1%	1%	43%
		EXOTIC TOTAL	**36%**	**20%**	

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Swale and Pond** CompontAc: **4.20** MonitorYr: **Yr4** Date: **11/3/2009**

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Deschampsia elongata	Slender Hairgrass	NATIVE	29%	16%	57%
Lupinus polyphyllus	Large-leaved Lupine	NATIVE	7%	4%	71%
Grindelia integrifolia	Entire-leafed Gumweed	NATIVE	6%	4%	43%
Epilobium ciliatum	Common Willow-weed	NATIVE	5%	3%	43%
Elymus glaucus	Blue Wildrye	NATIVE	3%	1%	29%
Prunella vulgaris	Heal-all	NATIVE	0%	0%	14%
		NATIVE TOTAL	**50%**	**28%**	

Species	CommonName:	Origins:	SpeciesCove	SpeciesComp:	SpeciesFrequenc
Grass Thatch	Grass Thatch	OTHER	82%	47%	100%
Coarse Woody Debris	Coarse Woody Debris	OTHER	4%	2%	29%
Bare Ground	Bare Ground	OTHER	3%	2%	57%
Leaf Litter	Leaf Litter	OTHER	1%	1%	43%
		OTHER TOTAL	**91%**	**52%**	

Completed Treats

Treatment	Qnty	Units	Completion Date
Monitor	6	hr	11/20/2009
Monitor	6	hr	11/3/2009
Labor WRP	4	hr	11/3/2009
Labor WRP	8	hr	11/2/2009
Spray Reimbursement	1	ea	9/23/2009
Spray Hourly	42	Hr	9/23/2009
Cut Hourly	14	hr	7/1/2009
Spray WRP	40	hr	7/1/2009
Labor WRP	37	hr	7/1/2009
Spray WRP	36	hr	6/30/2009
Spray WRP	8	hr	5/28/2009
Spray WRP	8	hr	5/11/2009
Spray WRP	4	hr	5/6/2009
Spray WRP	4	hr	3/13/2009
Spray WRP	4	hr	3/13/2009
Spray WRP	5	hr	2/4/2009
Labor WRP	12	hr	10/14/2008
Spray Hourly	24	Hr	7/28/2008
Spray WRP	25	hr	7/1/2008
Manual Labor	24	Hr	5/8/2008
Materials	1.5	tons	5/8/2008
Spray Hourly	43	Hr	5/5/2008
Manual Labor	36	Hr	4/16/2008
Bamboo Lg (Mtrl)	4	thous	4/16/2008
Bamboo Lg (Mtrl)	0.5	thous	2/14/2008

Scheduled Treats

Treatment	Qnty	Units	Scheduled Date
Note	1	ea	12/1/2009
Spray WRP	8	hr	4/1/2010
Spray Hourly	48	hr	5/1/2010
Proj Mngt WRP	8	hr	5/1/2010
Labor WRP	48	hr	6/1/2010
Proj Mngt WRP	8	hr	7/1/2010
Spray Hourly	48	hr	7/1/2010

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Swale and Pond** CompontAc: **4.20** MonitorYr: **Yr4** Date: **11/3/2009**

mboo Sm (Mtrl)	0.5	thous	2/14/2008
es (Mtrl)	0.5	thous	2/14/2008
Native Plants (Mtrl)	0.5	thous	2/14/2008
Hourly Planting	21	Hr	2/14/2008
Seed - Native Upland	2	ac	11/14/2007
Seed - Cover (Mtrl)	8	ac	11/14/2007
Seed Appl	10	Ac	11/14/2007
Labor WRP	0	Hr	9/30/2007
Labor WRP	8	Hr	8/31/2007
Labor WRP	33	Hr	7/31/2007
Spray WRP	4	hr	6/30/2007
Labor WRP	20	hr	6/30/2007
Labor WRP	30	hr	6/30/2007
Labor WRP	69	hr	5/31/2007
Spray Reimbursement	1.5	gal	5/22/2007
Cut Hourly	12	Hr	3/12/2007
Manual Labor	73	Hr	3/12/2007
Labor WRP	12	hr	3/12/2007
Seed Appl	15	Ac	11/9/2006
Seed - Native Upland	15	ac	11/9/2006
Cut Hourly	25	Hr	11/9/2006
Labor WRP	16	hr	10/30/2006
Monitor	18	ea	10/25/2006
Labor WRP	6	ea	9/15/2006
Spray WRP	16	hr	9/12/2006
ed - Native Upland	2	ac	9/11/2006
ed WRP	8	hr	9/11/2006
Labor Volunteer	64	hr	9/2/2006
Labor WRP	8	hr	8/23/2006
Mulch Wood (Mtrl)	20.5333	thous	3/22/2006
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Staking	1.86	Thous	2/21/2006
Bamboo Lg (Mtrl)	2.74	thous	2/21/2006
Bamboo Sm (Mtrl)	0.88	thous	2/21/2006
Tubing	0.88	Thous	2/21/2006
Tubes (Mtrl)	0.88	thous	2/21/2006
Bare Root Inst	2.74	Thous	2/21/2006
Native Plants (Mtrl)	2.74	thous	2/21/2006
Hourly Planting	135	Hr	2/14/2006
Staking	7.44	Thous	2/14/2006
Pole Cuttings (Mtrl)	3.63	thous	2/14/2006
Tubes (Mtrl)	4.172	thous	2/14/2006
Tubing	4.172	Thous	2/14/2006

McCormick & Baxter

Site Acres: **43.00** Site #: **1667** Watershed: **WR**

Component: **Swale and Pond** CompontAc: **4.20** MonitorYr: **Yr4** Date: **11/3/2009**

Bamboo Sm (Mtrl)	4.172	thous	2/14/2006
Bamboo Lg (Mtrl)	11.612	thous	2/14/2006
Bare Root Inst	16.212	Thous	2/14/2006
Native Plants (Mtrl)	14.016	thous	2/14/2006

Appendix D

APPENDIX D
SURFACE, INTER-ARMORING, AND SUB-ARMORING WATER QUALITY ASSESSMENT

OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009

Hart Crowser/GSI
15670-05/Task 7 May 25, 2010

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ATTACHMENTS

A Photograph Documentation
B Laboratory Analytical Reports and QA Memoranda for Surface, Inter-Armoring, and Sub-Armoring Water Spring 2009 Sampling Event (DVD)
C Laboratory Analytical Reports and QA Memoranda for Surface, Inter-Armoring, and Sub-Armoring Water Fall 2009 Sampling Event (DVD)
D NW Construction Spring and Fall 2009 Sampling Videos (DVD)
E University of Texas Final Sampling and Analysis Plan for SPMEs and the Draft SPME Methodology and Results Report

ACRONYMS

ACB	articulated concrete block
AWQC	ambient water quality criteria
cfs	cubic feet per second
COCs	contaminants of concern
cPAHs	carcinogenic polynuclear aromatic hydrocarbons
DEQ	Oregon Department of Environmental Quality
DI	de-ionized water
DO	dissolved oxygen
E&E	Ecology & Environment, Inc.
EPA	United States Environmental Protection Agency
GSI	GSI Water Solutions, Inc.
HPAHs	high molecular weight polynuclear aromatic hydrocarbons
LPAHs	low molecular weight polynuclear aromatic hydrocarbons
McCormick and Baxter	McCormick and Baxter Creosoting Company
MCL	maximum contaminant level
MDL	method detection limit
MLE	maximum likelihood estimation
MRL	method reporting limit
MS/MSD	matrix spike/matrix spike duplicate
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter
mg/L	milligrams per liter
mV	millivolts
NPDWR	National Primary Drinking Water Regulations
NRWQC	National Recommended Water Quality Criteria
NAVD	North American Vertical Datum
O&M	operation and maintenance
ORP	oxidation-reduction potential
cPAHs	carcinogenic polynuclear aromatic hydrocarbons

ACRONYMS (CONTINUED)

PAHs	polynuclear aromatic hydrocarbons
PCP	pentachlorophenol
QC	quality control
ROD	Record of Decision
ROS	regression on order statistics
Site	McCormick & Baxter Superfund Site
SPME	solid phase micro-extraction
TDS	total dissolved solids
TSS	total suspended solids
TFA	tank farm area
TPAHs	total polynuclear aromatic hydrocarbons
UCL	upper confidence limit
UT	University of Texas

APPENDIX D
SURFACE, INTER-ARMORING, AND SUB-ARMORING WATER ASSESSMENT OPERATION AND MAINTENANCE REPORT JANUARY 2009 THROUGH DECEMBER 2009 MCCORMICK AND BAXTER SUPERFUND SITE

1.0 INTRODUCTION

Appendix D to the January 2009 through December 2009 Operation and Maintenance (O&M) Report summarizes the sampling activities and analytical results for the Spring and Fall 2009 surface, inter-armoring, and sub-armoring water sampling events at the McCormick and Baxter Superfund Site (Site) in Portland, Oregon. Analytical results for water sampling events conducted in 2002 through 2009 are also included in the form of plots and summary tables. The location of the Site, Site layout, and surface elevations are shown on Figures 1 through 3 in the main section of the O&M Report. The Fall 2005 to 2009 sampling events were conducted in general accordance with the *2005 Surface Water and Transition-Zone Water Sampling and Analysis Plan* (E&E, 2005), and *Revised O&M Manual* (Hart Crowser/GSI, 2008).

1.1 Sampling Program

The surface, inter-armoring, and sub-armoring water sampling objectives are described in the Draft O&M Plan (DEQ, 2007). Sampling activities for the Spring and Fall 2009 sampling events took place from: March 16 through March 20, 2009; and October 12 through 20, 2009, respectively. Water samples were analyzed for the Site contaminants of concern (COCs). COCs include:

- Polynuclear aromatic hydrocarbons (PAHs);
- Pentachlorophenol (PCP); and
- Metals (arsenic, chromium, copper, and zinc).

Sampling activities are conducted in the Fall and Spring of each year (beginning in Fall 2005) to collect surface water and sub-armoring water (sand cap layer) samples for use in evaluating post-sediment cap construction water quality conditions under both low-river discharge (Fall) and high-river discharge (Spring) conditions. The Spring river level was not significantly higher than in Fall; however, the discharge volume and stream velocity are both significantly higher.

During the first post-sediment cap sampling event in Fall 2005, sampling terminology included surface water and porewater and/or transition zone water.

The latter term has been replaced by sub-armoring water, which denotes samples collected from within the placed cap sand overlying the native sediments. In 2006, the third sampling interval that was added was originally termed "flux chamber" after the design of the sampling equipment, which resembles a flux chamber sampling device. This interval has been renamed inter-armoring water, which denotes water samples collected from within the armoring overlying the sediment cap. The use of the term "flux chamber" for denoting the sample was dropped because sample collection does not provide a measurement of flux (i.e., groundwater entering the river).

1.2 Report Organization

Following this introduction (Section 1), the Appendix is organized as follows:

- **Section 2, Sampling Methodology.** This section presents specific sampling methodologies.
- **Section 3, Sampling Results.** This section presents the sampling analytical program, summary of sampling results, review of data quality, a statistical comparison of sampling results, and a summary of river hydraulics in Spring and Fall 2009.
- **Section 4, Summary.** This section presents a summary of the sediment cap monitoring activities to date and a discussion of planned sampling activities.
- **Section 5, References.**

Tables and figures are included in individual sections at the end of the text portion of the Appendix. The following attachments supplement the text and are included as electronic files on the attached DVD.

- **Attachment A.** This attachment contains a photograph log of sampling activities during the Spring and Fall 2009 sampling events.
- **Attachment B.** This attachment contains a copy of the Pace Analytical certified laboratory analytical data, including data validation of laboratory data for the Spring 2009 sampling event.
- **Attachment C.** This attachment contains a copy of the Pace Analytical certified laboratory analytical data, including data validation of laboratory data for the Fall 2009 sampling event.
- **Attachment D.** This attachment contains a copy of the NW Underwater Construction Spring and Fall 2009 sampling videos.
- **Attachment E.** This attachment contains the final Sampling and Analysis Plan for installation, extraction and analysis of solid phase micro-extraction (SPMEs)

to be co-located with 13 surface water, inter-armoring, and sub-armoring sampling locations. It also contains the draft report including actual field methodology, analysis, results, conclusions, and recommendations.

2.0 SAMPLING METHODOLOGY

This section presents the sampling methodology employed during the Spring and Fall 2009 sampling events. Sampling was conducted in accordance with the Revised O&M Manual (Hart Crowser/GSI 2008). Sampling methodologies for surface, inter-armoring, and sub-armoring water samples are described below.

2.1 Methodology

During the Spring and Fall 2009 sampling events, surface, inter-armoring, and sub-armoring water samples were collected from 22 co-located sampling locations. Sampling locations for Spring and Fall 2009 are shown on Figures D-1 and D-2, respectively. These sampling locations were within the boundary of the sediment cap. Two surface water samples were collected outside of the sediment cap limits, one upriver and one downriver. Generally, sampling locations from the Spring and Fall 2009 events mirrored those of the previous sampling events since 2005.

During the Spring and Fall 2009 sampling events, divers assisted in collecting samples only in deeper water, while near-shore samples were collected by the Hart Crowser/GSI sampling team. NW Underwater Construction, Inc., under subcontract to Hart Crowser, assisted during the Spring and Fall 2009 sampling events. Video of the diver-assisted samples was taken and is available on the DVD in Appendix D.

2.1.1 Surface Water Sampling

During the Spring and Fall 2009 sampling events, surface water samples were collected at 24 locations. Prior to the Spring 2007 sampling event, surface water samples in deep water were collected from a boat using a stainless steel bomb-sampler. Beginning with the Spring 2007 sampling event, methodology for surface water samples was changed to using a peristaltic pump. This addresses several concerns regarding volatilization of certain organic compounds, as well as to decrease the time needed to collect a sample. The tubing is secured approximately one foot above the bottom of a weighted rope, which is then slowly lowered to the bottom of the river. Once in place, the tubing is connected to a peristaltic pump used to purge the surface water and collect the sample. A new length of polyethylene tubing is used at each sampling location

thus eliminating the need for decontamination and minimizing the possibility for cross contamination. In shallower water the tubing to the peristaltic pump was manually held about a foot off the bottom to collect the surface water sample. In 2007, the shallow surface water samples were collected by dipping the sampling jars into the surface water and allowing them to fill at approximately 1 foot from the bottom.

The peristaltic pump collection method reduces turbulence and/or aeration of the samples by eliminating pouring, as encountered while transferring the contents of the bomb sampler into the sample bottle. This minimizes the opportunity for certain organic compounds to volatilize during collection. Sample bottles were completely filled, leaving no headspace to further hinder volatilization. This method also reduced the amount of time required to collect a sample by creating an uninterrupted supply of water to fill the required sample bottles. Following collection, samples are placed on ice and stored in a cooler for transport to the laboratory.

2.1.2 Inter-Armoring Sampling

During the Spring and Fall 2009 sampling events, inter-armoring sampling devices were deployed at 22 locations. The inter-armoring sampling device is placed directly on top of the armor and then pushed down into the armor layer to allow collection of water from the pore spaces between the armoring of the sediment cap. The main chamber is constructed from the bottom one-third of a 33-gallon plastic container. The chamber is attached to small diameter polyethylene tubing using a "quick connect" fitting, which connects to the peristaltic pump used to purge the sample chamber and extract the sample. As the sampling device is placed, a 2-inch diameter rubber stopper is pulled to allow air and surface water to pass through the chamber as it is pushed to the target depth. Once in place, the rubber stopper is reinserted prior to sampling. A peristaltic pump is used to purge the chamber for 1 minute at a low flow rate prior to collecting the sample. Field parameters are collected at the beginning and end of sample collection for each sample. Following collection, samples are placed on ice and stored in a cooler for transport to the laboratory.

2.1.3 Sub-Armoring Sampling

Sub-armoring water samples were co-located with surface-water sample locations and inter-armoring sampling locations within the sediment cap. The sub-armoring samples were collected from approximately 6-inches beneath the armoring layer within the sand layer of the sediment cap.

Sub-armoring water sampling is conducted using tubing connected to a PushPoint® mini-piezometer probe developed and sold by MHE Products (commonly known as Henry Samplers). These probes are constructed of stainless steel, and are easily decontaminated, reusable, and have been used on similar sites throughout the country to obtain the same type of data. The probes are made of small-diameter, 316 stainless steel, and have a screened zone that consists of a series of interlaced machined slots which form a short-screened zone with approximately 20 percent open area. The probe used in this sampling had an overall length of 36 inches and a screen length of approximately 1 inch. These devices are pushed into the sediment to the desired depth using a twisting motion. Then an internal guard rod is removed from the probe body, and tubing is attached to the end of the probe. In general, the desired depth is approximately 6 inches into the sand cap beneath the overlying armoring (rock or articulated concrete block [ACB]).

Tubing is attached to the probe and porewater purged using a peristaltic pump. During purging, water quality parameters are monitored until they stabilize as described in the O&M Manual. Following collection, samples are placed on ice and stored in a cooler for transport to the laboratory.

2.1.4 Water Quality Parameters

Water quality parameters are recorded in conjunction with the collection of each water sample. A Horiba U50, MP20DT Micro Purge, or YSI 6600 V2-4 Sonde multiparameter meter with a flow-through cell were utilized to monitor surface water, inter-armoring water, and sub-armoring water conditions during the 2009 sampling events. One set of parameters was recorded prior to collection of a surface water sample; three sets of parameters were recorded during the collection of each inter-armoring and sub-armoring sample. The first (initial) set of parameters was recorded immediately after pumping was initiated, and the second set of parameters was recorded after conditions stabilized and before the sample was collected (approximately 1 minute after the initial set during inter-armoring water sampling). The third (final) set of parameters was recorded upon completion of the sample collection. The initial and final sets of parameters are presented in Tables D-1 and D-2. Each set of parameters consisted of the following:

- Temperature;
- Dissolved oxygen (DO);
- Oxidation-reduction potential (ORP);
- Specific conductance (Conductivity);

- pH; and
- Turbidity (Fall only).

2.2 Quality Control Sampling

During the Spring and Fall 2009 events, Quality Control (QC) samples were collected including Matrix Spike and Matrix Spike Duplicate (MS/MSD) samples for every group of 20 primary samples or fewer submitted to the laboratory for analysis. Blind duplicate samples were also collected at a rate of one duplicate for every group of 20 primary samples.

One equipment rinsate blank was collected for each type of sampling equipment used. The samples were collected at the end of each sampling event. Laboratory-supplied de-ionized (DI) water was used as the water source of the samples. Rinsate samples were collected from the inter-armoring sampling device by pouring DI water into an inverted decontaminated inter-armoring sampling device. Sample bottles were filled by holding the uncapped bottles under the stream of water being discharged through the quick connect valve. The equipment rinsate blank for the Henry Sampler was collected by placing the screened end of the sampling device in a container of DI water and pumping into the sample jars using the peristaltic pump. These samples were collected in a manner consistent with other samples, in that no headspace was left in the sampling containers and upon collection, sample containers were labeled, sealed in plastic bubble wrap bags, and placed on ice in a cooler for transport to the contract laboratory.

2.3 Modifications to Methodology

Deviations from the Revised O&M Manual for the Spring and Fall 2009 events are described below.

During the Spring 2009 event, the following deviations occurred:

- The sampling device for Location 3 inter-armoring sample shifted during sampling; the sampling device was reset and subsequently re-sampled.
- The sampling device for Location 11 inter-armoring sample shifted during sampling on March 16, 2009; the sampling device was reset and re-sampled on March 19, 2009.
- Post water quality parameters were not collected during the Location 21 sub-armoring sampling event.

- Consistent with the Fall 2008 event, total suspended solids (TSS) and total dissolved solids (TDS) were added to the laboratory requests for Spring and Fall 2009 events. TSS and TDS are not required by the O&M Plan; however, they are valuable in understanding whether concentrations of PAHs are primarily associated with particulate matter or dissolved in water. They have been periodically measured in previous events.

During the Fall 2009 event, the following deviations from the O&M Plan occurred:

- The Location 8 sub-armoring sampling device (Henry Sampler) silted up during purging. The sampling device was reset and a second round of purging and measurement of field parameters were collected prior to sampling.
- Post water quality parameters were not collected during the Location 11 sub-armoring sampling event.
- Turbidity was added to the field parameters.
- Sample Locations 25 and 26 were located roughly 50 feet to the southwest from the O&M planned locations, because the planned locations were not under water.
- At Locations 25 and 26, the rock armoring was too thick to completely penetrate; therefore, the sub-armoring samples were collected from the greatest depth that could be achieved with the equipment, which was still in the rock armoring layer rather than the underlying sand layer.
- During the annual technical meeting, the project team recommended conducting a pilot study using SPME sampling within the cap sand as performance monitoring for both the sediment and groundwater operable units. This work was conducted in accordance with the *SPME Sampling and Analysis Plan* prepared by Dr. Reible/University of Texas (UT) (Reible/UT, 2009). The pilot study consists of thirteen locations where SPME monitoring as well as the conventional monitoring would occur as shown on Figure D-2. SPME were placed immediately following sampling of inter-armoring and sub-armoring water at Locations 2, 3, 5, 6, 8, 9, 10, 11, 12, 13, 16, 19, and 25. At each pilot study location, an 18-inch long SPME fiber within a slotted metal rod was placed in the sediment adjacent to where the Henry Sampler for the sub-armoring sample (sediment cap sand porewater sample) was collected. The rods were placed so that the bottom of the fiber was located one foot into the sand portion of the cap sand. After emplacement of the SPME rod, the armoring rocks (where present) were replaced to one foot above the cap sand layer. Where ACB armoring was present, the rods were pushed 2 feet into the sediment cap as measured from the top of the ACB. The SPME rods were left in place for approximately one week and removed on October 21, 2009. After removal of the SPMEs, the fiber length were cut

and extracted in the field by the UT. It was important to extract the SPMEs quickly in the field so that the lower molecular weight PAHs (LPAHs) could be accurately measured; for example, naphthalene begins to desorb from the fiber within minutes of removing the SPME from the sediment. The SPMEs were extracted within 5 to 15 minutes of removing them from the sediment. SPME fiber sample containers were labeled, sealed in plastic bubble wrap bags, and placed on ice in a cooler for transport to UT for analysis. A more detailed description of the placement and processing of SPMEs in the field, the laboratory analysis, results and conclusions is described in Attachment E, which contains the UT preliminary report.

3.0 SAMPLING RESULTS

This section describes the analytical results for samples collected during the Spring and Fall 2009 sampling events. Analytical results for COCs identified in the Record of Decision (ROD) (EPA, 1996) for the Site were compared to the 1996 ROD Ambient Water Quality Criteria (AWQCs), the most recent EPA National Recommended Water Quality Criteria (NRWQCs) (EPA, 2007a) and the most recent EPA National Primary Drinking Water Regulations (NPDWRs) (EPA, 2007b). The following values are the lowest values for each COC from the above-mentioned comparison criteria:

- Arsenic (III) - 0.00014 milligrams per liter (mg/L);
- Chromium (III) - 0.074 mg/L;
- Copper - 0.009 mg/L;
- Zinc - 0.110 mg/L;
- PCP - 1.00 micrograms per liter (µg/L);
- Acenaphthene - 520 µg/L;
- Anthracene - 40,000 µg/L;
- Fluoranthene - 54.0 µg/L;
- Fluorene - 5,300 µg/L;
- Naphthalene - 620 µg/L;
- Pyrene - 4,000 µg/L;
- Total carcinogenic polynuclear aromatic hydrocarbons (cPAHs) - 0.031 µg/L; and
- Benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene - 0.018 µg/L each.

The comparison criteria allow for Site-specific adjustments to their standard table values. PCP can be adjusted for Site-specific pH; chromium, copper, and zinc can be adjusted for hardness. Tables D-1 through D-5 reflect adjustments to PCP to reflect Site pH, but the metals criteria have not been revised to reflect Site-specific hardness. The hardness of the Willamette River is approximately 25 mg/L while the hardness in the sub-armoring zone ranges from 70 to 190 mg/L. Hardness of the inter-armoring zone has not been measured. Therefore, until the water quality point of compliance is resolved, the comparison criteria calculated based on a hardness of 100 mg/L is used. It is recommended that Site-specific hardness analysis of the surface water, inter-armoring, and sub-armoring zones be conducted in the upcoming sampling events. This will allow hardness conversions for comparison criteria to be conducted for each zone in the future. For surface water, if the NRWQC for chronic aquatic water were adjusted for hardness, the values would be 0.0238 mg/L for chromium III, 0.0027 mg/L for copper, and 0.0365 mg/L for zinc. No surface water concentrations in the Spring or Fall of 2009 exceed these values. Copper in inter-armoring and sub-armoring water exceed for individual locations but the mean is below the hardness adjusted criteria. Zinc only exceeds in sub-armoring water at one location when comparing to the hardness adjusted value.

The comparison criteria are based on carcinogenic risk level of 10^{-6}. The criteria listed above for zinc, acenaphthene, fluoranthene, naphthalene, and total cPAHs are based on AWQCs in place in 1996. The criteria listed above for PCP represents the NPDWR maximum contaminant level (MCL). In 1996, AWQCs for metals were based on total metal concentrations. The criteria listed above for arsenic, chromium, and copper are based on the NRWQCs in place in 2007, which were developed for dissolved metals.

The results presented in Tables D-1 through D-5, which represent total metals concentrations, are compared with NRWQCs for dissolved metals, as required by EPA. Dissolved metal concentration is a more accurate and appropriate analysis when comparing to NRWQCs, and therefore, are also analyzed and reported. Appropriate adjustments to the comparison criteria will be made when compliance criteria and methodology are determined prior to entering the operational and maintenance stage of the project.

3.1 Sample Analysis

Upon collection, sample containers were labeled, sealed in plastic bubble wrap bags, and placed on ice in a cooler for transport to the contract laboratory by the laboratory courier. Analytical services were provided by Pace Laboratories with the Spring samples analyzed by their Seattle, Washington, laboratory and

the Fall samples analyzed by their Minneapolis, Minnesota, laboratory. Chain-of-custody procedures were followed from sample collection to analysis. Samples were analyzed for:

- PAHs and PCP using EPA Method 8270-SIM (using ultra low-level detection limits);
- Total arsenic, copper, chromium, and zinc using EPA Method 6020;
- Dissolved arsenic, copper, chromium, and zinc using EPA Method 6020-diss (field filtered using a 0.45-micron filter);
- TDS using SM 2540C; and
- TSS using SM 2540D.

3.2 Conventional Analytical Results

Analytical summary tables for PAHs, PCP, total and dissolved metals for the conventionally collected surface water, inter-armoring, and sub-armoring water samples from the Spring and Fall 2009 sampling events are summarized in Tables D-1 and D-2. TSS and TDS analyses were conducted in Spring and Fall 2009 events. While TSS and TDS are not requirements of the O&M Plan, they are valuable comparison data when evaluating the concentrations of PAHs, which are commonly associated with particulate matter.

Copies of the laboratory analytical reports and data review summary reports for Spring and Fall 2009 events are included as Attachments B and C, respectively, on the attached O&M Report DVD. Where concentrations are reported as not detected, it means that the constituent was not detected above the method detection limit (MDL). Additionally, where concentrations are detected above the MDL, but below the method reporting limit (MRL), the quantity is considered estimated.

Water samples were collected from 24 surface water locations and 22 subsurface locations in both the Spring and Fall 2009 events. Total cPAH results for each sampling event are shown on Figures D-3 through D-8; naphthalene results for each sampling event are shown on Figures D-9 through D-14; and copper results for each event are shown on Figures D-15 through D-20. Figures 21 through 29 present the temporal concentration trends for mean

concentrations of total arsenic and copper; total PAHs[1]; total cPAHs; and for select analytes at select individual locations.

3.2.1 Rinsate Blank Results

Four rinsate blanks were collected during each of the Fall and Spring 2009 events: two from the Henry Samplers used to collect sub-armoring samples and two from inter-armoring sampling devices. The results are presented in Tables D-1 and D-2 (Spring and Fall results, respectively). The rinsate blanks were analyzed for PAHs, PCP, and total metals. Dissolved metals are collected for comparison criteria at this Site, and are not considered a potential indicator of cross-contamination; residual contamination after decontamination would be in particulate form.

In the Spring sampling event, rinsate blanks were collected from Henry Samplers after sampling Location 6 and after sampling Location 10. Estimated values for total chromium and copper detected at Location 6 were 0.00012 and 0.0015 mg/L, respectively. Estimated values for total copper and zinc and chromium at Location 10 were 0.0018, 0.0042, and 0.0036 mg/L, respectively.

Two rinsate blanks were also collected in the Spring from the inter-armoring sampling devices after sampling Location 12, and after sampling Location 20. The inter-armoring device rinsate blanks were analyzed for PAHs and total metals. Total chromium and naphthalene were detected at Location 12 at estimated concentrations of 0.00018 mg/L and 0.066 µg/L, respectively.

During the Fall event, rinsate samples were collected from Henry Samplers used at Locations 7 and 16. Rinsate blanks were analyzed for PAHs, PCP, and total metals. Copper was detected at an estimated value of 0.00042 mg/L from Location 07. Naphthalene was detected at 0.098 and 0.08 µg/L, respectively. Pentachlorophenol was also estimated at 0.25 µg/L.

A rinsate sample was collection from inter-armor sampling devices used at Locations 4 and 9, and analyzed for PAHs, PCP, and total metals. Naphthalene was detected at 0.11 µg/L at Location 4 and 0.096 µg/L at Location 9; zinc was estimated at 0.0028 mg/L at Location 4.

The Spring and Fall sampling event results were compared to the rinsate blank results. Samples with detections of a contaminant that are less than five times an

[1] Note that the means of total LPAH, HPAH, cPAH, and PAH concentrations in the tables and figures have increased from previous years' documents. An error was discovered in the 2002 spreadsheet which translated throughout the 2008 data since the same formula was used year-to-year. It erroneously took ½ of non-detects for totals that already were sums of ½ of the non-detect values.

associated detection in the rinsate blank would receive a flag indicating the contaminant was not detected (U). No samples from either Spring or Fall events were qualified as "not detected" due to concentrations in rinsate blanks.

3.2.2 Surface Water Sampling Results

During the Spring 2009 event, 26 surface water samples were collected from 24 locations including two duplicates (MBSW0309-04D from Location 4, MBSW0309-13D from Location 13) and background samples from Location 1 and Location 27 (upstream and downstream, respectively). The following summarizes results for the 22 sample locations overlying the sediment cap. The background sample location results are discussed, as necessary.

Of the 22 locations overlying the sediment cap, eleven had detectable concentrations of PAHs with only one of these locations containing detectable levels of cPAHs (Figure D-3). Naphthalene was detected in five locations (Locations 13, 17, 18, 19, and 21) at concentrations more than 3 orders of magnitude below the comparison criteria (Figure D-9). PCP was not detected in any of the samples. Total arsenic was detected and exceeded the comparison criteria of 0.00014 mg/L at all locations. Total copper exceeded the comparison criteria at one location (Location 19) (Figure D-15). Chromium and zinc did not exceed comparison criteria in any locations.

During the Fall 2009 event, 26 surface water samples were collected from 24 locations including one duplicate, MBSW1009-13D, from Location 13. Of these samples, five samples had detectable PAHs with no detectable cPAHs (Figure D-4). Naphthalene was detected in five locations (Locations 4, 5, 17, 19, and 25) at more than 3 orders of magnitude below the comparison criteria (Figure D-10). None of the samples had detections of PCP. Sixteen locations had detectable total arsenic, all of which exceeded the comparison criteria of 0.00014 mg/L. Chromium, copper (Figure D-16), and zinc did not exceed the comparison criteria in any locations.

As shown on the trend plots of the mean concentrations, concentrations have not increased since 2005 when the sediment cap was completed (Figures D-21 through D-23). In fact, it appears that PAH (both cPAH and total polynuclear aromatic hydrocarbons [TPAH]) concentrations have decreased in the sub-armoring layer while the surface water and inter-armoring layers have remained stable (i.e., are not increasing or decreasing). TPAHs in surface water are consistently higher in the Fall when groundwater discharge is lowest. Since the same pattern is not present in cPAHs, this suggests that low molecular weight PAHs migrate through the sediment cap through lateral discharge of

groundwater. The metals concentrations are stable and show no trends since installation of the sediment cap.

Upstream (Location 1) and downstream (Location 27) samples had detections of total and dissolved metals but no detectable PCP. During the Spring sampling event, the downstream (Location 27) sample had a detection of fluorene; there were no other detectable PAHs in either event. Analytical results for surface water samples are summarized in Tables D-1 and D-2 and are discussed below in more detail.

PAH Results. Total cPAH results for surface water samples are shown on Figure D-3 (Spring) and D-4 (Fall). Figures D-9 and D-10 show the sampling locations where naphthalene was detected in Spring and Fall surface water samples, respectively.

In the Spring 2009 event, five of the eight cPAHs were detected at Location 15. No individual cPAH at that location exceeded it's individual comparison criteria; however, the total cPAH concentration of 0.060 µg/L exceeds the comparison criteria of 0.031 µg/L for total cPAHs. No LPAHs were detected at Location 15, suggesting the cPAHs are associated with particulate matter. Total metals at this location were an order of magnitude higher than dissolved; another indication of particulate matter is high in the surface water.

Eleven samples had measurable low level concentrations of LPAHs. As discussed above, five samples had low level detections of naphthalene. None of these samples exceeded comparison criteria for LPAHs.

In the Fall 2009 sampling event, no detectable cPAH concentrations were reported (Figure D-4). Low level LPAHs were detected at 6 locations including Locations 4, 5, 13, 17, 19, and 25. Location 25 did not have detectable PAHs in the sub-armoring sample, suggesting the low level PAHs may be either in surface water from another location in the Willamette River or from lateral discharge of groundwater. The other locations all contained PAHs at depth; however, since they are also nearshore, it is not known whether the PAHs in surface water are due to PAHs migrating upward through the cap or due to lateral discharge of groundwater. The highest TPAH result was from Location 5 at 0.754 µg/L.

Naphthalene was detected in 5 locations as shown on Figure D-10. Detected concentrations were 3 orders of magnitude below the comparison criteria of 620 µg/L.

These results are consistent with previous results where low level PAHs have been detected in samples collected along the shore of Willamette Cove and in

the former tank farm area (TFA) especially in the Fall event when the river discharge is lower.

PCP Results. PCP was not detected above the MDLs in any of the surface water samples collected during the Spring or Fall 2009 sampling events. The MDL for PCP ranged from 0.100 to 0.600 µg/L.

Metals. Total and dissolved metals analysis was conducted for arsenic, chromium, copper, and zinc. In Spring 2009, total arsenic and total chromium were reported in every surface water sample; total copper was detected in 21 of 22 samples and total zinc was detected in 5 sample locations. In Fall 2009, total copper was reported in every surface water location, with total arsenic and total zinc reported in 16 of 22 surface water locations and total chromium reported in 10 locations.

Total arsenic was detected between the detection limit and the MRL in all but one of the Spring 2009 surface water samples; Location 19 (MBSW0309-19) had a detection at 0.0018 mg/L. The dissolved arsenic concentration at this location was an order of magnitude lower (0.00018 mg/L) suggesting that the sample contained particulate matter; however, the TSS was below a detection limit of 2 mg/L. Total arsenic exceeded the comparison criteria of 0.00014 mg/L at all locations. However, in general the arsenic concentrations are comparable to historic concentrations. The upstream and downstream locations had concentrations of total arsenic at 0.0004 and 0.00042 mg/L, respectively. This is close to the mean concentrations for overlying the sediment cap (0.0005 mg/L total arsenic).

In Fall 2009, arsenic was detected at 16 locations at concentrations ranging from 0.00048 mg/L to 0.00071 mg/L (Location 17). The laboratory was able to achieve a lower MDL in the Spring (0.00010 mg/L) than in the Fall (0.000540 mg/L). This is likely the reason for the additional number of detections in the Spring. With the exception of MBSW0309-19, arsenic concentrations in 2009 were estimated values because they are between the MDL and MRL. The reported concentrations exceeded the comparison criteria of 0.00014 mg/L. Arsenic was detected in the Fall 2009 upstream location (MBSW1009-01) at 0.00047 mg/L and downstream Location (MBSW1009-27) at 0.00043 mg/L. These concentrations are similar to the mean for total arsenic concentrations in surface water samples collected from overtop of the sediment cap at 0.00042 mg/L.

In Spring 2009, total chromium was detected at all locations at concentrations ranging up to 0.0095 mg/L. Dissolved chromium was detected in 21 of the 22 locations. The mean concentrations were 0.0013 mg/L and 0.0003 mg/L for

total and dissolved chromium, respectively. In Fall 2009, ten sample locations (45% of the locations) had detections of total chromium ranging up to 0.00046 mg/L. The mean concentrations were 0.0002 and 0.00018 mg/L for total and dissolved chromium, respectively. Total chromium concentrations in both the Spring and Fall surface water samples were below the corresponding comparison criteria of 0.074 mg/L.

In Spring 2009, total copper was detected at 21 of the 22 locations and dissolved copper was detected at 59% of the locations. At Location 19, total copper was detected at 0.0150 mg/L which exceeds the lowest comparison criteria of 0.009 mg/L. The dissolved concentration at this location was two orders of magnitude lower. The mean concentrations were 0.0026 and 0.0008 mg/L for total and dissolved copper, respectively. The mean concentrations and concentrations from individual locations, with the exception of Location 19, were below the comparison criteria. Surface water from upstream Location 27 contained 0.0016 mg/L and <0.00052 mg/L total and dissolved copper, respectively. Neither total nor dissolved copper were detected in the downstream location. In Fall, total copper was detected at all locations for both total and dissolved copper. No samples in the Fall exceeded the comparison criteria. The mean concentrations were 0.00097 mg/L and 0.0007 mg/L for total and dissolved copper, respectively. For the upstream and downstream sampling locations, copper was detected at 0.00079 mg/L (total) and 0.00082 mg/L (dissolved) at Location 1 and at 0.0009 mg/L (total) and 0.0006 mg/L (dissolved) at Location 27. These concentrations are similar to the mean concentration overlying the sediment cap.

With the exception of the Spring sample result reported for Location 19, copper concentrations in 2009 did not exceed the corresponding comparison criteria of 0.009 mg/L. Total copper results for surface water are shown in Figures D-15 (Spring) and D-16 (Fall). Copper concentrations in the Spring show a larger range in concentrations for totals than in the Fall and the mean is higher. The inter-armoring and sub-armoring copper concentrations at Location 19 (and many other locations) in the Spring showed lower concentrations than in surface water, indicating that the metals are associated with particulate matter in the surface water load. This is likely due to the higher discharge volume in the river increasing the particulate volume.

In Spring 2009, total zinc was detected at 5 of the 22 locations and dissolved zinc at 2 of the 22 locations. The maximum total zinc concentration was 0.0320 mg/L, which is an order of magnitude below the comparison criteria of 0.11 mg/L. In Fall 2009, total zinc was detected at 18 of the 22 locations and dissolved zinc at 6 of the locations. The maximum total zinc concentration was 0.0089 mg/L, which is two orders of magnitude below the comparison criteria of

0.11 mg/L. Zinc concentrations in the Spring were higher than in the Fall due to the high discharge volume in the Spring, as mentioned above for copper.

3.2.3 Inter-Armoring Water Sampling Results

During the Spring 2009 sampling event, 24 samples were collected from 22 inter-armoring locations, including two duplicates: Location 5 (MBIA0309-05D), and Location 12 (MBIA0309-12D). None of the samples contained detectable amounts of PCP. Three locations (Locations 10, 18, and 25) contained detectable cPAHs (Figure D-5) below the comparison criteria, and over half of the samples had detectable TPAHs. Naphthalene was detected in five locations as shown on Figure D-11, all well below the comparison criteria. Arsenic exceeded the comparison criteria at all locations and copper exceeded the comparison criteria at one location. One location exceeded the comparison criteria for copper, and no locations exceeded comparison criteria for chromium or zinc.

During the Fall 2009 sampling event there were 23 samples collected from 22 locations, including a duplicate from the inter-armor sample collected from Location 13 (MBIA1009-13D). PCP was not detected in any locations. Ten locations had detectable PAHs; however, no cPAHs were detected (Figure D-6). Naphthalene was detected in 7 locations (Figure D-12); these detections were well below the comparison criteria.

Inter-armoring results have remained stable since the sediment cap was installed (Figures D-21 through D-23). The inter-armor layer typically has the highest concentrations of copper while for arsenic and PAHs, concentrations in the inter-armoring layer are typically lower than the sub-armoring layer. This pattern for copper suggests that it may be related to surface water loads and not related to copper migrating from the Site.

Analytical results for inter-armoring samples are summarized in Tables D-1 and D-2, and are discussed below in more detail.

PAH Results. Total cPAH results for inter-armoring water samples are shown on Figures D-5 (Spring) and D-6 (Fall). Figures D-11 and D-12 illustrate naphthalene results for inter-armoring water samples for Spring and Fall 2009 sampling events.

In the Spring, chrysene (a cPAH) was detected at Locations 10 and 25 below the comparison criteria of 0.018 ug/L. Carcinogenic PAHs were not detected in the surface water or sub-armoring samples from these locations. Carcinogenic PAHs chrysene and benzo(a)pyrene were detected at 0.014 µg/L and 0.0095 µg/L, respectively, at Location 18. These concentrations are also below their

respective comparison criteria of 0.018 µg/L and no cPAHs were detected in the surface water or sub-armoring samples at Location 18.

Low level LPAHs were detected at locations 2, 7, 10, 12, 14, 15, 16, 17, 19, and 20. Fluorene was the most commonly-detected LPAH, occurring in six of the ten samples; naphthalene was detected in five samples (Figure D-11). Low level high molecular weight polynuclear aromatic hydrocarbons (HPAHs) were detected at five locations (Locations 7, 10, 18, 20, and 25). None of these locations exceed comparison criteria for PAHs. The maximum TPAH concentration was 7.861 µg/L at Location 20 and the mean concentration for TPAHs from all locations was 0.454 µg/L. MDLs ranged from 0.0095 µg/L to 0.0760 µg/L.

Ten samples collected in the Fall 2009 event had detections of TPAHs. The highest TPAH concentration detected was 0.594 µg/L. No cPAHs were detected. Naphthalene was detected in 7 of the samples (Figure D-12) with a maximum detection of 0.36 µg/L and a mean of 0.03 µg/L.

No increasing (or decreasing) trends are apparent for PAHs since the sediment cap was installed (Figures 22 and 23). The inter-armoring layer appears to vary based on river discharge and is most influenced by porewater in the Fall and surface water in the Spring.

PCP Results. During the Spring and Fall 2009 sampling events, PCP was not detected above the MDL in the inter-armoring samples. The MDL ranged from 0.320 to 0.520 µg/L.

Metals. Inter-armoring samples were analyzed for total and dissolved arsenic, chromium, copper, and zinc. In Spring 2009, total arsenic, chromium, and copper were detected at all locations. Total zinc was detected at 6 locations. During the Fall 2009 event, total arsenic was detected in 17 of 22 locations and total chromium was detected in 15 locations. Total copper and zinc were detected in all locations.

In Spring 2009, arsenic was detected above the comparison criteria for total arsenic (0.00014 mg/L) at all locations. Total arsenic concentrations ranged from 0.00019 mg/L to 0.0071 mg/L, with a mean of 0.0009 mg/L. The dissolved concentrations were significantly less with a maximum of 0.0008 mg/L and a mean of 0.0003 mg/L. The mean for the dissolved arsenic is the same as the mean for dissolved arsenic in surface water. The total arsenic concentrations are slightly higher in the inter-armoring samples than in the surface water samples. In the Fall event, total arsenic was detected at 17 locations with a maximum concentration of 0.00040 mg/L and a mean of 0.00064 mg/L. In the locations

where arsenic was not detected, the detection limit is above 0.000520 mg/L which is almost three times the comparison value. Therefore these values are shaded grey in Table D-2 indicating that the detection limit exceeds the comparison criteria. Dissolved arsenic was detected at all locations. The dissolved concentrations were similar to the concentrations of total arsenic suggesting that the total arsenic in the Fall was primarily present in the dissolved phase. Arsenic concentrations in the inter-armoring layer have been stable since the sediment cap was installed. They are typically lower than the sub-armoring layer and are typically similar to the surface water concentrations (Figure D-21).

In Spring 2009, total chromium was detected in all locations with a maximum concentration of 0.0043 mg/L and a mean of 0.0018 mg/L. Dissolved chromium was detected at 91% of the locations with a maximum concentration of 0.0017 mg/L and a mean of 0.0003 mg/L. Dissolved chromium concentrations are significantly lower than total chromium concentrations suggesting a large portion of the total chromium is present associated with particulate matter. This is consistent with the high river discharge in the Spring. No chromium concentrations exceed comparison criteria. In the Fall event, total chromium was detected at 68% of the locations with a maximum of 0.0027 mg/L and a mean of 0.00049 mg/L. Dissolved chromium was detected at 27% of the locations with a maximum concentration of 0.00065 mg/L and a mean of 0.00025 mg/L. Total chromium concentrations are significantly higher than the dissolved chromium concentrations suggesting that the chromium is primarily associated with particulate matter. No chromium concentrations exceed the comparison criteria.

Total copper during the Spring 2009 sampling event was detected at all locations with a maximum of 0.0092 mg/L and a mean of 0.0038. Only Location 17 (0.0092 mg/L) exceeded the comparison criteria of 0.009 mg/L. Dissolved copper was detected at 82% of the locations with a maximum of 0.0029 and a mean of 0.0011 mg/L. In fall 2009, total copper was detected in all locations with a maximum of 0.0102 mg/L and a mean of 0.00186 mg/L. Dissolved copper was also detected at all locations with a maximum of 0.00160 mg/L and a mean of 0.00091 mg/L. During the Fall sampling event, total copper at Location 4 (0.0102 mg/L) exceeds the comparison criteria of 0.009 mg/L. TSS, measured by the laboratory, at this location was elevated (1150 mg/L), suggesting that the copper is associated with the particulate matter. In addition, the dissolved concentration was an order of magnitude lower. No other locations exceed the comparison criteria for copper.

In Spring 2009, total zinc was detected at 6 of the 22 locations with a maximum of 0.018 mg/L and a mean of 0.0067 mg/L. Dissolved zinc was detected at 4% of the locations with a maximum of 0.023 mg/L and a mean of 0.0046 mg/L. No

samples exceeded the comparison criteria of 0.11 mg/L for zinc. In Fall 2009, total zinc was detected at all locations with a maximum of 0.0303 mg/L and a mean of 0.00643 mg/L. Dissolved zinc was detected at 18 of the 22 locations with a maximum of 0.0058 mg/L and a mean of 0.0029 mg/L. No samples exceeded the comparison criteria of 0.11 mg/L for zinc.

3.2.4 Sub-Armoring Water Sampling Results

In the Spring 2009 sampling event, 24 sub-armoring water samples were collected from 22 locations including two duplicate samples (MBSA0309-06D and MBSA0309-11D collected from Locations 6 and 11, respectively). Of these samples, three had detectable concentrations of cPAHs and 19 of the locations contained detectable LPAHs. No inter-armoring samples contained concentrations of PCP above the MDL. Total and dissolved arsenic were detected at all locations and exceeded the comparison criteria of 0.00014 mg/L. Copper exceeded the comparison criteria in 2 of the locations where it was detected. Chromium and zinc, where detected, were all below comparison criteria.

In the Fall 2009 sampling event, 23 samples were collected from 22 Locations including two duplicate samples (MBSA1009-06D and MBSA1009-13D at Locations 6 and 13). Of the 22 sample locations, cPAHs were detected at four locations and 19 of the locations contained detectable LPAHs. PCP was not detected at any locations. Total and dissolved arsenic were detected at 21 and 22 of the 22 locations, respectively, and exceeded the comparison criteria of 0.00014 mg/L. Chromium, copper, and zinc, where detected, were all below comparison criteria.

Metals and cPAH concentrations have been stable since the sediment cap was installed (Figures D-21 and D-22). TPAHs appear to be decreasing in concentration (Figure D-23). Sub-armoring concentrations for PAHs and arsenic are higher in the sub-armoring than the surface water and inter-armoring layer while copper concentrations are lower in the sub-armoring than in the inter-armoring layer.

Analytical results for sub-armoring water samples are summarized in Tables D-1 and D-2 and are discussed below in more detail.

PAH Results. Total cPAH results for sub-armoring samples are shown on Figures D-7 and D-8. Figures D-13 and D-14 show naphthalene concentrations in sub-armoring water samples results from the Spring and Fall sampling events, respectively.

In the Spring 2009 sampling event, detectable cPAH concentrations were reported in three of the 22 sub-armoring water samples (Location 11 at 0.297 µg/L, Location 4 at 0.094 µg/L, and Location 7 at 0.048 µg/L). Total cPAHs from these locations exceed the comparison criteria of 0.031µg/L.

Location 11 was the highest of the three samples referenced above. This sample is suspect as no PAHs were detected in the parent sample while the duplicate sample contained 6 of the eight cPAHs at concentrations above individual cPAH comparison criteria. Note that the worse case individual constituent concentrations are used in calculating the statistics. The variation between the parent and duplicate values may have been related to a shift of the sampling device. However, the pre- and post-field parameters do not show a significant change in values which would be expected if conditions changed. The total copper and arsenic were also significantly higher in the duplicate than parent sample suggesting either a different sample or one that varied significantly during sampling. This is not reflected in the field parameters, and therefore, we suspect that there was an error in the laboratory. Location 11 is not a location where elevated cPAHs have been observed historically.

In the Fall, detectable cPAH concentrations were reported in four of the 22 sub-armoring water samples collected (Locations 7 and 17 in the TFA, Location 16, and Location 13 in Willamette Cove). All four locations exceed the comparison criteria of 0.031 µg/L. LPAHs were detected at 19 locations with a maximum total LPAH concentration of 52.58 µg/L (Location 16) and a mean of 8.45 µg/L.

PCP Results. PCP was not detected above the MDL in any of the sub-armoring samples collected in 2009. The MDL ranged from 0.236 to 0.240 µg/L.

Metals. Sub-armoring samples were analyzed for total and dissolved arsenic, chromium, copper, and zinc. Total and dissolved arsenic was detected and exceeded comparison criteria in 100% of the Spring samples and in 95% and 100%, respectively, of the Fall samples. In the Spring, total copper exceeded the comparison criteria at 2 locations (11 and 16). Copper, where detected, did not exceed comparison criteria in the Fall. Chromium and zinc did not exceed their respective comparison criteria.

All locations exceeded the comparison criteria for total arsenic (0.00014 mg/L). In the Spring sampling event, the maximum total arsenic concentration was 0.0570 mg/L and the mean was 0.0080 mg/L. The dissolved concentrations were similar with a maximum of 0.057 mg/L and a mean of 0.0078 mg/L suggesting that the detected total arsenic is primarily in the dissolved phase. Total arsenic concentrations are approximately an order of magnitude higher in the sub-armoring samples than in the inter-armoring samples. In the Fall event,

total arsenic was detected at 20 locations with a maximum concentration of 0.0451 mg/L and a mean of 0.0093 mg/L. In the locations where arsenic was not detected, the MDL is above 0.00054 mg/L, which is above the comparison value. Therefore these values are shaded grey in Table D-2 indicating that the MDL exceeds the comparison criteria. Dissolved arsenic was detected at all locations. The dissolved concentrations were similar to the concentrations of total arsenic suggesting that the total arsenic in the Fall was primarily present in the dissolved phase.

In Spring 2009, total chromium was detected in 20 locations with a maximum concentration of 0.0100 mg/L and a mean of 0.0015 mg/L. Dissolved chromium was detected at 15 of the locations with a maximum concentration of 0.0016 mg/L and a mean of 0.0003 µg/L. Dissolved chromium concentrations are significantly lower than total chromium concentrations and similar to the inter-armoring and surface water chromium concentrations suggesting a large portion of the total chromium present is associated with particulate matter. This is consistent with the high river discharge in the Spring. No chromium concentrations exceed comparison criteria. During the Fall event, total chromium was detected at 11 of the locations with a maximum of 0.0022 mg/L and a mean of 0.00049 mg/L. Dissolved chromium was detected at 7 of the locations with a maximum concentration of 0.00036 mg/L and a mean of 0.00019 mg/L. Total chromium concentrations are significantly higher than the dissolved chromium concentrations suggesting that the chromium is primarily associated with particulate matter. No chromium concentrations exceed the comparison criteria.

During the Spring 2009 sampling event, total copper was detected at 16 locations with a maximum of 0.0192 mg/L and a mean of 0.0026. Location 11 (0.0192 mg/L) and Location 16 (0.019 mg/L) exceeded copper's comparison criteria of 0.009 mg/L. As discussed above under PAHs, the exceedance at Location 11 was in the duplicate sample, which was significantly different than the parent sample. Dissolved copper was detected at 7 of the locations with a maximum of 0.003 mg/L and a mean of 0.0007 mg/L. In Fall 2009, total copper was detected at 20 locations with a maximum of 0.0070 mg/L and a mean of 0.00173 mg/L. Dissolved copper was also detected at 9 locations with a maximum of 0.0022 mg/L and a mean of 0.00049 mg/L.

In Spring 2009, total zinc was detected at 6 of the 22 locations with a maximum of 0.081 mg/L and a mean of 0.0101 mg/L. Dissolved zinc was detected at 2 locations with a maximum of 0.086 mg/L and a mean of 0.0038 mg/L. No samples exceeded the comparison criteria of 0.11 mg/L for zinc. In Fall 2009, total zinc was detected at 16 of the 22 locations with a maximum of 0.0379 mg/L and a mean of 0.00754 mg/L. Dissolved zinc was detected at 6 locations with a

maximum of 0.0075 mg/L and a mean of 0.0024 mg/L. No samples exceeded the comparison criteria of 0.11 mg/L for zinc.

3.3 Water Quality Parameters

Water quality parameters (temperature, specific conductance, DO, ORP, pH and turbidity [only measured in the Fall because interpretation of the Spring results suggested that supplemental information to the TSS would be valuable]), recorded during the collection, were reviewed to obtain a general understand the geochemistry. In addition, water quality field parameters help understand the contribution of surface water and groundwater in a sample.

Water temperatures in the Spring were approximately 5°C lower than the temperature for each layer sampled in the Fall. The median/average temperature for surface water, inter-armoring water, and sub-armoring water in the Spring was 7.9/8.2°C, 8.5/8.6°C, and 8.8/8.8°C, respectively, while the median/average temperatures in the Fall for surface water, inter-armoring water, and sub-armoring water were 13.3/13.4°C, 13.6/13.85°C, and 13.9/14.25°C, respectively. The Spring also showed a wider range in the temperatures for each layer than in the Fall. Generally, temperatures in both the Spring and Fall increase with depth (from surface water to the sub-armoring water) suggesting that the groundwater is generally warmer than the surface water even in the Fall when surface water temperatures are warm.

Specific conductance was lower and showed a smaller spread in the data in the Spring when the river discharge is high. The median/average specific conductance for surface water, inter-armoring water, and sub-armoring water in the Spring was 52/54 µS/cm, 53/59 µS/cm, and 110/194 µS/cm, respectively, while the median/average for specific conductance in the Fall for surface water, inter-armoring water, and sub-armoring water was 80/85 µS/cm, 85/95 µS/cm, and 200/424 µS/cm, respectively. In the Spring, the surface water and inter-armoring were similar with high specific conductivities in the sub-armoring water. In fact, in the Spring there are several locations where the sub-armoring water has a similar specific conductance to the surface water indicating that the surface water (or hyporheic zone) extends to or below the sub-armoring layer. In the Fall, the surface water has the lowest specific conductance slightly increasing into the inter-armoring with the sub-armoring water significantly higher than both the surface and inter-armoring water. Generally, the data show that the zone influenced by surface water is deeper in the Spring than in the Fall as would be expected with the high discharge.

DO was generally higher in the Spring than in the Fall. The range in the DO in the sub-armoring was higher in the spring (showing the influence of surface

water) while the range in the surface water and inter-armoring was higher in the Fall (showing the influence of groundwater/porewater). The median/average DO for surface water, inter-armoring water, and sub-armoring water in the Spring was 10.4/10.4 mg/L, 10.2/10.1 mg/L, and 4.3/5.3 mg/L, respectively. While the median/average for DO in the Fall for surface water, inter-armoring water, and sub-armoring water, respectively, was 8.9/9.1 mg/L, 7.6/7.2 mg/L, and 2.4/3.0 mg/L.

The pH in the Spring showed a limited range of pH in all layers and was generally neutral (7.0-7.9). In the Fall, the surface water was slightly acidic to neutral with a pH range from 5.5 to 7.0 with the pH increasing with depth.

The ORP data showed a smaller range in the Spring and was more similar between the layers (with a small increase with depth at most locations). While in the Fall, the surface water ORP was clearly higher with increasing ORP values with depth. The median/average ORP for surface water, inter-armoring water, and sub-armoring water in the Spring was 50/61 mV, 35/28 mV, and 48/33 mV, respectively. While the median/average for ORP in the Fall for surface water, inter-armoring water, and sub-armoring water, respectively, was 80/99 mV, 35/53 mV, and -30/12 mV.

The water quality parameters were very consistent between parameters showing significant surface water influence into the sub-armoring layer in the Spring when the river discharge is high. In the Fall, the sub-armoring zone appears to be in equilibrium with the cap sand.

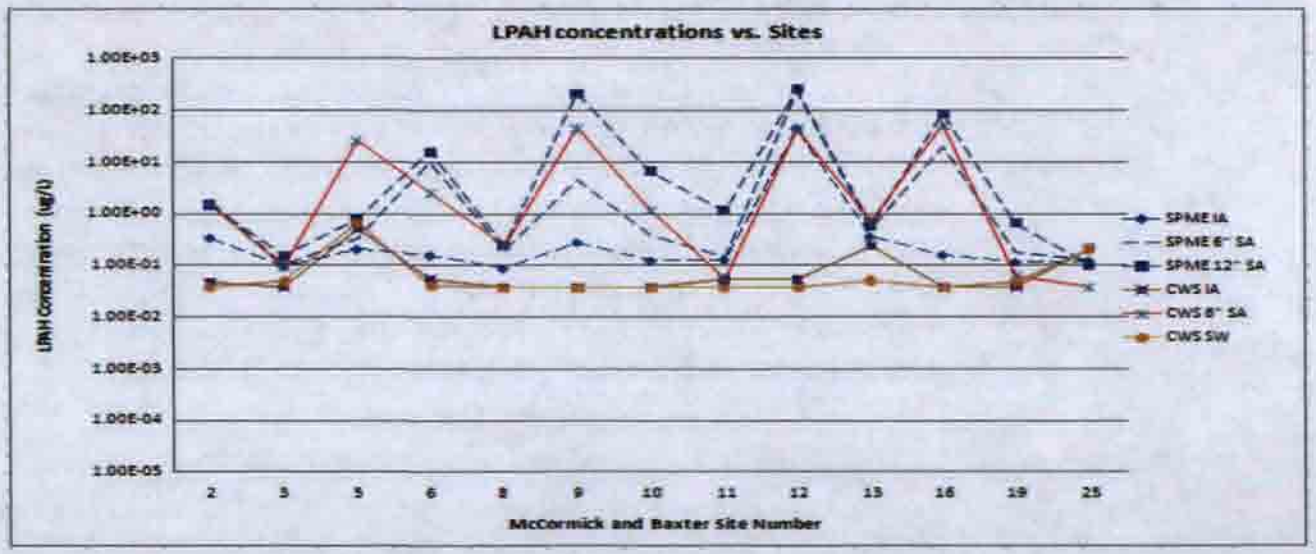
3.4 Solid Phase Micro-extraction Results

During the Fall semi-annual sampling event, SPME passive samplers using polydimethylsiloxane (PDMS) were deployed at 13 of the 22 locations overlying the sediment cap. The objective was to determine the effectiveness of SPME samplers as a long-term monitoring strategy for sediment cap performance. *In-situ* porewater concentrations derived from the SPMEs were compared to the same surface water criteria used for the semi-annual sampling comparisons, analyzed for vertical concentration profiles and intra-site variability, and compared to the conventional semi-annual sampling data from Fall 2009.

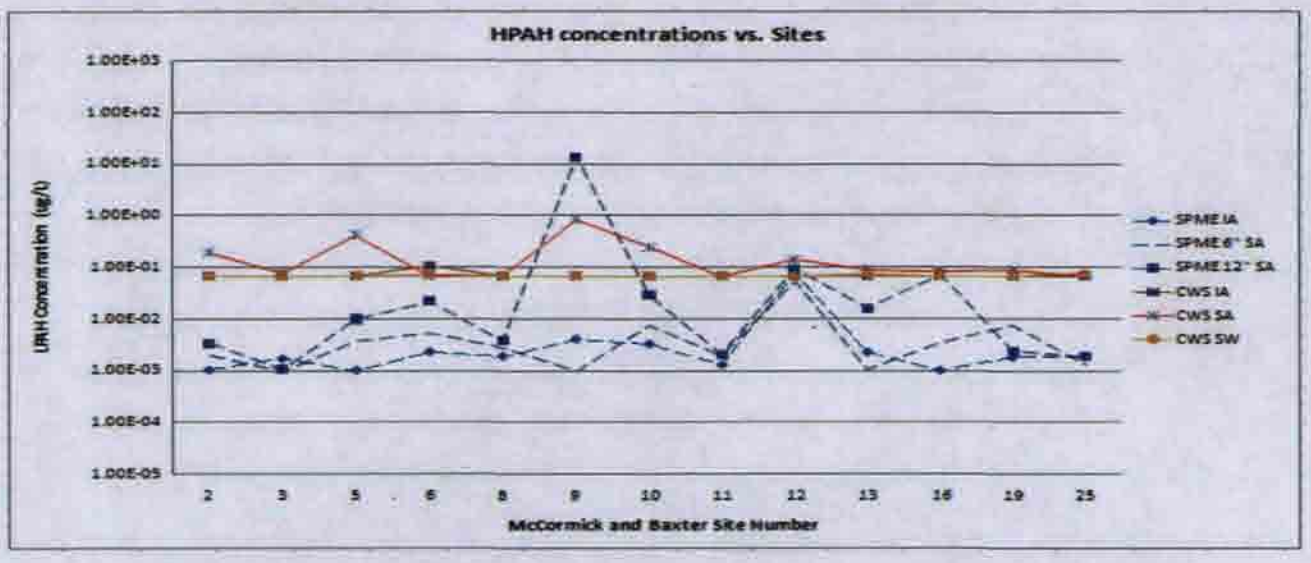
Site	Acenaphthene			Phenanthrene			Benzo(b)fluoranthene			Benzo(a)pyrene		
	IA	6" SA	12" SA	IA	6" SA	12" SA	IA	6" SA	12" SA	IA	6" SA	12" SA
M&B 02	0.249	1.647	1.394	0.004	0.017	0.017	4.35E-05	8.79E-05	1.29E-04	7.57E-06	7.57E-06	7.57E-06
M&B 03	0.013	0.008	0.008	0.002	0.004	0.003	4.33E-05	2.41E-05	6.76E-05	7.57E-06	7.57E-06	1.61E-05
M&B 05	0.023	0.181	0.537	0.006	0.019	0.028	4.22E-05	4.79E-05	2.76E-04	7.57E-06	7.57E-06	4.32E-05
M&B 06	0.014	9.013	12.889	0.009	0.041	0.760	5.13E-05	1.32E-04	1.11E-04	1.32E-05	2.12E-05	1.83E-05
M&B 08	0.008	0.052	0.115	0.003	0.008	0.009	6.87E-04	1.28E-04	8.22E-05	7.57E-06	7.57E-06	1.23E-05
M&B 09	0.127	3.663	137.265	0.024	0.010	32.677	2.41E-05	2.41E-05	3.54E-01	7.57E-06	7.57E-06	1.01E-02
M&B 10	0.027	0.219	6.065	0.007	0.017	0.023	6.01E-05	4.61E-05	1.93E-04	1.21E-05	1.47E-05	3.49E-05
M&B 11	0.014	0.034	0.998	0.003	0.007	0.007	5.16E-05	9.18E-05	8.77E-05	1.33E-05	1.85E-05	2.86E-05
M&B 12	38.501	213.050	239.490	0.146	1.056	1.268	3.47E-04	6.40E-04	6.70E-04	2.54E-05	1.44E-04	1.54E-04
M&B 13	0.216	0.323	0.266	0.013	0.032	0.032	4.24E-05	7.57E-05	2.41E-05	1.38E-05	7.57E-06	7.57E-06
M&B 16	0.015	19.259	71.029	0.004	0.075	3.220	2.41E-05	7.86E-05	2.07E-04	7.57E-06	2.10E-05	2.32E-04
M&B 19	0.008	0.061	0.543	0.003	0.010	0.007	2.41E-05	2.41E-05	2.41E-05	7.57E-06	7.57E-06	7.57E-06
M&B 25	0.015	0.031	0.013	0.003	0.002	0.004	5.75E-05	5.19E-05	6.03E-05	1.28E-05	1.15E-05	1.18E-05

SPME measured porewater concentrations (µg/L) for the various locations across the three depths (IA- inter-armoring, 6" sub-armoring and 12" sub-armoring). Exceedances highlighted in black.

Concentrations in excess of surface water quality criteria were only observed at one location at depth (Location 9 at 12 inches into the sub-armoring layer for cPAHs [e.g., 2 feet below the top of the sediment cap]). The two samplers closer to the surface at the same sampling location, at 6 inches in the sub-armoring layer and in the inter-armoring layer, did not show elevated levels of PAHs, suggesting no significant migration to the surface. Uniform concentration profiles were present in samples located along the shoreline. Tidal effects likely increased the vertical mixing of the porewater through the cap resulting in this profile. The pronounced gradient, observed in river locations, suggested more limited vertical mixing of contaminants and potentially an area of groundwater discharge.



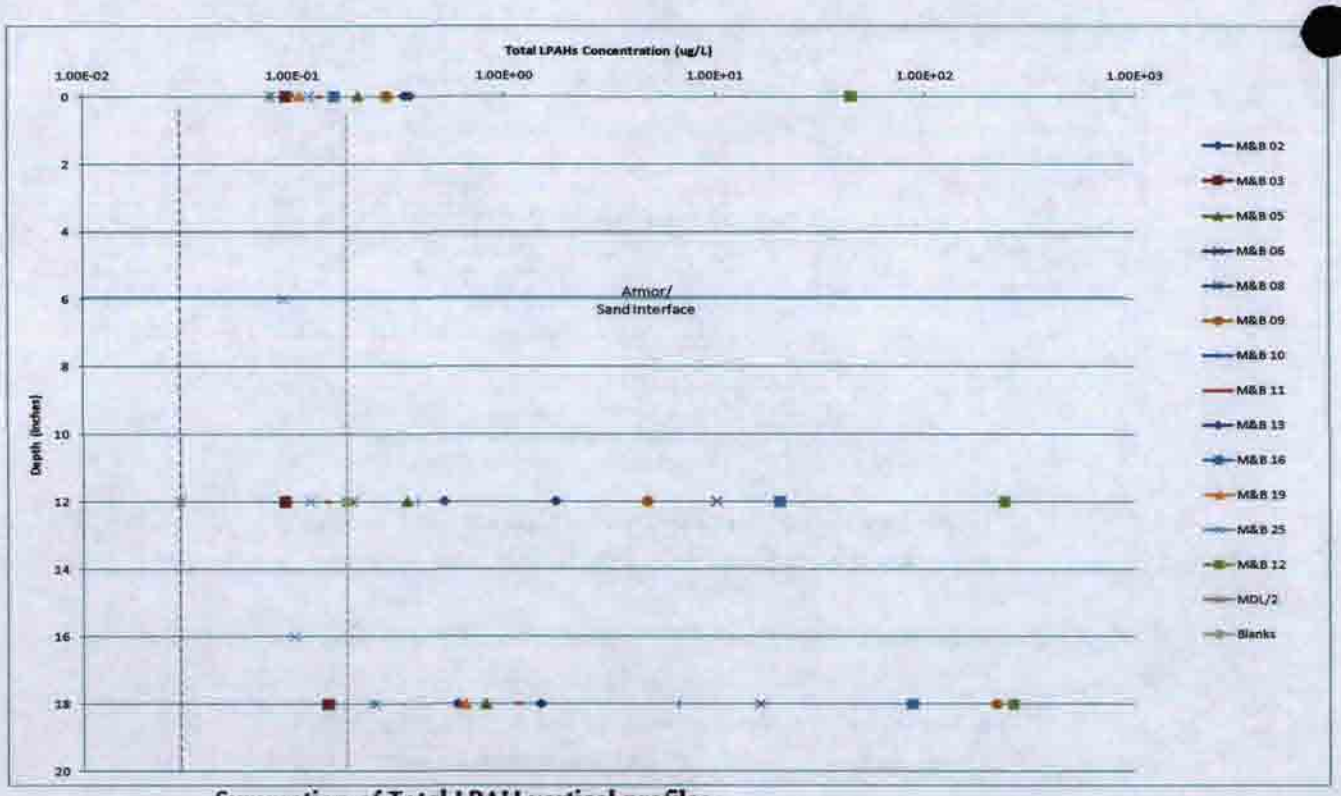
LPAH concentration profiles across locations and varying depths for CWS and SPME.



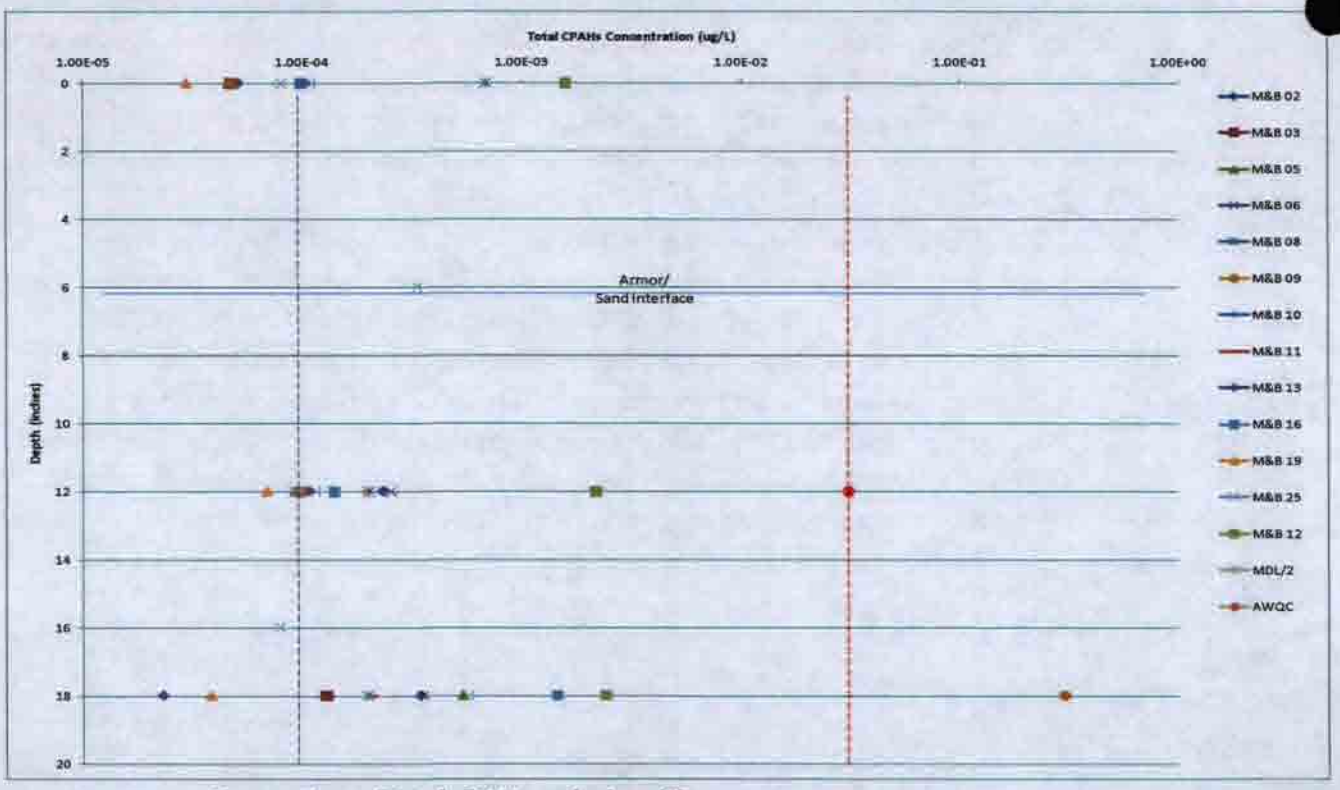
HPAH concentration profiles across locations and varying depths for CWS and SPME (note that the CWS sample detection limit is approximately 0.075 µg/L).

The correlation of SPME and conventional porewater extraction techniques was limited due to the low detection frequency by conventional porewater extraction methods as a result of the higher detection limits by that method. The correlation was good for LPAHs with most measurements of the same order of magnitude and improved with increasing depth (due to the greater number of detections). Higher molecular weight PAHs, fluoranthene and pyrene, differed more significantly. This is possibly due to colloidal organic matter (dissolved organic matter) in the conventional samples which increases the total water concentration. Any comparison between the two datasets is necessarily limited, however, due to the large number of non-detects in the conventional data.

The summation of vertical profiles as shown on Page D-26 shows the large amount of attenuation between the sample concentrations at 1 foot into the sand cap and the inter-armoring samples. In summary, SPMEs provide better resolution for vertical profiling, more appropriate measurement of freely dissolved porewater concentrations through equilibrium partitioning, reach lower detection limits and provide an equilibrated concentration over several tidal cycles versus the one-time grab for the conventional sampling method. The high vertical profiling resolution of the SPME sampling will provide early warning for potential sediment cap protectiveness issues for long-term monitoring.



Summation of Total LPAH vertical profiles.



Summation of Total cPAH vertical profiles.

3.5 Data Review

All data presented in this report have been reviewed by a Hart Crowser chemist to determine data quality and usability. In this review, the following criteria were evaluated:

- Sample receipt temperatures;
- Holding times;
- Method blank samples;
- Matrix spike samples;
- Laboratory control samples;
- Duplicate samples;
- Surrogate spike recoveries; and
- Rinsate blank samples.

Conclusions and recommendations pertaining to the overall usefulness of the laboratory data are summarized in the Quality Assurance Reports located in Attachments B and C with the analytical data for the sampling event. Data reviewed for this report were assessed to be valid for their intended use with minor qualifications.

3.6 Statistical Analysis

Data collected during the Spring and Fall 2009 sampling events have been summarized and organized using several statistical methods. Data are tabulated by sampling event and media (surface, inter-armoring or sub-armoring water). Results for PAHs were totalized into four types: LPAHs, HPAHs, cPAHs, and TPAHs.

3.6.1 Statistical Parameters

A series of statistical parameters were used to summarize the data and were provided for each media (i.e., surface, inter-armoring, and sub-armoring water) and each sampling event (i.e., Fall 2002, Fall 2003, Fall 2005, Spring 2006, Fall 2006, Spring 2007, Fall 2007, Spring 2008, Fall 2008, Spring 2009, and Fall 2009). The parameters include the following:

- Number of Samples;
- Detection Frequency;

- Maximum Detected Concentration;
- Location of Maximum;
- Mean Concentration;
- Data Distribution; and
- 95% Upper Confidence Limit on the Mean (95% UCL).

Samples resulting in all PAH constituents below MDLs, were totalized by adding one half of the MDL for each constituent being summed. If a sample resulted in detectable concentrations for any PAH constituent, only the detections were summed for that total. We recognize that this may lead to data bias; however, consistency with the previous methodology was considered more important in comparing the 2009 data to previous data. Previous statistics were not recalculated.

The summary statistics for Spring and Fall 2009 are provided in Tables D-1 and D-2. Summary statistics for previous sampling events and 2009 events are provided in Tables D-3 (surface water), D-4 (inter-armoring), and D-5 (sub-armoring). The methodology used to calculate these statistics are provided in this section and are consistent with previous years' methodology. Background or reference samples (upstream and downstream samples collected outside the cap footprint) were not included in the statistical analysis.

The number of samples, detection frequency, maximum detected concentration, and location of maximum were determined by standard means using Microsoft Excel functions. Duplicate samples were not included in the calculation of number of samples or detection frequency. In the summary tables, if an analyte was not detected in any sample for the media and year combination, the detection frequency was shown as 0%, the maximum detected concentration was indicated as ND (not detected), and the location of maximum concentration was indicated as NA (not applicable).

Additional processing of the data was necessary to calculate the mean concentration, data distribution, and 95% UCL: non-detected analyte concentrations were represented using half the MDL. Duplicate sample datasets were reduced to "worst-case" scenarios, extracting the highest concentration for each analyte from the paired duplicate. The maximum detected concentration or maximum MDL for non-detected results between a duplicate sample and original were used to calculate the statistical parameters. If fewer than 4 of the sample concentrations were non-unique, ProUCL advised that the 95% UCL was not valid. This is reflected in the data where no values are given for the 95% UCL. However, because half the MDL is used for samples that had no

detections of a constituent and MDLs varied; the calculated 95% UCL for locations with low frequencies of detection should also be used with caution.

Data distribution and the 95% UCL were calculated using EPA's ProUCL Version 4.00.04 (EPA, 2009). Non-detects and duplicates were included in the analysis as mentioned above. Within ProUCL, the UCL for each analyte was calculated for all UCL types at the 0.95 confidence coefficient. The number of bootstrap runs was set to the default of 2000. The ProUCL output includes raw statistics (mean, maximum, standard deviation, etc.), results of each distribution test, and recommendations for distribution and 95% UCL. The method for calculating data distribution and 95% UCL and for determining the recommended values is presented in the ProUCL Technical Guide (EPA, 2009).

In cases where few detections were present in the data set (i.e., 19 of 22 are non-detect) the recommended UCL was a nonparametric 99% statistic, resulting in a higher value than is likely to be reflected at the station, a second nonparametric 95% value was substituted (Standard Bootstrap Method). This is consistent with previous methodology. Note that conducting statistics on the data sets with predominantly non-detects or all non-detects result in means and UCLs that are not very meaningful. For these locations that have so few detections, the methods of applying distributions, such as the maximum likelihood estimation (MLE) or the regression on order statistics (ROS), to the non-detect values are also not applicable (Helsel, 2005). Although statistical methods may not be completely valid, general trends can be observed in the statistical results as described below.

3.6.2 Statistical Results

Summary tables and graphs were developed to show results from multiple sampling events. Tables D-3 through D-5 summarize the statistical results from pre- and post-capping sampling events for surface, inter-armoring, and sub-armoring water. The mean for sampling events from 2002 through 2009 for total arsenic, total copper, TPAHs and cPAHs are presented on Figures D-21 through D-23a, respectively. These contaminants were selected because:

- TPAH provides an overall indication of contaminant reduction and trends. Acenaphthene, fluoranthene, and naphthalene also have ROD required performance standards (520 µg/L, 54 µg/L, and 620 µg/L, respectively). These are not individually plotted.
- Total cPAH is a ROD required performance standard (0.031 µg/L total cPAHs); the results will be considered to determine overall remedy protectiveness.

- Arsenic, chromium, copper, and zinc have ROD required performance standards (0.19 mg/L, 0.21 mg/L, 0.012 mg/L, and 0.11 mg/L, respectively), the results will be used to determine the overall protectiveness. Arsenic and copper were selected for presentation because they have a higher frequency of detections above or near the comparison criteria.

Each graph shows data from surface, inter-armoring, and sub-armoring water samples. Select graphs are presented on a log scale in addition to the linear scale.

Data is also graphically depicted for selected sample locations to show changes in contaminant concentrations over time from 2002 through 2009. Figures D-24 through D-26 show total arsenic and copper concentrations for samples collected from Locations 12, 4, and 10, respectively. These locations were agreed upon by EPA because they are in locations where detections in the sub-armoring sand have had consistent detections of PAHs. Figures D-28 through D-29 show total cPAH and total PAH concentrations for Locations 12, 10, and 4, respectively.

3.6.3 Comparison of Statistical Results

The mean concentration and 95% UCL were compared over time to evaluate overall contaminant concentration trends. The mean concentrations for total metals (arsenic, chromium, copper, and zinc) remained relatively stable between Fall 2002 and Fall 2009 in the three media. With the exception of copper, the sub-armoring samples are consistently higher in concentration than the inter-armoring and surface water samples. Metal concentrations appear to be consistent with background concentrations and have not changed significantly since installation of the sediment cap.

PCP was detected in surface water during the 2002 sampling event but has not been detected in subsequent sampling events. PCP was detected at low levels, well below comparison criteria, in Fall 2006 in the inter-armoring samples; however, it was not detected again in the 2007, 2008, or 2009 events.

Carcinogenic PAHs appear to be fairly stable, with the exception of elevated surface water concentrations in Fall 2002 prior to installation of the sediment cap and sub-armoring concentrations in 2005 directly after installation of the sediment cap that may have mobilized contaminants. The elevated concentration in the mean surface water concentration from the Spring 2009 event (0.0382 µg/L) was a single detection (MBSW0309-15, 0.0600 µg/L); all other locations were below MDLs (though the cumulative MDL for this calculated value is above the comparison criteria). Inter-armoring and surface water have been primarily non-detect for cPAHs since the cap was installed (Figures D-22 and D-22a; Tables D-3 and D-4). The clear reduction in cPAHs

between the sub-armoring samples and the surface water and inter-armoring samples indicate that the sediment cap is functioning as designed.

Total PAHs in the inter-armoring and surface water have remained stable since installation of the sediment cap. TPAHs are regularly higher in the surface water samples in the Fall than in the Spring. River levels and discharge volumes are lower during the Fall time periods and the higher concentrations in surface water may represent a contribution from the lateral discharge of groundwater. Concentrations of TPAHs in the sub-armoring samples are consistently about an order of magnitude more than the surface water and inter-armoring samples. The sub-armoring sample concentrations have a decreasing trend since the sediment cap was installed. Again, the reduction in concentration between the sub-armoring and the decreasing trend in TPAH concentrations in the sub-armoring layer show that the sediment cap is performing as designed.

A significant influence on the surface water data came from a single sample (SED-6) collected during the 2002 sampling event. Sample SED 6 contained 61.5 µg/L TPAHs. This result significantly skewed the data set. When SED 6 was removed from the data set, the mean and 95% UCL varied less than 0.2 µg/L from the remaining data sets. Statistical data sets for surface water are summarized in Table D-3. For 2002, data sets are presented with and without SED 6 data.

3.7 Willamette River Hydraulics

Discharge data for the Willamette River are presented on Figures D-30 (Spring 2009) and D-31 (Fall 2009); stream elevation data is presented in Figures D-32 (Spring 2009) and D-33 (Fall 2009); and stream velocity data are presented on Figures D-34 (Spring 2009) and D-35 (Fall 2009). The primary hydraulic differences between Fall and Spring sampling events are higher river levels, flow, and muted diurnal tidal variation during Spring. During the Spring 2009 sampling event, river elevations ranged from between 7.7 and 11.3 feet NAVD88. During the Fall 2009 sampling event, elevations ranged between 5.5 and 10.6 feet NAVD88. During the Spring 2009 event, river discharge averaged roughly 40,000 cubic feet per second (cfs), ranging from -10,000 to 55,000 cfs, while discharge rates during the Fall 2009 sampling event were considerably lower, averaging about 18,000 cfs, with a range from -50,000 to 45,000 cfs. Additionally, discharge rates and stream velocities were often negative on a daily basis, resulting in reverse flow and potentially more stagnant conditions during Fall sampling events. These hydraulic differences appear to generally result in higher COC concentrations in the Fall than observed in the Spring.

4.0 SUMMARY

Surface water and sub-armoring water sampling events have been conducted since the installation of the sediment cap at the McCormick and Baxter Site: Fall 2005, Spring and Fall 2006, Spring and Fall 2007, Spring and Fall 2008, and Spring and Fall 2009. Additional sampling of inter-armoring water was added to monitor sediment cap performance in Spring 2006. Sampling conducted in 2002 and 2003 represents pre-sediment cap conditions and did not include inter-armoring or sub-armoring sampling. Porewater samples were collected in 2002. Sampling activities were conducted in general accordance with the *2005 Surface Water and Transition-Zone Water Sampling and Analysis Plan* (E&E, 2005), and *Revised O&M Manual* (Hart Crowser/GSI, 2008). Samples have been collected generally from the same 24 sampling locations since the sediment cap construction was completed. SPME samples were collected in the Fall of 2009 according to the SOW provided in Attachment E.

Samples were analyzed for Site-specific COCs, including both total and dissolved metals (arsenic, chromium, copper, and zinc), PAHs, and PCP. Sample analysis through Spring 2008 was provided by TestAmerica and the Fall 2008 and 2009 sample analysis was provided by Pace Analytical, both under separate contract with the Oregon DEQ. Analytical results were compared against a group of water quality guidelines including AWQCs established in the 1996 ROD, and NRWQCs and NPDWRs established by the EPA. These guidelines are collectively referred to as comparison criteria. Of the Site COCs, comparison criteria have been developed for total metals, PCP, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)flouranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, pyrene, and total cPAHs.

Based on the post-sediment cap construction water sampling, trends and preliminary conclusions are presented, to include:

- Metal concentrations in sub-armoring samples are stable and consistent in sampled locations across the sediment cap, suggesting contaminant concentrations reflect background values. Copper appears to be associated with the Willamette River loading as evidenced by the lower concentrations in sub-armoring samples.
- With few exceptions, contaminant concentrations from surface water and inter-armoring water are consistently below both performance and comparison criteria, except for arsenic, a background metal.
- PAH contaminant concentrations in surface water are higher in samples collected from Fall sampling but are consistently below comparison criteria.

Table D-6 summarizes the exceedances of the lowest comparison criteria for post-sediment cap data. In Spring 2009, arsenic exceeded its criterion at all locations. Location 15 exceeded the total cPAH criteria of 0.0310 µg/L with a sum of 0.0600 µg/L total cPAHs while no individual cPAHs exceeded their individual comparison criteria. Location 19 exceeded the comparison criteria for copper. In the Fall event, arsenic was detected in almost three quarters of the locations; even where arsenic was not detected above the MDL, the analytical MDL was greater than the comparison criterion. Location 15 exceeded the cPAH criteria of 0.0310 µg/L with a detection of 0.0600 µg/L. There were no other exceedances of comparison criteria in surface water in Spring or Fall 2009.

In the inter-armoring in Spring 2009, there were 22 exceedances for arsenic and one for copper. In Fall 2009, there were 17 exceedances for arsenic and one for copper. Sub-armoring samples show more exceedances; however, the rates of exceedances and concentrations have remained consistent since installation of the sediment cap.

Maximum detections are summarized for select analytes in Table D-7. In general, the maximum detected concentrations are relatively stable since installation of the sediment cap, particularly concentrations of metals. Several maximum surface water PAH contaminant concentrations vary from Spring compared to Fall; a strong correlation exists between TPAHs and naphthalene from Spring 2006 through Fall 2009. Table D-8 presents the detection frequencies by year and media. The detection frequency for TPAHs is higher than in previous years in both surface and inter-armoring samples. The detection frequency for TPAH in the sub-armoring appears to be consistent with previous years.

Arsenic is consistently detected in all layers with the exception of Spring 2008, which may be associated with high river discharge volumes. Chromium, copper, and zinc are detected more frequently in 2009 than in 2008 in surface water and inter-armoring water, but sub-armoring detection frequencies have remained consistent. The persistence of sub-armoring detections suggests that the metals are primarily naturally occurring, and not due to Site contamination.

Detection frequencies increase with depth. Surface water detection of TPAHs between Fall 2005 through 2009 ranged from 19 to 68 percent, while sub-armoring water detections ranged from 68 to 91 percent. Detection frequencies for total metals were generally much higher than PAHs as would be expected as the metals are naturally occurring; however, no discernable pattern was observed between sampling events. This suggests that the presence of the metals are primarily due to naturally occurring metals and not associated with

the metals contamination associated with the wood treating products used at the Site.

COC concentrations in surface water and inter-armoring water are below comparison criteria with the exception of arsenic for which the comparison criterion is below the MDL for arsenic. COC concentrations in the sub-armoring water are below comparison criteria with a few exceptions. Concentration trends are stable or decreasing. Based on water sampling from the surface water, inter-armoring and sub-armoring, the sediment cap appears to be protective and functioning as designed.

5.0 REFERENCES

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Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

		Sediment Cap Performance Goals		Comparison Criteria			Surface Water Statistics						
		McCormick & Baxter Record of Descision, 1996, Ambient Water Quality Criteria (AWQCs)		EPA Current, 2007, National Recommended Water Quality Criteria (NRWQCs)		EPA National Primary Drinking Water Regulations (NPDWRs)							
CONTAMINANT OF INTEREST		Aquatic Life (chronic)[1]	Human Health (fish consumption only)[1]	Aquatic Life (chronic)[2]	Human Health (consumption of organism only)[2]	Maximum Contaminant Levels (MCLs)[3]	Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value
Total Dissolved Solids (mg/L)							22	100%	83	Location 13	52	Student's T	58.26
Total Suspended Solids (mg/L)							22	82%	25	Location 25	4.59	Gamma	6.4
Total Metals (mg/L)													
Arsenic		0.19		0.15	0.00014	0.01	22	100%	0.0018	Location 19	0.0005	Non parametric	0.00075
Chromium		0.21		0.074		0.1	22	100%	0.0095	Location 19	0.0013	Non parametric	0.00306
Copper		0.012		0.009			22	95%	0.0150	Location 19	0.0026	Non parametric	0.00530
Zinc		0.11		0.12	26		22	23%	0.0320	Location 19	0.0062	Non parametric	0.01160
Total Dissolved Metals (mg/L)													
Arsenic							22	100%	0.0004	Location 3	0.0003	Non parametric	0.00032
Chromium							22	95%	0.0010	Location 8	0.0003	Non parametric	0.00046
Copper							22	59%	0.0017	Location 5	0.0008	Non parametric	0.00117
Zinc							22	9%	0.0230	Location 3	0.0039	NA	NA
Pentachlorophenol (µg/L)		13		11	3	1	22	0%	ND	NA	0.1609	NA	NA
Polynuclear Aromatic Hydrocarbons (µg/L)													
Acenaphthene	L	520		990			22	9%	0.0200	Location 2	0.0059	NA	NA
Acenaphthylene	L						22	5%	0.0100	Location 4	0.0050	NA	NA
Anthracene	L			40,000			22	0%	ND	NA	0.0048	NA	NA
Benz (a) anthracene	H, C			0.018			22	5%	0.0110	Location 15	0.0050	NA	NA
Benzo (a) pyrene	H, C			0.018		0.2	22	0%	ND	NA	0.0048	NA	NA
Benzo (b) fluoranthene	H, C			0.018			22	5%	0.0120	Location 15	0.0051	NA	NA
Benzo (ghi) perylene	H, C						22	5%	0.0150	Location 15	0.0052	NA	NA
Benzo (k) fluoranthene	H, C			0.018			22	5%	0.0110	Location 15	0.0050	NA	NA
Chrysene	H, C			0.018			22	5%	0.0110	Location 15	0.0050	NA	NA
Dibenz (a,h) anthracene	H, C			0.018			22	0%	ND	NA	0.0048	NA	NA
Fluoranthene	H		54	140			22	9%	0.0120	Location 15	0.0054	NA	NA
Fluorene	L			5300			22	27%	0.0940	Location 2	0.0280	Non parametric	0.101
Indeno (1,2,3-cd) pyrene	H, C			0.018			22	0%	ND	NA	0.0048	NA	NA
Naphthalene	L	620					22	23%	0.1100	Location 13	0.0168	Non parametric	0.224
Phenanthrene	L						22	0%	ND	NA	0.0048	NA	NA
Pyrene	H			4,000			22	5%	0.0110	Location 25	0.0051	NA	NA
Total LPAHs[4]							22	50%	0.1140	Location 2	0.0525	Non parametric	0.153
Total HPAHs[4]							22	9%	0.0720	Location 15	0.0466	NA	NA
Total CPAHs[4]			0.031				22	5%	0.0600	Location 15	0.0382	NA	NA
Total PAHs[4]							22	59%	0.1158	Location 12	0.0735	Non parametric	0.169

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

		Inter-Armoring Water Statistics							Sub-Armoring Water Statistics						
CONTAMINANT OF INTEREST		Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value	Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value
Total Dissolved Solids (mg/L)		22	100%	100	Location 15	58	Student's T	64.37	22	100%	6700	Location 11	449	Non parametric	1754
Total Suspended Solids (mg/L)		22	86%	150	Location 4	15	Non parametric	45.52	22	91%	220	Location 11	35	Lognormal	95.61
Total Metals (mg/L)															
Arsenic		22	100%	0.0071	Location 7	0.0009	Non parametric	0.00217	22	100%	0.05700	Location 5	0.0080	Gamma	0.01390
Chromium		22	100%	0.0043	Location 4	0.0018	Student's T	0.00214	22	95%	0.01000	Location 16	0.0015	Lognormal	0.00311
Copper		22	100%	0.0092	Location 17	0.0038	Gamma	0.00481	22	73%	0.01900	Location 16	0.0026	Gamma	0.00423
Zinc		22	27%	0.0180	Location 4	0.0067	Non parametric	0.01000	22	27%	0.08100	Location 11	0.0101	Non parametric	0.02640
Total Dissolved Metals (mg/L)															
Arsenic		22	100%	0.0008	Location 14	0.0003	Non parametric	0.00044	22	100%	0.05700	Location 5	0.0078	Gamma	0.01410
Chromium		22	91%	0.0017	Location 10	0.0003	Non parametric	0.00061	22	68%	0.00160	Location 15	0.0003	Gamma	0.00036
Copper		22	82%	0.0029	Location 25	0.0011	Non parametric	0.00168	22	32%	0.00300	Location 15	0.0007	Non parametric	0.00136
Zinc		22	18%	0.0230	Location 14	0.0046	Non parametric	0.00881	22	9%	0.00860	Location 3	0.0038	NA	NA
Pentachlorophenol (µg/L)		22	0%	ND	NA	0.1602	NA		22	5%	0.74	Location 5	0.1868	NA	NA
Polynuclear Aromatic Hydrocarbons (µg/L)															
Acenaphthene	L	22	18%	6	Location 20	0.2896	Non parametric	1.476	22	55%	19	Location 5	2.2821	Non parametric	7.418
Acenaphthylene	L	22	0%	ND	NA	0.0048	NA	NA	22	14%	0.35	Location 12	0.0268	Non parametric	0.099
Anthracene	L	22	5%	0.029	Location 20	0.0059	NA	NA	22	23%	0.22	Location 5	0.0259	Non parametric	0.0761
Benz (a) anthracene	H, C	22	5%	0.0095	Location 18	0.0050	NA	NA	22	14%	0.066	Location 11	0.0091	Non parametric	0.0218
Benzo (a) pyrene	H, C	22	0%	ND	NA	0.0048	NA	NA	22	5%	0.013	Location 4	0.0051	NA	NA
Benzo (b) fluoranthene	H, C	22	0%	ND	NA	0.0048	NA	NA	22	9%	0.07	Location 11	0.0084	NA	NA
Benzo (ghi) perylene	H, C	22	0%	ND	NA	0.0048	NA	NA	22	5%	0.028	Location 11	0.0058	NA	NA
Benzo (k) fluoranthene	H, C	22	0%	ND	NA	0.0048	NA	NA	22	9%	0.026	Location 11	0.0063	NA	NA
Chrysene	H, C	22	14%	0.014	Location 18	0.0056	Non parametric	0.00782	22	14%	0.077	Location 11	0.0098	NA	NA
Dibenz (a,h) anthracene	H, C	22	0%	ND	NA	0.0048	NA	NA	22	0%	ND	NA	0.0048	NA	NA
Fluoranthene	H	22	14%	0.11	Location 7	0.0125	Non parametric	0.0353	22	32%	0.79	Location 7	0.0633	Non parametric	0.223
Fluorene	L	22	27%	1.4	Location 20	0.0828	Non parametric	0.358	22	68%	10	Location 5	0.8080	Non parametric	5.61
Indeno (1,2,3-cd) pyrene	H, C	22	0%	ND	NA	0.0048	NA	NA	22	5%	0.03	Location 11	0.0059	NA	NA
Naphthalene	L	22	23%	0.42	Location 2	0.0407	Non parametric	0.141	22	41%	0.2	Location 2	0.0298	Non parametric	0.0735
Phenanthrene	L	22	14%	0.016	Location 20	0.0059	Non parametric	0.00867	22	50%	1.2	Location 5	0.0847	Non parametric	0.322
Pyrene	H	22	18%	0.073	Location 7	0.0101	Non parametric	0.0249	22	27%	0.49	Location 7	0.0440	Non parametric	0.145
Total LPAHs[5]		22	45%	7.765	Location 20	0.4201	Non parametric	1.948	22	86%	30.655	Location 5	3.2422	Non parametric	20.24
Total HPAHs[5]		22	23%	0.183	Location 7	0.0529	Non parametric	0.0827	22	32%	1.328	Location 7	0.1530	Non parametric	0.434
Total CPAHs[5]		22	14%	0.0235	Location 18	0.0348	NA	NA	22	14%	0.297	Location 11	0.0528	Non parametric	0.105
Total PAHs[5]		22	55%	7.861	Location 20	0.4536	Non parametric	1.996	22	86%	30.762	Location 5	3.3692	Lognormal	8.688

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 1		Location 2						Location 3					
SAMPLE TYPE		Surface Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSW0309-01		MBSW0309-02		MBIA0309-02		MBSA0309-02		MBSW0309-03		MBIA0309-03		MBSA0309-03	
Sample Date		3/17/2009		3/18/2009		3/18/2009		3/18/2009		3/17/2009		3/19/2009		3/17/2009	
Sample Time		14:26		8:17		8:36		8:44		8:52		13:10		9:23	
CONTAMINANT OF INTEREST															
Total Dissolved Solids (mg/L)		57		60		53		100		54		72		60	
Total Suspended Solids (mg/L)		6		4		3		15		3		7		35	
Total Metals (mg/L)															
Arsenic		0.00040	J	0.00043	J	0.00054	J	0.0038		0.00038	J	0.00019	J	0.0039	
Chromium		**0.00069**	J	**0.00076**	J	**0.0012**		**0.00052**	J	**0.00058**	J	**0.00031**	J	**0.0021**	
Copper		0.0022	U	**0.0014**	J	**0.0026**		**0.00091**	J	0.002	U	**0.0012**	J	**0.0047**	
Zinc		0.01	UJ	0.01	U	0.01	UJ	0.014	U	0.01	UJ	**0.0019**	J	**0.015**	
Total Dissolved Metals (mg/L)															
Arsenic		**0.00031**	J	**0.00024**	J	**0.00022**	J	**0.0032**		**0.00042**	J	**0.00021**	J	**0.0026**	
Chromium		**0.00017**	J	**0.00022**	J	**0.00015**	J	**0.00018**	J	**0.00031**	J	**0.00018**	J	**0.00026**	J
Copper		**0.0014**	J	0.00052	U	**0.00080**	J	0.00052	U	0.00052	U	**0.0011**	J	0.00052	U
Zinc		**0.0062**	J	0.01	U	0.01	U	0.010	U	**0.023**		**0.0030**	J	**0.0086**	J
Pentachlorophenol (µg/L)		0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	UJ	0.32	U
Polynuclear Aromatic Hydrocarbons (µg/L)															
Acenaphthene	L	0.0095	UJ	**0.020**		**0.022**		**0.25**		0.0095	UJ	0.0095	UJ	0.0095	UJ
Acenaphthylene	L	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	UJ	0.0095	UJ
Anthracene	L	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Benz (a) anthracene	H, C	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Benzo (a) pyrene	H, C	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Benzo (b) fluoranthene	H, C	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Benzo (ghi) perylene	H, C	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Benzo (k) fluoranthene	H, C	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Chrysene	H, C	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Dibenz (a,h) anthracene	H, C	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Fluoranthene	H	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Fluorene	L	0.0095	UJ	**0.094**	J	**0.010**		**0.020**		0.0095	U	0.0095	UJ	**0.028**	
Indeno (1,2,3-cd) pyrene	H, C	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	U
Naphthalene	L	0.0095	UJ	0.025	U	**0.42**		**0.20**		0.0095	UJ	0.0095	UJ	0.0095	UJ
Phenanthrene	L	0.0095	UJ	0.0095	U	0.0095	U	**0.012**		0.0095	U	0.0095	UJ	0.0095	U
Pyrene	H	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U	0.0095	UJ	0.0095	UJ	0.0095	UJ
Total LPAHs[4]		0.0285	UJ	**0.1140**	J	**0.452**		**0.482**		0.0285	U	0.0285	UJ	**0.028**	
Total HPAHs[4]		0.0475	UJ	0.0475	U	0.0475	U	0.0475	U	0.0475	U	0.0475	UJ	0.0475	U
Total CPAHs[4]		0.0380	UJ	0.0380	U	0.0380	U	0.0380	U	0.0380	U	0.0380	UJ	0.0380	U
Total PAHs[4]		0.0760	UJ	**0.1140**	J	**0.452**		**0.482**		0.0760	U	0.0760	UJ	**0.028**	
Field Parameters (pre-/post-sample)															
Temperature (°C)		7.66		7.3		7.33 / 7.38		7.3 / 7.24		6.78		6.93 / 7.35		7.06 / 7.25	
Specific Conductance (mS/cm)		0.057		0.057		0.057 / 0.065		0.186 / 0.117		0.055		0.055 / 0.055		0.069 / 0.059	
Dissolved Oxygen (mg/L)		10.43		10.92		10.82 / 10.61		7.59 / 8.67		10.45		10.75 / 10.52		5.28 / 8.45	
pH		7.64		7.7		7.56 / 6.94		6.75 / 6.7		7.82		7.55 / 7.04		6.91 / 6.99	
Oxidation Reduction Potential (mV)		20.9		103.5		112.4 / -12.5		108.6 / 28.2		138		144.6 / 14.8		87 / 32.7	
Turbidity (NTU)		NA		NA		NA		NA		NA		NA		NA	

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 4								Location 5							
SAMPLE TYPE		Surface Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSW0309-04		MBSW0309-04D		MBIA0309-04		MBSA0309-04		MBSW0309-05		MBIA0309-05		MBIA0309-05D		MBSA0309-05	
Sample Date		3/17/2009		3/17/2009		3/17/2009		3/17/2009		3/17/2009		3/17/2009		3/17/2009		3/17/2009	
Sample Time		11:35		11:35		12:06		12:15		10:11		10:33		10:03		10:59	
CONTAMINANT OF INTEREST																	
Total Dissolved Solids (mg/L)		57				66		230		53		51				640	J
Total Suspended Solids (mg/L)		3				150		67		7		9				190	J
Total Metals (mg/L)																	
Arsenic		0.00042	J	0.00040	J	0.0011		0.0085		0.00036	J	0.00049	J	0.00056	J	0.057	
Chromium		0.00057	J	0.00057	J	0.0043		0.0011		0.00057	J	0.0011		0.0013		0.00042	J
Copper		0.0015	J	0.003		0.0089		0.0021		0.0013	J	0.0026		0.0037		0.00052	U
Zinc		0.0031	J	0.0071	J	0.018		0.0096	J	0.0048	J	0.0073	J	0.0083	J	0.0026	J
Total Dissolved Metals (mg/L)																	
Arsenic		0.00031	J	0.00032	J	0.00047	J	0.0084		0.00030	J	0.0003	J	0.00030	J	0.057	
Chromium		0.00064	J	0.00040	J	0.00079	J	0.00032	J	0.00020	J	0.00022	J	0.00021	J	0.00033	J
Copper		0.0015	J	0.00059	J	0.0027		0.00052	U	0.0017	J	0.00086	J	0.00072	J	0.00052	U
Zinc		0.0042	J	0.01	UJ	0.016	U	0.01	UJ	0.01	UJ	0.01	UJ	0.01	UJ	0.01	UJ
Pentachlorophenol (µg/L)		0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.74	
Polynuclear Aromatic Hydrocarbons (µg/L)																	
Acenaphthene	L	0.0095	UJ	0.014		0.0095	UJ	0.17	J	0.0095	UJ	0.0096	UJ	0.0095	U	19	J
Acenaphthylene	L	0.0095	UJ	0.010		0.0095	UJ	0.0095	UJ	0.0095	UJ	0.0096	UJ	0.0095	U	0.14	J
Anthracene	L	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.22	
Benz (a) anthracene	H, C	0.0095	U	0.0095	U	0.0095	U	0.020		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (a) pyrene	H, C	0.0095	U	0.0095	U	0.0095	U	0.013		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (b) fluoranthene	H, C	0.0095	U	0.0095	U	0.0095	U	0.019		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (ghi) perylene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (k) fluoranthene	H, C	0.0095	U	0.0095	U	0.0095	U	0.018		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Chrysene	H, C	0.0095	U	0.0095	U	0.0095	U	0.024		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Dibenz (a,h) anthracene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
	H	0.0095	U	0.0095	U	0.0095	U	0.043		0.0095	U	0.0095	U	0.0095	U	0.069	
Fluorene	L	0.0095	U	0.0095	U	0.0095	U	0.064		0.0095	U	0.0095	U	0.0095	U	10	
Indeno (1,2,3-cd) pyrene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Naphthalene	L	0.0095	UJ	0.026	U	0.0095	UJ	0.025	J	0.0095	UJ	0.0096	UJ	0.021	U	0.095	J
Phenanthrene	L	0.0095	U	0.0095	U	0.0095	U	0.030		0.0095	U	0.0095	U	0.0095	U	1.2	
Pyrene	H	0.0095	UJ	0.0095	U	0.0095	UJ	0.033	J	0.0095	UJ	0.0095	UJ	0.0095	UJ	0.038	J
Total LPAHs[4]		0.0285	U	0.024		0.0285	U	0.289	J	0.0285	U	0.0287	U	0.0343	U	30.655	J
Total HPAHs[4]		0.0475	U	0.0475	U	0.0475	U	0.170	J	0.0475	U	0.0475	U	0.0475	U	0.107	J
Total CPAHs[4]		0.0380	U	0.0380	U	0.0380	U	0.094		0.0380	U	0.0380	U	0.0380	U	0.038	U
Total PAHs[4]		0.0760	U	0.024		0.0380	U	0.459	J	0.0760	U	0.0762	U	0.0818	U	30.762	J
Field Parameters (pre-/post-sample)																	
Temperature (°C)		7.46		7.43		7.26 / 7.4		7.27 / 7.26		7.25		7.56 / 7.61		7.56 / 7.61		7.44 / 7.62	
Specific Conductance (mS/cm)		0.057		0.058		0.087 / 0.068		0.402 / 0.285		0.055		0.056 / 0.094		0.056 / 0.094		0.845 / 0.815	
Dissolved Oxygen (mg/L)		10.07		10.59		10.5 / 10.31		4.5 / 3.03		10.68		10.38 / 9.89		10.38 / 9.89		2.8 / 4.02	
pH		7.58		7.24		7.47 / 7.4		6.73 / 6.82		7.26		7.36 / 7.37		7.36 / 7.37		6.77 / 6.74	
Oxidation Reduction Potential (mV)		-73.5		43.1		-61 / -59.4		35 / -70		45		65.5 / -81.6		65.5 / -81.6		-108.2 / -79.6	
Turbidity (NTU)		NA		NA		NA		NA		NA		NA		NA		NA	

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 6					Location 7			Location 8		
SAMPLE TYPE		Surface Water	Inter-Armoring Water	Sub-Armoring Water	Sub-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water
Sample ID		MBSW0309-06	MBIA0309-06	MBSA0309-06	MBSA0309-06D	MBSA0309-06R	MBSW0309-07	MBIA0309-07	MBSA0309-07	MBSW0309-08	MBIA0309-08	MBSA0309-08
Sample Date		3/17/2009	3/17/2009	3/17/2009	3/17/2009	3/17/2009	3/18/2009	3/18/2009	3/18/2009	3/18/2009	3/18/2009	3/18/2009
Sample Time		12:56	1:20	1:29	1:29	4:00	9:28	9:57	10:08	11:16	11:37	11:45
CONTAMINANT OF INTEREST												
Total Dissolved Solids (mg/L)		53	64	120			50	61	44	56	44	30
Total Suspended Solids (mg/L)		5	16	4			3	2	6	2	5	4
Total Metals (mg/L)												
Arsenic		0.00042 J	0.00045 J	0.0059	0.0059	0.00010 U	0.00044 J	0.0071	0.038	0.00040 J	0.00048 J	0.00092 J
Chromium		0.00065 J	0.00089 J	0.00012 J	0.00025 J	0.00012 J	0.0012	0.0036	0.00054 J	0.0012	0.0016	0.0011
Copper		0.0055	0.0021	0.00053 J	0.00052 U	0.0015 J	0.002	0.0081	0.00052 U	0.0020 J	0.0023	0.0023
Zinc		0.0049 J	0.0058 J	0.0031 J	0.0032 J	0.01 UJ	0.01 UJ	0.012 U	0.01 U	0.01 UJ	0.01 UJ	0.01 UJ
Total Dissolved Metals (mg/L)												
Arsenic		0.00034 J	0.00031 J	0.0058	0.0058		0.00021 J	0.00060 J	0.038	0.00027 J	0.00021 J	0.00012 J
Chromium		0.00019 J	0.00023 J	0.00013 J	0.00012 U		0.00026 J	0.00031 J	0.00068 J	0.00097 J	0.00024 J	0.00012 U
Copper		0.00052 U	0.00075 J	0.00064 J	0.00052 U		0.00052 U	0.00075 J	0.00052 U	0.00052 U	0.00077 J	0.00052 U
Zinc		0.01 UJ	0.01 UJ	0.01 UJ	0.0018 U		0.0018 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Pentachlorophenol (µg/L)		0.32 U	0.32 U	0.33 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.33 U	0.33 U	0.32 U
Polynuclear Aromatic Hydrocarbons (µg/L)												
Acenaphthene	L	0.0095 UJ	0.0095 U	0.19	0.2	0.0095 U	0.0095 U	0.24	10	0.0096 U	0.0096 U	0.0095 U
Acenaphthylene	L	0.0095 UJ	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0096 U	0.0095 U
Anthracene	L	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.11	0.0096 U	0.0096 U	0.0095 U
Benz (a) anthracene	H, C	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.024	0.0096 U	0.0096 U	0.0095 U
Benzo (a) pyrene	H, C	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0096 U	0.0095 U
Benzo (b) fluoranthene	H, C	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0096 U	0.0095 U
Benzo (ghi) perylene	H, C	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0096 U	0.0095 U
Benzo (k) fluoranthene	H, C	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0096 U	0.0095 U
Chrysene	H, C	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.024	0.0096 U	0.0096 U	0.0095 U
Dibenz (a,h) anthracene	H, C	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0096 U	0.0095 U
	H	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.11	0.79	0.0096 U	0.0096 U	0.0095 U
Fluorene	L	0.0095 U	0.0095 U	0.026	0.032	0.0095 U	0.0095 U	0.067	2.7 J	0.0096 U	0.0096 U	0.0095 U
Indeno (1,2,3-cd) pyrene	H, C	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0096 U	0.0095 U
Naphthalene	L	0.0095 UJ	0.0095 UJ	0.022 U	0.030 U	0.071 U	0.012 U	0.016 U	0.11	0.022 U	0.014 U	0.013 U
Phenanthrene	L	0.0095 U	0.0095 U	0.0097 U	0.0095 U	0.0095 U	0.0095 U	0.011	0.090	0.0096 U	0.0096 U	0.0095 U
Pyrene	H	0.0095 UJ	0.0095 UJ	0.0097 U	0.0095 UJ	0.0095 UJ	0.0095 U	0.073	0.49	0.0096 U	0.0096 U	0.0095 U
Total LPAHs[4]		0.0285 U	0.0285 U	0.216	0.232	0.0593 U	0.0298 U	0.318	13.010 J	0.0350 U	0.0310 U	0.0303 U
Total HPAHs[4]		0.0475 U	0.0475 U	0.0485 U	0.0475 U	0.0475 U	0.0475 U	0.183	1.328	0.0480 U	0.0480 U	0.0475 U
Total CPAHs[4]		0.0380 U	0.0380 U	0.0388 U	0.0380 U	0.0380 U	0.0380 U	0.038 U	0.048	0.0384 U	0.0384 U	0.0380 U
Total PAHs[4]		0.0760 U	0.0760 U	0.216	0.232	0.1068 U	0.0773 U	0.501	14.338 J	0.0830 U	0.0790 U	0.0778 U
Field Parameters (pre-/post-sample)												
Temperature (°C)		7.69	7.76 / 7.67	7.76 / 7.89	11.06 /	10.51 / 10.76	7.62	8.4 / 8.61	8.27 / 9.03	8.4	8.71 / 8.67	8.71 / 9.21
Specific Conductance (mS/cm)		0.061	0.056 / 0.056	0.065 / 0.142	0.052 /	0.117 / 0.11	0.052	0.056 / 0.073	0.327 / 0.494	0.065	0.056 / 0.053	0.053 / 0.051
Dissolved Oxygen (mg/L)		10.24	10.55 / 10.52	4.36 / 4.3	9.9 /	4.94 / 4.35	10.87	10.91 / 10.31	7.06 / 2.67	10.04	10.26 / 10.07	7.51 / 4.53
pH		7.49	7.43 / 7.43	7.34 / 7.16	7.69 /	7.62 / 7.69	7.08	2.2 / 7.46	6.89 / 7.04	7.94	7.78 / 7.38	7.56 / 7.28
Oxidation Reduction Potential (mV)		-21.9	23.8 / 13.6	21 / 43.3	132 /	117.8 / 87.2	19.5	45.8 / 88.4	52.3 / -68.8	7	29 / 55.7	42.2 / 51.7
Turbidity (NTU)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 9			Location 10			Location 11			
SAMPLE TYPE		Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water	Sub-Armoring Water
Sample ID		MBSW0309-09	MBIA0309-09	MBSA0309-09	MBSW0309-10	MBIA0309-10	MBSA0309-10	MBSW0309-11	MBIA0309-11	MBSA0309-11	MBSA0309-11D
Sample Date		3/18/2009	3/18/2009	3/18/2009	3/19/2009	3/19/2009	3/19/2009	3/16/2009	3/19/2009	3/16/2009	3/16/2009
Sample Time		12:28	12:54	1:04	8:10	8:41	8:50	14:07	9:44:	3:35	3:35
CONTAMINANT OF INTEREST											
Total Dissolved Solids (mg/L)		40	48	100	33	28	16	75	76	6700	
Total Suspended Solids (mg/L)		4	2 U	2 U	2 U	2	2	4	8	220	
Total Metals (mg/L)											
Arsenic		0.00039 J	0.00056 J	0.0066	0.00040 J	0.00075 J	0.00018 J	0.00025 J	0.00036 J	0.00074 J	0.0012 J
Chromium		**0.0012**	**0.0019**	**0.0048**	**0.0012**	**0.0028**	**0.00044** J	**0.00037** J	**0.0011**	**0.0027**	**0.0059**
Copper		**0.0016** J	**0.0033**	**0.0024**	**0.0018** J	**0.0053**	**0.00085** J	**0.00083** J	**0.0030**	**0.0048**	**0.0096**
Zinc		0.01 UJ	0.01 UJ	0.01 UJ	0.01 U	**0.0096** J	0.01 U	0.01 U	**0.0078** J	**0.081**	0.022 U
Total Dissolved Metals (mg/L)											
Arsenic		**0.00026** J	**0.00024** J	**0.0063**	**0.00019** J	**0.00027** J	**0.00014** J	**0.00021** J	**0.00023** J	**0.00031** J	**0.00029** J
Chromium		**0.00020** J	**0.00019** J	**0.00013** J	**0.00018** J	**0.0017**	0.00012 U	**0.00015** J	**0.00018** J	**0.00025** J	**0.00021** J
Copper		0.00052 U	**0.00067** J	0.00052 U	**0.0012** J	**0.0013** J	**0.0011** J	**0.0006** J	**0.0016** J	0.002 U	0.002 U
Zinc		0.01 U	0.01 U	0.01 U	0.0018 U	**0.0019** J	0.0018 U	0.0018 U	**0.0024** J	0.01 UJ	0.01 UJ
Pentachlorophenol (µg/L)		0.34 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.33 U	0.32 UJ	0.32 U	0.32 U
Polynuclear Aromatic Hydrocarbons (µg/L)											
Acenaphthene	L	0.010 U	0.0095 U	**1**	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	0.0095 U
Acenaphthylene	L	0.010 U	0.0095 U	**0.010**	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	0.0095 U
Anthracene	L	0.010 U	0.0095 U	**0.012**	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	0.0095 U
Benz (a) anthracene	H, C	0.010 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	0.066
Benzo (a) pyrene	H, C	0.010 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	0.0095 U
Benzo (b) fluoranthene	H, C	0.010 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	0.07
Benzo (ghi) perylene	H, C	0.010 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	**0.028**
Benzo (k) fluoranthene	H, C	0.010 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	0.026
Chrysene	H, C	0.010 U	0.0095 U	0.0095 U	0.0095 U	**0.0095**	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	0.077
Dibenz (a,h) anthracene	H, C	0.010 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	0.0095 U
Fluoranthene	H	0.010 U	0.0095 U	**0.085**	0.0095 U	**0.018**	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	**0.26**
Fluorene	L	0.010 U	0.0095 U	**0.29** J	**0.088** J	**0.091** J	**0.087** J	0.0096 U	0.0095 UJ	0.0095 U	0.0095 U
Indeno (1,2,3-cd) pyrene	H, C	0.010 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	**0.03**
Naphthalene	L	0.020 U	0.011 U	0.026 U	0.011 U	0.017 U	0.014 U	0.016 U	0.0095 UJ	0.041 U	0.0095 U
Phenanthrene	L	0.010 U	0.0095 U	**0.16**	0.0095 U	**0.012**	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	**0.044**
Pyrene	H	0.010 U	0.0095 U	**0.071**	0.0095 U	**0.015**	0.0095 U	0.0096 U	0.0095 UJ	0.0095 U	**0.19**
Total LPAHs[4]		0.0350 U	0.0293 U	**1.472** J	**0.088** J	**0.103** J	**0.087** J	0.0320 U	0.0285 UJ	0.0443 U	**0.044**
Total HPAHs[4]		0.0500 U	0.0475 U	**0.156**	0.0475 U	**0.033**	0.0475 U	0.0480 U	0.0475 UJ	0.0475 U	**0.747**
Total CPAHs[4]		0.0400 U	0.0380 U	0.0380 U	0.0380 U	**0.0095**	0.0380 U	0.0384 U	0.0380 UJ	0.0380 U	0.297
Total PAHs[4]		0.0850 U	0.0768 U	**1.628** J	**0.088** J	**0.136** J	**0.087** J	0.0800 U	0.0760 UJ	0.0918 U	**0.791**
Field Parameters (pre-/post-sample)											
Temperature (°C)		8.47	9.05 / 8.8	9.05 / 9.85	8.1	7.86 / 7.77	7.83 / 7.78	7.43	8.14 / 7.73	8.12 / 8	8.12 / 8
Specific Conductance (mS/cm)		0.053	0.054 / 0.056	0.108 / 0.113	0.047	0.046 / 0.046	0.048 / 0.053	0.058	0.054 / 0.055	0.056 / 0.054	0.056 / 0.054
Dissolved Oxygen (mg/L)		10.05	10.15 / 10.66	9.63 / 9.42	10.12	10.88 / 11.03	10.67 / 9.83	10.59	10.27 / 10.75	10.27 / 10.2	10.27 / 10.2
pH		7.11	7.33 / 7.16	6.97 / 6398	8.05	7.54 / 7.43	7.44 / 7.3	7.24	7.35 / 7.42	7.41 / 7.46	7.41 / 7.46
Oxidation Reduction Potential (mV)		67.6	84.9 / 8.7	109.5 / 107.2	51.6	75.1 / 84	82.1 / 94.2	43.1	75.9 / 81.3	77.6 / 86.4	77.6 / 86.4
Turbidity (NTU)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 12								Location 13							
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSW0309-12		MBIA0309-12		MBIA0309-12D		MBSA0309-12		MBSW0309-13		MBSW0309-13D		MBIA0309-13		MBSA0309-13	
Sample Date		3/16/2009		3/16/2009		3/16/2009		3/16/2009		3/16/2009		3/16/2009		3/16/2009		3/16/2009	
Sample Time		11:56		12:13		12:01		12:21		10:35		10:35		10:59		11:07	
CONTAMINANT OF INTEREST																	
Total Dissolved Solids (mg/L)		80		75				260		83				70		130	
Total Suspended Solids (mg/L)		6		5				52		8				3		15	
Total Metals (mg/L)																	
Arsenic		0.00029	J	0.00030	J	0.00033	J	0.016		0.00035	J	0.00035	J	0.00029	J	0.0019	
Chromium		0.00040	J	0.00040	J	0.00085	J	0.00012	U	0.00056	J	0.00048	J	0.00039	J	0.00016	J
Copper		0.0010	J	0.0010	J	0.0011	J	0.00052	U	0.001	J	0.0011	J	0.00092	J	0.00052	U
Zinc		0.0027	J	0.031	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Total Dissolved Metals (mg/L)																	
Arsenic		0.00029	J	0.00031	J	0.00027	J	0.017		0.00026	J	0.00033	J	0.00029	J	0.0018	
Chromium		0.00018	J	0.00018	J	0.00022	J	0.00024	J	0.00024	J	0.00029	J	0.00018	J	0.00012	U
Copper		0.002	U	0.0021	U	0.002	U	0.002	U	0.002	U	0.00073	J	0.002	U	0.00052	U
Zinc		0.01	UJ	0.01	UJ	0.01	UJ	0.010	UJ	0.01	UJ	0.01	UJ	0.01	UJ	0.01	UJ
Pentachlorophenol (µg/L)		0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U
Polynuclear Aromatic Hydrocarbons (µg/L)																	
Acenaphthene	L	0.0095	U	0.023		0.0095	U	17	J	0.0095	U	0.0095	U	0.0096	U	0.05	J
Acenaphthylene	L	0.0095	U	0.0095	U	0.0095	U	0.35	J	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Anthracene	L	0.0095	U	0.0095	U	0.0095	U	0.12		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benz (a) anthracene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (a) pyrene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (b) fluoranthene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (ghi) perylene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (k) fluoranthene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Chrysene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Dibenz (a,h) anthracene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Fluoranthene	H	0.0095	U	0.0095	U	0.0095	U	0.062		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Fluorene	L	0.0095	U	0.0095	U	0.0095	U	3.8		0.0095	U	0.0095	U	0.0095	U	0.032	
Indeno (1,2,3-cd) pyrene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Naphthalene	L	0.089	U	0.036	U	0.0095	U	0.0097	U	0.09	J	0.11	J	0.0096	U	0.038	J
Phenanthrene	L	0.0095	U	0.0095	U	0.0095	U	0.21		0.0095	U	0.0095	U	0.0095	U	0.027	
Pyrene	H	0.0095	U	0.0095	U	0.0095	U	0.069		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Total LPAHs[4]		0.0683	U	0.023		0.0286	U	21.480	J	0.09	J	0.11	J	0.0286	U	0.147	J
Total HPAHs[4]		0.0475	U	0.0475	U	0.0476	U	0.131		0.0475	U	0.0475	U	0.0475	U	0.0475	U
Total CPAHs[4]		0.0380	U	0.0380	U	0.0380	U	0.038	U	0.0380	U	0.0380	U	0.0380	U	0.0380	U
Total PAHs[4]		0.1158	U	0.023		0.0760	U	21.611	J	0.09	J	0.11	J	0.0761	U	0.147	J
Field Parameters (pre-/post-sample)																	
Temperature (°C)		7.33		7.21		7.75		7.47 / 7.57		6.49		6.49		6.76 / 6.91		6.83 / 7.18	
Specific Conductance (mS/cm)		0.056		0.054		0.062		0.258 / 0.316		0.058		0.058		0.053 / 0.058		0.108 / 0.11	
Dissolved Oxygen (mg/L)		9.89		10.22		10.1		5.32 / 2.98		10.57		10.57		10.57 / 10.1		3.61 / 2.99	
pH		6.97		7.13		7.2		6.63 / 6.72		7.16		7.16		7.29 / 7.07		6.74 / 6.71	
Oxidation Reduction Potential (mV)		9.5		12.1		-91.3		-53 / -92.5		4.5		4.5		28 / -81.1		-30.3 / -36.8	
Turbidity (NTU)		NA		NA		NA		NA		NA		NA		NA		NA	

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 14			Location 15			Location 16		
SAMPLE TYPE		Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water
Sample ID		MBSW0309-14	MBIA0309-14	MBSA0309-14	MBSW0309-15	MBIA0309-15	MBSA0309-15	MBSW0309-16	MBIA0309-16	MBSA0309-16
Sample Date		3/18/2009	3/18/2009	3/18/2009	3/19/2009	3/19/2009	3/19/2009	3/19/2009	3/19/200	3/19/2009
Sample Time		13:44	2:04	2:13	10:19	10:40	10:52	11:34	11:54	12:03
CONTAMINANT OF INTEREST										
Total Dissolved Solids (mg/L)		45	49	64	31	100	40	25	41	230
Total Suspended Solids (mg/L)		2	3	3	2 U	13	3	2	3	3
Total Metals (mg/L)										
Arsenic		0.00058 J	0.0012	0.0034	0.00045 J	0.00058 J	0.00020 J	0.00047 J	0.00068 J	0.0049 J
Chromium		**0.0014**	**0.0024**	**0.00086** J	**0.0013**	**0.0018**	**0.00018** J	**0.0013**	**0.0026**	**0.010**
Copper		**0.0019** J	**0.0053**	**0.0012** J	**0.0019** J	**0.0032**	0.00052 U	**0.002**	**0.0044**	0.019
Zinc		0.01 UJ	0.01 UJ	0.01 UJ	0.01 U	0.01 U	0.0018 U	0.01 U	0.01 U	**0.037**
Total Dissolved Metals (mg/L)										
Arsenic		**0.00027** J	**0.00083** J	**0.0031**	**0.00018** J	**0.00018** J	**0.00061** J	**0.00023** J	**0.00022** J	**0.0035**
Chromium		**0.00023** J	**0.00018** J	**0.00022** J	**0.00024** J	**0.00025** J	**0.0016**	**0.0002** J	**0.00023** J	**0.00015** J
Copper		**0.00053** J	0.00052 U	0.00052 U	**0.00075** J	**0.0011** J	**0.003**	**0.00099** J	**0.0011** J	0.00052 U
Zinc		0.01 U	0.046 U	0.0018 U	0.0018 U	0.0018 U	0.01 U	0.0018 U	0.01 U	0.01 U
Pentachlorophenol (µg/L)		0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.33 U	0.32 U	0.32 U	0.32 U
Polynuclear Aromatic Hydrocarbons (µg/L)										
Acenaphthene	L	0.0095 U	0.0095 U	**0.042**	0.0096 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	**2.2**
Acenaphthylene	L	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Anthracene	L	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benz (a) anthracene	H, C	0.0095 U	0.0095 U	0.0095 U	**0.011**	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benzo (a) pyrene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benzo (b) fluoranthene	H, C	0.0095 U	0.0095 U	0.0095 U	**0.012**	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benzo (ghi) perylene	H, C	0.0095 U	0.0095 U	0.0095 U	**0.015**	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benzo (k) fluoranthene	H, C	0.0095 U	0.0095 U	0.0095 U	**0.011**	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Chrysene	H, C	0.0095 U	0.0095 U	0.0095 U	**0.011**	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Dibenz (a,h) anthracene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Fluoranthene	H	0.0095 U	0.0095 U	0.0095 U	**0.012**	0.0095 U	0.0095 U	0.0095 U	0.0095 U	**0.013**
Fluorene	L	**0.090** J	**0.089** J	**0.10** J	0.0096 U	**0.089** J	**0.090** J	**0.089** J	0.0095 U	**0.35** J
Indeno (1,2,3-cd) pyrene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Naphthalene	L	0.014 U	0.015 U	0.020 U	0.0096 U	0.017 U	0.015 U	0.018 U	**0.012**	0.0095 U
Phenanthrene	L	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 U	**0.010**	0.0095 U	0.0095 U	**0.013**
Pyrene	H	0.0095 U	0.0095 U	0.0095 U	0.0096 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.012 U
Total LPAHs[4]		**0.090** J	**0.089** J	**0.142** J	0.0288 U	**0.089** J	**0.100** J	**0.089** J	**0.012**	**2.563** J
Total HPAHs[4]		0.0475 U	0.0475 U	0.0475 U	**0.072**	0.0475 U	0.0475 U	0.0475 U	0.0475 U	**0.013**
Total CPAHs[4]		0.0380 U	0.0380 U	0.0380 U	0.060	0.0380 U	0.0380 U	0.0380 U	0.0380 U	0.0380 U
Total PAHs[4]		**0.090** J	**0.089** J	**0.142** J	**0.072**	**0.089** J	**0.100** J	**0.089** J	**0.012**	**2.576** J
Field Parameters (pre-/post-sample)										
Temperature (°C)		8.65	9.08 / 9.65	9 / 9.46	8.06	8.14 / 8.32	8.36 / 8.55	8.46	8.75 / 8.36	8.4 / 8.46
Specific Conductance (mS/cm)		0.054	0.055 / 0.062	0.08 / 0.087	0.046	0.046 / 0.047	0.047 / 0.053	0.047	0.051 / 0.046	0.056 / 0.228
Dissolved Oxygen (mg/L)		10.34	10.46 / 8.13	7.32 / 4.15	10.91	11 / 11.04	10.32 / 8.83	10.75	10.95 / 11.09	9.62 / 4.8
pH		7.33	7.34 / 7.11	7.08 / 6.99	7.52	7.51 / 7.36	7.48 / 7.26	7.36	7.3 / 7.39	7.1 / 6.85
Oxidation Reduction Potential (mV)		10.4	39.6 / 4.4	51.1 / -4.5	107.1	110.3 / 117	112.9 / 120.3	123.8	51.5 / 127	145.4 / 63.2
Turbidity (NTU)		NA	NA	NA	NA	NA	NA	NA	NA	NA

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 17			Location 18			Location 19		
SAMPLE TYPE		Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water
Sample ID		MBSW0309-17	MBIA0309-17	MBSA0309-17	MBSW0309-18	MBIA0309-18	MBSA0309-18	MBSW0309-19	MBIA0309-19	MBSA0309-19
Sample Date		3/20/2009	3/20/2009	3/20/2009	3/20/2009	3/20/2009	3/20/2009	3/20/2009	3/20/2009	3/20/2009
Sample Time		12:43	12:50	1:00	10:48	10:59	11:08	8:16	8:32	8:43
CONTAMINANT OF INTEREST										
Total Dissolved Solids (mg/L)		40	40	110	40	40	45	32	36	79
Total Suspended Solids (mg/L)		3	2 U	4	2 U	2 U	5	2 U	3	2 U
Total Metals (mg/L)										
Arsenic		0.00049 J	0.00076 J	0.0035	0.00036 J	0.00037 J	0.00047 J	0.0018	0.00042 J	0.0026
Chromium		0.0014	0.0029	0.00017 J	0.00095 J	0.0011	0.00018 J	0.0095	0.0013	0.00058 J
Copper		0.0026	0.0092	0.0013 J	0.0021	0.0024	0.0011 J	0.015	0.0029	0.0033
Zinc		0.01 U	0.014 U	0.01 U	0.01 U	0.01 U	0.0018 U	0.032	0.01 U	0.01 U
Total Dissolved Metals (mg/L)										
Arsenic		0.00022 J	0.00023 J	0.0037	0.00019 J	0.00019 J	0.00057 J	0.00018 J	0.00023 J	0.0027
Chromium		0.00016 J	0.00013 J	0.00012 U	0.00016 J	0.00015 J	0.00032 J	0.00014 J	0.00012 U	0.00012 U
Copper		0.00084 J	0.001 J	0.00052 U	0.00067 J	0.00091 J	0.00078 J	0.00081 J	0.0012 J	0.0023
Zinc		0.0018 U	0.0018 U	0.0018 U	0.0018 U	0.0018 U	0.0018 U	0.01 U	0.01 U	0.0018 U
Pentachlorophenol (µg/L)		0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 UJ	0.32 UJ	0.32 UJ	0.32 UJ
Polynuclear Aromatic Hydrocarbons (µg/L)										
Acenaphthene	L	0.0095 U	0.0095 U	0.016	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Acenaphthylene	L	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Anthracene	L	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benz (a) anthracene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 J	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benzo (a) pyrene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benzo (b) fluoranthene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benzo (ghi) perylene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Benzo (k) fluoranthene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Chrysene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.014 J	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Dibenz (a,h) anthracene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Fluoranthene	H	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Fluorene	L	0.090 J	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Indeno (1,2,3-cd) pyrene	H, C	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Naphthalene	L	0.023	0.021	0.029	0.010	0.0095 U	0.012	0.021	0.017	0.018
Phenanthrene	L	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Pyrene	H	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
Total LPAHs[4]		0.113 J	0.021	0.045	0.010	0.0285 U	0.012	0.021	0.017	0.018
Total HPAHs[4]		0.0475 U	0.0475 U	0.0475 U	0.0475 U	0.024 J	0.0475 U	0.0475 U	0.0475 U	0.0475 U
Total CPAHs[4]		0.0380 U	0.0380 U	0.0380 U	0.0380 U	0.0235 J	0.0380 U	0.0380 U	0.0380 U	0.0380 U
Total PAHs[4]		0.113 J	0.021	0.045	0.010	0.024 J	0.012	0.021	0.017	0.018
Field Parameters (pre-/post-sample)										
Temperature (°C)		11.06	11.11 / 11.09	10.51 / 10.76	9.28	9.13 / 9.33	9.31 / 9.1	9.46	9.19 / 9.11	9.39 / 9.28
Specific Conductance (mS/cm)		0.052	0.052 / 0.054	0.117 / 0.11	0.049	0.048 / 0.05	0.068 / 0.069	0.057	0.056 / 0.055	0.083 / 0.074
Dissolved Oxygen (mg/L)		9.9	10.39 / 9.78	4.94 / 4.35	10.14	10.52 / 10.07	8.1 / 7.88	9.1	9.03 / 9.1	4.3 / 6.07
pH		7.69	7.77 / 7.97	7.62 / 7.69	75	7.44 / 7.51	7.38 / 7.45	8.02	7.5 / 7.43	7.43 / 7.42
Oxidation Reduction Potential (mV)		132	112.8 / 77.6	117.8 / 87.2	125.3	123.3 / 89.1	127.6 / 130.9	103.1	87.1 / 89.7	88.7 / 99.2
Turbidity (NTU)		NA	NA	NA	NA	NA	NA	NA	NA	NA

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 20						Location 21					
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSW0309-20		MBIA0309-20		MBSA0309-20		MBSW0309-21		MBIA0309-21		MBSA0309-21	
Sample Date		3/18/2009		3/18/2009		3/18/2009		3/16/2009		3/16/2009		3/16/2009	
Sample Time		15:15		3:34		3:43		9:15		9:40		9:55	
CONTAMINANT OF INTEREST													
Total Dissolved Solids (mg/L)		41		41		360		60		75		370	
Total Suspended Solids (mg/L)		2		2		4		3		4		84	
Total Metals (mg/L)													
Arsenic		0.00040	J	0.00059	J	0.0085		0.00028	J	0.00026	J	0.0076	
Chromium		**0.0012**		**0.0020**		**0.00030**	J	**0.00052**	J	**0.00043**	J	**0.00065**	J
Copper		**0.0021**		**0.0041**		0.00052	U	**0.00098**	J	**0.0012**	J	**0.00065**	J
Zinc		0.01	U	0.01	U	0.0018	U	0.01	U	0.01	U	0.01	U
Total Dissolved Metals (mg/L)													
Arsenic		**0.00031**	J	**0.00028**	J	**0.0082**		**0.00033**	J	**0.00031**	J	**0.0084**	
Chromium		**0.00028**	J	**0.00032**	J	**0.00013**	J	**0.00055**	J	**0.00024**	J	**0.00014**	J
Copper		0.00052	U	**0.00069**	J	0.00052	U	0.002	U	0.002	U	0.00052	U
Zinc		0.0018	U	**0.0024**	J	0.01	U	0.01	UJ	0.01	U	0.0018	U
Pentachlorophenol (µg/L)		0.32	U	0.32	U	0.32	U	0.32	U	0.32	U	0.32	U
Polynuclear Aromatic Hydrocarbons (µg/L)													
Acenaphthene	L	0.0095	U	**6.0**		**0.23**		0.0095	U	0.0095	U	0.0095	U
Acenaphthylene	L	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Anthracene	L	0.0095	U	**0.029**		0.0095	U	0.0095	U	0.0095	U	**0.026**	
Benz (a) anthracene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (a) pyrene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (b) fluoranthene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (ghi) perylene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Benzo (k) fluoranthene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Chrysene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Dibenz (a,h) anthracene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Fluoranthene	H	0.0095	U	**0.057**		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Fluorene	L	**0.089**	J	**1.4**	J	**0.14**	J	0.0095	U	0.0095	U	**0.0095**	
Indeno (1,2,3-cd) pyrene	H, C	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U	0.0095	U
Naphthalene	L	0.029	U	**0.32**		0.022	U	**0.029**	J	0.0095	U	**0.011**	J
Phenanthrene	L	0.0095	U	**0.016**		0.0095	U	0.0095	U	0.0095	U	**0.014**	
Pyrene	H	0.0095	U	**0.039**		0.0095	U	0.0095	U	0.0095	U	0.0095	U
Total LPAHs[4]		**0.089**	J	**7.765**	J	**0.370**	J	**0.029**	J	0.0285	U	**0.061**	J
Total HPAHs[4]		0.0475	U	**0.096**		0.048	U	0.0475	U	0.0475	U	0.0475	U
Total CPAHs[4]		0.0380	U	0.038	U	0.038	U	0.0380	U	0.0380	U	0.0380	U
Total PAHs[4]		**0.089**	J	**7.861**	J	**0.370**	J	**0.029**	J	0.0760	U	**0.061**	J
Field Parameters (pre-/post-sample)													
Temperature (°C)		8.83		9.9 / 9.12		9.64 / 9.81		6.6		6.51 / 6.36		7.05 / 7.22	
Specific Conductance (mS/cm)		0.055		0.055 / 0.059		0.202 / 0.228		0.06		0.054 / 0.061		0.38 / 0.434	
Dissolved Oxygen (mg/L)		10.05		10.36 / 9.98		7.83 / 3.55		10.86		10.75 / 10.21		6.17 / 3.39	
pH		7.18		7.24 / 7.21		6.66 / 6.71		8.04		7.89 / 7.31		6.64 / 6.68	
Oxidation Reduction Potential (mV)		17.5		48.6 / -39.5		63.1 / -13.8		99		104.6 / -59.2		-55.3 / -93.3	
Turbidity (NTU)		NA		NA		NA		NA		NA		NA	

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 25						Location 26						Location 27	
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring		Surface Water	
Sample ID		MBSW0309-25		MBIA0309-25		MBSA0309-25		MBSW0309-26		MBIA0309-26		MBSA0309-26		MBSW0309-27	
Sample Date		3/20/2009		3/20/2009		3/20/2009		3/20/2009		3/20/2009		3/20/2009		3/17/2009	
Sample Time		13:31		1:40		1:52		9:31		9:38		9:53		14:55	
CONTAMINANT OF INTEREST															
Total Dissolved Solids (mg/L)		70		77		63		71		66		86		62	
Total Suspended Solids (mg/L)		25		11		9		11		68		46		9	
Total Metals (mg/L)															
Arsenic		0.00052	J	0.00073	J	0.00041	J	0.00029	J	0.00043	J	0.00037	J	0.00042	J
Chromium		**0.0017**		**0.0017**		**0.00035**	J	**0.00071**	J	**0.0023**		**0.0014**		**0.00076**	J
Copper		**0.0033**		**0.0034**		**0.0022**		**0.0018**	J	**0.0054**		**0.0036**		**0.0016**	J
Zinc		0.011	U	0.01	U	0.01	U	0.01	U	0.013	U	0.018	U	**0.0054**	J
Total Dissolved Metals (mg/L)															
Arsenic		**0.00018**	J	**0.00019**	J	**0.00036**	J	**0.00022**	J	**0.00022**	J	**0.00020**	J	**0.00024**	J
Chromium		0.00012	U	0.00012	U	0.00012	U	**0.00016**	J	**0.00014**	J	0.00012	U	**0.00041**	J
Copper		**0.0015**	J	**0.0029**		**0.0011**	J	**0.00099**	J	**0.0010**	J	**0.00087**	J	0.00052	U
Zinc		0.0018	U	0.0018	U	0.0018	U	0.0018	U	0.0018	U	**0.0039**	J	0.01	UJ
Pentachlorophenol (µg/L)		0.32	U	0.32	UJ	0.32	UJ	0.32	UJ	0.32	U	0.32	U	0.32	U
Polynuclear Aromatic Hydrocarbons (µg/L)															
Acenaphthene	L	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Acenaphthylene	L	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Anthracene	L	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Benz (a) anthracene	H, C	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Benzo (a) pyrene	H, C	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Benzo (b) fluoranthene	H, C	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Benzo (ghi) perylene	H, C	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Benzo (k) fluoranthene	H, C	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Chrysene	H, C	0.0094	U	**0.0099**	J	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Dibenz (a,h) anthracene	H, C	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Fluoranthene	H	**0.012**		0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Fluorene	L	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	**0.090**	J
Indeno (1,2,3-cd) pyrene	H, C	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Naphthalene	L	0.023	U	0.0094	UJ	0.013	U	0.0095	UJ	0.027	U	0.014	U	0.020	U
Phenanthrene	L	0.0094	U	0.0094	UJ	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Pyrene	H	**0.011**		**0.010**	J	0.0095	U	0.0095	UJ	0.0095	U	0.0095	U	0.0095	U
Total LPAHs[4]		0.0350	U	0.0282	UJ	0.0303	U	0.0285	UJ	0.0373	U	0.0308	U	**0.090**	J
Total HPAHs[4]		**0.023**		**0.020**	J	0.0475	U	0.0475	UJ	0.0475	U	0.0475	U	0.0475	U
Total CPAHs[4]		0.0376	U	**0.010**	J	0.0380	U	0.0380	UJ	0.0380	U	0.0380	U	0.0380	U
Total PAHs[4]		**0.023**		**0.020**	J	0.0778	U	0.0760	UJ	0.0848	U	0.0783	U	**0.090**	J
Field Parameters (pre-/post-sample)															
Temperature (°C)		11.57		11.97 / 12.27		11.4 / 10.85		9.13		9.45 / 9.62		9.41 / 10.56		7.76	
Specific Conductance (mS/cm)		0.053		0.051 / 0.052		0.068 / 0.0666		0.049		0.049 / 0.051		0.069 / 0.07		0.055	
Dissolved Oxygen (mg/L)		10.3		10.33 / 9.11		4.2 / 5.22		10.45		10.28 / 9.96		4.21 / 3.81		10.67	
pH		8.11		8.09 / 7.67		7.59 / 57.36		7.57		7.54 / 7.27		7.25 / 7.13		7.62	
Oxidation Reduction Potential (mV)		51.9		65.4 / 91		82.1 / 103.9		106.2		107.3 / 87.5		122.5 / 138		52.4	
Turbidity (NTU)		NA		NA		NA		NA		NA		NA		NA	

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 25			Location 26			Location 27
SAMPLE TYPE		Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring	Surface Water
Sample ID		MBSW0309-25	MBIA0309-25	MBSA0309-25	MBSW0309-26	MBIA0309-26	MBSA0309-26	MBSW0309-27
Sample Date		3/20/2009	3/20/2009	3/20/2009	3/20/2009	3/20/2009	3/20/2009	3/17/2009
Sample Time		13:31	1:40	1:52	9:31	9:38	9:53	14:55
CONTAMINANT OF INTEREST								
Total Dissolved Solids (mg/L)		70	77	63	71	66	86	62
Total Suspended Solids (mg/L)		25	11	9	11	68	46	9
Total Metals (mg/L)								
Arsenic		0.00052 J	0.00073 J	0.00041 J	0.00029 J	0.00043 J	0.00037 J	0.00042 J
Chromium		**0.0017**	**0.0017**	**0.00035** J	**0.00071** J	**0.0023**	**0.0014**	**0.00076** J
Copper		**0.0033**	**0.0034**	**0.0022**	**0.0018** J	**0.0054**	**0.0036**	**0.0016** J
Zinc		0.011 U	0.01 U	0.01 U	0.01 U	0.013 U	0.018 U	**0.0054** J
Total Dissolved Metals (mg/L)								
Arsenic		**0.00018** J	**0.00019** J	**0.00036** J	**0.00022** J	**0.00022** J	**0.00020** J	**0.00024** J
Chromium		0.00012 U	0.00012 U	0.00012 U	**0.00016** J	**0.00014** J	0.00012 U	**0.00041** J
Copper		**0.0015** J	**0.0029**	**0.0011** J	**0.00099** J	**0.0010** J	**0.00087** J	0.00052 U
Zinc		0.0018 U	0.0018 U	0.0018 U	0.0018 U	0.0018 U	**0.0039** J	0.01 UJ
Pentachlorophenol (µg/L)		0.32 U	0.32 UJ	0.32 UJ	0.32 UJ	0.32 U	0.32 U	0.32 U
Polynuclear Aromatic Hydrocarbons (µg/L)								
Acenaphthene	L	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Acenaphthylene	L	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Anthracene	L	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Benz (a) anthracene	H, C	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Benzo (a) pyrene	H, C	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Benzo (b) fluoranthene	H, C	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Benzo (ghi) perylene	H, C	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Benzo (k) fluoranthene	H, C	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Chrysene	H, C	0.0094 U	**0.0099** J	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Dibenz (a,h) anthracene	H, C	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Fluoranthene	H	**0.012**	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Fluorene	L	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	**0.090** J
Indeno (1,2,3-cd) pyrene	H, C	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Naphthalene	L	0.023 U	0.0094 UJ	0.013 U	0.0095 UJ	0.027 U	0.014 U	0.020 U
Phenanthrene	L	0.0094 U	0.0094 UJ	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Pyrene	H	**0.011**	**0.010** J	0.0095 U	0.0095 UJ	0.0095 U	0.0095 U	0.0095 U
Total LPAHs[4]		0.0350 U	0.0282 UJ	0.0303 U	0.0285 UJ	0.0373 U	0.0308 U	**0.090** J
Total HPAHs[4]		**0.023**	**0.020** J	0.0475 U	0.0475 UJ	0.0475 U	0.0475 U	0.0475 U
Total CPAHs[4]		0.0376 U	**0.010** J	0.0380 U	0.0380 UJ	0.0380 U	0.0380 U	0.0380 U
Total PAHs[4]		**0.023**	**0.020** J	0.0778 U	0.0760 UJ	0.0848 U	0.0783 U	**0.090** J
Field Parameters (pre-/post-sample)								
Temperature (°C)		11.57	11.97 / 12.27	11.4 / 10.85	9.13	9.45 / 9.62	9.41 / 10.56	7.76
Specific Conductance (mS/cm)		0.053	0.051 / 0.052	0.068 / 0.0666	0.049	0.049 / 0.051	0.069 / 0.07	0.055
Dissolved Oxygen (mg/L)		10.3	10.33 / 9.11	4.2 / 5.22	10.45	10.28 / 9.96	4.21 / 3.81	10.67
pH		8.11	8.09 / 7.67	7.59 / 57.36	7.57	7.54 / 7.27	7.25 / 7.13	7.62
Oxidation Reduction Potential (mV)		51.9	65.4 / 91	82.1 / 103.9	106.2	107.3 / 87.5	122.5 / 138	52.4
Turbidity (NTU)		NA	NA	NA	NA	NA	NA	NA

Please refer to notes at end of this table.

Table D-1
Surface, Inter-Armoring, and Sub-Armoring Water Data: Spring 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Notes:

[1] The 1996 Record of Decision (ROD) specifies the remedial action objectives of the sediment cap as: 1) preventing human and aquatic organisms from direct contact with contaminated sediment: and 2) minimizing releases of contaminants from sediment that might result in contamination of the Willamette River in excess of federal and state Ambient Water Quality Criteria (AWQCs).

[2] National Recommended Water Quality Criteria (NRWQCs) published as of August 15, 2007, are included for comparison (see http://www.epa.gov/waterscience/criteria/wqcriteria.html). The current publication includes criteria revisions published in 2002 National Recommended Water Quality Criteria: 2002 table (EPA-822-R-02-047) and 2003 Revised human Health Water Quality Criteria (EPA-822-F-03-012). Note that the aquatic life chronic criteria for pentachlorophenol has been adjusted to site-specific pH (7.5, representing a mid-range of the pH values measured in surface water at the site), and therefore differs from the standard table value. Criteria for metals (Cr, Cu, Zn) have not been adjusted for site-specific hardness. Carcinogenic risk-based numbers reflect a carcinogenicity risk of 10^{-6}.

[3] National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs) promulgated as of August 15, 2007, are included for comparison (see http://www.epa.gov/safewater/contaminants/index.html#primary).

[4]The number of significant figures presented in PAH summary do not reflect true accuracy presented by the laboratory results. Due to statistical evaluation using Microsoft Excel, additional significant figures may be shown.

Key:
AWQC = Aquatic Water Quality Criteria (1996 version)
C = Carcinogenic PAH
Gamma = Gamma Distribution
H = High Molecular Weight PAH (HPAH)
HS = Henrey Sampler
J = Estimated Value
L = Low Molecular Weight PAH (LPAH)
MDL = Method Detection Limit
mg/L = milligrams per liter
MRL = Method Reporting Limit
NA= Not Applicable
ND = Not Detected
NP = Nonparametric Distribution
U = Value Below MDL (value represents MDL)
ug/L = micrograms per liter

Bold Indicates analyte was detected, but does not exceed the most stringent criteria.

shaded Indicates a value less than the MDL where the MDL exceeds the stringent sediment cap performance goal or comparison criteria. Only used on the Spring and Fall 2007 data tables.

Inverse Indicates results that exceed the lowest (most stringent) of the sediment cap performance goals or comparison criteria.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

		Sediment Cap Performance Goals		Comparison Criteria			Surface Water Statistics						
		McCormick & Baxter Record of Descision, 1996, Ambient Water Quality Criteria (AWQCs)		EPA Current, 2007, National Recommended Water Quality Criteria (NRWQCs)		EPA National Primary Drinking Water Regulations (NPDWRs)							
CONTAMINANT OF INTEREST		Aquatic Life (chronic)[1]	Human Health (fish consumption only)[1]	Aquatic Life (chronic)[2]	Human Health (consumption of organism only)[2]	Maximum Contaminant Levels (MCLs)[3]	Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value
Total Dissolved Solids (mg/L)							22	100%	73	Location 11	58.1363636	Lognormal	61.06
Total Suspended Solids (mg/L)							22	100%	37.2	Location 16	22.7619048	Normal	25.18
Total Metals (mg/L)													
Arsenic		0.19		0.15	0.00014	0.01	22	73%	0.00071	Location 19	0.00042	Nonparametric	0.00046
Chromium		0.21		0.074		0.1	22	45%	0.00046	Location 09	0.00022	Nonparametric	0.00033
Copper		0.012		0.009			22	100%	0.00150	Location 04	0.00097	Nonparametric	0.00106
Zinc		0.11		0.12	26		22	73%	0.00650	Location 10	0.00290	Nonparametric	0.00338
Total Dissolved Metals (mg/L)													
Arsenic							22	100%	0.00086	Location 19	0.00048	Gamma	0.00052
Chromium							22	23%	0.00062	Location 25	0.00018	Nonparametric	0.00023
Copper							22	100%	0.00150	Location 19	0.00070	Nonparametric	0.00078
Zinc							22	23%	0.00430	Location 21	0.00165	Nonparametric	0.00195
Pentachlorophenol (µg/L)		13		11	3	1	22	0%	ND	NA	0.25523	NA	NA
Polynuclear Aromatic Hydrocarbons (µg/L)													
Acenaphthene	L	520		990			22	23%	0.09800	Location 05	0.01618	Nonparametric	0.053399
Acenaphthylene	L						22	0%	ND	NA	0.00755	NA	NA
Anthracene	L			40,000			22	0%	ND	NA	0.00755	NA	NA
Benz (a) anthracene	H, C			0.018			22	0%	ND	NA	0.00755	NA	NA
Benzo (a) pyrene	H, C			0.018		0.2	22	0%	ND	NA	0.00755	NA	NA
Benzo (b) fluoranthene	H, C			0.018			22	0%	ND	NA	0.00755	NA	NA
Benzo (ghi) perylene	H, C						22	0%	ND	NA	0.00755	NA	NA
Benzo (k) fluoranthene	H, C			0.018			22	0%	ND	NA	0.00755	NA	NA
Chrysene	H, C			0.018			22	0%	ND	NA	0.00755	NA	NA
Dibenz (a,h) anthracene	H, C			0.018			22	0%	ND	NA	0.00755	NA	NA
Fluoranthene	H		54	140			22	5%	0.01600	Location 25	0.00793	NA	NA
Fluorene	L			5300			22	14%	0.03600	Location 05	0.00970	Nonparametric	0.0121
Indeno (1,2,3-cd) pyrene	H, C			0.018			22	0%	ND	NA	0.00755	NA	NA
Naphthalene	L	620					22	23%	0.51000	Location 05	0.04934	Nonparametric	0.0894
Phenanthrene	L						22	5%	0.02050	Location 03	0.00930	NA	NA
Pyrene	H			4,000			22	0%	ND	NA	0.00755	NA	NA
Total LPAHs[5]							22	27%	0.66400	Location 05	0.09141	Nonparametric	0.226
Total HPAHs[5]							22	5%	0.08000	Location 06	0.07277	NA	NA
Total CPAHs[5]			0.031				22	0%	ND	NA	0.06036	NA	NA
Total PAHs[5]							22	27%	0.75400	Location 05	0.17545	Nonparametric	0.23

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

		Inter-Armoring Water Statistics							Sub-Armoring Water Statistics						
CONTAMINANT OF INTEREST		Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value	Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value
Total Dissolved Solids (mg/L)		22	100%	101	Location 13	63.772727	Gamma	68.16	22	100%	1110	Location 16	256.68182	Lognormal	391.7
Total Suspended Solids (mg/L)		22	100%	1150	Location 04	117.79545	Gamma	190.4	22	100%	615	Location 16	189.27727	Gamma	298.3
Total Metals (mg/L)															
Arsenic		22	77%	0.00400	Location 17	0.00064	Nonparametric	0.00136	22	95%	0.04510	Location 04	0.00929	Gamma	0.01450
Chromium		22	68%	0.00270	Location 04	0.00049	Gamma	0.00070	22	50%	0.00220	Location 18	0.00049	Nonparametric	0.00098
Copper		22	100%	0.01020	Location 04	0.00186	Nonparametric	0.00367	22	95%	0.00700	Location 02	0.00173	Gamma	0.00260
Zinc		22	100%	0.03030	Location 04	0.00643	Nonparametric	0.00849	22	73%	0.03790	Location 18	0.00754	Gamma	0.01110
Total Dissolved Metals (mg/L)															
Arsenic		22	100%	0.00450	Location 17	0.00066	Nonparametric	0.00147	22	100%	0.04390	Location 04	0.00970	Gamma	0.01550
Chromium		22	27%	0.00065	Location 04	0.00025	Nonparametric	0.00054	22	32%	0.00036	Location 14	0.00019	Nonparametric	0.00022
Copper		22	100%	0.00160	Location 04	0.00091	Normal	0.00100	22	41%	0.00220	Location 02	0.00049	Nonparametric	0.00068
Zinc		22	82%	0.00580	Location 12	0.00294	Nonparametric	0.00338	22	27%	0.00750	Location 02	0.00240	Nonparametric	0.00436
Pentachlorophenol (µg/L)		22	0%	ND	NA	0.25	NA	NA	22	0%	ND	NA	0.2556818	NA	NA
Polynuclear Aromatic Hydrocarbons (µg/L)															
Acenaphthene	L	22	32%	0.14	Location 13	0.0256818	Nonparametric	0.0379	22	82%	45.1	Location 16	6.1519545	Gamma	16.2
Acenaphthylene	L	22	0%	ND	NA	0.0075227	NA	NA	22	27%	0.28	Location 12	0.0307727	Nonparametric	0.0511
Anthracene	L	22	5%	0.016	Location 17	0.0079091	NA	NA	22	27%	0.58	Location 09	0.0581818	Nonparametric	0.105
Benz (a) anthracene	H, C	22	0%	ND	NA	0.0075227	NA	NA	22	9%	0.024	Location 17	0.0086364	NA	NA
Benzo (a) pyrene	H, C	22	0%	ND	NA	0.0075227	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Benzo (b) fluoranthene	H, C	22	0%	ND	NA	0.0075227	NA	NA	22	9%	0.021	Location 13	0.0086818	NA	NA
Benzo (ghi) perylene	H, C	22	0%	ND	NA	0.0075227	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Benzo (k) fluoranthene	H, C	22	0%	ND	NA	0.0075227	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Chrysene	H, C	22	0%	ND	NA	0.0075227	NA	NA	22	9%	0.038	Location 07	0.0095455	NA	NA
Dibenzo (a,h) anthracene	H, C	22	0%	ND	NA	0.0075227	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Fluoranthene	H	22	9%	0.028	Location 06	0.0088636	NA	NA	22	41%	1.4	Location 07	0.1199773	Nonparametric	0.227
Fluorene	L	22	18%	0.09	Location 17	0.0153409	Nonparametric	0.0347	22	64%	13	Location 09	1.7328636	Nonparametric	3.006
Indeno (1,2,3-cd) pyrene	H, C	22	0%	ND	NA	0.0075227	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Naphthalene	L	22	32%	0.36	Location 05	0.0310455	Nonparametric	0.103	22	45%	0.93	Location 16	0.1558409	Nonparametric	0.244
Phenanthrene	L	22	9%	0.023	Location 06	0.0111364	NA	NA	22	32%	3.5	Location 09	0.3536136	Nonparametric	0.677
Pyrene	H	22	5%	0.023	Location 06	0.0082045	NA	NA	22	41%	0.79	Location 07	0.0733409	Nonparametric	0.132
Total LPAHs[5]		22	45%	0.504	Location 05	0.0841364	Nonparametric	0.188	22	86%	52.496	Location 16	8.4538636	Gamma	21.88
Total HPAHs[5]		22	9%	0.0845	Location 17	0.0743409	NA	NA	22	55%	2.228	Location 07	0.2249545	Nonparametric	0.393
Total CPAHs[5]		22	0%	ND	NA	0.0601818	NA	NA	22	18%	0.082	Location 13	0.0575455	Student's T	0.0617
Total PAHs[5]		22	45%	0.594	Location 05	0.1758864	Nonparametric	0.218	22	86%	52.5835	Location 16	8.7409091	Nonparametric	14.45

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 1		Location 2						Location 3					
SAMPLE TYPE		Surface Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSW1009-01		MBSW1009-02		MBIA1009-02		MBSA1009-02		MBSW1009-03		MBIA1009-03		MBSA1009-03	
Sample Date		10/14/2009		10/16/2009		10/16/2009		10/16/2009		10/16/2009		10/16/2009		10/16/2009	
Sample Time		15:00		10:25		10:48		10:41		9:10		9:33		9:46	
CONTAMINANT OF INTEREST															
Total Dissolved Solids (mg/L)		58		58		58		132		50		50		60	
Total Suspended Solids (mg/L)		1	U	26.8		68.1		100		35.3		15.8		298	
Total Metals (mg/L)															
Arsenic		0.00047	J	0.00045	J	0.00051		0.0082		0.00037	J	0.00041	J	0.0032	
Chromium		0.00025	U	0.00025	U	0.00057		0.00025	U	0.00031	J	0.00025	J	0.00074	
Copper		0.00079		0.00095		0.0016		0.007		0.0012		0.0012		0.0044	
Zinc		0.0026	J	0.0031	J	0.0059		0.0072		0.0035	J	0.0044	J	0.0103	
Total Dissolved Metals (mg/L)															
Arsenic		0.00041	J	0.00048	J	0.00043	J	0.0095		0.00037	J	0.00039	J	0.0015	
Chromium		0.00025	U	0.00025	U	0.00039	J	0.00031	J	0.00025	U	0.00025	U	0.00025	U
Copper		0.00082		0.001		0.00088		0.0022		0.00068		0.00087		0.0011	
Zinc		0.0027	J	0.0025	U	0.0025	J	0.0075		0.0025	U	0.0029	J	0.0032	J
Pentachlorophenol (µg/L)		0.51	UJ	0.51	U	0.51	U	0.52	U	0.51	U	0.51	U	0.51	U
Polynuclear Aromatic Hydrocarbons (µg/L)															
Acenaphthene	L	0.015	U	0.015	U	0.015	U	1.1		0.015	U	0.015	U	0.066	
Acenaphthylene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Anthracene	L	0.015	U	0.015	U	0.015	U	0.031	J	0.015	U	0.015	U	0.015	U
Benz (a) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (a) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (b) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (ghi) perylene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (k) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Chrysene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Dibenzo (a,h) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluoranthene	H	0.015	U	0.015	U	0.015	U	0.089		0.015	U	0.015	U	0.018	J
Fluorene	L	0.015	U	0.015	U	0.015	U	0.16		0.015	U	0.015	U	0.015	U
Indeno (1,2,3-cd) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Naphthalene	L	0.015	U	0.015	U	0.016	J	0.015	U	0.015	U	0.015	U	0.015	U
Phenanthrene	L	0.015	U	0.015	U	0.015	U	0.21		0.041	U	0.015	U	0.015	U
Pyrene	H	0.015	U	0.015	U	0.015	U	0.054		0.015	U	0.015	U	0.015	U
Total LPAHs[5]		0.045	U	0.045	U	0.016	J	1.501	J	0.058	U	0.045	U	0.066	
Total HPAHs[5]		0.075	U	0.075	U	0.075	U	0.143		0.075	U	0.075	U	0.018	J
Total CPAHs[5]		0.030	U	0.030	U	0.030	U	0.033	U	0.030	U	0.030	U	0.030	U
Total PAHs[5]		0.120	U	0.120	U	0.129	J	1.719	J	0.133	U	0.120	U	0.189	J
Field Parameters (pre-/post-sample)[4]															
Temperature (°C)		13.84		14.99		14.98 / 14.2		14.34 / 15.06		12.68		14.14 / 13.84		13.79 / 14.58	
Specific Conductance (mS/cm)		0.085		0.077		0.079 / 0.079		0.177 / 0.166		0.078		0.078 / 0.079		0.158 / 0.158	
Dissolved Oxygen (mg/L)		8.72		8.32		7.85 / 7.8		2.9 / 1.65		8.84		7.56 / 8.01		1.67 / 1.66	
pH		7.88		5.54		6.38 / 6.58		3.99 / 6.76		6.21		7.15 / 5.88		6.48 / 6.04	
Oxidation Reduction Potential (mV)		0.67		153		-23 / -20		5 / 125		260		150 / 208		127 / 175	
Turbidity (NTU)		16.9		19.3		22.8 / 23.5		23.3 / 4.9		8.2		11.7 / 23.8		754 / 261	

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, *Oregon*

SAMPLE LOCATION		Location 4			Location 5			Location 6			
SAMPLE TYPE		Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water	Surface Water	Inter-Armoring Water	Sub-Armoring Water	Sub-Armoring Water
Sample ID		MBSW1009-04	MBIA1009-04	MBSA1009-04	MBSW1009-05	MBIA1009-05	MBSA1009-05	MBSW1009-06	MBIA1009-06	MBSA1009-06	MBSA1009-06D
Sample Date		10/14/2009	10/14/2009	10/14/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009
Sample Time		13:30	14:10	14:15	13:30	13:35	14:00	15:00	15:30	15:35	15:35
CONTAMINANT OF INTEREST											
Total Dissolved Solids (mg/L)		55	68	1040	70	71	588	64	64	234	236
Total Suspended Solids (mg/L)		NA	1150	540	16.5	111	504	34.4	95.4	227	172
Total Metals (mg/L)											
Arsenic		0.00048 J	0.0011	0.0451	[illegible]	[illegible]	0.0164	[illegible]	[illegible]	0.0097	0.0095
Chromium		0.00025 U	0.0027	0.00042 J	0.00029 J	0.00063	0.0013	0.00042 J	0.00044 J	0.00036 J	0.00041 J
Copper		0.0015	0.0102	0.0011	0.0008	0.0018	0.0022	0.00097	0.0015	0.0005	0.00061
Zinc		0.0031 J	0.0303	0.0061	0.0026 J	0.0049 J	0.0077	0.0049 J	0.0052	0.0025 U	0.0025 U
Total Dissolved Metals (mg/L)											
Arsenic		0.00041 J	0.00075	0.0439	0.00053	0.00053	0.0189	0.00052	0.00059	0.0105	0.0103
Chromium		0.00025 U	0.00065	0.00025 U	0.00025 U	0.00025 J	0.00028 J	0.00029 J	0.00034 J	0.00032 J	0.00025 U
Copper		0.00081	0.0016	0.00083	0.00064	0.001	0.00025 U	0.0006	0.0008	0.00025 U	0.00025 U
Zinc		0.0025 U	0.0049 J	0.0037 J	0.0025 U	0.0026 J	0.0025 U	0.0025 U	0.0031 J	0.0025 U	0.0025 U
Pentachlorophenol (µg/L)		0.51 UJ	0.51 UJ	0.51 UJ	0.51 U	0.52 UJ	0.52 U	0.52 U	0.52 U	0.51 U	0.51 U
Polynuclear Aromatic Hydrocarbons (µg/L)											
Acenaphthene	L	0.02 J	0.015 U	0.081	0.098	0.09	15.5	0.016 U	0.016 U	1.9	1.7
Acenaphthylene	L	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.058	0.016 U	0.016 U	0.015 U	0.016 U
Anthracene	L	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.37	0.016 U	0.016 U	0.015 U	0.016 U
Benz (a) anthracene	H, C	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.016 U	0.016 U	0.015 U	0.016 U
Benzo (a) pyrene	H, C	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.016 U	0.016 U	0.015 U	0.016 U
Benzo (b) fluoranthene	H, C	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.016 U	0.016 U	0.015 U	0.016 U
Benzo (ghi) perylene	H, C	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.016 U	0.016 U	0.015 U	0.016 U
Benzo (k) fluoranthene	H, C	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.016 U	0.016 U	0.015 U	0.016 U
Chrysene	H, C	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.016 U	0.016 U	0.015 U	0.016 U
Dibenzo (a,h) anthracene	H, C	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.016 U	0.016 U	0.015 U	0.016 U
Fluoranthene	H	0.015 U	0.015 U	0.044	0.015 U	0.015 U	0.25	0.016 U	0.028 J	0.015 U	0.016 U
Fluorene	L	0.015 U	0.015 U	0.033 J	0.036 J	0.034 J	7.3	0.016 U	0.016 U	0.38	0.36
Indeno (1,2,3-cd) pyrene	H, C	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.016 U	0.016 U	0.015 U	0.016 U
Naphthalene	L	0.038 J	0.015 U	0.015 U	0.51	0.36	0.22	0.016 U	0.016 U	0.23	0.21
Phenanthrene	L	0.015 U	0.015 U	0.015 U	0.02 J	0.02 J	2.9	0.016 U	0.023 J	0.034 J	0.036 J
Pyrene	H	0.015 U	0.015 U	0.042	0.015 U	0.015 U	0.12	0.016 U	0.023 J	0.015 U	0.016 U
Total LPAHs[5]		0.058 J	0.045 U	0.114 J	0.664 J	0.504 J	26.35	0.048 U	0.023 J	2.544 J	2.322 J
Total HPAHs[5]		0.075 U	0.075 U	0.086	0.075 U	0.075 U	0.370	0.080 U	0.051 J	0.075 U	0.080 U
Total CPAHs[5]		[illegible] U	[illegible] U	[illegible] U	[illegible] U	[illegible] U	[illegible] U	0.034 U	0.034 U	0.034 U	0.034 U
Total PAHs[5]		0.163 J	0.120 U	0.290 J	0.754 J	0.594 J	26.78	0.128 U	0.178 J	2.634 J	2.402 J
Field Parameters (pre-/post-sample)[4]											
Temperature (°C)		13.58	14.38 / 14.32	14.74 / 14.95	11.64	11.48 / 11.56	12.24 / 11.77	12.5	12.46 / 12.64	12.5	12.5
Specific Conductance (mS/cm)		0.085	0.141 / 0.088	1.56 / 1.57	0.21	0.074 / 0.092	0.856 / 0.713	0.126	0.084 / 0.12	0.352	0.361
Dissolved Oxygen (mg/L)		10.06	4.55 / 5.5	1.48 / 1.02	7.29	8.78 / 14.6	2.68 / 2.24	8.65	8.21 / 9.34	2.71	2.37
pH		5.55	7.76 / 7.19	7.39 / 7.37	5.57	6.25 / 5.68	6.82 / 6.12	5.51	6.07 / 5.3	5.99	5.22
Oxidation Reduction Potential (mV)		76	-140 / 26	-145 / -174	58	79 / -2	-73 / -54	34	-7 / 107	-42	-9
Turbidity (NTU)		17.6	542 / 284	180 / 91.2	5.5	6.1 / 9.7	44.3 / 572	10.2	16.2 / 308	239	10.9

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 7						Location 8						Location 9					
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSW1009-07		MBIA1009-07		MBSA1009-07		MBSW1009-08		MBIA1009-08		MBSA1009-08		MBSW1009-09		MBIA1009-09		MBSA1009-09	
Sample Date		10/15/2009		10/15/2009		10/15/2009		10/13/2009		10/13/2009		10/13/2009		10/12/2009		10/12/2009		10/12/2009	
Sample Time		12:35		13:21		13:10		9:00		9:08		9:15		16:00		16:30		16:39	
CONTAMINANT OF INTEREST																			
Total Dissolved Solids (mg/L)		57		50		364		67		69		224		69		68		292	
Total Suspended Solids (mg/L)		26.3		151		119		30.6		21.6		107		27.4		23.5		209	
Total Metals (mg/L)																			
Arsenic		0.00044	J	0.00052		0.0181		0.00025	U	0.00042	J	0.0068		0.00025	U	0.00025	U	0.0222	
Chromium		0.00032	J	0.00028	J	0.00028	J	0.00025	U	0.00025	U	0.0012		0.00046	J	0.00028	J	0.00025	U
Copper		0.00083		0.0015		0.0005		0.0011		0.00098		0.0038		0.0009		0.0013		0.00026	J
Zinc		0.0035	J	0.0041	J	0.0035	J	0.0032	J	0.0031	J	0.0165		0.0038	J	0.0038	J	0.0025	U
Total Dissolved Metals (mg/L)																			
Arsenic		0.00047	J	0.00049	J	0.0204		0.00051		0.00051		0.0074		0.00052		0.0005		0.0241	
Chromium		0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00029	J	0.00025	U	0.00025	U
Copper		0.00064		0.00082		0.00025	U	0.00056		0.00097		0.00025	U	0.00061		0.001		0.00025	U
Zinc		0.0025	U	0.0025	U	0.0025	U	0.0025	U	0.0032	J	0.0025	U	0.0025	U	0.0028	J	0.0025	U
Pentachlorophenol (µg/L)		0.51	U	0.53	U	0.51	U	0.52	U	0.52	U	0.51	U	0.52	U	0.1	U	0.51	U
Polynuclear Aromatic Hydrocarbons (µg/L)																			
Acenaphthene	L	0.015	U	0.048		2.8		0.015	U	0.015	U	0.19		0.015	U	0.015	U	28.1	
Acenaphthylene	L	0.015	U	0.015	U	0.044		0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.078	
Anthracene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.58	
Benz (a) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (a) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (b) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (ghi) perylene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (k) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Chrysene	H, C	0.015	U	0.015	U	0.038	J	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Dibenz (a,h) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluoranthene	H	0.015	U	0.015	U	1.4		0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.54	
Fluorene	L	0.015	U	0.015	U	0.074		0.015	U	0.015	U	0.022	J	0.015	U	0.015	U	13	
Indeno (1,2,3-cd) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Naphthalene	L	0.015	U	0.015	U	0.49	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.28	
Phenanthrene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	3.5	
Pyrene	H	0.015	U	0.015	U	0.79		0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.26	
Total LPAHs[5]		0.045	U	0.048		2.92		0.045	U	0.045	U	0.212	J	0.045	U	0.045	U	45.538	
Total HPAHs[5]		0.075	U	0.075	U	2.228	J	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U	0.800	
Total CPAHs[5]		0.030	U	0.030	U	0.038	J	0.030	U	0.030	U	0.030	U	0.030	U	0.030	U	0.030	U
Total PAHs[5]		0.120	U	0.161		5.46	J	0.120	U	0.120	U	0.317	J	0.120	U	0.120	U	46.398	
Field Parameters (pre-/post-sample)[4]																			
Temperature (°C)		13.62		14.11 / 14.33		14.54 / 14.67		12.22		11.5 / 11.28		12.49 / 10.26		6.11		13.39 / 13.52		13.92 / 13.96	
Specific Conductance (mS/cm)		0.081		0.088 / 0.097		0.581 / 0.38		0.088		0.085 / 0.097		0.87 / 0.287		0.091		0.091 / 0.128		0.524 / 0.317	
Dissolved Oxygen (mg/L)		9.66		6.75 / 6.9		1.42 / 0.99		9.52		7.06 / 10.96		3.45 / 6.9		9.74		11.02 / 7.62		7.42 / 3.15	
pH		6.13		7.11 / 7.3		6.93 / 6.91		5.29		5.31 / 5.05		4.11 / 7.13		6.05		6.58 / 6.87		5.73 / 5.09	
Oxidation Reduction Potential (mV)		89		-98 / -92		-42 / -79		18.9		217 / 39		102 / 47		148		-47 / 160		-61 / -24	
Turbidity (NTU)		11.9		216 / 134		408 / 106		7.7		11.3 / 68.6		90.6 / 8		6.6		45.7 / 6.4		14.9 / 15.8	

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 10						Location 11					
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSW1009-10		MBIA1009-10		MBSA1009-10		MBSW1009-11		MBIA1009-11		MBSA1009-11	
Sample Date		10/12/2009		10/12/2009		10/12/2009		10/12/2009		10/12/2009		10/12/2009	
Sample Time		14:18		14:50		15:09		10:50		11:30		12:20	
CONTAMINANT OF INTEREST													
Total Dissolved Solids (mg/L)		69		69		129		73		74		81	
Total Suspended Solids (mg/L)		23.6		95.2		5.6		21		20.7		81.2	
Total Metals (mg/L)													
Arsenic		0.0024	U	0.0013	U	**0.0041**		0.0029	U	0.0016	U	0.0016	U
Chromium		0.00025	U	**0.00054**		0.00025	U	**0.00036**	J	**0.00036**	J	**0.00049**	J
Copper		**0.0015**		**0.0019**		**0.00028**	J	**0.00097**		**0.0012**		**0.0015**	
Zinc		**0.0065**		**0.0059**		**0.0059**		**0.003**	J	**0.0037**	J	**0.0042**	J
Total Dissolved Metals (mg/L)													
Arsenic		**0.00053**		**0.00051**		**0.0045**		**0.00054**		**0.00049**	J	**0.00067**	
Chromium		0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U
Copper		**0.00055**		**0.001**		0.00025	U	**0.00057**		**0.00092**		**0.00079**	
Zinc		**0.0025**	J	**0.0026**	J	**0.0054**		0.0025	U	**0.0026**	J	0.0025	U
Pentachlorophenol (µg/L)		0.51	U	0.52	U	0.5	U	0.5	U	0.51	U	0.51	U
Polynuclear Aromatic Hydrocarbons (µg/L)													
Acenaphthene	L	0.015	U	0.015	U	**0.93**		0.015	U	0.015	U	**0.025**	J
Acenaphthylene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Anthracene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benz (a) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (a) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (b) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (ghi) perylene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (k) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Chrysene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Dibenz (a,h) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluoranthene	H	0.015	U	0.015	U	**0.088**		0.015	U	0.015	U	0.015	U
Fluorene	L	0.015	U	0.015	U	**0.18**		0.015	U	0.015	U	0.015	U
Indeno (1,2,3-cd) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Naphthalene	L	0.015	U	0.015	U	**0.032**	J	0.015	U	**0.023**	J	0.015	U
Phenanthrene	L	0.015	U	0.015	U	**0.028**	J	0.015	U	0.015	U	0.015	U
Pyrene	H	0.015	U	0.015	U	**0.11**		0.015	U	0.015	U	0.015	U
Total LPAHs[5]		0.045	U	0.045	U	**1.185**	J	0.045	U	**0.023**	J	**0.025**	J
Total HPAHs[5]		0.075	U	0.075	U	**0.198**		0.075	U	0.075	U	0.075	U
Total CPAHs[5]		0.060	U	0.060	U	0.060	U	0.060	U	0.060	U	0.060	U
Total PAHs[5]		0.120	U	0.120	U	**1.443**	J	0.120	U	**0.136**	J	**0.138**	J
Field Parameters (pre-/post-sample)[4]													
Temperature (°C)		13.48		13.62 / 13.87		13.86 / 13.72		13.11		13.11 / 13.3		12.86 / IM	
Specific Conductance (mS/cm)		0.103		0.093 / 0.096		0.188 / 0.203		0.9		0.075 / 0.077		0.09 / IM	
Dissolved Oxygen (mg/L)		10.5		8.68 / 8.35		3.8 / 3.22		9.72		9.85 / 9.78		9.1 / IM	
pH		7.21		5.08 / 6.2		6.36 / 4.85		7.92		7.37 / 7.7		5.91 / IM	
Oxidation Reduction Potential (mV)		17.8		328 / 140		90 / -18		107.5		140 / 102.8		66.1 / IM	
Turbidity (NTU)		6.8		16.5 / 40.6		2.1 / 16.5		NA		NA		NA	

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 12						Location 13							
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Surface Water		Inter-Armoring Water		Inter-Armoring Water	
Sample ID		MBSW1009-12		MBIA1009-12		MBSA1009-12		MBSW1009-13		MBSW1009-13D		MBIA1009-13		MBIA1009-13D	
Sample Date		10/14/2009		10/14/2009		10/14/2009		10/19/2009		10/19/2009		10/19/2009		10/19/2009	
Sample Time		8:53		9:25		9:35		12:10		12:10		13:10		13:10	
CONTAMINANT OF INTEREST															
Total Dissolved Solids (mg/L)		55		58		94		50		62		101		114	
Total Suspended Solids (mg/L)		17.1		27.8		26.5		17.2		24		64.4		61	
Total Metals (mg/L)															
Arsenic		0.00049	J	0.0004	J	0.0071		0.00047	J	0.00042	J	0.00074		0.00079	
Chromium		0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U
Copper		0.00075		0.0009		0.00051		0.00098		0.00089		0.00081		0.00074	
Zinc		0.0025	U	0.0052		0.0025	J	0.0028	J	0.0025	U	0.006		0.0054	
Total Dissolved Metals (mg/L)															
Arsenic		0.00038	J	0.00042	J	0.0072		0.0004	J	0.00036	J	0.00071		0.00062	
Chromium		0.00045	J	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U
Copper		0.0007		0.0011		0.0005	U	0.00054		0.00066		0.00039	J	0.0005	U
Zinc		0.0028	J	0.0058		0.0025	U	0.0025	U	0.0089		0.0049	J	0.005	U
Pentachlorophenol (µg/L)		0.5	UJ	0.5	UJ	0.5	UJ	0.51	U	0.52	U	0.51	U	0.52	U
Polynuclear Aromatic Hydrocarbons (µg/L)															
Acenaphthene	L	0.015	U	0.023	J	34.8		0.019	J	0.024	J	0.14		0.11	
Acenaphthylene	L	0.015	U	0.015	U	0.28		0.016	U	0.016	U	0.015	U	0.015	U
Anthracene	L	0.015	U	0.015	U	0.061		0.016	U	0.016	U	0.015	U	0.015	U
Benz (a) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.016	U	0.016	U	0.015	U	0.015	U
Benzo (a) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.016	U	0.016	U	0.015	U	0.015	U
Benzo (b) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.016	U	0.016	U	0.015	U	0.015	U
Benzo (ghi) perylene	H, C	0.015	U	0.015	U	0.015	U	0.016	U	0.016	U	0.015	U	0.015	U
Benzo (k) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.016	U	0.016	U	0.015	U	0.015	U
Chrysene	H, C	0.015	U	0.015	U	0.015	U	0.016	U	0.016	U	0.015	U	0.015	U
Dibenz (a,h) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.016	U	0.016	U	0.015	U	0.015	U
Fluoranthene	H	0.015	U	0.015	U	0.043		0.016	U	0.016	U	0.015	U	0.015	U
Fluorene	L	0.015	U	0.015	U	8.6		0.016	U	0.016	U	0.061		0.047	
Indeno (1,2,3-cd) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.016	U	0.016	U	0.015	U	0.015	U
Naphthalene	L	0.015	U	0.015	U	0.42		0.016	U	0.016	U	0.017	J	0.015	U
Phenanthrene	L	0.015	U	0.015	U	0.039	J	0.016	U	0.016	U	0.041	U	0.041	U
Pyrene	H	0.015	U	0.015	U	0.048		0.016	U	0.016	U	0.015	U	0.015	U
Total LPAHs[5]		0.045	U	0.023	J	44.200	J	0.019	J	0.024	J	0.233	J	0.157	
Total HPAHs[5]		0.075	U	0.075	U	0.091		0.080	U	0.080	U	0.075	U	0.075	U
Total CPAHs[5]		0.050	U	0.038	U	0.050	U	0.054	U	0.054	U	0.050	U	0.050	U
Total PAHs[5]		0.120	U	0.136	J	44.351	J	0.139	J	0.144	J	0.329	J	0.275	
Field Parameters (pre-/post-sample)[4]															
Temperature (°C)		12.86		13.14 / 13.2		13.43 / 13.3		16.96		16.96		16.89		15.63	
Specific Conductance (mS/cm)		.085		0.088 / 0.086		0.137 / 0.127		0.077		0.077		0.082		0.173	
Dissolved Oxygen (mg/L)		9.10		8.68 / 7.68		2.44 / 2.78		7.44		7.44		3.06		7.7	
pH		5.91		5.60 / 7.15		5.29 / 6.79		6.95		6.95		6.37		6.41	
Oxidation Reduction Potential (mV)		179		197 / -44		-50 / 31		177		177		158		-45	
Turbidity (NTU)		4.7		14.3 / 10.2		45.5 / 4.8		17.7		17.7		10.2		12.5	

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 13				Location 14						Location 15					
SAMPLE TYPE		Sub-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSA1009-13		MBSA1009-13D		MBSW1009-14		MBIA1009-14		MBSA1009-14		MBSW1009-15		MBIA1009-15		MBSA1009-15	
Sample Date		10/19/2009		10/19/2009		10/15/2009		10/15/2009		10/15/2009		10/15/2009		10/15/2009		10/15/2009	
Sample Time		13:15		13:15		9:40		10:15		10:30		11:12		11:38		11:50	
CONTAMINANT OF INTEREST																	
Total Dissolved Solids (mg/L)		262		260		51		55		175		52		55		112	
Total Suspended Solids (mg/L)		168		172		25.7		27.8		14.7		29.6		201		74.4	
Total Metals (mg/L)																	
Arsenic		0.0013		0.0014		0.00044	J	0.00047	J	0.01		0.00048	J	0.00063		0.00063	
Chromium		0.00025	U	0.00025	U	0.00025	U	0.00033	J	0.00025	U	0.00032	J	0.0011		0.00077	
Copper		0.00025	U	0.0014		0.00086		0.0011		0.00027	J	0.00082		0.0025		0.0019	
Zinc		0.0025	U	0.0025	U	0.0029	J	0.0039	J	0.0033	J	0.0028	J	0.0066		0.0047	J
Total Dissolved Metals (mg/L)																	
Arsenic		0.0012		0.0013		0.00049	J	0.00042	J	0.0116		0.00045	J	0.00041	J	0.00048	J
Chromium		0.00025	U	0.00025	U	0.00028	J	0.00025	U	0.00036	J	0.00025	U	0.00025	U	0.00031	J
Copper		0.00025	U	0.0005	U	0.00064		0.00077		0.00025	U	0.00056		0.00078		0.0011	
Zinc		0.0025	U	0.0025	U	0.0025	U	0.0025	J	0.0025	U	0.0025	U	0.0027	J	0.0062	
Pentachlorophenol (µg/L)		0.52	U	0.52	U	0.51	U	0.51	U	0.51	U	0.51	U	0.51	U	0.51	U
Polynuclear Aromatic Hydrocarbons (µg/L)																	
Acenaphthene	L	0.48		0.5		0.015	U	0.015	U	0.095		0.015	U	0.015	U	0.027	J
Acenaphthylene	L	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Anthracene	L	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benz (a) anthracene	H, C	0.016	J	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (a) pyrene	H, C	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (b) fluoranthene	H, C	0.021	J	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (ghi) perylene	H, C	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (k) fluoranthene	H, C	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Chrysene	H, C	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Dibenz (a,h) anthracene	H, C	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluoranthene	H	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluorene	L	0.054		0.057		0.015	U	0.015	U	0.02	J	0.015	U	0.015	U	0.015	U
Indeno (1,2,3-cd) pyrene	H, C	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Naphthalene	L	0.16		0.17		0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Phenanthrene	L	0.041	U	0.042	U	0.015	U	0.015	U	0.015	U	0.015	U	0.041	U	0.015	U
Pyrene	H	0.015	U	0.016	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Total LPAHs[5]		0.694		0.727		0.045	U	0.045	U	0.115	J	0.045	U	0.058	U	0.027	J
Total HPAHs[5]		0.037	J	0.080	U	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U
Total CPAHs[5]		0.082	J	0.084	U	0.060	U	0.060	U	0.080	U	0.060	U	0.066	U	0.060	U
Total PAHs[5]		0.827	J	0.844		0.120	U	0.120	U	0.220	J	0.120	U	0.133	U	0.140	J
Field Parameters (pre-/post-sample)[4]																	
Temperature (°C)		16.06		15.33		12.79		13.27 / 13.05		13.36 / 13.68		13.1		13.65 / 13.29		13.67 / 13.64	
Specific Conductance (mS/cm)		.424		0.415		0.081		0.08 / 0.081		0.268 / 0.227		0.079		0.079 / 0.08		0.164 / 0.192	
Dissolved Oxygen (mg/L)		1.66		1.29		8.73		7.55 / 9.23		7.01 / 1.25		9.3		7.27 / 7.18		1.9 / 0.99	
pH		5.66		6.67		6.95		7.35 / 7.06		7.26 / 6.95		6.14		7.19 / 7.75		7.27 / 6.9	
Oxidation Reduction Potential (mV)		-10		57		180		170 / -34		70 / -80		62		18 / -25		50 / -24	
Turbidity (NTU)		70		6		8.1		14.6 / 9.1		44.1 / 11.8		8.8		48.8 / 60.4		430 / 37.8	

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 16					Location 17					Location 18				
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Sub-Armoring Water	Surface Water		Inter-Armoring Water		Sub-Armoring Water	Surface Water		Inter-Armoring Water		Sub-Armoring Water
Sample ID		MBSW1009-16		MBIA1009-16		MBSA1009-16	MBSW1009-17		MBIA1009-17		MBSA1009-17	MBSW1009-18		MBIA1009-18		MBSA1009-18
Sample Date		10/13/2009		10/13/2009		10/13/2009	10/19/2009		10/19/2009		10/19/2009	10/16/2009		10/16/2009		10/16/2009
Sample Time		11:30		12:15		12:00	14:50		15:00		15:20	11:50		12:18		12:10
CONTAMINANT OF INTEREST																
Total Dissolved Solids (mg/L)		66		66		1110	54		85		100	54		54		61
Total Suspended Solids (mg/L)		37.2		39.4		615	15.5		18.3		51	12		261		470
Total Metals (mg/L)																
Arsenic		0.00046	J	0.00043	J	0.0247	0.00048	J	0.004		0.0095	0.0005		0.00081		0.0018
Chromium		0.00025	U	0.00035	J	0.00025	U	0.00025	J	0.00025	U	0.00025	U	0.0013		0.0022
Copper		0.001		0.0012		0.0016	0.00085		0.0013		0.0012	0.00084		0.0032		0.0038
Zinc		0.0036	J	0.0036	J	0.0149	0.0033	J	0.0046	J	0.0043	J	0.0025	U	0.0086	0.0379
Total Dissolved Metals (mg/L)																
Arsenic		0.0004	J	0.00038	J	0.0241	0.00047	J	0.0045		0.011	0.00052		0.00058		0.0011
Chromium		0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00034	J
Copper		0.00058		0.00079		0.00085	0.00053		0.00068		0.00025	U	0.00066		0.00089	0.00066
Zinc		0.0025	U	0.0025	U	0.0069	0.0025	U	0.0027	J	0.0025	U	0.0025	U	0.0025	U	0.0025	U
Pentachlorophenol (µg/L)		0.5	UJ	0.52	UJ	0.52	UJ	0.51	U	0.51	U	0.51	U	0.51	U	0.51	U	0.51	U
Polynuclear Aromatic Hydrocarbons (µg/L)																
Acenaphthene	L	0.015	U	0.015	U	45.1	0.046		0.085		2.6	0.015	U	0.015	U	0.015	U
Acenaphthylene	L	0.015	U	0.015	U	0.075	0.015	U	0.015	U	0.022	J	0.015	U	0.015	U	0.015	U
Anthracene	L	0.015	U	0.015	U	0.061	0.015	U	0.016	J	0.057	0.015	U	0.015	U	0.015	U
Benz (a) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.024	J	0.015	U	0.015	U	0.015	U
Benzo (a) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (b) fluoranthene	H, C	0.015	U	0.015	U	0.02	J	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (ghi) perylene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (k) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Chrysene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.022	J	0.015	U	0.015	U	0.015	U
Dibenz (a,h) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluoranthene	H	0.015	U	0.015	U	0.015	U	0.015	U	0.017	J	0.07	0.015	U	0.015	U	0.015	U
Fluorene	L	0.015	U	0.015	U	5.4	0.018	J	0.09		2.5	0.015	U	0.015	U	0.015	U
Indeno (1,2,3-cd) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Naphthalene	L	0.015	U	0.015	U	0.93	0.27		0.016	J	0.045	0.015	U	0.015	U	0.015	U
Phenanthrene	L	0.015	U	0.015	U	0.93	0.015	U	0.041	U	0.041	U	0.015	U	0.015	U	0.015	U
Pyrene	H	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.061	0.015	U	0.015	U	0.015	U
Total LPAHs[5]		0.045	U	0.045	U	52.50	0.334	J	0.207	J	5.224	J	0.045	U	0.045	U	0.045	U
Total HPAHs[5]		0.075	U	0.075	U	0.020	J	0.075	U	0.085	J	0.177	J	0.075	U	0.075	U	0.075	U
Total CPAHs[5]		0.050	U	0.050	U	0.020	J	0.050	U	0.050	U	0.046	J	0.050	U	0.050	U	0.050	U
Total PAHs[5]		0.120	U	0.120	U	52.58	J	0.432	J	0.320	J	5.467	J	0.120	U	0.120	U	0.120	U
Field Parameters (pre-/post-sample)[4]																
Temperature (°C)		12.4		12.2 / 12.54		11.99 / 12.63	15.12		16.58 / 14.83		18.75 / 16.9	14.09		14.41 / 14.48		15.09 / 14.63
Specific Conductance (mS/cm)		0.086		0.084 / 0.079		1.42 / 1.73	0.082		0.088 / 0.115		0.12 / 0.116	0.079		0.08 / 0.081		0.09 / 0.093
Dissolved Oxygen (mg/L)		8.63		8.32 / 11.13		3.12 / 2.56	8.14		7.49 / 2.6		2.97 / 1.12	9.03		7.79 / 7.52		6.37 / 6.19
pH		5.55		4.6 / 5.88		8.6 / 6.69	7.2		7.25 / 7.29		6.81 / 7.13	5.66		7.19 / 7.22		7.14 / 7.36
Oxidation Reduction Potential (mV)		43		192 / 33		-95 / -201	-45		-15 / -72		3 / -56	127		81 / 105		49 / 83
Turbidity (NTU)		8.8		122 / 7.9		38.4 / 65.8	15		16 / 16.7		430 / 13.2	7.6		186 / 42.9		46.1 / 24.7

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 19						Location 20						Location 21					
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSW1009-19		MBIA1009-19		MBSA1009-19		MBSW1009-20		MBIA1009-20		MBSA1009-20		MBSW1009-21		MBIA1009-21		MBSA1009-21	
Sample Date		10/19/2009		10/19/2009		10/19/2009		10/14/2009		10/14/2009		10/14/2009		10/14/2009		10/14/2009		10/14/2009	
Sample Time		8:30		8:50		8:58		11:50		12:40		12:50		10:40		10:58		11:08	
CONTAMINANT OF INTEREST																			
Total Dissolved Solids (mg/L)		51		58		70		55		53		106		52		62		285	
Total Suspended Solids (mg/L)		8.3		33.4		11.5		19.4		18.4		33.8		14.4		44.3		408	
Total Metals (mg/L)																			
Arsenic		0.00071		0.00048	J	0.0043		0.00045	J	0.00042	J	0.0021		0.00049	J	0.00046	J	0.007	
Chromium		0.00025	U	0.00025	U	0.00025	U	0.00038	J	0.00025	U	0.00025	U	0.00025	U	0.00038	J	0.00025	U
Copper		0.0014		0.0014		0.00064		0.00079		0.0011		0.00037	J	0.00077		0.0011		0.00029	J
Zinc		0.0025	U	0.0042	J	0.0025	U	0.0025	U	0.0057		0.0025	U	0.0037	J	0.0076		0.0025	U
Total Dissolved Metals (mg/L)																			
Arsenic		0.00086		0.00042	J	0.0049		0.00043	J	0.00048	J	0.002		0.00056		0.00039	J	0.0073	
Chromium		0.00025	U	0.0015		0.00025	U	0.00025	U	0.00032	J	0.00025	U	0.00025	U	0.00025	U	0.00031	J
Copper		0.0015		0.001		0.00025	U	0.00084		0.0012		0.00025	U	0.00083		0.00085		0.00025	U
Zinc		0.0027	J	0.0032	J	0.0025	U	0.0027	J	0.0034	J	0.0025	U	0.0043	J	0.0042	J	0.0025	U
Pentachlorophenol (µg/L)		0.51	U	0.53	U	0.51	U	0.51	UJ	0.6	UJ	0.51	UJ	0.51	UJ	0.52	UJ	0.51	UJ
Polynuclear Aromatic Hydrocarbons (µg/L)																			
Acenaphthene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	1.5		0.015	U	0.015	U	0.019	J
Acenaphthylene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Anthracene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benz (a) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (a) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (b) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (ghi) perylene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (k) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Chrysene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Dibenz (a,h) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluoranthene	H	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluorene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.34		0.015	U	0.015	U	0.015	U
Indeno (1,2,3-cd) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Naphthalene	L	0.019	J	0.015	U	0.034	J	0.015	U	0.015	U	0.75		0.015	U	0.015	U	0.015	U
Phenanthrene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Pyrene	H	0.015	U	0.015	U	0.031	J	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Total LPAHs[5]		0.019	J	0.045	U	0.034	J	0.045	U	0.045	U	2.590		0.045	U	0.045	U	0.019	J
Total HPAHs[5]		0.075	U	0.075	U	0.031	J	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U
Total CPAHs[5]		0.000	U	0.000	U	0.000	U	0.000	U	0.000	U	0.000	U	0.000	U	0.000	U	0.000	U
Total PAHs[5]		0.132	J	0.120	U	0.170	J	0.120	U	0.120	U	2.688		0.120	U	0.120	U	0.132	J
Field Parameters (pre-/post-sample)[4]																			
Temperature (°C)		14.14		14.12 / 14.36		14.16 / 14.17		13.31		13.44 / 13.48		13.91 / 13.76		13.38		13.66 / 13.43		13.94 / 13.84	
Specific Conductance (mS/cm)		0.081		0.098 / 0.101		0.081 / 0.08		0.086		0.086 / 0.086		0.15 / 0.167		0.085		0.126 / 0.095		0.527 / 0.46	
Dissolved Oxygen (mg/L)		8.9		4.22 2.18		7.68 / 7.64		9.85		11.01 / 7.54		2.62 / 1.53		8.74		7.75 / 7.04		2.39 / 7.84	
pH		7.24		6.75 / 7.21		7.03 / 7.43		5.55		4.58 / 7.09		6.88 / 7.05		6.15		7.13 / 7.17		6.43 / 6.84	
Oxidation Reduction Potential (mV)		242		235 / 47		50 / 63		29		81 / -50		-19 / -49		51		-11 / -98		-55 / -71	
Turbidity (NTU)		7.8		676 / 11.7		54.5 / 16.3		12.5		11.6 / 6.9		24.5 / 2.9		12.1		15 / 5.8		51.8 / 181	

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 25						Location 26					
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Surface Water		Inter-Armoring Water		Sub-Armoring	
Sample ID		MBSW1009-25		MBIA1009-25		MBSA1009-25		MBSW1009-26		MBIA1009-26		MBSA1009-26	
Sample Date		10/20/2009		10/20/2009		10/20/2009		10/19/2009		10/19/2009		10/19/2009	
Sample Time		9:05		8:35		8:50		10:05		10:20		10:25	
CONTAMINANT OF INTEREST													
Total Dissolved Solids (mg/L)		59		61		61		48		54		67	
Total Suspended Solids (mg/L)		27.6		88.4		88.2		12.1		14		12.2	
Total Metals (mg/L)													
Arsenic		0.00047	J	0.0005		0.00086		0.00043	J	0.0005		0.00094	
Chromium		**0.00028**	J	**0.0004**	J	**0.0007**		0.00025	U	0.00025	U	**0.00086**	
Copper		**0.00072**		**0.0021**		**0.0021**		**0.00086**		**0.001**		**0.0038**	
Zinc		0.0025	U	**0.0103**		**0.0115**		0.0025	U	**0.0039**	J	**0.0178**	
Total Dissolved Metals (mg/L)													
Arsenic		**0.00037**	J	**0.00037**	J	**0.00055**		**0.00044**	J	**0.00035**	J	**0.00056**	
Chromium		**0.00062**		0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U
Copper		**0.00072**		**0.0011**		**0.001**		**0.0006**		**0.00067**		**0.00058**	
Zinc		0.0025	U	**0.0031**	J	0.0025	U	0.0025	U	0.0025	U	0.0025	U
Pentachlorophenol (µg/L)		0.51	U	0.51	U	0.51	U	0.52	U	0.52	U	0.52	U
Polynuclear Aromatic Hydrocarbons (µg/L)													
Acenaphthene	L	**0.045**		**0.047**		0.015	U	0.015	U	**0.019**	J	0.015	U
Acenaphthylene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Anthracene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benz (a) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (a) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (b) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (ghi) perylene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (k) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Chrysene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Dibenz (a,h) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluoranthene	H	**0.016**	J	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluorene	L	**0.016**	J	**0.017**	J	0.015	U	0.015	U	0.015	U	0.015	U
Indeno (1,2,3-cd) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Naphthalene	L	**0.12**		**0.12**		0.015	U	0.015	U	**0.018**	J	0.015	U
Phenanthrene	L	0.041	U	0.041	U	0.015	U	0.015	U	0.015	U	0.015	U
Pyrene	H	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Total LPAHs[5]		**0.181**		**0.184**		0.045	U	0.045	U	**0.037**	J	0.045	U
Total HPAHs[5]		**0.016**	J	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U
Total CPAHs[5]		0.060	U	0.045	U	0.060	U	0.060	U	0.060	U	0.045	U
Total PAHs[5]		**0.300**	J	**0.295**	J	0.120	U	0.120	U	**0.142**	J	0.120	U
Field Parameters (pre-/post-sample)[4]													
Temperature (°C)		13.4		12.97 / 14.51		14.98 / 14.94		13.62		14.06 / 14.07		15.62 / 14.58	
Specific Conductance (mS/cm)		0.083		0.084 / 0.08		0.086 / 0.106		0.082		0.085 / 0.084		0.085 / 0.1	
Dissolved Oxygen (mg/L)		7.07		7.58 / 6.37		6.67 / 5.96		8.7		7.76 / 7.71		8.74 / 3.76	
pH		7.04		7.01 / 6.41		7.11 / 7.06		7.48		6.62 / 7.05		6.88 / 6.71	
Oxidation Reduction Potential (mV)		218		219 / 218		210 / 203		104		176 / 166		166 / 159	
Turbidity (NTU)		21.8		47 / 44		63.1 / 24.2		9		9.9 / 7.7		80.9 / 20.2	

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		Location 27		Location 04		Location 07		Location 09		Location 16	
SAMPLE TYPE		Surface Water		Inter-Armoring Water		Sub-Armoring Water		Inter-Armoring Water		Sub-Armoring Water	
Sample ID		MBSW1009-27		MBIA1009-04R		MBSA1009-07R		MBIA1009-09R		MBSA1009-16R	
Sample Date		10/15/2009		10/14/2009		10/15/2009		10/12/2009		10/13/2009	
Sample Time		0:00		16:10		15:15		17:40		14:00	
CONTAMINANT OF INTEREST											
Total Dissolved Solids (mg/L)		53									
Total Suspended Solids (mg/L)		27.9									
Total Metals (mg/L)											
Arsenic		0.00043	J	0.00006	U	0.00006	U	[illegible]	J	0.00006	U
Chromium		0.00048	J	0.00025	U	0.00025	U	0.00025	U	0.00025	U
Copper		0.0009		0.00025	U	0.00042	J	0.00025	U	0.00025	U
Zinc		0.003	J	0.0028	J	0.0025	U	0.0025	U	0.0025	U
Total Dissolved Metals (mg/L)											
Arsenic		0.00042	J	NA		0.00006	U	NA		0.00006	U
Chromium		0.00025	U	NA		0.00025	U	NA		0.00025	U
Copper		0.0006		NA		0.00025	U	NA		0.00025	U
Zinc		0.0025	U	NA		0.0025	U	NA		0.0025	U
Pentachlorophenol (µg/L)		0.51	U	0.51	UJ	0.51	U	0.54	U	0.25	R
Polynuclear Aromatic Hydrocarbons (µg/L)											
Acenaphthene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Acenaphthylene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Anthracene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benz (a) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (a) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (b) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (ghi) perylene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Benzo (k) fluoranthene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Chrysene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Dibenz (a,h) anthracene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluoranthene	H	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Fluorene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Indeno (1,2,3-cd) pyrene	H, C	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Naphthalene	L	0.015	U	0.11	J	0.098		0.096		0.08	
Phenanthrene	L	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Pyrene	H	0.015	U	0.015	U	0.015	U	0.015	U	0.015	U
Total LPAHs[5]		0.045	U	0.11	J	0.098		0.096		0.08	
Total HPAHs[5]		0.075	U	0.075	U	0.075	U	0.075	U	0.075	U
Total CPAHs[5]		[illegible]	U	[illegible]	U	[illegible]	U	[illegible]	U	[illegible]	U
Total PAHs[5]		0.120	U	0.11	J	0.098		0.096		0.08	
Field Parameters (pre-/post-sample)[4]											
Temperature (°C)		12.75		14.38 / 14.32		14.54 / 14.67		13.39 / 13.52		11.99 / 12.63	
Specific Conductance (mS/cm)		0.08		0.141 / 0.088		0.581 / 0.38		0.091 / 0.128		1.42 / 1.73	
Dissolved Oxygen (mg/L)		9.77		4.55 / 5.5		1.42 / 0.99		11.02 / 7.62		3.12 / 2.56	
pH		6.26		7.76 / 7.19		6.93 / 6.91		6.58 / 6.87		8.6 / 6.69	
Oxidation Reduction Potential (mV)		221		-140 / 26		-42 / -79		-47 / 160		-95 / -201	
Turbidity (NTU)		7.7		542 / 284		408 / 106		45.7 / 6.4		38.4 / 65.8	

Please refer to notes at end of this table.

Table D-2
Surface, Inter-Armoring, and Sub-Armoring Water Data: Fall 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Notes:

[1] The 1996 Record of Decision (ROD) specifies the remedial action objectives of the sediment cap as: 1) preventing human and aquatic organisms from direct contact with contaminated sediment; and 2) minimizing releases of contaminants from sediment that might result in contamination of the Willamette River in excess of federal and state Ambient Water Quality Criteria (AWQCs).

[2] National Recommended Water Quality Criteria (NRWQCs) published as of August 15, 2007, are included for comparison (see http://www.epa.gov/waterscience/criteria/wqcriteria.html). The current publication includes criteria revisions published in 2002 National Recommended Water Quality Criteria: 2002 table (EPA-822-R-02-047) and 2003 Revised human Health Water Quality Criteria (EPA-822-F-03-012). Note that the aquatic life chronic criteria for pentachlorophenol has been adjusted to site-specific pH (7.5, representing a mid-range of the pH values measured in surface water at the site), and therefore differs from the standard table value. Criteria for metals (Cr, Cu, Zn) have not been adjusted for site-specific hardness. Carcinogenic risk-based numbers reflect a carcinogenicity risk of 10^{-6}.

[3] National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs) promulgated as of August 15, 2007, are included for comparison (see http://www.epa.gov/safewater/contaminants/index.html#primary).

[4] Field parameters for duplicate inter-armor and sub-armor water samples were collected before and after the entire suite of bottles was collected; to clarify this, the "pre" parameters are listed beneath the first sample, with "post" parameters listed beneath the associated duplicate.

[5]The number of significant figures presented in PAH summary do not reflect true accuracy presented by the laboratory results. Due to statistical evaluation using Microsoft Excel, additional significant figures may be shown.

Key:
AWQC = Aquatic Water Quality Criteria (1996 version)
C = Carcinogenic PAH
Gamma = Gamma Distribution
H = High Molecular Weight PAH (HPAH)
HS = Henry Sampler
J = Estimated Value
L = Low Molecular Weight PAH (LPAH)
MDL = Method Detection Limit
mg/L = milligrams per liter
MRL = Method Reporting Limit
NA= Not Applicable
ND = Not Detected
NP = Nonparametric Distribution
U = Value Below MDL (value represents MDL)
IM = Instrument Malfunction
R = Re-analysis of sample was requested, but due laboratory error sample not re-analyzed.
ug/L = micrograms per liter

Bold Indicates Analyte was detected, but does not exceed the most stringent criteria.

shaded Indicates a value less than the MDL where the MDL exceeds the stringent sediment cap performance goal or comparison criteria. Only used on the Spring and Fall 2007 data tables.

Inverse Indicates results that exceed the lowest (most stringent) of the sediment cap performance goals or comparison criteria.

Table D-3
Summary of Surface Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		McCormick & Baxter Record of Decision, 1996, Ambient Water Quality Criteria (AWQCs)		EPA Current, 2007, National Recommended Water Quality Criteria (NRWQCs)		EPA National Primary Drinking Water Regulations (NPDWRs)	Surface Water Fall 2002						
Contaminant of Interest		Aquatic Life (chronic)[2]	Human Health (fish consumption only)[2]	Aquatic Life (chronic)[3]	Human Health (consumption of organism only)[3]	Maximum Contaminant Levels (MCLs)[4]	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)							--	--	--	--	--	--	--
Total Suspended Solids (mg/L)							--	--	--	--	--	--	--
Dissolved Organic Carbon (mg/L)							--	--	--	--	--	--	--
Total Metals (mg/L)													
Arsenic		0.19		0.15	0.00014	0.01	15	27%	0.0011	SED-6	0.0003	NP	0.0005
Chromium		0.21		0.074		0.1	15	33%	0.0021	SED-8	0.0006	NP	0.0010
Copper		0.012		0.009			15	100%	0.0209	SED-7	0.0046	Gamma	0.0158
Zinc		0.11		0.12	26		15	100%	0.0181	SED-9	0.0049	NP	0.0083
Dissolved Metals (mg/L)													
Arsenic							--	--	--	--	--	--	--
Chromium							--	--	--	--	--	--	--
Copper							--	--	--	--	--	--	--
Zinc							--	--	--	--	--	--	--
Pentachlorophenol (µg/L)		13		15	3	1	15	40%	0.079	SED-3	0.0684	NP	0.1233
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)													
Acenaphthene	L	520			990		15	13%	9.8	SED-6	0.6634	NP	7.157
Acenaphthylene	L						15	7%	0.042	SED-6	0.0127	NA	NA
Anthracene	L				40,000		15	7%	3.8	SED-6	0.2632	NA	NA
Benz[a]anthracene	H, C				0.018		15	27%	1.5	SED-6	0.1140	NP	1.099
Benzo[a]pyrene	H, C						15	7%	0.44	SED-6	0.0441	NA	NA
Benzo[b]fluoranthene	H, C				0.018	0.2	15	7%	0.77	SED-6	0.0612	NA	NA
Benzo[g,h,i]perylene	H, C				0.018		15	7%	0.087	SED-6	0.0157	NA	NA
Benzo[k]fluoranthene	H				0.018		15	7%	0.39	SED-6	0.0359	NA	NA
Chrysene	H, C				0.018		15	27%	1.2	SED-6	0.0941	NP	0.8803
Dibenzo[a,h]anthracene	H, C				0.018		15	20%	0.093	SED-6	0.0282	NP	0.0374
Fluoranthene	H		54		140		15	60%	11.9	SED-6	0.8068	NP	8.691
Fluorene	L				5300		6	0%	ND	N/A	0.0120	NA	NA
Ideno[1,2,3-cd]pyrene	H, C				0.018		15	7%	0.13	SED-6	0.0234	NA	NA
Naphthalene	L	620					15	7%	3.3	SED-6	0.2299	NA	NA
Phenanthrene	L						15	33%	22.7	SED-6	1.524	NP	16.574
Pyrene	H				4,000		15	33%	5.3	SED-6	0.3645	NP	3.872
Total LPAHs							15	33%	39.6	SED-6	2.680	NP	14.180
Total HPAHs							15	60%	21.8	SED-6 (ug/L)	1.520	NP	7.830
Total Carcinogenic PAHs			0.031				15	20%	4.22	SED-6 (ug/L)	0.2720	NP	1.570
Total PAHs							15	53%	61.5	SED-6	4.198	NP	22.04

Please refer to notes at end of this table.

Table D-3
Summary of Surface Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Surface Water Fall 2002 - Without Sample SED-6						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		--	--	--	--	--	--	--
Total Suspended Solids (mg/L)		--	--	--	--	--	--	--
Dissolved Organic Carbon (mg/L)		--	--	--	--	--	--	--
Total Metals (mg/L)								
Arsenic		14	21%	0.94	SED-8 (ug/L)	0.2756	NP	0.4395
Chromium		14	36%	2.1	SED-8 (ug/L)	0.5683	NP	0.9701
Copper		14	100%	20.9	SED-7 (ug/L)	4.7286	Gamma	18.1255
Zinc		14	100%	18.1	SED-9 (ug/L)	4.5853	NP	9.5572
Dissolved Metals (mg/L)								
Arsenic		--	--	--	--	--	--	--
Chromium		--	--	--	--	--	--	--
Copper		--	--	--	--	--	--	--
Zinc		--	--	--	--	--	--	--
Pentachlorophenol (µg/L)		14	36%	0.079	SED-3 (ug/L)	0.0677	Max	0.0790
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)								
Acenaphthene	L	14	7%	0.013	SED-8 (ug/L)	0.0108	NA	NA
Acenaphthylene	L	14	0%	ND	N/A	0.0106	NA	NA
Anthracene	L	14	0%	ND	N/A	0.0106	NA	NA
Benz[a]anthracene	H, C	14	21%	0.036	SED-1 (ug/L)	0.0150	Gamma	0.0195
Benzo[a]pyrene	H, C	14	0%	ND	N/A	0.0158	NA	NA
Benzo[b]fluoranthene	H, C	14	0%	ND	N/A	0.0106	NA	NA
Benzo[g,h,i]perylene	H, C	14	0%	ND	N/A	0.0106	NA	NA
Benzo[k]fluoranthene	H	14	0%	ND	N/A	0.0106	NA	NA
Chrysene	H, C	14	21%	0.036	SED-1 (ug/L)	0.0151	Gamma	0.0195
Dibenzo[a,h]anthracene	H, C	14	14%	0.037	SED-2 (ug/L)	0.0235	Gamma	0.0265
Fluoranthene	H	14	57%	0.032	SED-3 (ug/L)	0.0144	Gamma	0.0192
Fluorene	L	6	0%	ND	N/A	0.0120	NA	NA
Ideno[1,2,3-cd]pyrene	H, C	14	0%	ND	N/A	0.0158	NA	NA
Naphthalene	L	14	0%	ND	N/A	0.0106	NA	NA
Phenanthrene	L	14	29%	0.018	SED-1 (ug/L)	0.0114	Gamma	0.0125
Pyrene	H	14	29%	0.018	SED-1 (ug/L)	0.0120	Gamma	0.0132
Total LPAHs		14	29%	0.076	SPMD 15	0.0458	NP	0.0772
Total HPAHs		14	57%	0.162	SED-3 (ug/L)	0.0705	NP	0.1340
Total Carcinogenic PAHs		14	14%	0.128	SED-3 (ug/L)	0.0981	NP	0.1380
Total PAHs		14	57%	0.204	SPMD-20 (ug/L)	0.1050	NP	0.2060

Please refer to notes at end of this table.

Table D-3
Summary of Surface Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Surface Water Fall 2003							Surface Water Fall 2005						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Suspended Solids (mg/L)		21	100%	180	MBSWGB0326	22.3333	NP	112.5361	26	92%	17	MBSWGB05-2A	5.9296	Gamma	7.3008
Dissolved Organic Carbon (mg/L)		21	100%	3.33	MBSWGB0312	2.2195	Gamma	2.3462	26	88%	10.9	MBSWGB05-12	2.7767	NP	5.3601
Total Metals (mg/L)															
Arsenic		21	81%	0.00206	MBSWGB0326	0.0010	Normal	0.0012	26	100%	0.00142	MBSWGB05-04	0.0008	Gamma	0.0008
Chromium		21	100%	0.00547	MBSWGB0326	0.0024	NP	0.0027	26	0%	ND	NA	0.0004	NA	NA
Copper		21	100%	0.0211	MBSWGB0315	0.0035	NP	0.0079	26	81%	0.00283	MBSWGB05-32	0.0010	NP	0.0012
Zinc		21	100%	0.0199	MBSWGB0326	0.0072	NP	0.0088	26	88%	0.00843	MBSWGB05-32	0.0031	NP	0.0046
Dissolved Metals (mg/L)															
Arsenic		--	--	--	--	--	--	--	26	46%	0.000978	MBSWGB05-18	0.0004	NP	0.0006
Chromium		--	--	--	--	--	--	--	26	0%	ND	NA	0.0004	NA	NA
Copper		--	--	--	--	--	--	--	26	81%	0.0112	MBSWGB05-13	0.0014	NP	0.0031
Zinc		--	--	--	--	--	--	--	26	85%	0.00979	MBSWGB05-13	0.0036	Gamma	0.0046
Pentachlorophenol (µg/L)		21	0%	ND	N/A	0.0340	NA	NA	26	0%	ND	NA	0.1745	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	21	0%	ND	N/A	0.0060	NA	NA	26	19%	0.0972	MBSWGB05-17	0.0168	NP	0.0356
Acenaphthylene	L	21	0%	ND	N/A	0.0060	NA	NA	26	0%	ND	NA	0.0087	NA	NA
Anthracene	L	21	0%	ND	N/A	0.0060	NA	NA	26	0%	ND	NA	0.0087	NA	NA
Benz[a]anthracene	H, C	21	0%	ND	N/A	0.0024	NA	NA	26	0%	ND	NA	0.0087	NA	NA
Benzo[a]pyrene	H, C	21	5%	0.00239	MBSWGB0301	0.0012	NA	NA	26	0%	ND	NA	0.0087	NA	NA
Benzo[b]fluoranthene	H, C	21	5%	0.00806	MBSWGB0309	0.0027	NA	NA	26	0%	ND	NA	0.0087	NA	NA
Benzo[g,h,i]perylene	H, C	21	0%	ND	N/A	0.0060	NA	NA	26	0%	ND	NA	0.0087	NA	NA
Benzo[k]fluoranthene	H	21	5%	0.00806	MBSWGB0309	0.0027	NA	NA	26	0%	ND	NA	0.0087	NA	NA
Chrysene	H, C	21	5%	0.0121	MBSWGB0309	0.0028	NA	NA	26	0%	ND	NA	0.0087	NA	NA
Dibenzo[a,h]anthracene	H, C	21	0%	ND	N/A	0.0027	NA	NA	26	0%	ND	NA	0.0174	NA	NA
Fluoranthene	H	21	19%	0.0783	MBSWGB0309	0.0073	NP	0.0438	26	0%	ND	NA	0.0087	NA	NA
Fluorene	L	21	5%	0.0125	MBSWGB0309	0.0063	NA	NA	26	8%	0.0234	MBSWGB05-17	0.0098	NA	NA
Ideno[1,2,3-cd]pyrene	H, C	21	0%	ND	N/A	0.0027	NA	NA	26	0%	ND	NA	0.0087	NA	NA
Naphthalene	L	21	0%	ND	N/A	0.0073	NA	NA	26	15%	0.911	MBSWGB05-17	0.0663	NP	0.0444
Phenanthrene	L	21	5%	0.116	MBSWGB0309	0.0112	NA	NA	26	4%	0.0129	MBSWGB05-17	0.0090	NA	NA
Pyrene	H	21	33%	2.58	MBSWGB0324	0.1269	NP	1.3475	26	0%	ND	NA	0.0087	NA	NA
Total LPAHs		21	5%	0.116	MBSWGB0309	0.0407	NA	NA	26	19%	1.0445	MBSWGB05-17	0.0931	NP	0.1150
Total HPAHs		21	43%	0.166	MBSWGB0309	0.0269	NP	0.0602	26	4%	0.0132	MBSWGB05-32	0.0460	NA	NA
Total Carcinogenic PAHs		21	5%	0.101	MBSWGB0309	0.0238	NA	NA	26	0%	ND	NA	0.0414	NA	NA
Total PAHs		21	43%	0.282	MBSWGB0309	0.0498	NP	0.1070	26	19%	1.105	MBSWGB05-17	0.1437	NP	0.2000

Please refer to notes at end of this table.

Table D-3
Summary of Surface Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Surface Water Spring 2006							Surface Water Fall 2006						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		–	–	--	--	--	--	--	–	–	–	–	--	–	–
Total Suspended Solids (mg/L)		–	--	--	--	--	--	--	22	95%	20	Location 19	5.6905	Lognormal	7.2709
Dissolved Organic Carbon (mg/L)		–	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (mg/L)															
Arsenic		23	22%	0.00233	Location 25	0.0006	NP	0.0011	22	95%	0.00071	Location 25	0.0005	Gamma	0.0005
Chromium		23	74%	0.00455	Location 14	0.0010	NP	0.0036	22	64%	0.00234	Location 3	0.0003	NP	0.0007
Copper		23	74%	0.0168	Location 18	0.0040	Max	0.0168	22	100%	0.00344	Location 3	0.0011	NP	0.0014
Zinc		23	87%	0.04	Location 25	0.0082	NP	0.0291	22	27%	0.00482	Location 7	0.0016	NP	0.0028
Dissolved Metals (mg/L)															
Arsenic		--	--	--	--	--	--	--	21	95%	0.00061	Location 18	0.0004	NP	0.0005
Chromium		–	--	--	--	–	--	--	21	52%	0.00013	Location 11	0.0001	NP	0.0001
Copper		–	--	--	--	--	--	--	21	100%	0.00132	Location 25	0.0007	NP	0.0008
Zinc		–	--	--	--	--	--	--	21	71%	0.00487	Location 11	0.0028	NP	0.0068
Pentachlorophenol (µg/L)		23	0%	ND	NA	0.1197	NA	NA	22	0%	ND	NA	0.1239	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	23	0%	ND	NA	0.0060	NA	NA	22	23%	0.166	Location 25	0.0190	NP	0.0534
Acenaphthylene	L	23	0%	ND	NA	0.0060	NA	NA	22	5%	0.0126	Location 4	0.0065	NA	NA
Anthracene	L	23	0%	ND	NA	0.0060	NA	NA	22	5%	0.0126	Location 4	0.0065	NA	NA
Benz[a]anthracene	H, C	23	0%	ND	NA	0.0060	NA	NA	22	5%	0.0126	Location 4	0.0065	NA	NA
Benzo[a]pyrene	H, C	23	4%	0.0146	Location 13	0.0064	NA	NA	22	0%	ND	NA	0.0062	NA	NA
Benzo[b]fluoranthene	H, C	23	4%	0.0124	Location 13	0.0063	NA	NA	22	5%	0.0126	Location 4	0.0065	NA	NA
Benzo[g,h,i]perylene	H, C	23	0%	0.0062	Location 12	0.0060	NA	NA	22	0%	ND	NA	0.0062	NA	NA
Benzo[k]fluoranthene	H	23	4%	0.0119	Location 13	0.0063	NA	NA	22	0%	ND	NA	0.0062	NA	NA
Chrysene	H, C	23	9%	0.0195	Location 25	0.0069	NA	NA	22	5%	0.0126	Location 4	0.0065	NA	NA
Dibenzo[a,h]anthracene	H, C	23	0%	ND	NA	0.0120	NA	NA	22	0%	ND	NA	0.0124	NA	NA
Fluoranthene	H	23	9%	0.0396	Location 25	0.0085	NA	NA	22	5%	0.0143	Location 14	0.0066	NA	NA
Fluorene	L	23	0%	ND	NA	0.0060	NA	NA	22	9%	0.062	Location 25	0.0098	NA	NA
Ideno[1,2,3-cd]pyrene	H, C	23	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0062	NA	NA
Naphthalene	L	23	26%	0.19	Location 25	0.0173	NP	0.0523	22	18%	0.93	Location 25	0.0873	NP	0.6179
Phenanthrene	L	23	4%	0.0159	Location 13	0.0064	NA	NA	22	9%	0.0295	Location 25	0.0075	NA	NA
Pyrene	H	23	13%	0.0319	Location 25	0.0082	NP	0.0104	22	9%	0.0128	Location 14	0.0068	NA	NA
Total LPAHs		23	26%	0.19	Location 25	0.0402	NP	0.0709	22	18%	1.1875	Location 25	0.1313	NP	0.4080
Total HPAHs		23	13%	0.1066	Location 13	0.0717	NP	0.0855	22	0%	ND	NA	0.0681	NA	NA
Total Carcinogenic PAHs		23	9%	0.053	Location 13	0.0524	NA	NA	22	0%	ND	NA	0.0557	NA	NA
Total PAHs		23	30%	0.281	Location 25	0.0936	NP	0.1450	22	23%	1.1875	Location 25	0.1429	NP	0.4160

Please refer to notes at end of this table.

Table D-3
Summary of Surface Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Surface Water Spring 2007							Surface Water Fall 2007						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Suspended Solids (mg/L)		23	100%	12	Location 6	7.2609	Normal	8.4000	22	91%	86	Location 25	19.0427	Log	36.4492
Dissolved Organic Carbon (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (mg/L)															
Arsenic		23	100%	0.00041	Location 6	0.0003	Normal	0.0003	22	100%	0.00143	Location 17	0.0007	NP	0.0010
Chromium		23	52%	0.00165	Location 26	0.0004	NP	0.0015	22	55%	0.000825	Location 10	0.0003	Log	0.0004
Copper		23	100%	0.00315	Location 19	0.0014	NP	0.0016	22	86%	0.00223	Location 12	0.0012	Normal	0.0014
Zinc		23	35%	0.0216	Location 20	0.0028	NP	0.0068	22	68%	0.00445	Location 12	0.0027	Max	0.0045
Dissolved Metals (mg/L)															
Arsenic		23	83%	0.00004	Location 10	0.0000	NP	0.0003	22	9%	0.000967	Location 17	0.0004	NA	NA
Chromium		23	100%	0.00039	Location 10	0.0004	Normal	0.0004	22	0%	ND	N/A	0.0001	NA	NA
Copper		23	100%	0.00053	Location 10	0.0005	NP	0.0007	22	95%	0.00103	Location 25	0.0007	Normal	0.0072
Zinc		23	83%	0.00158	Location 10	0.0003	NP	0.0120	22	73%	0.0058	Location 2	0.0024	NP	0.0036
Pentachlorophenol (µg/L)		23	0%	ND	N/A	0.1229	NA	NA	22	0%	ND	N/A	0.1189	NP	0.1191
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	23	0%	ND	N/A	0.0061	NA	NA	22	45%	0.411	Location 12	0.0681	NP	0.3359
Acenaphthylene	L	23	0%	ND	N/A	0.0061	NA	NA	22	9%	0.0581	Location 17	0.0088	NA	NA
Anthracene	L	23	0%	ND	N/A	0.0061	NA	NA	22	0%	ND	N/A	0.0059	NA	NA
Benz[a]anthracene	H, C	23	0%	ND	N/A	0.0061	NA	NA	22	0%	ND	N/A	0.0059	NA	NA
Benzo[a]pyrene	H, C	23	0%	ND	N/A	0.0061	NA	NA	22	0%	ND	N/A	0.0059	NA	NA
Benzo[b]fluoranthene	H, C	23	0%	ND	N/A	0.0061	NA	NA	22	0%	ND	N/A	0.0059	NA	NA
Benzo[g,h,i]perylene	H, C	23	0%	ND	N/A	0.0061	NA	NA	22	0%	ND	N/A	0.0059	NA	NA
Benzo[k]fluoranthene	H	23	0%	ND	N/A	0.0061	NA	NA	22	0%	ND	N/A	0.0059	NA	NA
Chrysene	H, C	23	0%	ND	N/A	0.0061	NA	NA	22	0%	ND	N/A	0.0059	NA	NA
Dibenzo[a,h]anthracene	H, C	23	0%	ND	N/A	0.0123	NA	NA	22	0%	ND	N/A	0.0119	NA	NA
Fluoranthene	H	23	4%	0.0133	Location 19	0.0065	NA	NA	22	14%	0.0286	Location 12	0.0084	NP	0.0109
Fluorene	L	23	0%	ND	N/A	0.0061	NA	NA	22	27%	0.254	Location 17	0.0295	NP	0.1574
Ideno[1,2,3-cd]pyrene	H, C	23	0%	ND	N/A	0.0061	NA	NA	22	0%	ND	N/A	0.0059	NA	NA
Naphthalene	L	23	0%	ND	N/A	0.0064	NA	NA	22	50%	1.33	Location 7	0.1937	NP	1.025
Phenanthrene	L	23	0%	ND	N/A	0.0061	NA	NA	22	23%	0.073	Location 17	0.0148	NP	0.0319
Pyrene	H	23	0%	ND	N/A	0.0061	NA	NA	22	14%	0.0277	Location 12	0.0083	NP	0.0108
Total LPAHs		23	0%	ND	N/A	0.0371	NA	NA	22	68%	1.9901	Location 17	0.3028	NP	0.810
Total HPAHs		23	4%	0.0133	Location 19	0.0652	NA	NA	22	14%	0.0563	Location 12	0.0626	NP	0.0690
Total Carcinogenic PAHs		23	0%	ND	N/A	0.0553	NA	NA	22	0%	ND	N/A	0.0522	NA	NA
Total PAHs		23	4%	0.0133	Location 19	0.1007	NA	NA	22	68%	1.9901	Location 17	0.3200	NP	0.797

Please refer to notes at end of this table.

Table D-3
Summary of Surface Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Surface Water Spring 2008							Surface Water Fall 2008						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Suspended Solids (mg/L)															
Dissolved Organic Carbon (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (mg/L)															
Arsenic		22	0%	ND	NA	0.0003	NA	NA	22	91%	0.00132	Location 26	0.0005	Gamma	0.0006
Chromium		22	77%	0.00097	Location 18	0.0004	NP	0.0006	22	36%	0.00257	Location 13	0.0005	NP	0.0012
Copper		22	77%	0.00348	Location 12	0.0011	Normal	0.0012	22	100%	0.00282	Location 18	0.0011	Gamma	0.0013
Zinc		22	9%	0.0125	Location 25	0.0031	NA	NA	22	100%	0.0111	Location 26	0.0057	Normal	0.0064
Dissolved Metals (mg/L)															
Arsenic		22	0%	ND	NA	0.0003	NA	NA	22	86%	0.0018	Location 26	0.0004	Log	0.0005
Chromium		22	45%	0.000319	Location 26	0.0001	NP	0.0002	22	5%	ND	NA	0.0002	NA	NA
Copper		22	64%	0.00455	Location 13	0.0011	NP	0.0020	22	82%	0.00403	Location 13	0.0009	Log	0.0017
Zinc		22	36%	0.0136	Location 25	0.0027	Normal	0.0037	22	100%	0.005	Location 2	0.0044	Normal	0.0048
Pentachlorophenol (µg/L)		22	0%	ND	NA	0.1196	NA	NA	22	0%	ND	NA	0.1245	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	22	14%	0.0661	Location 2	0.0125	NP	0.0287	22	14%	0.704	Location 26	0.0442	NP	0.3600
Acenaphthylene	L	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Anthracene	L	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benz[a]anthracene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benzo[a]pyrene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benzo[b]fluoranthene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benzo[g,h,i]perylene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benzo[k]fluoranthene	H	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Chrysene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Dibenzo[a,h]anthracene	H, C	22	0%	ND	NA	0.0120	NA	NA	22	0%	ND	NA	0.0119	NA	NA
Fluoranthene	H	22	0%	ND	NA	0.0060	NA	NA	22	5%	0.0239	Location 26	0.0068	NA	NA
Fluorene	L	22	14%	0.0237	Location 2	0.0078	Normal	0.0096	22	14%	0.262	Location 26	0.0192	NP	0.0698
Ideno[1,2,3-cd]pyrene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Naphthalene	L	22	18%	0.0934	Location 25	0.0135	Normal	0.0324	22	9%	2.93	Location 26	0.1541	NA	NA
Phenanthrene	L	22	0%	ND	NA	0.0060	NA	NA	22	5%	0.0566	Location 26	0.0083	NA	NA
Pyrene	H	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Total LPAHs		22	18%	0.1475	Location 25	0.0463	NP	0.0789	22	14%	3.95	Location 26	0.2343	NP	1.010
Total HPAHs		22	0%	ND	NA	0.0628	NA	NA	22	5%	0.0239	Location 26	0.0620	NA	NA
Total Carcinogenic PAHs		22	0%	ND	NA	0.0514	NA	NA	22	0%	ND	NA	0.0527	NA	NA
Total PAHs		22	18%	0.1475	Location 25	0.0971	Normal	0.1220	22	14%	3.98	Location 26	0.2908	NP	1.059

Please refer to notes at end of this table.

Table D-3
Summary of Surface Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Surface Water Spring 2009							Surface Water Fall 2009						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		22	100%	83	Location 13	52.0000	Student's T	58.2600	22	100%	73	Location 11	58.6818	Lognormal	61.0600
Total Suspended Solids (mg/L)		22	82%	25	Location 25	4.5900	Gamma	6.4000	21	100%	37.2	Location 16	23.0857	Normal	25.1800
Dissolved Organic Carbon (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (mg/L)															
Arsenic		22	100%	0.0018	Location 19	0.0005	NP	0.0008	22	73%	0.00071	Location 19	0.0004	NP	0.0005
Chromium		22	100%	0.0095	Location 19	0.0013	NP	0.0031	22	45%	0.00046	Location 09	0.0002	NP	0.0003
Copper		22	95%	0.015	Location 19	0.0026	NP	0.0053	22	100%	0.0015	Location 04	0.0010	NP	0.0011
Zinc		22	23%	0.032	Location 19	0.0062	NP	0.0116	22	73%	0.0065	Location 10	0.0029	NP	0.0034
Dissolved Metals (mg/L)															
Arsenic		22	100%	0.0004	Location 3	0.0003	NP	0.0003	22	100%	0.00086	Location 19	0.0005	Gamma	0.0005
Chromium		22	95%	0.001	Location 8	0.0003	NP	0.0005	22	23%	0.00062	Location 25	0.0002	NP	0.0002
Copper		22	59%	0.0017	Location 5	0.0008	NP	0.0012	22	100%	0.0015	Location 19	0.0007	NP	0.0008
Zinc		22	9%	0.023	Location 3	0.0039	NA	NA	22	27%	0.0089	Location 13	0.0020	NP	0.0020
Pentachlorophenol (µg/L)		22	0%	ND	NA	0.1609	NA	NA	22	0%	ND	NA	0.0003	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	22	9%	0.02	Location 2	0.0059	NA	NA	22	23%	0.098	Location 05	0.0164	NP	0.0534
Acenaphthylene	L	22	5%	0.01	Location 4	0.0050	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Anthracene	L	22	0%	ND	NA	0.0048	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Benz[a]anthracene	H, C	22	5%	0.011	Location 15	0.0050	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Benzo[a]pyrene	H, C	22	0%	ND	NA	0.0048	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Benzo[b]fluoranthene	H, C	22	5%	0.012	Location 15	0.0051	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Benzo[g,h,i]perylene	H, C	22	5%	0.015	Location 15	0.0052	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Benzo[k]fluoranthene	H	22	5%	0.011	Location 15	0.0050	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Chrysene	H, C	22	5%	0.011	Location 15	0.0050	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Dibenzo[a,h]anthracene	H, C	22	0%	ND	NA	0.0048	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Fluoranthene	H	22	9%	0.012	Location 15	0.0054	NA	NA	22	5%	0.016	Location 25	0.0079	NA	NA
Fluorene	L	22	27%	0.094	Location 2	0.0280	NP	0.1010	22	14%	0.036	Location 05	0.0097	NP	0.0121
Ideno[1,2,3-cd]pyrene	H, C	22	0%	ND	NA	0.0048	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Naphthalene	L	22	23%	0.11	Location 13	0.0168	NP	0.2240	22	23%	0.51	Location 05	0.0493	NP	0.0894
Phenanthrene	L	22	0%	ND	NA	0.0048	NA	NA	22	5%	0.0205	Location 03	0.0093	NA	NA
Pyrene	H	22	5%	0.011	Location 25	0.0051	NA	NA	22	0%	ND	NA	0.0076	NA	NA
Total LPAHs		22	50%	0.114	Location 2	0.0525	NP	0.1530	22	27%	0.6715	Location 05	0.0758	NP	0.2260
Total HPAHs		22	9%	0.072	Location 15	0.0466	NA	NA	22	5%	0.09975	Location 05	0.0742	NA	NA
Total Carcinogenic PAHs		22	5%	0.06	Location 15	0.0382	NA	NA	22	5%	0.07225	Location 25	0.0645	NA	NA
Total PAHs		22	59%	0.1158	Location 12	0.0735	NP	0.1690	22	27%	0.709	Location 05	0.1173	NP	0.2300

Please refer to notes at end of this table.

Table D-3
Summary of Surface Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Notes:

[1]The number of significant figures presented in the table do not reflect true accuracy presented by the laboratory results. Data should only retain 3 significant figures. Due to statistical evaluation using Microsoft Excel, additional significant figures may be shown.

[2] The 1996 Record of Decision (ROD) specifies the remedial action objects of the sediment cap as: 1) preventing human and aquatic organisms from direct contact with contaminated sediment; and 2) minimizing releases of contaminants from sediment that might result in contamination of the Willamette River in excess of federal and state Ambient Water Quality Criteria (AWQCs).

[3] National Recommended Water Quality Criteria (NRWQCs) published as of August 15, 2007, are included for comparison (see http://www.epa.gov/waterscience/criteria/wqcriteria.html).

[4] National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs) promulgated as of August 15, 2007, are included for comparison (see http://www.epa.gov/safewater/contaminants/index.html).

Key:
C = Carcinogenic PAH
Gamma = Gamma Distribution
H = High Molecular Weight PAH (HPAH)
J = Estimated Value
L = Low Molecular Weight PAH (LPAH)
mg/L = milligrams per liter
MRL = Method Reporting Limit
NA= Not Applicable
ND = Not Detected
NP = Nonparametric Distribution
U = Value Below MDL (value represents MDL)
µg/L = micrograms per liter

Table D-4
Summary of Inter-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		McCormick & Baxter Record of Decision, 1996, Ambient Water Quality Criteria (AWQCs)		EPA Current, 2007, National Recommended Water Quality Criteria (NRWQCs)		EPA National Primary Drinking Water Regulations (NPDWRs)	Inter-Armoring Water Spring 2006						
Contaminant of Interest		Aquatic Life (chronic)[2]	Human Health (fish consumption only)[2]	Aquatic Life (chronic)[3]	Human Health (consumption of organism only)[3]	Maximum Contaminant Levels (MCLs)[4]	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)							--	--	--	--	--	--	--
Total Suspended Solids (mg/L)							--	--	--	--	--	--	--
Total Metals (mg/L)													
Arsenic		0.19		0.15	0.00014	0.01	23	30%	0.00493	Location 5	0.0012	NP	0.0023
Chromium		0.21		0.074		0.1	23	43%	0.0105	Location 12	0.0008	NP	0.0053
Copper		0.012		0.009			23	96%	0.0168	Location 12	0.0026	NP	0.0056
Zinc		0.11		0.12	26		23	78%	0.0392	Location 12	0.0069	NP	0.0154
Dissolved Metals (mg/L)													
Arsenic													
Chromium													
Copper													
Zinc													
Pentachlorophenol (µg/L)		13		15	3	1	22	0%	ND	NA	0.1200	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)													
Acenaphthene	L	520			990		22	32%	3.65	Location 5	0.3208	NP	2.323
Acenaphthylene	L						22	5%	0.0736	Location 10	0.0093	NA	NA
Anthracene	L				40,000		22	5%	0.199	Location 5	0.0148	NA	NA
Benz[a]anthracene	H, C				0.018		22	5%	0.0134	Location 5	0.0063	NA	NA
Benzo[b]fluoranthene	H, C				0.018	0.2	22	0%	ND	NA	0.0060	NA	NA
Benzo[k]fluoranthene	H				0.018		22	0%	ND	NA	0.0060	NA	NA
Benzo[a]pyrene	H, C						22	0%	ND	NA	0.0060	NA	NA
Benzo[g,h,i]perylene	H, C				0.018		22	0%	ND	NA	0.0060	NA	NA
Chrysene	H, C				0.018		22	5%	0.0186	Location 5	0.0066	NA	NA
Dibenzo[a,h]anthracene	H, C				0.018		22	0%	ND	NA	0.0120	NA	NA
Fluoranthene	H		54		140		22	5%	0.253	Location 5	0.0172	NA	NA
Fluorene	L				5300		22	9%	1.99	Location 5	0.0981	NA	NA
Ideno[1,2,3-cd]pyrene	H, C				0.018		22	0%	ND	NA	0.0060	NA	NA
Naphthalene	L	620					22	50%	1.13	Location 5	0.0850	NP	0.6037
Phenanthrene	L						22	14%	1.73	Location 5	0.0861	NP	0.8651
Pyrene	H				4,000		22	5%	0.138	Location 5	0.0120	NA	NA
Total LPAHs							22	55%	8.699	Location 5	0.6011	NP	2.377
Total HPAHs							22	5%	0.423	Location 5	0.0880	NA	NA
Total Carcinogenic PAHs			0.031				22	5%	0.032	Location 5	0.0530	NA	NA
Total PAHs							22	55%	9.122	Location 5	0.6503	NP	2.490

Please refer to notes at end of this table.

Table D-4
Summary of Inter-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Inter-Armoring Water Fall 2006						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		--	--	--	--	--	--	--
Total Suspended Solids (mg/L)		--	--	--	--	--	--	--
Total Metals (mg/L)								
Arsenic		22	100%	0.00206	Location 21	0.0007	NP	0.0008
Chromium		22	64%	0.00216	Location 3	0.0004	NP	0.0015
Copper		22	100%	0.00435	Location 20	0.0017	Lognormal	0.0022
Zinc		22	45%	0.0147	Location 17	0.0032	NP	0.0113
Dissolved Metals (mg/L)								
Arsenic								
Chromium								
Copper								
Zinc								
Pentachlorophenol (µg/L)		22	14%	0.25	Location 6	0.1351	NP	0.1495
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)								
Acenaphthene	L	22	23%	1.81	Location 20	0.0961	NP	0.9105
Acenaphthylene	L	22	18%	0.0506	Location 20	0.0088	NP	0.0126
Anthracene	L	22	14%	0.0161	Location 20	0.0070	NP	0.0080
Benz[a]anthracene	H, C	22	14%	0.0187	Location 5	0.0070	NP	0.0082
Benzo[b]fluoranthene	H, C	22	14%	0.0125	Location 6	0.0067	NP	0.0075
Benzo[k]fluoranthene	H	22	14%	0.0136	Location 5	0.0068	NP	0.0076
Benzo[a]pyrene	H, C	22	14%	0.0125	Location 6	0.0067	NP	0.0075
Benzo[g,h,i]perylene	H, C	22	9%	0.0125	Location 6	0.0065	NA	NA
Chrysene	H, C	22	14%	0.0236	Location 5	0.0073	NP	0.0088
Dibenzo[a,h]anthracene	H, C	22	9%	0.025	Location 6	0.0129	NP	0.0140
Fluoranthene	H	22	18%	0.111	Location 5	0.0123	NP	0.0333
Fluorene	L	22	18%	0.398	Location 20	0.0282	NP	0.2078
Ideno[1,2,3-cd]pyrene	H, C	22	9%	0.0125	Location 6	0.0065	NA	NA
Naphthalene	L	22	36%	2.08	Location 20	0.1364	NP	1.095
Phenanthrene	L	22	14%	0.147	Location 20	0.0185	NP	0.0557
Pyrene	H	22	23%	0.0601	Location 5	0.0099	NP	0.0208
Total LPAHs		22	36%	4.5017	Location 20	0.2830	NP	1.175
Total HPAHs		22	18%	0.227	Location 5	0.0718	NP	0.1060
Total Carcinogenic PAHs		22	9%	0.0559	Location 5	0.0556	NA	NA
Total PAHs		22	41%	4.5469	Location 20	0.3036	NP	1.209

Please refer to notes at end of this table.

Table D-4
Summary of Inter-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Inter-Armoring Water Spring 2007							Inter-Armoring Water Fall 2007						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Suspended Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (mg/L)															
Arsenic		23	13%	0.00713	Location 5	0.0007	NP	0.0038	22	100%	0.00202	Location 13	0.0010	Normal	0.0012
Chromium		23	13%	0.0227	Location 5	0.0020	Gamma	0.0040	22	55%	0.00456	Location 16	0.0009	Gamma	0.0014
Copper		23	100%	0.037	Location 5	0.0053	NP	0.0124	22	86%	0.00858	Location 16	0.0025	Gamma	0.0033
Zinc		23	4%	0.03325	Location 5	0.0051	NA	NA	22	64%	0.0222	Location 16	0.0068	Gamma	0.0093
Dissolved Metals (mg/L)															
Arsenic															
Chromium															
Copper															
Zinc															
Pentachlorophenol (µg/L)		23	0%	ND	NA	0.1228	NA	NA	22	0%	ND	NA	0.1140	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	23	13%	0.115	Location 20	0.0143	NP	0.0375	22	0%	ND	NA	0.0280	NA	NA
Acenaphthylene	L	23	0%	ND	NA	0.0061	NA	NA	22	9%	0.0673	Location 17	0.0091	NA	NA
Anthracene	L	23	0%	ND	NA	0.0061	NA	NA	22	0%	ND	NA	0.0059	NA	NA
Benz[a]anthracene	H, C	23	0%	ND	NA	0.0061	NA	NA	22	0%	ND	NA	0.0059	NA	NA
Benzo[b]fluoranthene	H, C	23	0%	ND	NA	0.0061	NA	NA	22	0%	ND	NA	0.0059	NA	NA
Benzo[k]fluoranthene	H	23	0%	ND	NA	0.0061	NA	NA	22	0%	ND	NA	0.0059	NA	NA
Benzo[a]pyrene	H, C	23	0%	ND	NA	0.0061	NA	NA	22	0%	ND	NA	0.0059	NA	NA
Benzo[g,h,i]perylene	H, C	23	0%	ND	NA	0.0061	NA	NA	22	0%	ND	NA	0.0059	NA	NA
Chrysene	H, C	23	0%	ND	NA	0.0061	NA	NA	22	0%	ND	NA	0.0059	NA	NA
Dibenzo[a,h]anthracene	H, C	23	0%	ND	NA	0.0123	NA	NA	22	0%	ND	NA	0.0119	NA	NA
Fluoranthene	H	23	0%	ND	NA	0.0061	NA	NA	22	32%	0.0173	Location 10	0.0084	NP	0.0098
Fluorene	L	23	9%	0.0345	Location 20	0.0078	NA	NA	22	0%	ND	NA	0.0149	NA	NA
Ideno[1,2,3-cd]pyrene	H, C	23	0%	ND	NA	0.0061	NA	NA	22	0%	ND	NA	0.0059	NA	NA
Naphthalene	L	23	0%	ND	NA	0.0066	NA	NA	22	0%	ND	NA	0.0474	NA	NA
Phenanthrene	L	23	0%	ND	NA	0.0061	NA	NA	22	0%	ND	NA	0.0089	NA	NA
Pyrene	H	23	0%	ND	NA	0.0061	NA	NA	22	5%	0.0141	Location 10	0.0063	NA	NA
Total LPAHs		23	17%	0.1495	Location 20	0.0416	NP	0.0643	22	9%	0.0673	Location 17	0.0779	NA	NA
Total HPAHs		23	0%	ND	NA	0.0678	NA	NA	22	32%	0.0314	Location 10	0.0493	NP	0.0714
Total Carcinogenic PAHs		23	0%	ND	NA	0.0553	NA	NA	22	0%	ND	NA	0.0534	NA	NA
Total PAHs		23	17%	0.1495	Location 20	0.0974	NP	0.1230	22	36%	0.0812	Location 17	0.0854	NP	0.1470

Please refer to notes at end of this table.

Table D-4
Summary of Inter-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Inter-Armoring Water Spring 2008							Inter-Armoring Water Fall 2008						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Suspended Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (mg/L)															
Arsenic		22	5%	0.00078	Location 14	0.0004	NA	NA	22	95%	0.00257	Location 14	0.0008	Gamma	0.0011
Chromium		22	91%	0.00229	Location 14	0.0006	Lognormal	0.0008	22	55%	0.0109	Location 14	0.0014	NP	0.0023
Copper		22	82%	0.00528	Location 7	0.0019	Gamma	0.0023	22	100%	0.0236	Location 14	0.0038	Normal	0.0084
Zinc		22	27%	0.172	Location 9	0.0117	NP	0.0879	22	77%	0.058	Location 14	0.0109	Normal	0.0220
Dissolved Metals (mg/L)															
Arsenic															
Chromium															
Copper															
Zinc															
Pentachlorophenol (µg/L)		22	0%	ND	NA	0.1198	NA	NA	22	0%	ND	NA	0.1192	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	22	14%	0.0582	Location 2	0.0107	NP	0.0233	22	18%	0.184	Location 26	0.0213	NP	0.0363
Acenaphthylene	L	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Anthracene	L	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benz[a]anthracene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benzo[b]fluoranthene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benzo[k]fluoranthene	H	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benzo[a]pyrene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Benzo[g,h,i]perylene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Chrysene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Dibenzo[a,h]anthracene	H, C	22	0%	ND	NA	0.0120	NA	NA	22	0%	ND	NA	0.0119	NA	NA
Fluoranthene	H	22	0%	ND	NA	0.0060	NA	NA	22	5%	0.017	Location 7	0.0065	NA	NA
Fluorene	L	22	9%	0.0157	Location 2	0.0067	NA	NA	22	14%	0.0692	Location 26	0.0107	NP	0.0247
Ideno[1,2,3-cd]pyrene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	0%	ND	NA	0.0060	NA	NA
Naphthalene	L	22	27%	0.0521	Location 2	0.0112	NP	0.0218	22	14%	0.488	Location 26	0.0312	NP	0.2500
Phenanthrene	L	22	0%	ND	NA	0.0060	NA	NA	22	5%	0.0154	Location 26	0.0064	NA	NA
Pyrene	H	22	0%	ND	NA	0.0060	NA	NA	22	5%	0.0181	Location 7	0.0065	Normal	0.0076
Total LPAHs		22	32%	0.126	Location 2	0.0381	NP	0.0609	22	18%	0.757	Location 26	0.0772	NP	0.0711
Total HPAHs		22	0%	ND	NA	0.0644	NA	NA	22	5%	0.0351	Location 7	0.0625	NA	NA
Total Carcinogenic PAHs		22	0%	ND	NA	0.0527	NA	NA	22	0%	ND	NA	0.0527	NA	NA
Total PAHs		22	32%	0.126	Location 2	0.0806	NP	0.1150	22	18%	0.757	Location 26	0.1308	NP	0.2620

Please refer to notes at end of this table.

Table D-4
Summary of Inter-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Inter-Armoring Water Spring 2009							Inter-Armoring Water Fall 2009						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		22	100%	100	Location 15	58	Student's T	64.37	22	100%	114	Location 13	64.36363636	Gamma	68.16
Total Suspended Solids (mg/L)		22	86%	150	Location 4	15	NP	45.52	22	100%	1150	Location 04	117.7954545	Gamma	190.4
Total Metals (mg/L)				0											
Arsenic		22	100%	0.0071	Location 7	0.0009	NP	0.0022	22	77%	0.004	Location 17	0.0007	NP	0.0014
Chromium		22	100%	0.0043	Location 4	0.0018	Student's T	0.0021	22	68%	0.0027	Location 04	0.0005	Gamma	0.0007
Copper		22	100%	0.0092	Location 17	0.0038	Gamma	0.0048	22	100%	0.0102	Location 04	0.0019	NP	0.0037
Zinc		22	27%	0.018	Location 4	0.0067	NP	0.0100	22	100%	0.0303	Location 04	0.0064	NP	0.0085
Dissolved Metals (mg/L)															
Arsenic		22	100%	0.0008	Location 14	0.0003	NP	0.0004	22	100%	0.0045	Location 17	0.0007	NP	0.0015
Chromium		22	91%	0.0017	Location 10	0.0003	NP	0.0006	22	27%	0.00065	Location 04	0.0003	NP	0.0005
Copper		22	82%	0.0029	Location 25	0.0011	NP	0.0017	22	100%	0.0016	Location 04	0.0009	Normal	0.0010
Zinc		22	18%	0.023	Location 14	0.0046	NP	0.0088	22	82%	0.0058	Location 12	0.0029	NP	0.0034
Pentachlorophenol (µg/L)		22	0%	0.165	Location 8	0.1602	NA		22	0%	ND	NA	0.0003	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	22	18%	6	Location 20	0.2896	NP	1.4760	22	32%	0.14	Location 13	0.0257	NP	0.0379
Acenaphthylene	L	22	0%	0.0048	Location 8	0.0048	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Anthracene	L	22	5%	0.029	Location 20	0.0059	NA	NA	22	5%	0.016	Location 17	0.0079	NA	NA
Benz[a]anthracene	H, C	22	5%	0.0095	Location 18	0.0050	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Benzo[b]fluoranthene	H, C	22	0%	0.0048	Location 8	0.0048	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Benzo[k]fluoranthene	H	22	0%	0.0048	Location 8	0.0048	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Benzo[a]pyrene	H, C	22	0%	0.0048	Location 8	0.0048	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Benzo[g,h,i]perylene	H, C	22	0%	0.0048	Location 8	0.0048	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Chrysene	H, C	22	14%	0.014	Location 18	0.0056	NP	0.0078	22	0%	ND	NA	0.0075	NA	NA
Dibenzo[a,h]anthracene	H, C	22	0%	0.0048	Location 8	0.0048	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Fluoranthene	H	22	14%	0.11	Location 7	0.0125	NP	0.0353	22	9%	0.028	Location 06	0.0089	NA	NA
Fluorene	L	22	27%	1.4	Location 20	0.0828	NP	0.3580	22	18%	0.09	Location 17	0.0153	NP	0.0347
Ideno[1,2,3-cd]pyrene	H, C	22	0%	0.0048	Location 8	0.0048	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Naphthalene	L	22	23%	0.42	Location 2	0.0407	NP	0.1410	22	32%	0.36	Location 05	0.0310	NP	0.1030
Phenanthrene	L	22	14%	0.016	Location 20	0.0059	NP	0.0087	22	9%	0.023	Location 06	0.0111	NA	NA
Pyrene	H	22	18%	0.073	Location 7	0.0101	NP	0.0249	22	5%	0.023	Location 06	0.0082	NA	NA
Total LPAHs		22	45%	7.765	Location 20	0.4201	NP	1.9480	22	45%	0.5115	Location 05	0.0754	NP	0.1880
Total HPAHs		22	23%	0.183	Location 7	0.0529	NP	0.0827	22	9%	0.16325	Location 17	0.0815	NA	NA
Total Carcinogenic PAHs		22	5%	0.0403	Location 18	0.0368	NA	NA	22	9%	0.088	Location 06	0.0653	NA	NA
Total PAHs		22	55%	7.861	Location 20	0.4536	NP	1.9960	22	45%	0.549	Location 05	0.1186	NP	0.2180

Please refer to notes at end of this table.

Table D-4
Summary of Inter-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Notes:

[1]The number of significant figures presented in the table do not reflect true accuracy presented by the laboratory results. Data should only retain 3 significant figures. Due to statistical evaluation using Microsoft Excel, additional significant figures may be shown.

[2] The 1996 Record of Decision (ROD) specifies the remedial action objects of the sediment cap as: 1) preventing human and aquatic organisms from direct contact with contaminated sediment; and 2) minimizing releases of contaminants from sediment that might result in contamination of the Willamette River in excess of federal and state Ambient Water Quality Criteria (AWQCs).

[3] National Recommended Water Quality Criteria (NRWQCs) published as of August 15, 2007, are included for comparison (see http://www.epa.gov/waterscience/criteria/wqcriteria.html).

[4] National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs) promulgated as of August 15, 2007, are included for comparison (see http://www.epa.gov/safewater/contaminants/index.html).

Key:
C = Carcinogenic PAH
Gamma = Gamma Distribution
H = High Molecular Weight PAH (HPAH)
J = Estimated Value
L = Low Molecular Weight PAH (LPAH)
mg/L = milligrams per liter
MRL = Method Reporting Limit
NA= Not Applicable
ND = Not Detected
NP = Nonparametric Distribution
U = Value Below MDL (value represents MDL)
µg/L = micrograms per liter

Table D-5
Summary of Sub-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		McCormick & Baxter Record of Decision, 1996, Ambient Water Quality Criteria (AWQCs)		EPA Current, 2007, National Recommended Water Quality Criteria (NRWQCs)		EPA National Primary Drinking Water Regulations (NPDWRs)	Sub-Armoring Water Fall 2005						
Contaminant of Interest		Aquatic Life (chronic)[2]	Human Health (fish consumption only)[2]	Aquatic Life (chronic)[3]	Human Health (consumption of organism only)[3]	Maximum Contaminant Levels (MCLs)[4]	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)							--	--	--	--	--	--	--
Total Suspended Solids (mg/L)							--	--	--	--	--	--	--
Total Metals (mg/L)													
Arsenic		0.19		0.15	0.00014	0.01	23	100%	0.0332	MBPWPR05-26	0.0053	Gamma	0.0084
Chromium		0.21		0.074		0.1	23	39%	0.0144	MBPWPR05-09	0.0014	NP	0.0041
Copper		0.012		0.009			23	70%	0.0282	MBPWPR05-09	0.0027	NP	0.0146
Zinc		0.11		0.12	26		23	100%	0.113	MBPWPR05-09	0.0202	Gamma	0.0280
Dissolved Metals (mg/L)													
Arsenic													
Chromium													
Copper													
Zinc													
Pentachlorophenol (µg/L)		13		15	3	1	23	4%	0.469	MBPWPR05-17 1	0.8562	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)													
Acenaphthene	L	520			990		23	57%	131	MBPWPR05-20	16.983	NP	32.650
Acenaphthylene	L						23	13%	1.22	MBPWPR05-23	0.1160	NP	0.6744
Anthracene	L				40,000		23	39%	3.42	MBPWPR05-09	0.5349	NP	2.876
Benzo[a]anthracene	H, C				0.018		23	17%	0.959	MBPWPR05-09	0.0668	NP	0.4855
Benzo[a]pyrene	H, C						23	0%	ND	NA	0.0146	NA	NA
Benzo[b]fluoranthene	H, C				0.018	0.2	23	4%	0.284	MBPWPR05-09	0.0216	NA	NA
Benzo[g,h,i]perylene	H, C				0.018		23	4%	0.369	MBPWPR05-09	0.0252	NA	NA
Benzo[k]fluoranthene	H				0.018		23	9%	0.355	MBPWPR05-09	0.0251	NA	NA
Chrysene	H, C				0.018		23	22%	1.05	MBPWPR05-09	0.0713	NP	0.5283
Dibenzo[a,h]anthracene	H, C				0.018		23	0%	ND	NA	0.0337	NA	NA
Fluoranthene	H		54		140		23	61%	7.4	MBPWPR05-07	0.8853	NP	5.259
Fluorene	L				5300		23	61%	53.9	MBPWPR05-20	5.861	NP	11.587
Ideno[1,2,3-cd]pyrene	H, C				0.018		23	0%	ND	NA	0.0146	NA	NA
Naphthalene	L	620					23	61%	772	MBPWPR05-09	74.567	NP	522
Phenanthrene	L						23	61%	41	MBPWPR05-20	4.796	NP	8.902
Pyrene	H				4,000		23	65%	4.49	MBPWPR05-09	0.5216	NP	3.190
Total LPAHs							23	78%	886	MBPWPR05-10	103	NP	547
Total HPAHs							23	65%	14.257	MBPWPR05-09	1.590	NP	5.104
Total Carcinogenic PAHs			0.031				23	22%	3.017	MBPWPR05-09	0.2390	NP	0.8040
Total PAHs							23	78%	886	MBPWPR05-10	104	NP	550

Please refer to notes at end of this table.

Table D-5
Summary of Sub-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Sub-Armoring Water Spring 2006							Sub-Armoring Water Fall 2006						
Contaminant of Interest		Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value	Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value
Total Dissolved Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Suspended Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (mg/L)															
Arsenic		23	91%	0.037	Location 3	0.0103	Gamma	0.0154	22	95%	0.0386	Location 18	0.0089	Gamma	0.0142
Chromium		23	78%	0.0169	Location 11	0.0013	Log	0.0027	22	23%	0.00106	Location 25	0.0002	NP	0.0004
Copper		23	70%	0.0352	Location 19	0.0055	Gamma	0.0107	22	82%	0.00281	Location 15	0.0008	Gamma	0.0012
Zinc		23	87%	0.388	Location 11	0.0366	Log	0.0718	22	50%	0.0263	Location 14	0.0059	NP	0.0207
Dissolved Metals (mg/L)															
Arsenic															
Chromium															
Copper															
Zinc															
Pentachlorophenol (µg/L)		23	4%	18.5	Location 6	0.9662	NA	NA	22	14%	0.25	Location 6	0.1409	NP	0.1578
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	23	74%	22.1	Location 20	4.520	Gamma	11.201	22	73%	19	Location 20	3.401	Gamma	8.510
Acenaphthylene	L	23	4%	0.3065	Location 20	0.0271	NA	NA	22	14%	3.27	Location 17	0.3053	NP	2.292
Anthracene	L	23	61%	0.709	Location 5	0.1116	NP	0.5145	22	50%	0.458	Location 9	0.0616	NP	0.2992
Benzo[a]anthracene	H, C	23	17%	0.0995	Location 5	0.0146	NP	0.0348	22	18%	0.055	Location 7	0.0110	NP	0.0225
Benzo[a]pyrene	H, C	23	0%	ND	NA	0.0086	NA	NA	22	9%	0.0187	Location 17	0.0070	NA	NA
Benzo[b]fluoranthene	H, C	23	9%	0.06	Location 16	0.0099	NA	NA	22	9%	0.0125	Location 4	0.0068	NA	NA
Benzo[g,h,i]perylene	H, C	23	0%	ND	NA	0.0084	NA	NA	22	14%	0.0125	Location 4	0.0070	NP	0.0079
Benzo[k]fluoranthene	H	23	9%	0.0894	Location 5	0.0130	NA	NA	22	9%	0.0125	Location 6	0.0068	NA	NA
Chrysene	H, C	23	22%	0.101	Location 5	0.0158	NP	0.0366	22	27%	0.0503	Location 7	0.0121	NP	0.0242
Dibenzo[a,h]anthracene	H, C	23	0%	ND	NA	0.0167	NA	NA	22	14%	0.025	Location 6	0.0141	NP	0.0158
Fluoranthene	H	23	65%	1.67	Location 7	0.2263	NP	1.122	22	59%	10.4	Location 7	0.6263	NP	5.312
Fluorene	L	23	65%	10.5	Location 5	1.117	NP	6.480	22	59%	10.3	Location 17	1.134	NP	6.446
Ideno[1,2,3-cd]pyrene	H, C	23	0%	0.06	Location 16	0.0084	NA	NA	22	5%	0.0144	Location 17	0.0066	NA	NA
Naphthalene	L	23	74%	726	Location 16	47.516	NP	296.574	22	73%	229	Location 5	13.323	NP	118.152
Phenanthrene	L	23	52%	6.91	Location 5	0.6117	NP	4.1800	22	59%	6.4	Location 17	0.5388	NP	3.735
Pyrene	H	23	48%	0.716	Location 7	0.1075	NP	0.5059	22	68%	3.14	Location 7	0.2309	NP	1.663
Total LPAHs		23	87%	738.2	Location 16	52.839	NP	205	22	91%	232.325	Location 5	18.452	NP	65.630
Total HPAHs		23	65%	2.4248	Location 7	0.4022	NP	1.039	22	64%	13.6453	Location 7	0.8895	NP	3.580
Total Carcinogenic PAHs		23	22%	0.3217	Location 5	0.0889	NP	0.1980	22	23%	0.1053	Location 7	0.0563	NP	0.0710
Total PAHs		23	91%	738.2	Location 16	55.530	NP	205	22	91%	232.3679	Location 5	19.318	Gamma	51.140

Please refer to notes at end of this table.

Table D-5
Summary of Sub-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Sub-Armoring Water Spring 2007							Sub-Armoring Water Fall 2007						
Contaminant of Interest		**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**	**Number of Samples**	**Detection Frequency**	**Max Detection**	**Max Location**	**Mean Conc.**	**Data Distribution**	**95% UCL Value**
Total Dissolved Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Suspended Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (mg/L)															
Arsenic		23	100%	0.0522	Location 3	0.0080	Gamma	0.0123	22	100%	0.0322	Location 4	0.0126	Normal	0.0162
Chromium		23	30%	0.00255	Location 15	0.0006	NP	0.0022	22	9%	0.00143	Location 3	0.0003	NP	0.0006
Copper		23	96%	0.544	Location 15	0.0253	NP	0.2600	22	86%	0.00476	Location 15	0.0008	NP	0.0018
Zinc		23	57%	0.0526	Location 15	0.0098	NP	0.0350	22	91%	0.0335	Location 16	0.0113	Gamma	0.0154
Dissolved Metals (mg/L)															
Arsenic															
Chromium															
Copper															
Zinc															
Pentachlorophenol (µg/L)		23	0%	ND	NA	0.3854	NA	NA	22	5%	3.27	Location 16	0.2621	NP	0.8864
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	23	78%	47.5	Location 8	8.431	Gamma	23.018	22	59%	67.6	Location 9	10.814	Gamma	27.062
Acenaphthylene	L	23	13%	0.605	Location 16	0.0581	NP	0.3423	22	0%	0.119	Location 6	0.0262	NP	0.0951
Anthracene	L	23	52%	1.32	Location 5	0.0938	NP	0.6670	22	18%	1.14	Location 9	0.1284	NP	0.6988
Benzo[a]anthracene	H, C	23	13%	0.3065	Location 5	0.0218	NP	0.0787	22	9%	0.153	Location 7	0.0140	NP	0.0434
Benzo[a]pyrene	H, C	23	4%	0.3065	Location 5	0.0204	NA	NA	22	0%	0.00595	Location 4	0.0059	NP	0.0059
Benzo[b]fluoranthene	H, C	23	4%	0.3065	Location 5	0.0199	NA	NA	22	0%	0.00595	Location 4	0.0059	NP	0.0059
Benzo[g,h,i]perylene	H, C	23	4%	0.3065	Location 5	0.0202	NA	NA	22	0%	0.00595	Location 4	0.0059	NP	0.0059
Benzo[k]fluoranthene	H	23	4%	0.3065	Location 5	0.0200	NA	NA	22	5%	0.0128	Location 7	0.0062	NP	0.0068
Chrysene	H, C	23	13%	0.3065	Location 5	0.0222	NP	0.0790	22	18%	0.151	Location 7	0.0152	NP	0.0448
Dibenzo[a,h]anthracene	H, C	23	4%	0.615	Location 5	0.0397	NA	NA	22	0%	0.0119	Location 4	0.0119	NP	0.0119
Fluoranthene	H	23	57%	2.75	Location 7	0.1935	NP	1.434	22	36%	12.2	Location 7	0.6482	NP	6.132
Fluorene	L	23	65%	20.3	Location 5	1.903	NP	12.450	22	36%	25.5	Location 9	3.114	Max	25.500
Ideno[1,2,3-cd]pyrene	H, C	23	4%	0.3065	Location 5	0.0205	NA	NA	22	0%	0.00595	Location 4	0.0059	NP	0.0059
Naphthalene	L	23	30%	848	Location 5	69.124	NP	150	22	18%	407	Location 16	24.132	NP	325
Phenanthrene	L	23	39%	17	Location 5	0.9896	NP	8.538	22	14%	14.4	Location 9	1.112	NP	8.217
Pyrene	H	23	43%	1.31	Location 7	0.0895	NP	0.6575	22	36%	5.53	Location 7	0.3260	NP	2.810
Total LPAHs		23	87%	928.12	Location 5	80.499	NP	160	22	59%	445.89	Location 16	38.960	Gamma	101
Total HPAHs		23	57%	4.1375	Location 7	0.3076	NP	1.090	22	45%	18.0468	Location 7	1.0155	NP	4.559
Total Carcinogenic PAHs		23	13%	0.2105	Location 10	0.1789	NP	0.6910	22	18%	0.1658	Location 7	0.0552	NP	0.0821
Total PAHs		23	91%	929.17	Location 5	80.784	NP	161	22	73%	445.89	Location 16	39.904	Gamma	102

Please refer to notes at end of this table.

Table D-5
Summary of Sub-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Sub-Armoring Water Spring 2008							Sub-Armoring Water Fall 2008						
Contaminant of Interest		Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value	Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value
Total Dissolved Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Suspended Solids (mg/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (mg/L)															
Arsenic		22	95%	0.0296	Location 9	0.0090	Gamma	0.0140	22	100%	0.0806	Location 5	0.0091	Gamma	0.0156
Chromium		22	55%	0.00122	Location 12	0.0003	NP	0.0011	22	64%	0.00577	Location 4	0.0008	Gamma	0.0012
Copper		22	45%	0.00421	Location 17	0.0007	NP	0.0029	22	86%	0.0135	Location 4	0.0021	Gamma	0.0033
Zinc		22	64%	0.0219	Location 2	0.0077	NP	0.0132	22	64%	0.0328	Location 4	0.0082	NP	0.0154
Dissolved Metals (mg/L)															
Arsenic															
Chromium															
Copper															
Zinc															
Pentachlorophenol (µg/L)		22	0%	ND	NA	0.1200	NA	NA	22	0%	ND	NA	0.1192	NA	NA
***Polynuclear Aromatic Hydrocarbons* (PAHs) (µg/L)**															
Acenaphthene	L	22	73%	50.5	Location 9	7.034	Gamma	18.920	22	59%	48	Location 12	7.814	NP	12.870
Acenaphthylene	L	22	18%	0.0647	Location 5	0.0255	NP	0.0927	22	5%	0.569	Location 12	0.0429	NA	NA
Anthracene	L	22	50%	1.27	Location 9	0.1168	NP	0.7230	22	36%	1.52	Location 9	0.1369	NP	0.2540
Benzo[a]anthracene	H, C	22	9%	0.176	Location 16	0.0163	NA	NA	22	18%	0.0912	Location 9	0.0158	NP	0.0388
Benzo[a]pyrene	H, C	22	5%	0.0131	Location 16	0.0063	NA	NA	22	5%	0.0242	Location 8	0.0068	NA	NA
Benzo[b]fluoranthene	H, C	22	5%	0.0375	Location 16	0.0074	NA	NA	22	9%	0.0321	Location 8	0.0075	NA	NA
Benzo[g,h,i]perylene	H, C	22	5%	0.0437	Location 16	0.0077	NA	NA	22	14%	0.0267	Location 8	0.0076	Normal	0.0095
Benzo[k]fluoranthene	H	22	5%	0.0458	Location 16	0.0078	NA	NA	22	14%	0.0368	Location 8	0.0084	Normal	0.0112
Chrysene	H, C	22	9%	0.146	Location 16	0.0151	NA	NA	22	18%	0.0986	Location 9	0.0173	NP	0.0420
Dibenzo[a,h]anthracene	H, C	22	0%	ND	NA	0.0120	NA	NA	22	0%	ND	NA	0.0119	NA	NA
Fluoranthene	H	22	64%	2.16	Location 9	0.2574	NP	1.474	22	41%	2.19	Location 9	0.2399	NP	0.428
Fluorene	L	22	64%	18.9	Location 9	2.199	NP	12.600	22	55%	17.7	Location 9	2.632	NP	4.346
Ideno[1,2,3-cd]pyrene	H, C	22	0%	ND	NA	0.0060	NA	NA	22	5%	0.0202	Location 8	0.0066	NA	NA
Naphthalene	L	22	41%	232	Location 5	12.168	NP	117.300	22	55%	83.5	Location 9	4.793	NP	10.860
Phenanthrene	L	22	41%	13.1	Location 9	1.1353	NP	7.508	22	36%	13.7	Location 9	1.205	NP	2.337
Pyrene	H	22	59%	1.06	Location 9	0.1554	NP	0.8150	22	36%	1.39	Location 9	0.1517	NP	0.271
Total LPAHs		22	77%	253.2	Location 5	22.613	NP	76.680	22	64%	157	Location 9	16.584	NP	50.530
Total HPAHs		22	68%	3.3488	Location 9	0.4527	NP	1.244	22	41%	3.8	Location 9	0.4549	NP	1.338
Total Carcinogenic PAHs		22	9%	0.4621	Location 16	0.0747	NA	NA	22	18%	0.218	Location 9	0.0760	NP	0.1260
Total PAHs		22	86%	253.3	Location 5	23.084	Gamma	62.810	22	68%	161	Location 9	17.029	NP	51.730

Please refer to notes at end of this table.

Table D-5
Summary of Sub-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Sample		Sub-Armoring Water Spring 2009							Sub-Armoring Water Fall 2009						
Contaminant of Interest		Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value	Number of Samples	Detection Frequency	Max Detection	Max Location	Mean Conc.	Data Distribution	95% UCL Value
Total Dissolved Solids (mg/L)		22	100%	6700	Location 11	449	NP	1754	22	1	1110	Location 16	256.6818182	Lognormal	391.7
Total Suspended Solids (mg/L)		22	91%	220	Location 11	35	Lognormal	95.61	22	1	615	Location 16	189.4590909	Gamma	298.3
Total Metals (mg/L)															
Arsenic		22	100%	0.057	Location 5	0.0080	Gamma	0.0139	22	95%	0.0451	Location 04	0.0093	Gamma	0.0145
Chromium		22	95%	0.01	Location 16	0.0015	Lognormal	0.0031	22	50%	0.0022	Location 18	0.0005	NP	0.0010
Copper		22	73%	0.019	Location 16	0.0026	Gamma	0.0042	22	95%	0.007	Location 02	0.0018	Gamma	0.0026
Zinc		22	27%	0.081	Location 11	0.0101	NP	0.0264	22	73%	0.0379	Location 18	0.0075	Gamma	0.0111
Dissolved Metals (mg/L)															
Arsenic		22	100%	0.057	Location 5	0.0078	Gamma	0.0141	22	100%	0.0439	Location 04	0.0097	Gamma	0.0155
Chromium		22	68%	0.0016	Location 15	0.0003	Gamma	0.0004	22	32%	0.00036	Location 14	0.0002	NP	0.0002
Copper		22	32%	0.003	Location 15	0.0007	NP	0.0014	22	41%	0.0022	Location 02	0.0005	NP	0.0007
Zinc		22	9%	0.0086	Location 3	0.0038	NA	NA	22	27%	0.0075	Location 02	0.0024	NP	0.0044
Pentachlorophenol (µg/L)		22	5%	0.74	Location 5	0.1868	NA	NA	22	0%	ND	NA	0.0003	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene	L	22	55%	19	Location 5	2.282	NP	7.418	22	82%	45.1	Location 16	6.153	Gamma	16.200
Acenaphthylene	L	22	14%	0.35	Location 12	0.0268	NP	0.0990	22	27%	0.28	Location 12	0.0308	NP	0.0511
Anthracene	L	22	23%	0.22	Location 5	0.0259	NP	0.0761	22	27%	0.58	Location 09	0.0582	NP	0.1050
Benzo[a]anthracene	H, C	22	14%	0.066	Location 11	0.0091	NP	0.0218	22	9%	0.024	Location 17	0.0086	NA	NA
Benzo[a]pyrene	H, C	22	5%	0.013	Location 4	0.0051	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Benzo[b]fluoranthene	H, C	22	9%	0.07	Location 11	0.0084	NA	NA	22	9%	0.021	Location 13	0.0087	NA	NA
Benzo[g,h,i]perylene	H, C	22	5%	0.028	Location 11	0.0058	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Benzo[k]fluoranthene	H	22	9%	0.026	Location 11	0.0063	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Chrysene	H, C	22	14%	0.077	Location 11	0.0098	NA	NA	22	9%	0.038	Location 07	0.0095	NA	NA
Dibenzo[a,h]anthracene	H, C	22	0%	0.00485	Location 6	0.0048	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Fluoranthene	H	22	32%	0.79	Location 7	0.0633	NP	0.223	22	41%	1.4	Location 07	0.1200	NP	0.227
Fluorene	L	22	68%	10	Location 5	0.808	NP	5.610	22	64%	13	Location 09	1.733	NP	3.006
Ideno[1,2,3-cd]pyrene	H, C	22	5%	0.03	Location 11	0.0059	NA	NA	22	0%	ND	NA	0.0075	NA	NA
Naphthalene	L	22	41%	0.2	Location 2	0.030	NP	0.074	22	45%	0.93	Location 16	0.156	NP	0.244
Phenanthrene	L	22	50%	1.2	Location 5	0.0847	NP	0.322	22	32%	3.5	Location 09	0.354	NP	0.677
Pyrene	H	22	27%	0.49	Location 7	0.0440	NP	0.1450	22	41%	0.79	Location 07	0.0733	NP	0.132
Total LPAHs		22	86%	30.655	Location 5	3.241	NP	20.240	22	86%	52.496	Location 16	8.451	Gamma	21.880
Total HPAHs		22	32%	1.328	Location 7	0.1530	NP	0.434	22	55%	2.228	Location 07	0.2079	NP	0.393
Total Carcinogenic PAHs		22	14%	0.297	Location 11	0.0528	NP	0.1050	22	18%	0.082	Location 13	0.0330	Student's T	0.0617
Total PAHs		22	86%	30.762	Location 5	3.369	Lognormal	8.688	22	86%	52.5835	Location 16	8.733	NP	14.450

Please refer to notes at end of this table.

Table D-5
Summary of Sub-Armoring Water Data
McCormick and Baxter Superfund Site
Portland, Oregon

Notes:

[1]The number of significant figures presented in the table do not reflect true accuracy presented by the laboratory results. Data should only retain 3 significant figures. Due to statistical evaluation using Microsoft Excel, additional significant figures may be shown.

[2] The 1996 Record of Decision (ROD) specifies the remedial action objects of the sediment cap as: 1) preventing human and aquatic organisms from direct contact with contaminated sediment; and 2) minimizing releases of contaminants from sediment that might result in contamination of the Willamette River in excess of federal and state Ambient Water Quality Criteria (AWQCs).

[3] National Recommended Water Quality Criteria (NRWQCs) published as of August 15, 2007, are included for comparison (see http://www.epa.gov/waterscience/criteria/wqcriteria.html).

[4] National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs) promulgated as of August 15, 2007, are included for comparison (see http://www.epa.gov/safewater/contaminants/index.html).

Key:
C = Carcinogenic PAH
Gamma = Gamma Distribution
H = High Molecular Weight PAH (HPAH)
J = Estimated Value
L = Low Molecular Weight PAH (LPAH)
mg/L = milligrams per liter
MRL = Method Reporting Limit
NA= Not Applicable
ND = Not Detected
NP = Nonparametric Distribution
U = Value Below MDL (value represents MDL)
µg/L = micrograms per liter

Table D-6
Comparison Criteria Exceedance Summary 2005 - 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Analyte	Comparison Criteria	2005			
		Surface Water		Sub-armoring Water	
		Total Exceedances	Sampling Location	Total Exceedances	Sampling Location
Total Arsenic	0.00014 mg/L	25	All	25	All
Total Chromium	0.074 mg/L				
Total Copper	0.009 mg/L			1	9
Total Zinc	0.11 mg/L			1	9
PCP	1 µg/L				
Acenaphthene	520 µg/L				
Anthracene	40,000 µg/L				
Benz (a) anthracene	0.018 µg/L			4	7, 9, 20, 26
Benzo (a) pyrene	0.018 µg/L			1	9
Benzo (b) fluoranthene	0.018 µg/L			1	9
Benzo (k) fluoranthene	0.018 µg/L			1	9
Chrysene	0.018 µg/L			3	9, 20, 26
Dibenz (a,h) anthracene	0.018 µg/L				
Fluoranthene	54 µg/L				
Fluorene	5,300 µg/L				
Indeno (1,2,3-cd) pyrene	0.018 µg/L				
Naphthalene	620 µg/L			2	9, 10
Pyrene	4,000 µg/L				
Total CPAHs	0.031 µg/L			4	7, 9, 20, 26
Total AWQC Exceedances		25		43	

Please refer to notes at end of this table.

Table D-6
Comparison Criteria Exceedance Summary 2005 - 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Analyte	Comparison Criteria	Spring 2006						Fall 2006					
		Surface Water		Inter-armoring Water		Sub-armoring Water		Surface Water		Inter-armoring Water		Sub-armoring Water	
		Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location
Total Arsenic	0.00014 mg/L	6	4, 15, 24, 25, 27	7	5, 7, 12, 13, 17, 20, 25	20	Multiple	23	Multiple	22		22	Multiple
Total Chromium	0.074 mg/L												
Total Copper	0.009 mg/L	3	9, 18, 27	1	12	4	11, 14, 15, 19						
Total Zinc	0.11 mg/L												
PCP	1 µg/L												
Acenaphthene	520 µg/L												
Anthracene	40,000 µg/L												
Benz (a) anthracene	0.018 µg/L					3	5, 7, 9,			1	5		
Benzo (a) pyrene	0.018 µg/L					1	5						
Benzo (b) fluoranthene	0.018 µg/L					2	5, 9						
Benzo (k) fluoranthene	0.018 µg/L												
Chrysene	0.018 µg/L	1	25	1	5	3	5, 9, 11			1	5		
Dibenz (a,h) anthracene	0.018 µg/L												
Fluoranthene	54 µg/L												
Fluorene	5,300 µg/L												
Indeno (1,2,3-cd) pyrene	0.018 µg/L												
Naphthalene	620 µg/L					1	16						
Pyrene	4,000 µg/L												
Total CPAHs	0.031 µg/L	1	13	1	5	5	5, 7, 9, 10, 11			1	5	4	7, 9, 10, 17
Total AWQC Exceedances		11		10		39		23		25			

Please refer to notes at end of this table.

Table D-6
Comparison Criteria Exceedance Summary 2005 - 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Analyte	Comparison Criteria	Spring 2007						Fall 2007					
		Surface Water		Inter-armoring Water		Sub-armoring Water		Surface Water		Inter-armoring Water		Sub-armoring Water	
		Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location
Total Arsenic	0.00014 mg/L	25	All	3	3, 5, 21	23	All	12	Multiple	18	Multiple	22	All
Total Chromium	0.074 mg/L												
Total Copper	0.009 mg/L			4	4, 5, 6, 21	2	12, 15						
Total Zinc	0.11 mg/L												
PCP	1 µg/L											1	16
Acenaphthene	520 µg/L												
Anthracene	40,000 µg/L												
Benz (a) anthracene	0.018 µg/L					2	7, 12					2	7, 10
Benzo (a) pyrene	0.018 µg/L					1	10						
Benzo (b) fluoranthene	0.018 µg/L					1	10						
Benzo (k) fluoranthene	0.018 µg/L					1	10						
Chrysene	0.018 µg/L					3	7, 10, 13					2	7, 10
Dibenz (a,h) anthracene	0.018 µg/L					1	10						
Fluoranthene	54 µg/L												
Fluorene	5,300 µg/L												
Indeno (1,2,3-cd) pyrene	0.018 µg/L					1	10						
Naphthalene	620 µg/L					1	5						
Pyrene	4,000 µg/L												
Total CPAHs	0.031 µg/L					3	7, 10, 13					2	7,10
Total AWQC Exceedances		25		7		39		12		18		29	

Please refer to notes at end of this table.

Table D-6
Comparison Criteria Exceedance Summary 2005 - 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Analyte	Comparison Criteria	Spring 2008						Fall 2008					
		Surface Water		Inter-armoring Water		Sub-armoring Water		Surface Water		Inter-armoring Water		Sub-armoring Water	
		Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location
Total Arsenic	0.00014 mg/L			1	14	21	All but 15	22	Multiple	21	All but 20		
Total Chromium	0.074 mg/L												
Total Copper	0.009 mg/L									2	5, 14	1	4
Total Zinc	0.11 mg/L			1	9								
PCP	1 µg/L												
Acenaphthene	520 µg/L												
Anthracene	40,000 µg/L												
Benz (a) anthracene	0.018 µg/L					2	9, 16					3	6, 7, 8
Benzo (a) pyrene	0.018 µg/L					1	16					1	8
Benzo (b) fluoranthene	0.018 µg/L					1	16					2	6, 8
Benzo (k) fluoranthene	0.018 µg/L					1	16					1	8
Chrysene	0.018 µg/L					2	9, 16					4	6, 7, 8, 9
Dibenz (a,h) anthracene	0.018 µg/L												
Fluoranthene	54 µg/L												
Fluorene	5,300 µg/L												
Indeno (1,2,3-cd) pyrene	0.018 µg/L											1	8
Naphthalene	620 µg/L												
Pyrene	4,000 µg/L												
Total CPAHs	0.031 µg/L						9, 16						
Total AWQC Exceedances				2		28		22		23		13	

Please refer to notes at end of this table.

Table D-6
Comparison Criteria Exceedance Summary 2005 - 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Analyte	Comparison Criteria	Spring 2009						Fall 2009					
		Surface Water		Inter-armoring Water		Sub-armoring Water		Surface Water		Inter-armoring Water		Sub-armoring Water	
		Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location	Total Exceedances	Sampling Location
Total Arsenic	0.00014 mg/L	24	All	22	All	22	All	18	Multiple	17	Multiple	21	Multiple
Total Chromium	0.074 mg/L												
Total Copper	0.009 mg/L	1	19	1	17	2	11, 16			1	4		
Total Zinc	0.11 mg/L												
PCP	1 µg/L												
Acenaphthene	520 µg/L												
Anthracene	40,000 µg/L												
Benz (a) anthracene	0.018 µg/L					3	4, 7, 11					1	17
Benzo (a) pyrene	0.018 µg/L												
Benzo (b) fluoranthene	0.018 µg/L					2	4, 11					2	13, 16
Benzo (k) fluoranthene	0.018 µg/L					1	11						
Chrysene	0.018 µg/L					3	4, 7, 11					2	7, 17
Dibenz (a,h) anthracene	0.018 µg/L												
Fluoranthene	54 µg/L												
Fluorene	5,300 µg/L												
Indeno (1,2,3-cd) pyrene	0.018 µg/L												
Naphthalene	620 µg/L												
Pyrene	4,000 µg/L												
Total CPAHs	0.031 µg/L	1	15			3	4, 7, 11					4	7, 13, 16, 17
Total AWQC Exceedances		26		23		36		18		18		30	

Notes:
AWQCs = Ambient Water Quality Criteria (1996)
Comparison Criteria = Most conservative values from AWQCs, NRWQCs, and NPDWRs
mg/L = milligrams per liter
NPDWRs = National Primary Drinking Water Regulations
NRWQCs = National Recommended Water Quality Criteria
µg/L = micrograms per liter
PCP = Pentachlorophenol
CPAH = Carcinogenic Polynuclear Aromatic Hydrocarbons

Table D-7
Maximum Concentration Summary
McCormick and Baxter Superfund Site
Portland, Oregon

Sampling Event	Maximum Detected Concentration										
	2002	2003	2005	Spring 2006	Fall 2006	Spring 2007	Fall 2007	Spring 2008	Fall 2008	Spring 2009	Fall 2009
Surface Water											
Total Arsenic mg/L	0.001	0.002	0.001	0.002	0.007	0.0004	0.001	ND	0.0013	0.0018	0.001
Total Chromium mg/L	0.002	0.005	ND	0.005	0.002	0.002	0.001	0.00097	0.00257	0.00950	0.000
Total Copper mg/L	0.021	0.021	0.003	0.017	0.003	0.003	0.002	0.00283	0.00282	0.01500	0.002
Total Zinc mg/L	0.018	0.019	0.008	0.040	0.005	0.022	0.004	0.0125	0.0111	0.0320	0.007
PCP µg/L	0.079	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene µg/L	9.800	ND	0.097	ND	0.166	0.013	0.411	0.066	0.704	0.020	0.098
Fluoranthene µg/L	11.900	0.078	ND	0.040	0.014	0.013	0.027	ND	0.024	0.012	0.016
Naphthalene µg/L	3.300	ND	0.911	0.190	0.930	0.025	1.330	0.093	2.930	0.110	0.510
Total CPAHs µg/L	4.220	0.101	ND	0.053	ND	ND	ND	ND	ND	0.060	ND
Total PAHs µg/L	61.500	0.282	1.044	0.281	1.188	0.111	1.990	0.148	3.980	0.116	0.754
Inter-Armoring Water											
Arsenic mg/L	--	--	--	0.005	0.002	0.007	0.020	0.00078	0.00257	0.00710	0.004
Chromium mg/L	--	--	--	0.011	0.002	0.023	0.005	0.002	0.011	0.004	0.003
Copper mg/L	--	--	--	0.017	0.004	0.037	0.009	0.005	0.024	0.009	0.010
Zinc mg/L	--	--	--	0.039	0.015	0.067	0.022	0.172	0.058	0.018	0.030
PCP µg/L	--	--	--	ND	0.250	ND	ND	ND	ND	0.165	ND
Acenaphthene µg/L	--	--	--	3.650	1.810	0.115	ND	0.058	0.184	6.000	0.140
Fluoranthene µg/L	--	--	--	0.253	0.111	ND	0.017	ND	0.017	0.110	0.028
Naphthalene µg/L	--	--	--	1.130	2.080	ND	ND	0.052	ND	0.420	0.360
Total CPAHs µg/L	--	--	--	0.032	0.056	ND	ND	ND	ND	0.024	ND
Total PAHs µg/L	--	--	--	9.122	4.457	0.150	0.081	0.126	0.757	7.861	0.594
Sub-Armoring Water											
Arsenic mg/L	--	--	0.033	0.037	0.039	0.052	0.032	0.030	0.081	0.057	0.045
Chromium mg/L	--	--	0.014	0.017	0.001	0.003	0.001	0.001	0.006	0.010	0.002
Copper mg/L	--	--	0.028	0.035	0.003	0.544	0.005	0.004	0.014	0.019	0.007
Zinc mg/L	--	--	0.113	0.388	0.026	0.053	0.036	0.022	0.033	0.081	0.038
PCP µg/L	--	--	0.469	18.500	0.250	ND	3.270	ND	ND	0.740	ND
Acenaphthene µg/L	--	--	131.000	22.100	19.000	47.500	67.600	50.5	48.0	19.0	45.1
Fluoranthene µg/L	--	--	7.400	1.670	10.400	2.750	12.200	2.16	2.19	0.790	1.40
Naphthalene µg/L	--	--	772.000	726.000	229.000	848.000	407.000	232	5	0.200	0.93
Total CPAHs µg/L	--	--	3.017	0.322	0.105	0.211	0.166	0.462	0.218	0.297	0.082
Total PAHs µg/L	--	--	885.000	738.000	232.000	929.150	445.890	253	161	30.8	52.6

Notes:
mg/L = milligrams per liter
µg/L = micrograms per liter
PCP = Pentachlorophenol
PAH = Polynuclear Aromatic Hydrocarbons
CPAH = Carcinogenic Polynuclear Aromatic Hydrocarbons
ND = Not Detected
-- Not Sampled

Table D-8
Detection Frequency Summary
McCormick and Baxter Superfund Site
Portland, Oregon

Sampling Event	Detection Frequency										
	2002	2003	2005	Spring 2006	Fall 2006	Spring 2007	Fall 2007	Spring 2008	Fall 2008	Spring 2009	Fall 2009
Surface Water											
Total Arsenic	27%	81%	100%	22%	95%	100%	48%	0%	91%	100%	73%
Total Chromium	33%	100%	0%	74%	52%	58%	52%	77%	36%	100%	45%
Total Copper	100%	100%	81%	74%	100%	100%	88%	77%	100%	95%	100%
Total Zinc	100%	100%	88%	87%	27%	35%	64%	9%	27%	23%	73%
Total PAHs	60%	43%	19%	30%	23%	8%	68%	18%	14%	59%	27%
Inter-Armoring Water											
Total Arsenic	--	--	--	30%	100%	13%	78%	5%	95%	100%	77%
Total Chromium	--	--	--	43%	64%	17%	52%	91%	55%	100%	68%
Total Copper	--	--	--	96%	100%	100%	83%	82%	100%	100%	100%
Total Zinc	--	--	--	78%	45%	4%	60%	27%	77%	27%	100%
Total PAHs	--	--	--	55%	41%	17%	35%	32%	18%	55%	45%
Sub-Armoring Water											
Total Arsenic	--	--	100%	91%	95%	100%	100%	95%	100%	100%	95%
Total Chromium	--	--	0%	78%	23%	28%	8%	55%	64%	95%	50%
Total Copper	--	--	70%	70%	82%	96%	88%	45%	86%	73%	95%
Total Zinc	--	--	100%	87%	50%	52%	92%	64%	64%	27%	73%
Total PAHs	--	--	78%	91%	91%	88%	75%	86%	68%	86%	86%

Notes:
PAH = Polynuclear Aromatic Hydrocarbons
-- Not Sampled

LEGEND

- Spring 2009 Sample Locations

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 16, 2009 to March 20, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Sample Location Map
Spring 2009 Sampling Event

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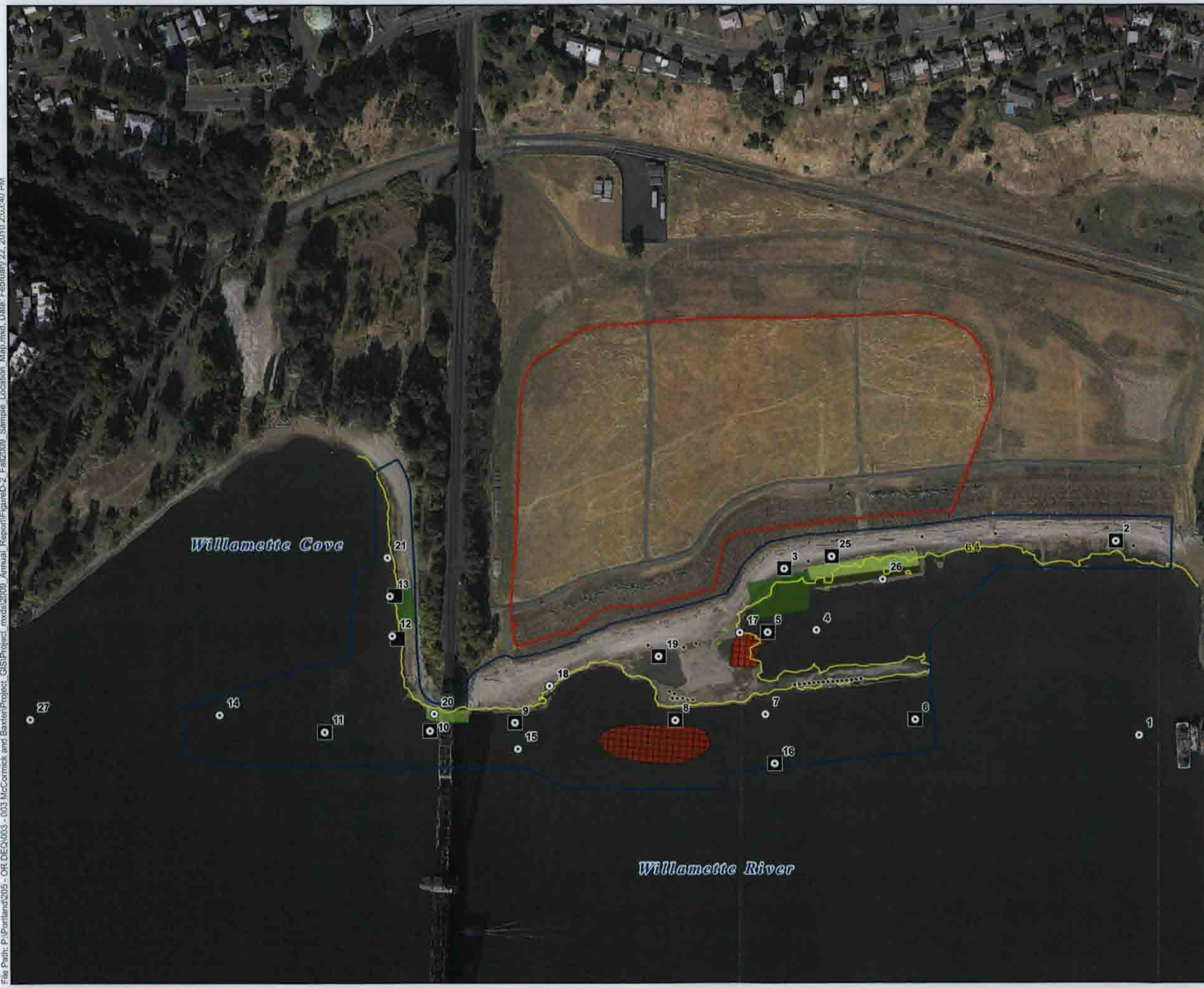
HARTCROWSER GSI Water Solutions, Inc.

Figure
D-1

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-1_Spring2009_Sample_Location_Map.mxd, Date: February 22, 2010 1:48:47 PM



LEGEND

- Fall 2009 Sample Locations
- SPME Sample Locations

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

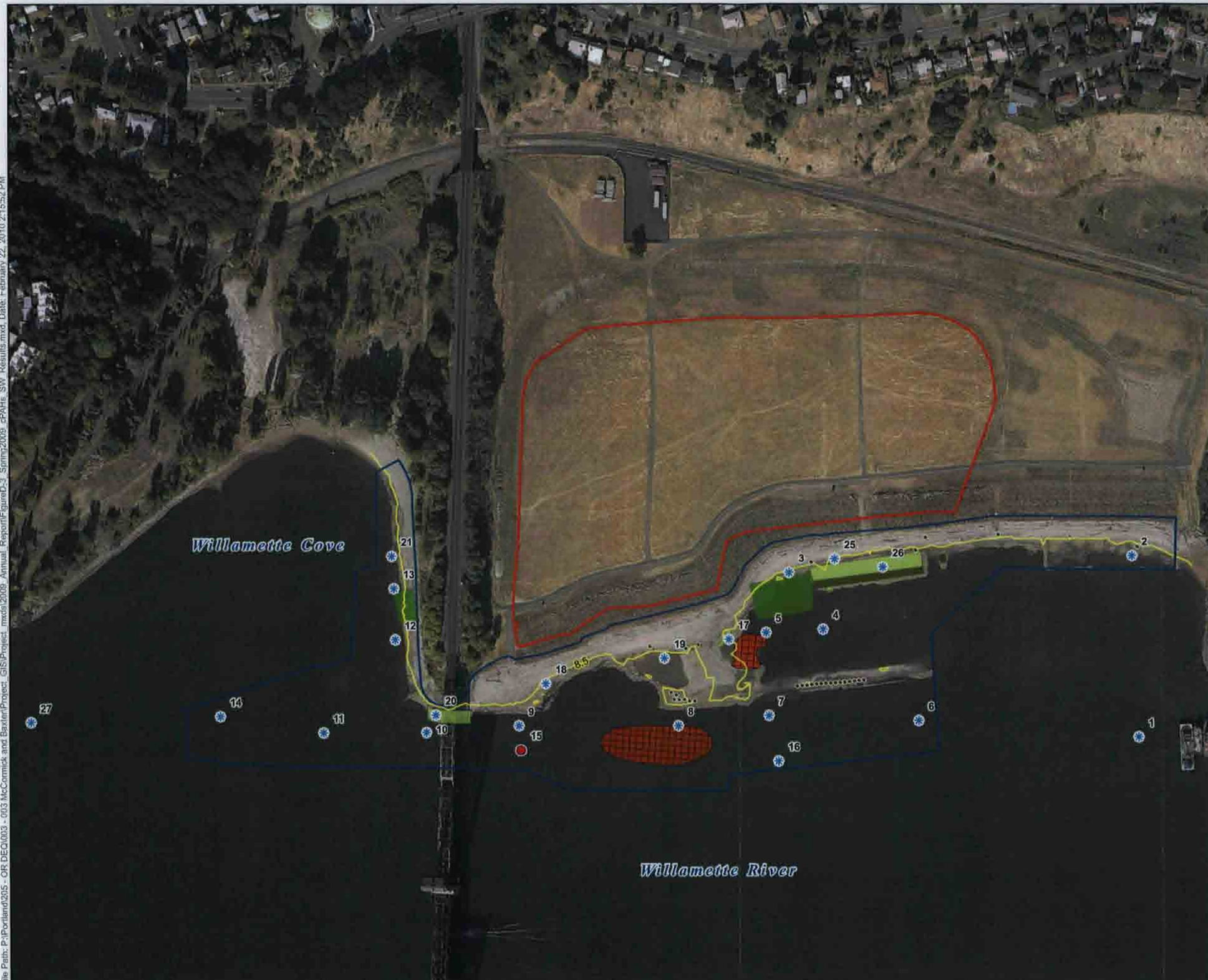
Sample Location Map
Fall 2009 Sampling Event

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure
D-2

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-2_Fall2009_Sample_Location_Map.mxd, Date: February 22, 2010 2:03:40 PM



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LEGEND

Sample Results

- Non-detect < 0.031 ug/L[1,2]
- Non-detect > 0.031 ug/L[1,2]
- < 0.031 ug/L[1]
- 0.031- 0.31 ug/L
- 0.31- 3.1 ug/L
- > 3.1 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

REFERENCE INFORMATION:

1) Reference criteria of 0.031 ug/L represents the 1996 ROD AWQC for human health (fish consumption only) for total cPAHs.
2) For cPAHs, the individual detection limits are typically below the 2007 NRWQCs for human health (consumption of organism only). However, the cumulative values, calculated with 1/2 detection limit values for each cPAH not detected, exceed the 1996 total cPAH reference criteria of 0.031 ug/L. Refer to summary tables for individual detection limits and results.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 31, 2009 to April 4, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

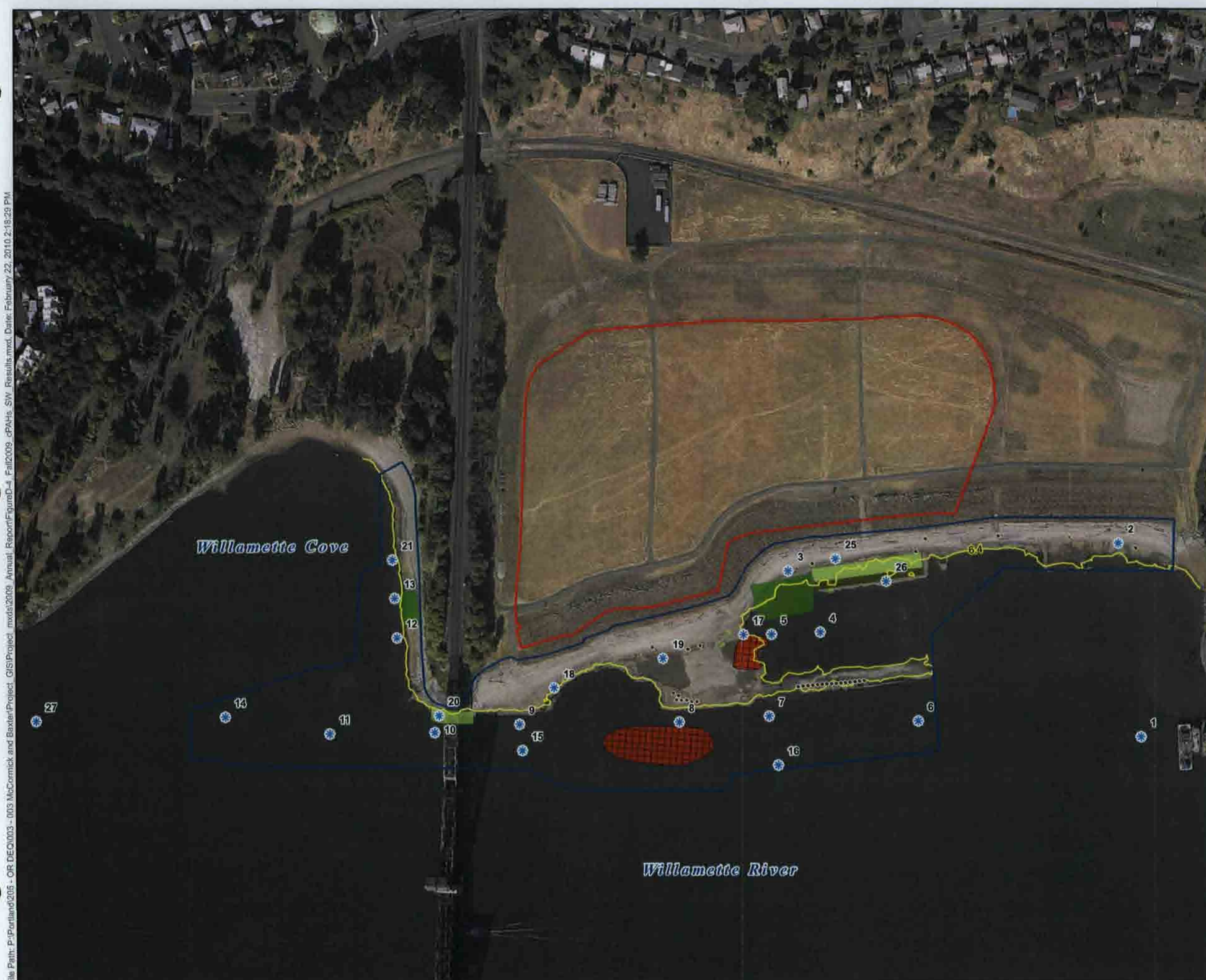
McCormick and Baxter Superfund Site
Portland, Oregon

Spring 2009 cPAHs Surface Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure
D-3



LEGEND

Sample Results

- Non-detect < 0.031 ug/L[1,2]
- Non-detect > 0.031 ug/L[1,2]
- < 0.031 ug/L[1]
- 0.031- 0.31 ug/L
- 0.31- 3.1 ug/L
- > 3.1 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

REFERENCE INFORMATION:

1) Reference criteria of 0.031 ug/L represents the 1996 ROD AWQC for human health (fish consumption only) for total cPAHs.
2) For cPAHs, the individual detection limits are typically below the 2007 NRWQCs for human health (consumption of organism only). However, the cumulative values, calculated with 1/2 detection limit values for each cPAH not detected, exceed the 1996 total cPAH reference criteria of 0.031 ug/L. Refer to summary tables for individual detection limits and results.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Fall 2009 cPAHs Surface Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-4**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-4_Fall2009_cPAHs_SW_Results.mxd, Date: February 22, 2010 2:18:29 PM

LEGEND

Sample Results

- Non-detect < 0.031 ug/L[1,2]
- Non-detect > 0.031 ug/L[1,2]
- < 0.031 ug/L[1]
- 0.031- 0.31 ug/L
- 0.31- 3.1 ug/L
- > 3.1 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

REFERENCE INFORMATION:

1) Reference criteria of 0.031 ug/L represents the 1996 ROD AWQC for human health (fish consumption only) for total cPAHs.
2) For cPAHs, the individual detection limits are typically below the 2007 NRWQCs for human health (consumption of organism only). However, the cumulative values, calculated with 1/2 detection limit values for each cPAH not detected, exceed the 1996 total cPAH reference criteria of 0.031 ug/L. Refer to summary tables for individual detection limits and results.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 31, 2009 to April 4, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

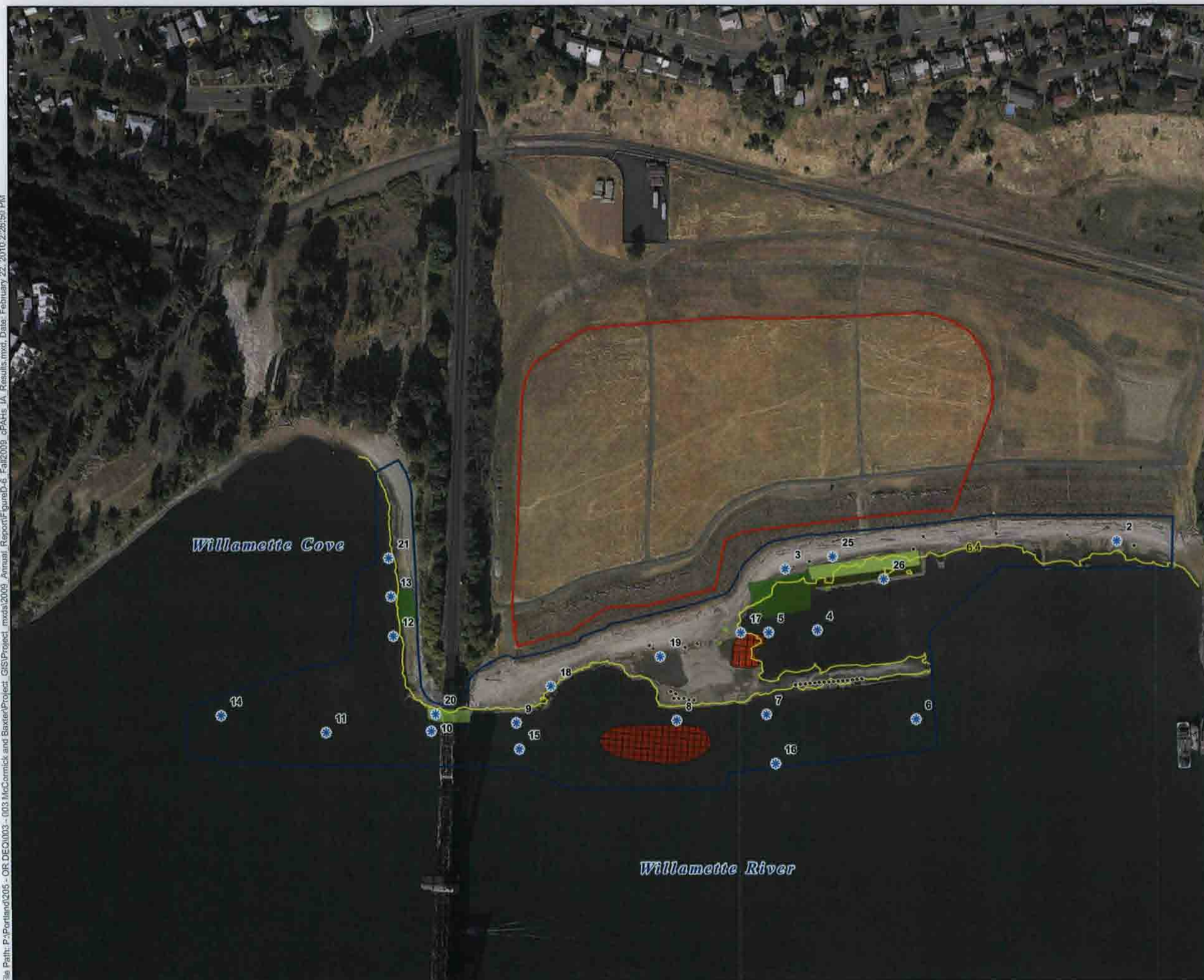
Spring 2009 cPAHs Inter-Armoring Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-5**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-5_Spring2009_cPAHs_IA_Results.mxd, Date: February 22, 2010 2:22:01 PM



LEGEND

Sample Results

- Non-detect < 0.031 ug/L[1,2]
- Non-detect > 0.031 ug/L[1,2]
- < 0.031 ug/L[1]
- 0.031- 0.31 ug/L
- 0.31- 3.1 ug/L
- > 3.1 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

REFERENCE INFORMATION:

1) Reference criteria of 0.031 ug/L represents the 1996 ROD AWQC for human health (fish consumption only) for total cPAHs.
2) For cPAHs, the individual detection limits are typically below the 2007 NRWQCs for human health (consumption of organism only). However, the cumulative values, calculated with 1/2 detection limit values for each cPAH not detected, exceed the 1996 total cPAH reference criteria of 0.031 ug/L. Refer to summary tables for individual detection limits and results.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Fall 2009 cPAHs Inter-Armoring Water Sample Results

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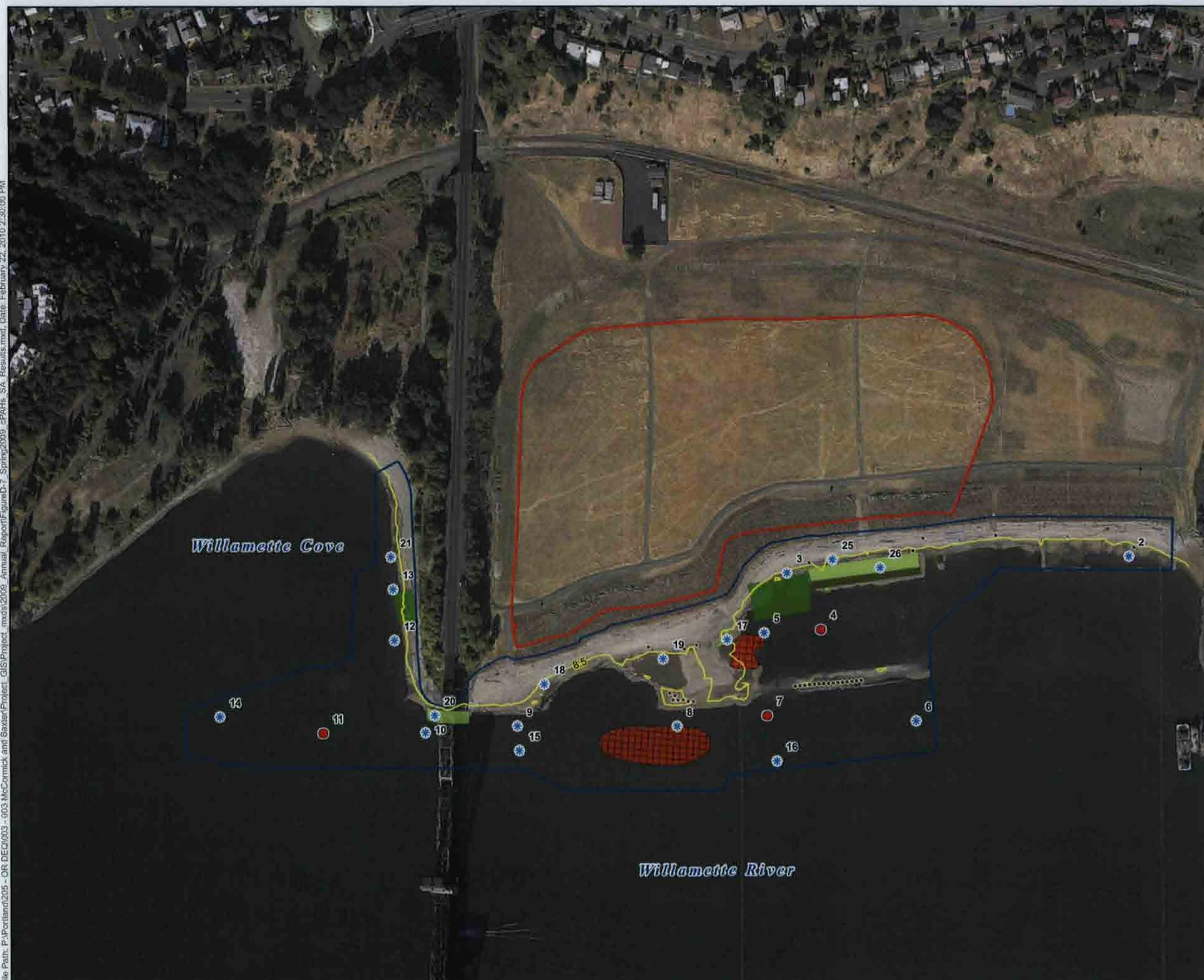
HARTCROWSER GSI Water Solutions, Inc.

Figure **D-6**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-6_Fall2009_cPAHs_IA_Results.mxd, Date: February 22, 2010 2:26:50 PM



LEGEND

Sample Results

- Non-detect < 0.031 ug/L[1,2]
- Non-detect > 0.031 ug/L[1,2]
- < 0.031 ug/L[1]
- 0.031- 0.31 ug/L
- 0.31- 3.1 ug/L
- > 3.1 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

REFERENCE INFORMATION:

1) Reference criteria of 0.031 ug/L represents the 1996 ROD AWQC for human health (fish consumption only) for total cPAHs.
2) For cPAHs, the individual detection limits are typically below the 2007 NRWQCs for human health (consumption of organism only). However, the cumulative values, calculated with 1/2 detection limit values for each cPAH not detected, exceed the 1996 total cPAH reference criteria of 0.031 ug/L. Refer to summary tables for individual detection limits and results.
3) No inter-armoring or sub-armoring samples are collected from some locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 31, 2009 to April 4, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Spring 2009 cPAHs Sub-Armoring Water Sample Results

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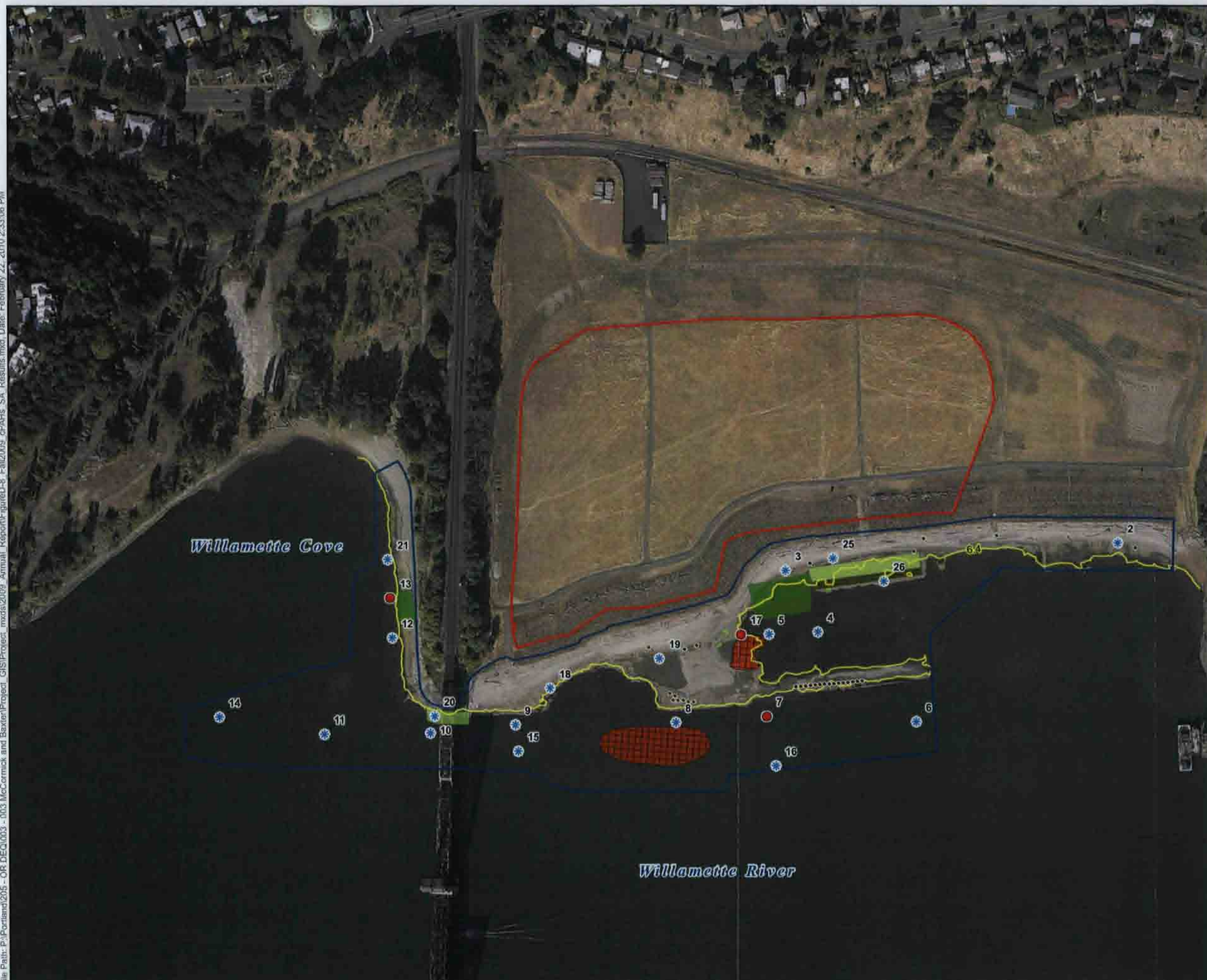
HARTCROWSER GSI Water Solutions, Inc.

Figure D-7

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-7_Spring2009_cPAHs_SA_Results.mxd, Date: February 22, 2010 2:30:00 PM



LEGEND

Sample Results

- Non-detect < 0.031 ug/L[1,2]
- Non-detect > 0.031 ug/L[1,2]
- < 0.031 ug/L[1]
- 0.031- 0.31 ug/L
- 0.31- 3.1 ug/L
- > 3.1 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

REFERENCE INFORMATION:

1) Reference criteria of 0.031 ug/L represents the 1996 ROD AWQC for human health (fish consumption only) for total cPAHs.
2) For cPAHs, the individual detection limits are typically below the 2007 NRWQCs for human health (consumption of organism only). However, the cumulative values, calculated with 1/2 detection limit values for each cPAH not detected, exceed the 1996 total cPAH reference criteria of 0.031 ug/L. Refer to summary tables for individual detection limits and results.
3) No inter-armoring or sub-armoring samples are collected from some locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

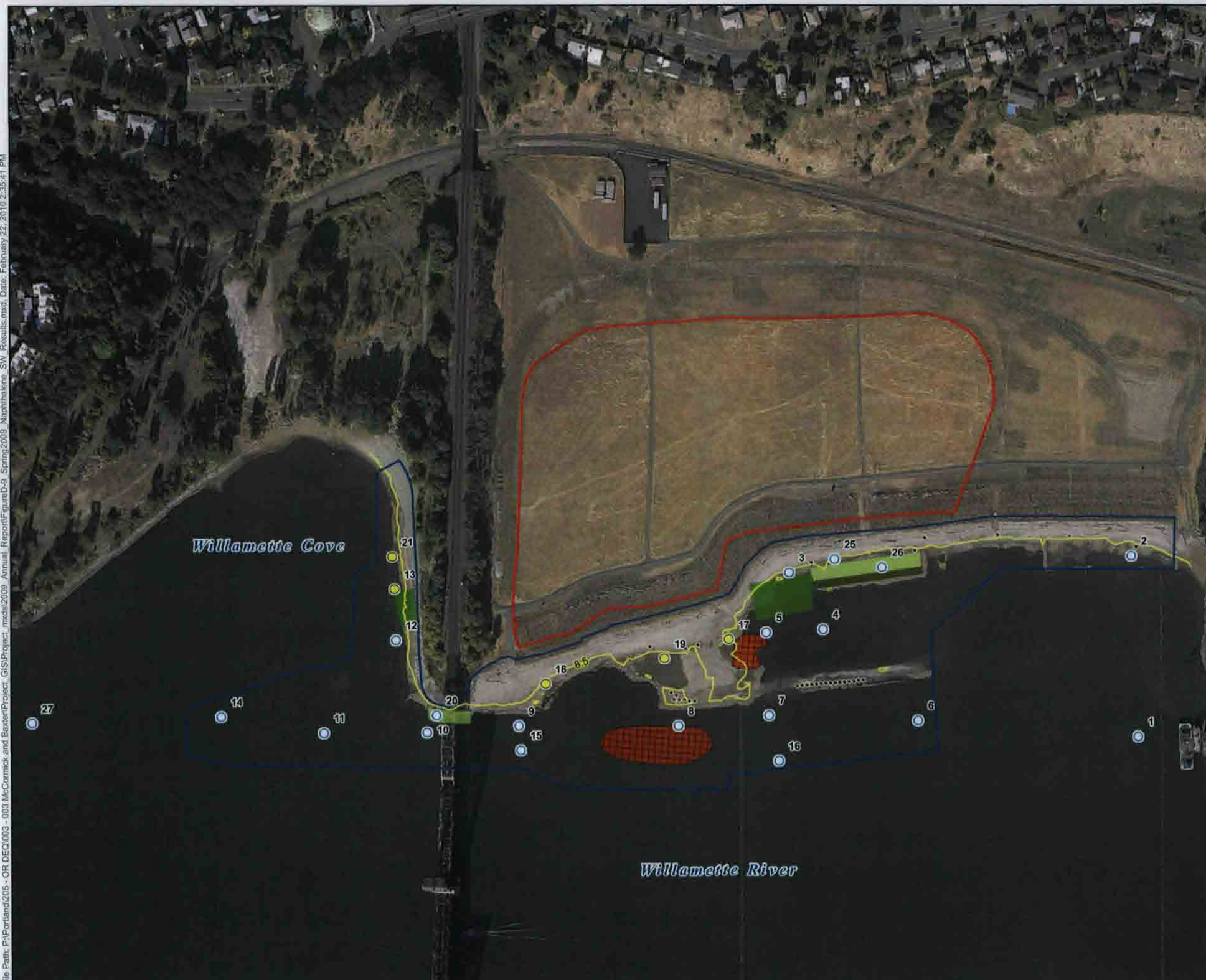
Fall 2009 cPAHs Sub-Armoring Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-8**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-8_Fall2009_cPAHs_SA_Results.mxd, Date: February 22, 2010 2:33:06 PM



LEGEND

Sample Results

- Non-detect
- < 620 ug/L
- 620 - 6,200 ug/L
- 6,200 - 62,000 ug/L
- > 62,000 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

REFERENCE INFORMATION:

1) Reference criteria of 620 ug/L represents the 1996 ROD AWQC for Human Health (fish consumption).

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 31, 2009 to April 4, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Spring 2009 Naphthalene Surface Water Sample Results

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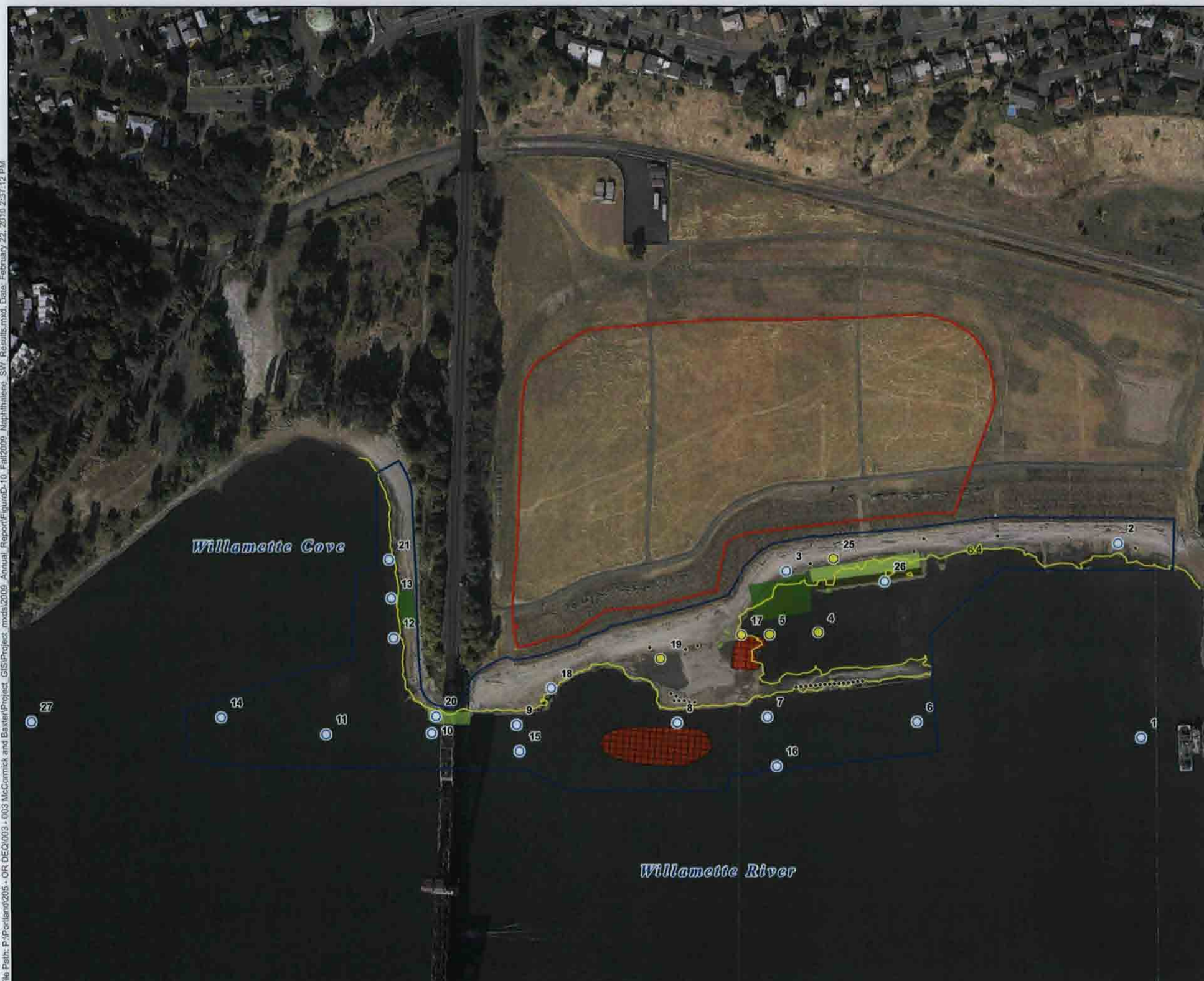
HARTCROWSER GSI Water Solutions, Inc.

Figure **D-9**

File Path: P:\Portland\015 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-9_Spring2009_Naphthalene_SW_Results.mxd, Date: February 22, 2010 2:35:41 PM



LEGEND

Sample Results

- Non-detect
- < 620 ug/L
- 620 - 6,200 ug/L
- 6,200 - 62,000 ug/L
- > 62,000 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

REFERENCE INFORMATION:

1) Reference criteria of 620 ug/L represents the 1996 ROD AWQC for Human Health (fish consumption).

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Fall 2009 Naphthalene Surface Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-10**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-10_Fall2009_Naphthalene_SW_Results.mxd, Date: February 22, 2010 2:37:12 PM

LEGEND

Sample Results

- Non-detect
- < 620 ug/L
- 620 - 6,200 ug/L
- 6,200 - 62,000 ug/L
- > 62,000 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

REFERENCE INFORMATION:

1) Reference criteria of 620 ug/L represents the 1996 ROD AWQC for Human Health (fish consumption).
2) No inter-armoring or sub-armoring samples are collected from sample locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 31, 2009 to April 4, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

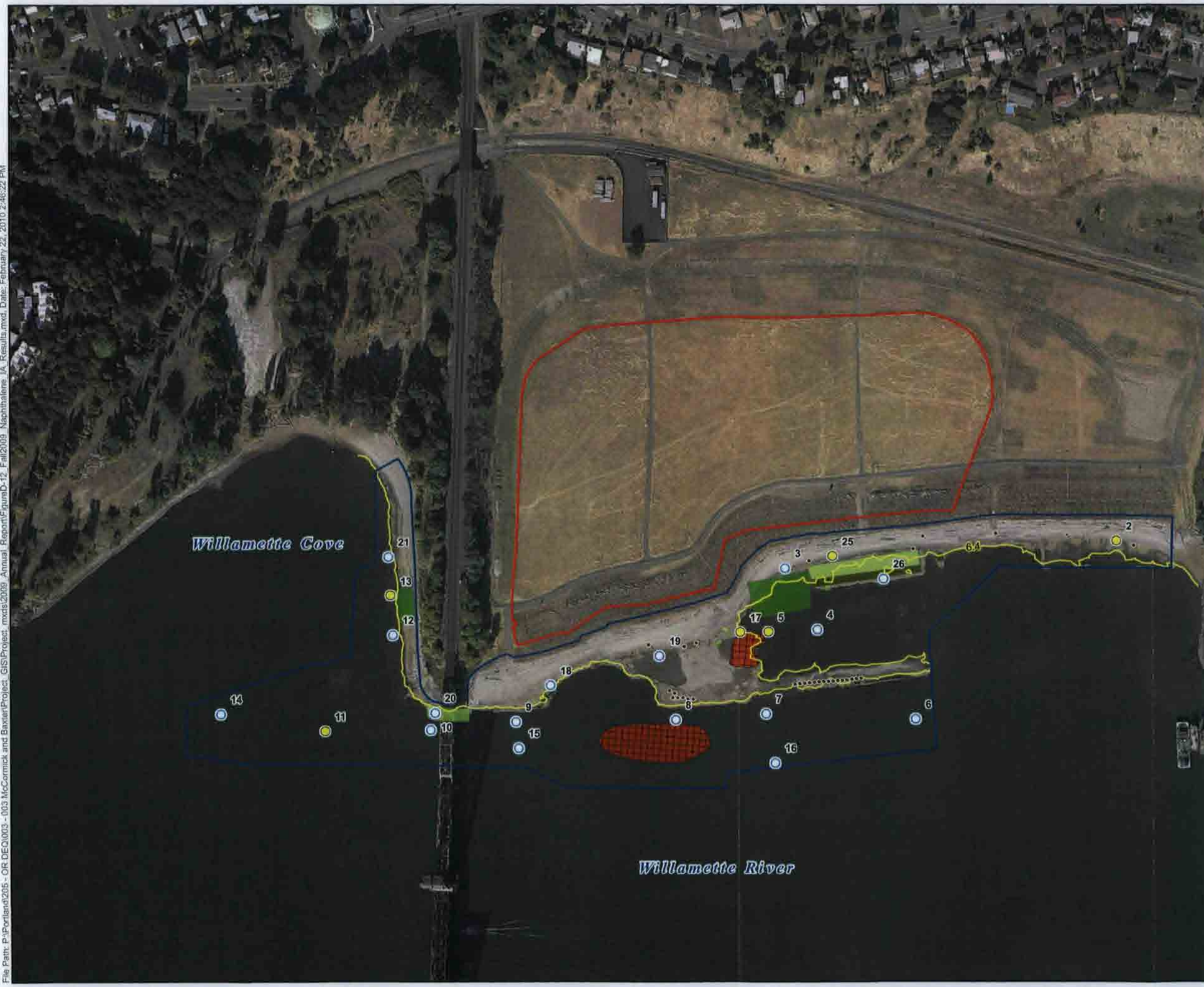
Spring 2009 Naphthalene Inter-Armoring Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-11**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\Figure\D-11_Spring2009_Naphthalene_IA_Results.mxd, Date: February 22, 2010 2:39:56 PM



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LEGEND

Sample Results

- Non-detect
- < 620 ug/L
- 620 - 6,200 ug/L
- 6,200 - 62,000 ug/L
- > 62,000 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

REFERENCE INFORMATION:

1) Reference criteria of 620 ug/L represents the 1996 ROD AWQC for Human Health (fish consumption).
2) No inter-armoring or sub-armoring samples are collected from sample locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

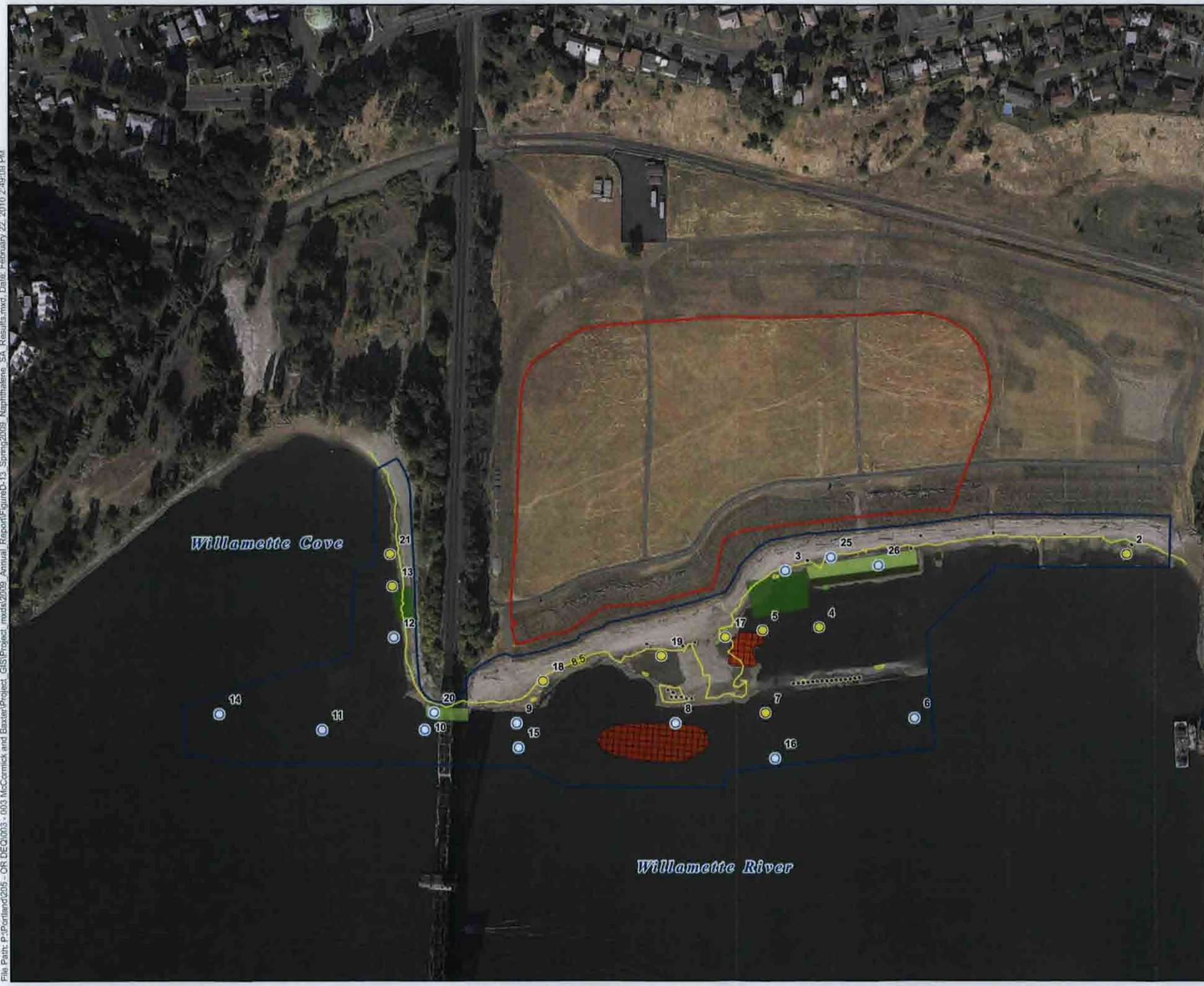
McCormick and Baxter Superfund Site
Portland, Oregon

Fall 2009 Naphthalene Inter-Armoring Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-12**



LEGEND

Sample Results

- Non-detect
- < 620 ug/L
- 620 - 6,200 ug/L
- 6,200 - 62,000 ug/L
- > 62,000 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

REFERENCE INFORMATION:

1) Reference criteria of 620 ug/L represents the 1996 ROD AWQC for Human Health (fish consumption).
2) No inter-armoring or sub-armoring samples are collected from sample locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 31, 2009 to April 4, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

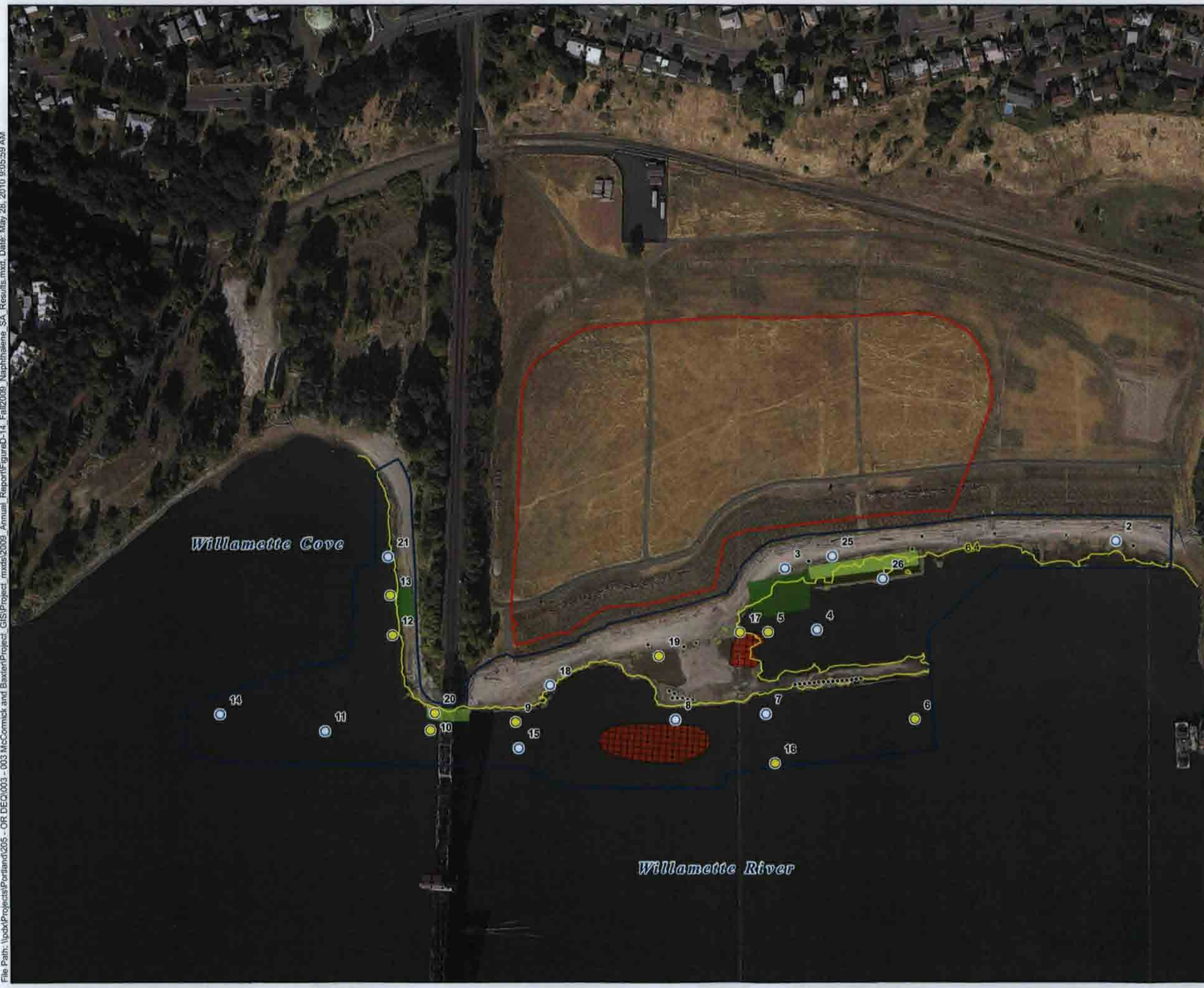
Spring 2009 Naphthalene Sub-Armoring Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-13**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\Figure\D-13_Spring2009_Naphthalene_SA_Results.mxd, Date: February 22, 2010 2:49:09 PM



LEGEND

Sample Results

- Non-detect
- < 620 ug/L
- 620 - 6,200 ug/L
- 6,200 - 62,000 ug/L
- > 62,000 ug/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

REFERENCE INFORMATION:

1) Reference criteria of 620 ug/L represents the 1996 ROD AWQC for Human Health (fish consumption).
2) No inter-armoring or sub-armoring samples are collected from sample locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Fall 2009 Naphthalene Sub-Armoring Water Sample Results

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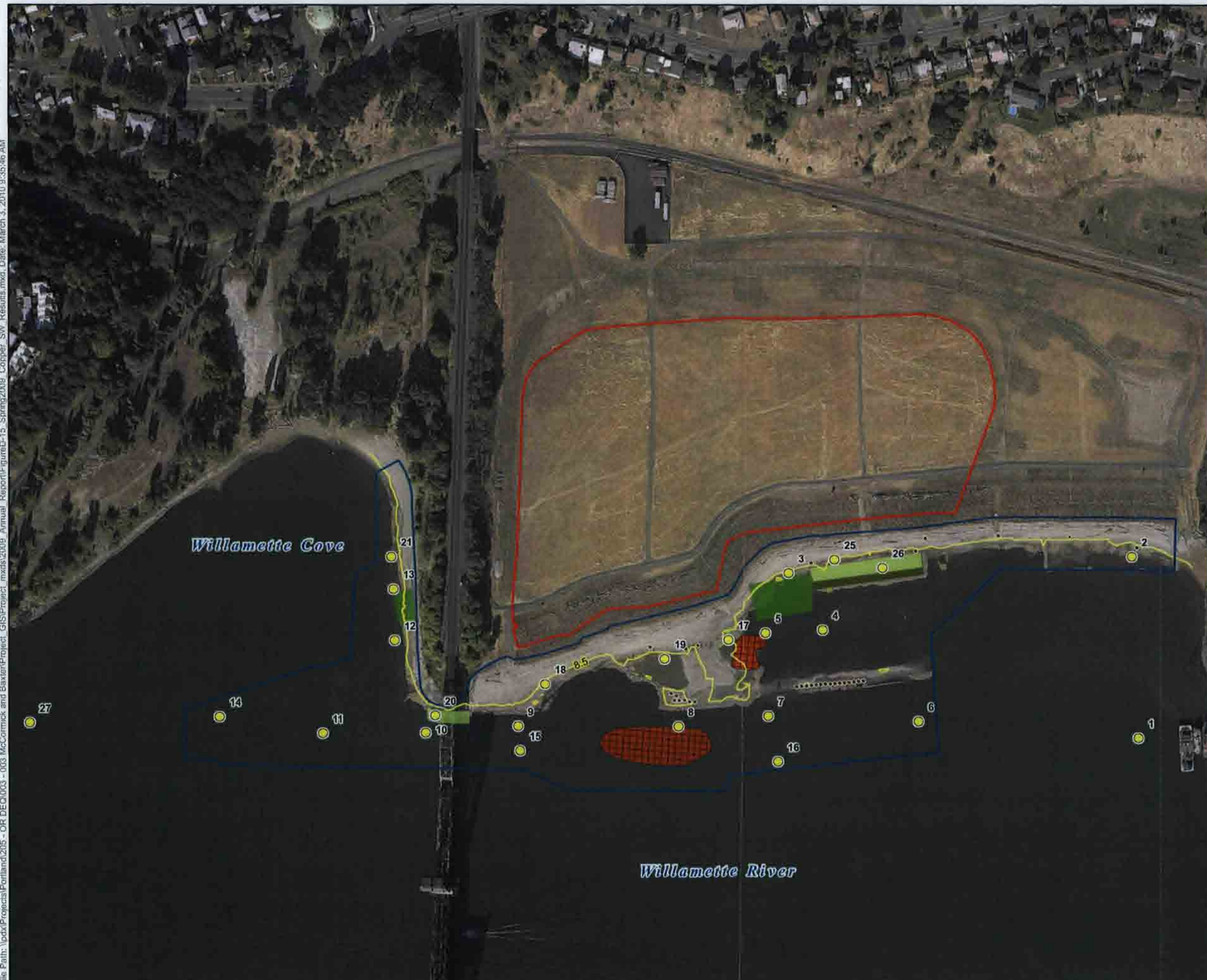
HARTCROWSER GSI Water Solutions, Inc.

Figure
D-14

File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-14_Fall2009_Naphthalene_SA_Results.mxd, Date: May 28, 2010 9:05:59 AM



LEGEND

Sample Results

- Non-detect
- < 0.009 mg/L
- 0.009 - 0.09 mg/L
- 0.09 - 0.9 mg/L
- > 0.9 mg/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

REFERENCE INFORMATION:

1) Reference criteria of .0009 mg/L represents the 2007 NRWQCs for the aquatic life (chronic).

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 31, 2009 to April 4, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Spring 2009 Copper Surface Water Sample Results

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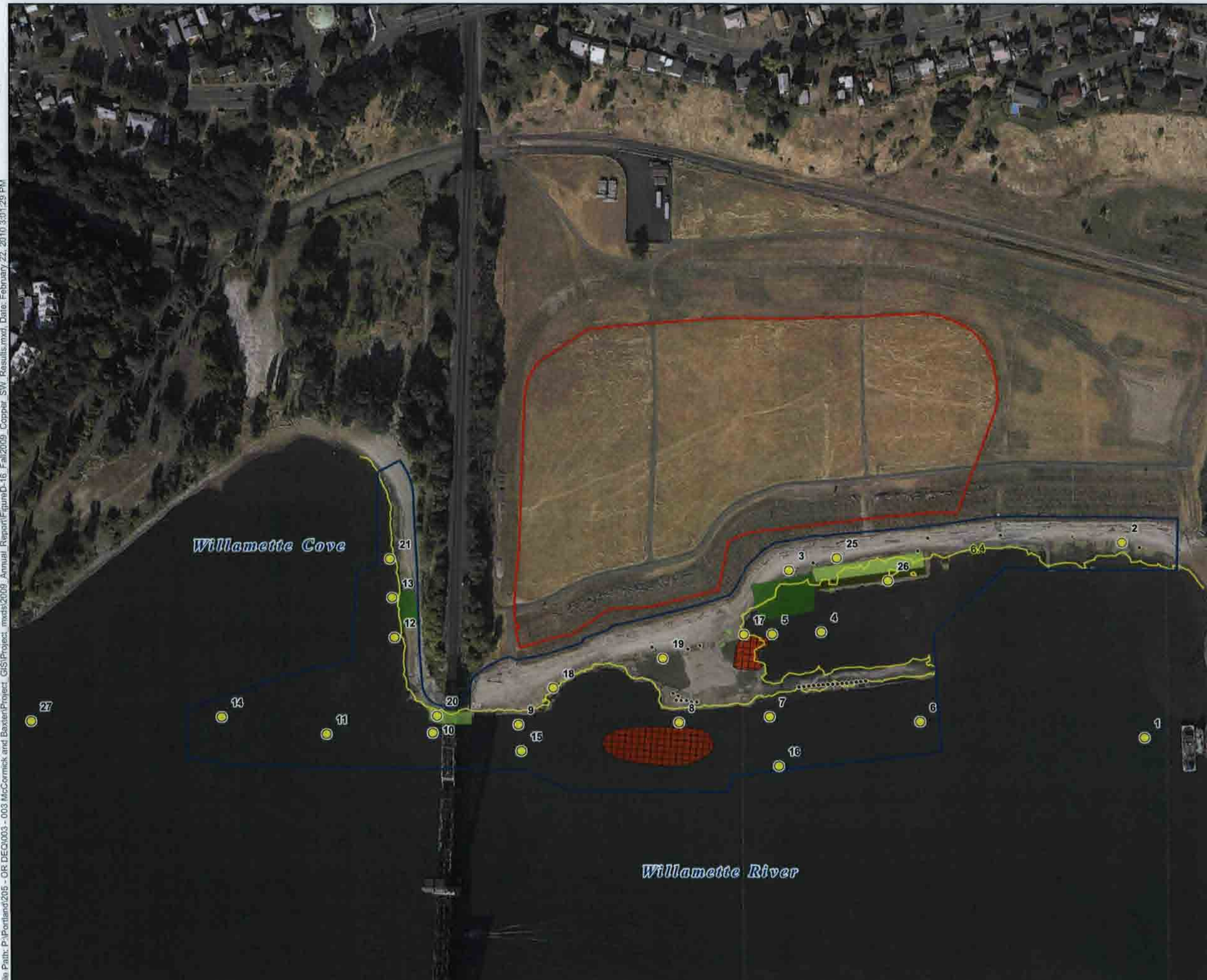
HARTCROWSER GSI Water Solutions, Inc.

Figure **D-15**

File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual Report\FigureD-15_Spring2009_Copper_SW_Results.mxd, Date: March 3, 2010 9:35:46 AM



LEGEND

Sample Results

- Non-detect
- < 0.009 mg/L
- 0.009 - 0.09 mg/L
- 0.09 - 0.9 mg/L
- > 0.9 mg/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

REFERENCE INFORMATION:

1) Reference criteria of .0009 mg/L represents the 2007 NRWQCs for the aquatic life (chronic).

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

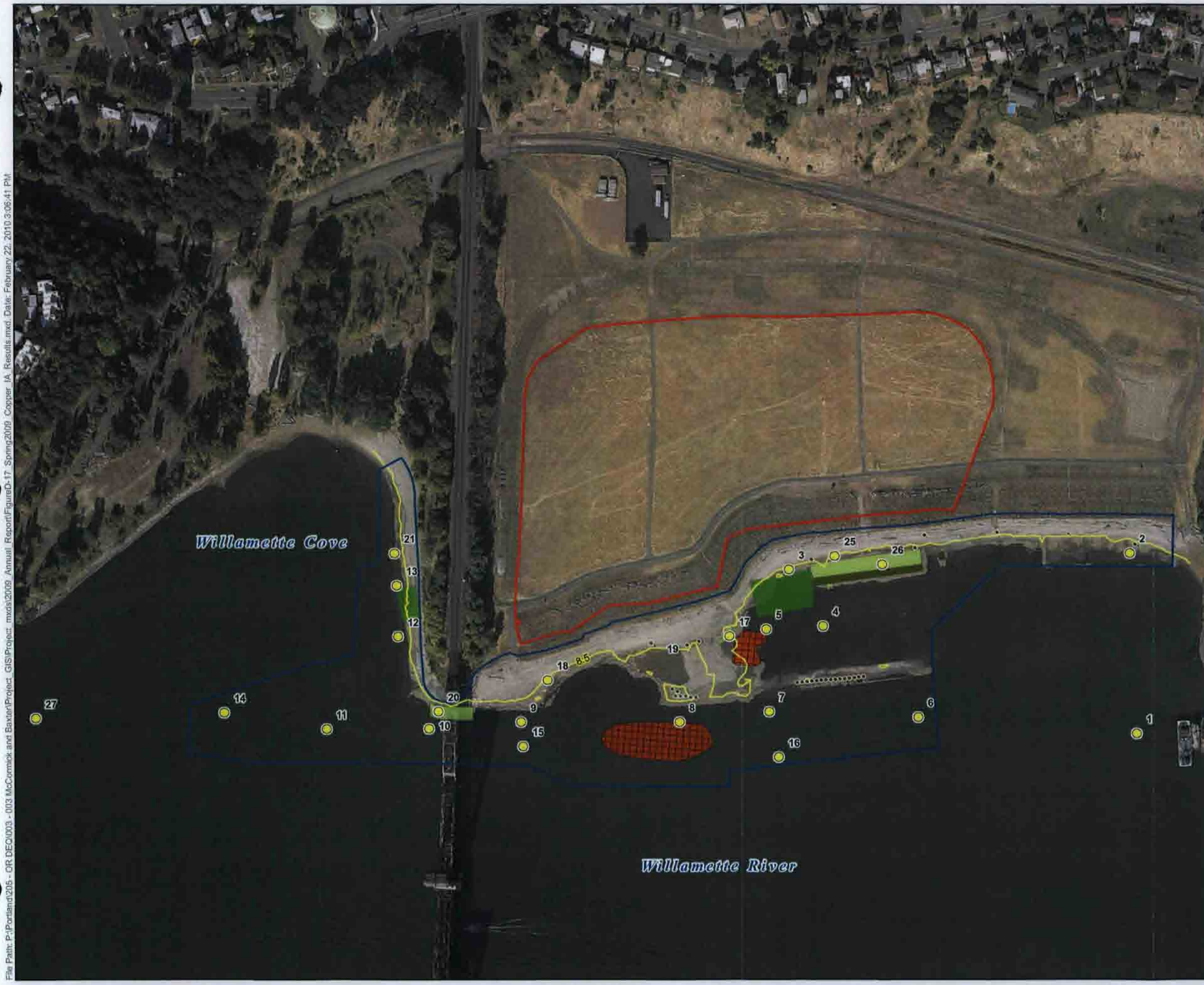
Fall 2009 Copper Surface Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-16**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\Figure\D-16_Fall2009_Copper_SW_Results.mxd, Date: February 22, 2010 3:01:29 PM



LEGEND

Sample Results

- Non-detect
- < 0.009 mg/L
- 0.009 - 0.09 mg/L
- 0.09 - 0.9 mg/L
- > 0.9 mg/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

REFERENCE INFORMATION:

1) Reference criteria of .0009 mg/L represents the 2007 NRWQCs for the aquatic life (chronic).
2) No inter-armoring or sub-armoring samples are collected from sample locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 31, 2009 to April 4, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

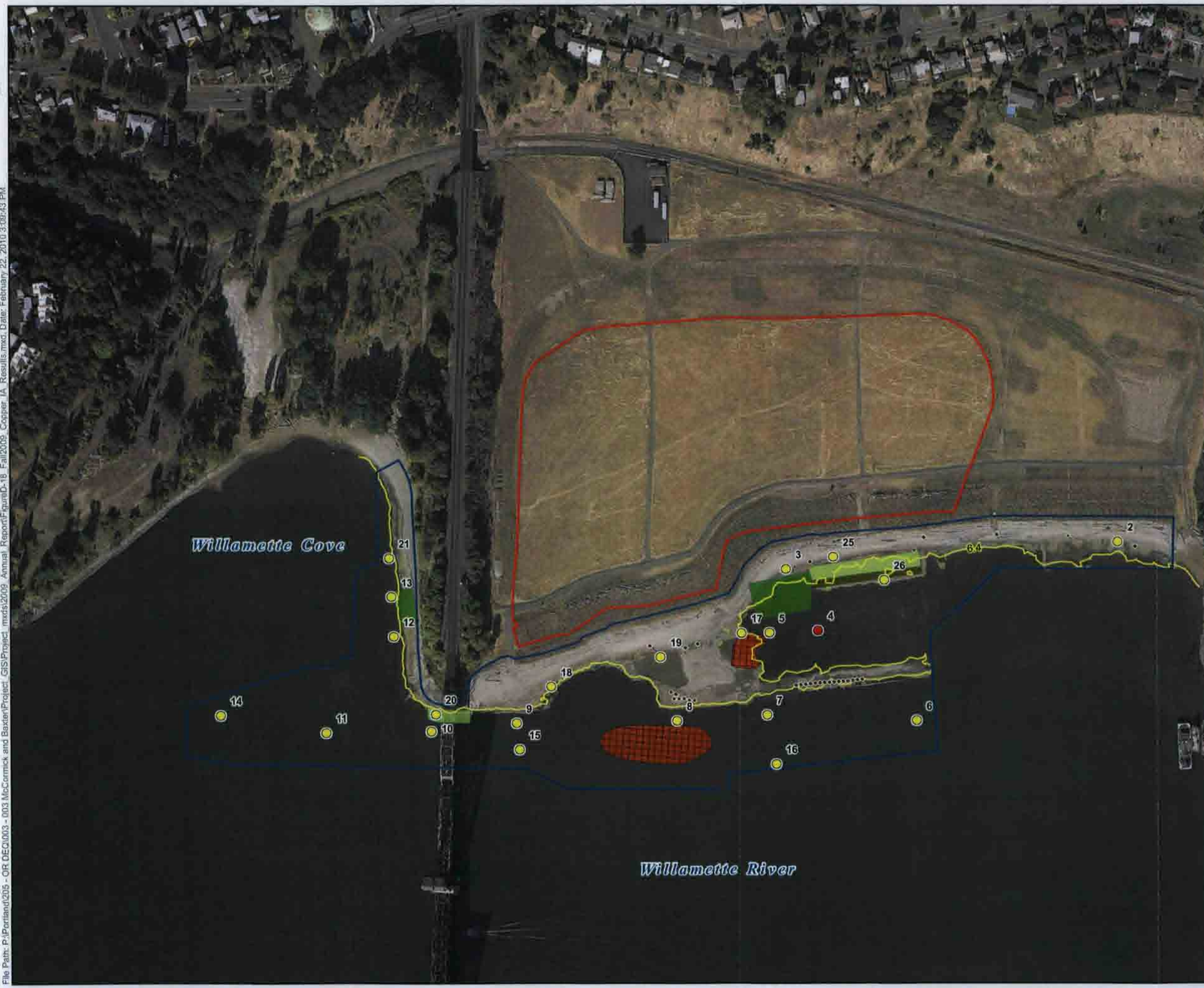
Spring 2009 Copper Inter-Armoring Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-17**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\Figure\D-17_Spring2009_Copper_IA_Results.mxd Date: February 22, 2010 3:06:41 PM



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LEGEND

Sample Results

- Non-detect
- < 0.009 mg/L
- 0.009 - 0.09 mg/L
- 0.09 - 0.9 mg/L
- > 0.9 mg/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

REFERENCE INFORMATION:

1) Reference criteria of .0009 mg/L represents the 2007 NRWQCs for the aquatic life (chronic).
2) No inter-armoring or sub-armoring samples are collected from sample locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

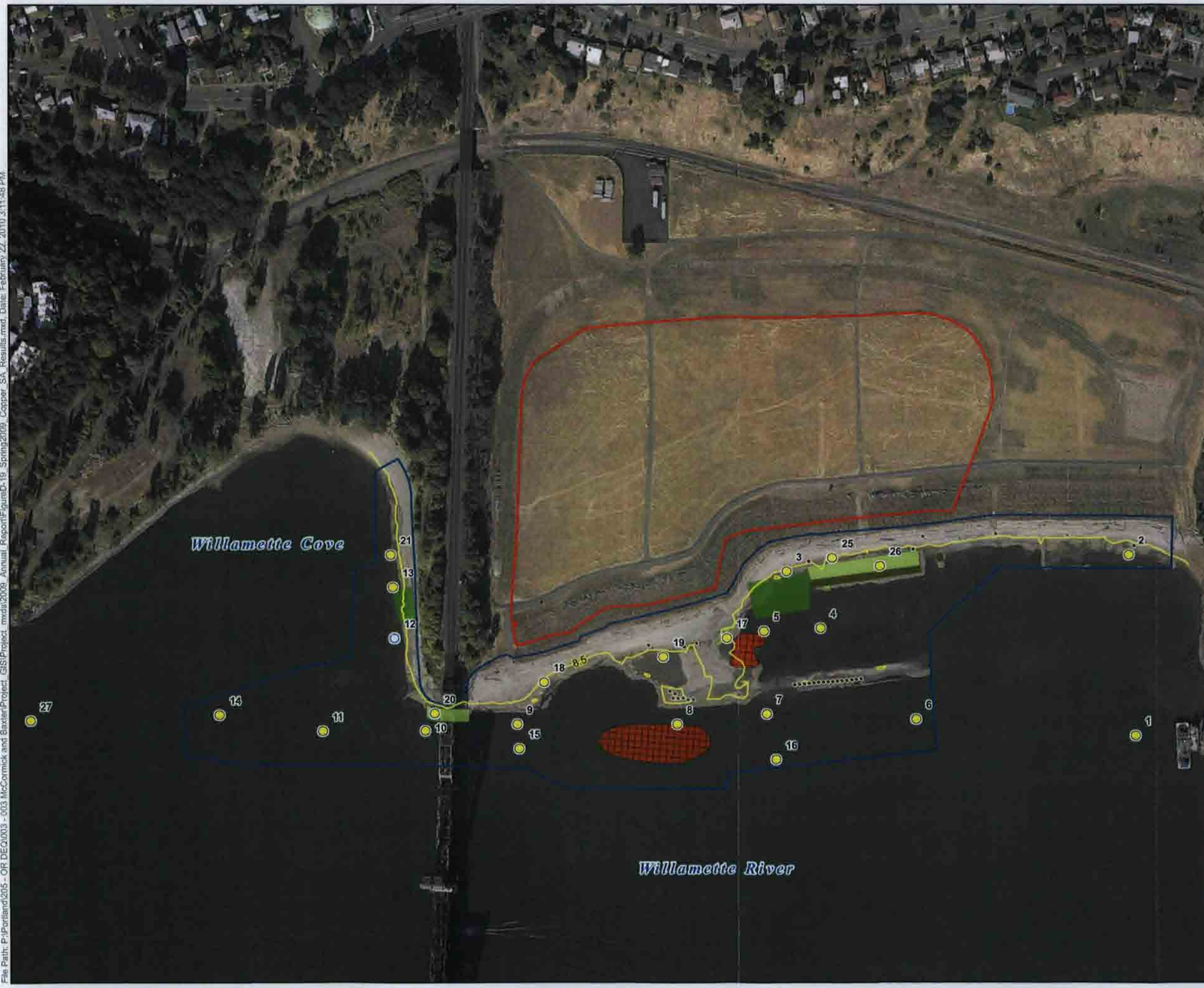
McCormick and Baxter Superfund Site
Portland, Oregon

Fall 2009 Copper Inter-Armoring Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure
D-18



LEGEND

Sample Results

- Non-detect
- < 0.009 mg/L
- 0.009 - 0.09 mg/L
- 0.09 - 0.9 mg/L
- > 0.9 mg/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (8.50 feet)

REFERENCE INFORMATION:

1) Reference criteria of .0009 mg/L represents the 2007 NRWQCs for the aquatic life (chronic).
2) No inter-armoring or sub-armoring samples are collected from sample locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (March 31, 2009 to April 4, 2009) was 8.5 feet NAVD88

0 250 500

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

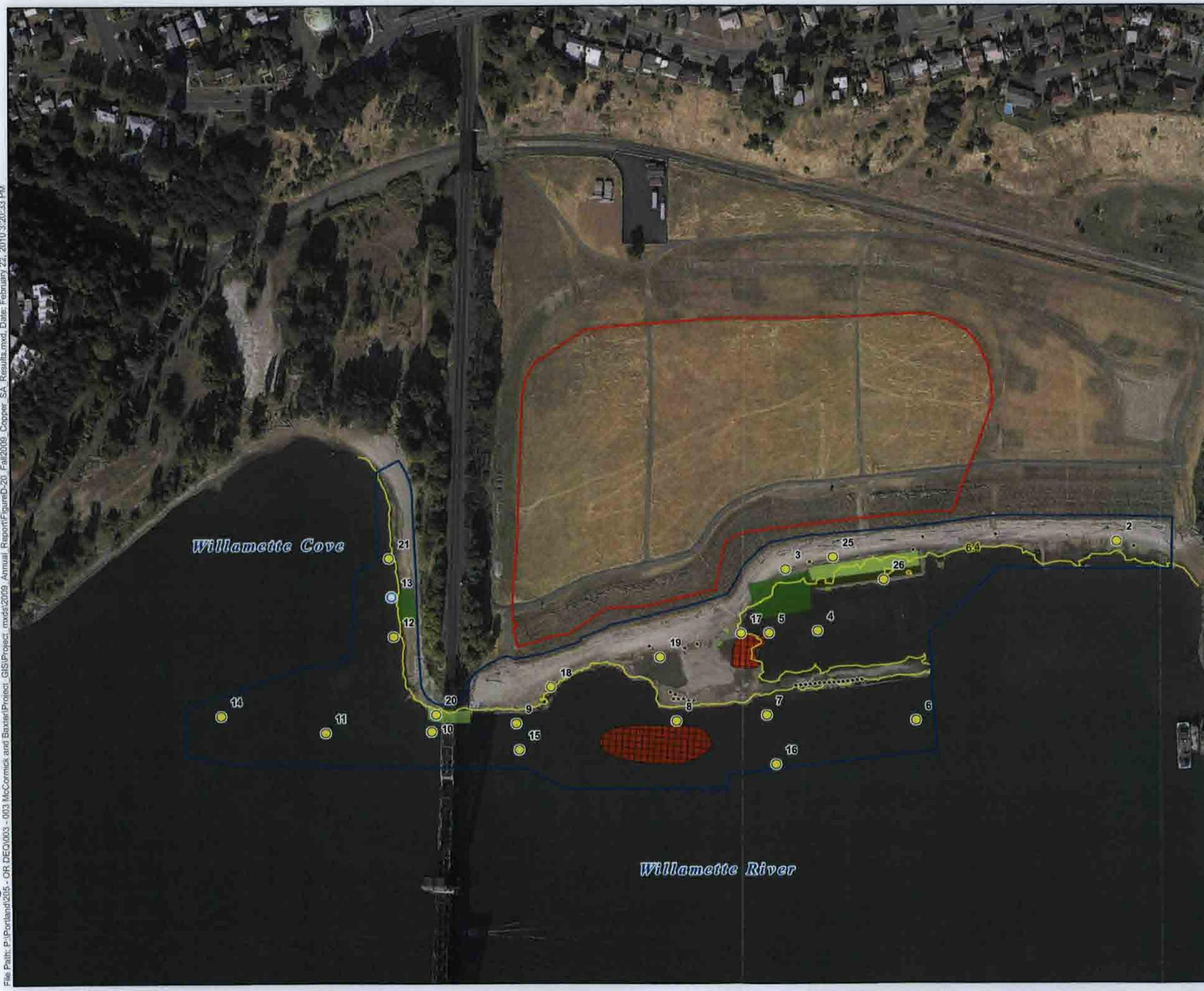
Spring 2009 Copper Sub-Armoring Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-19**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-19_Spring2009_Copper_SA_Results.mxd, Date: February 22, 2010 3:11:48 PM



File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureD-20_Fall2009_Copper_SA_Results.mxd, Date: February 22, 2010 3:20:33 PM

LEGEND

Sample Results

- Non-detect
- < 0.009 mg/L
- 0.009 - 0.09 mg/L
- 0.09 - 0.9 mg/L
- > 0.9 mg/L

Site Features

- Subsurface Barrier Wall
- Sediment Cap Boundary
- Organoclay Granular
- Organoclay Mats (Double)
- Organoclay Mats (Single)
- Hot Spot Treatment (thickened sand layer)
- Boulder Clusters
- Willamette River Level During Sampling Event (6.40 feet)

REFERENCE INFORMATION:

1) Reference criteria of .0009 mg/L represents the 2007 NRWQCs for the aquatic life (chronic).
2) No inter-armoring or sub-armoring samples are collected from sample locations 1 and 27, as they are outside of the cap boundary.

NOTES:

1) All elevations shown in NAVD88
2) Aerial photo taken on September 22, 2006
3) Average low tide during sampling period (October 12, 2009 to October 20, 2009) was 6.4 feet NAVD88

0 250 500

Scale in feet

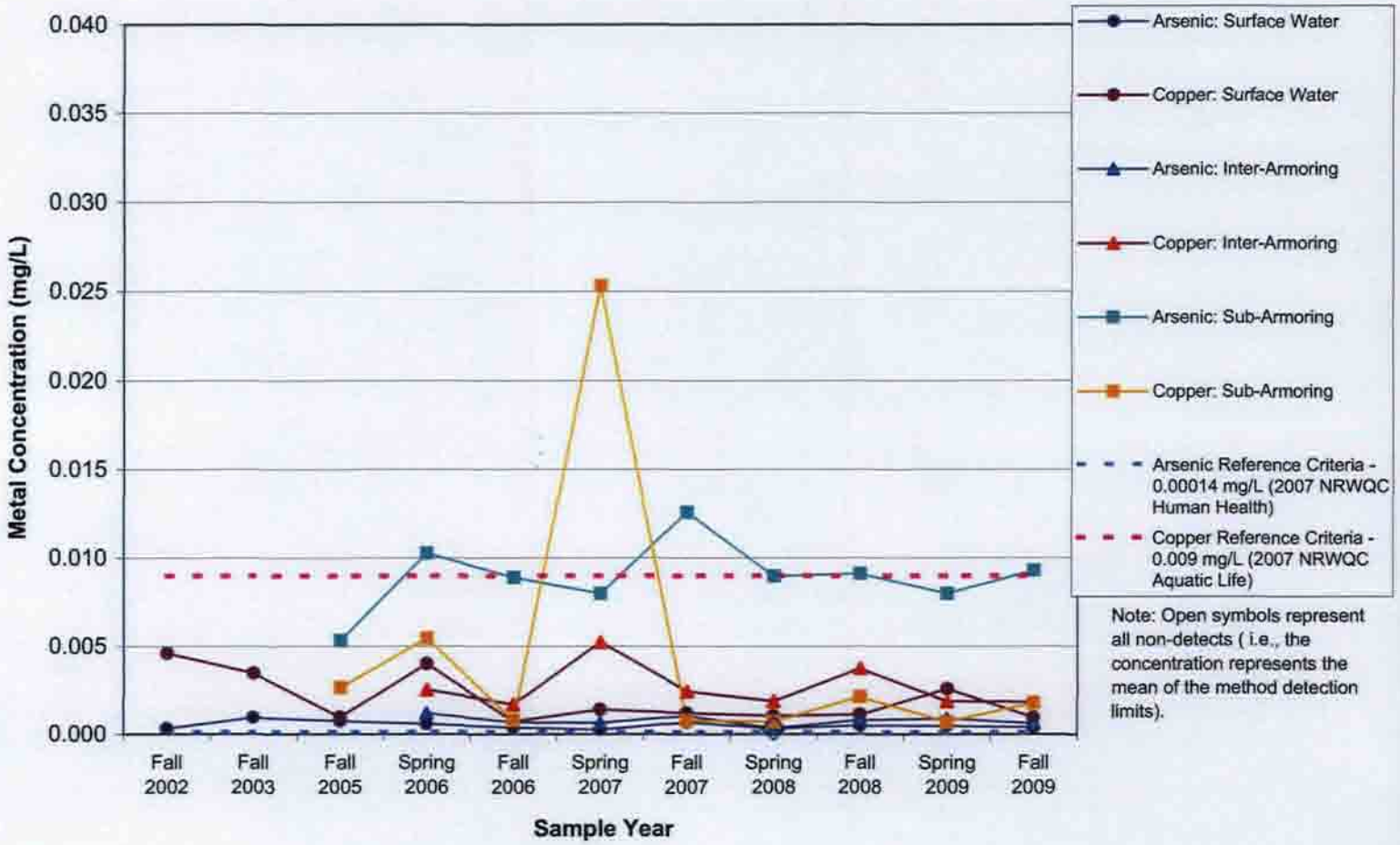
McCormick and Baxter Superfund Site
Portland, Oregon

Fall 2009 Copper Sub-Armoring Water Sample Results

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **D-20**



McCormick and Baxter Superfund Site
Portland, Oregon

Mean Concentrations for Total Arsenic and Total Copper in Surface, Inter-Armoring, and Sub-Armoring Samples

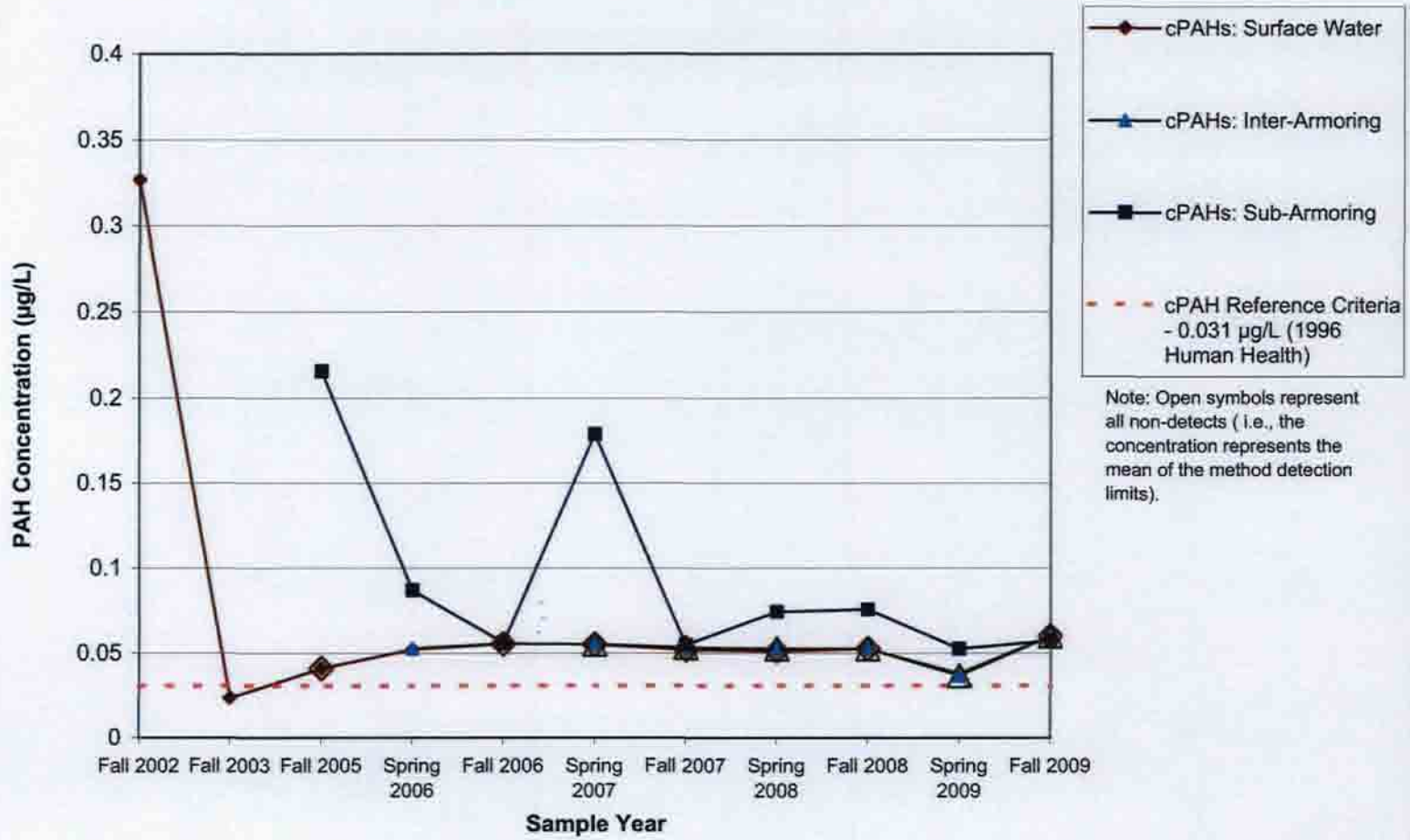
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-21



Note: Open symbols represent all non-detects (i.e., the concentration represents the mean of the method detection limits).

McCormick and Baxter Superfund Site
Portland, Oregon

Mean Concentrations for Total cPAHs in Surface, Inter-Armoring, and Sub-Armoring Water Samples

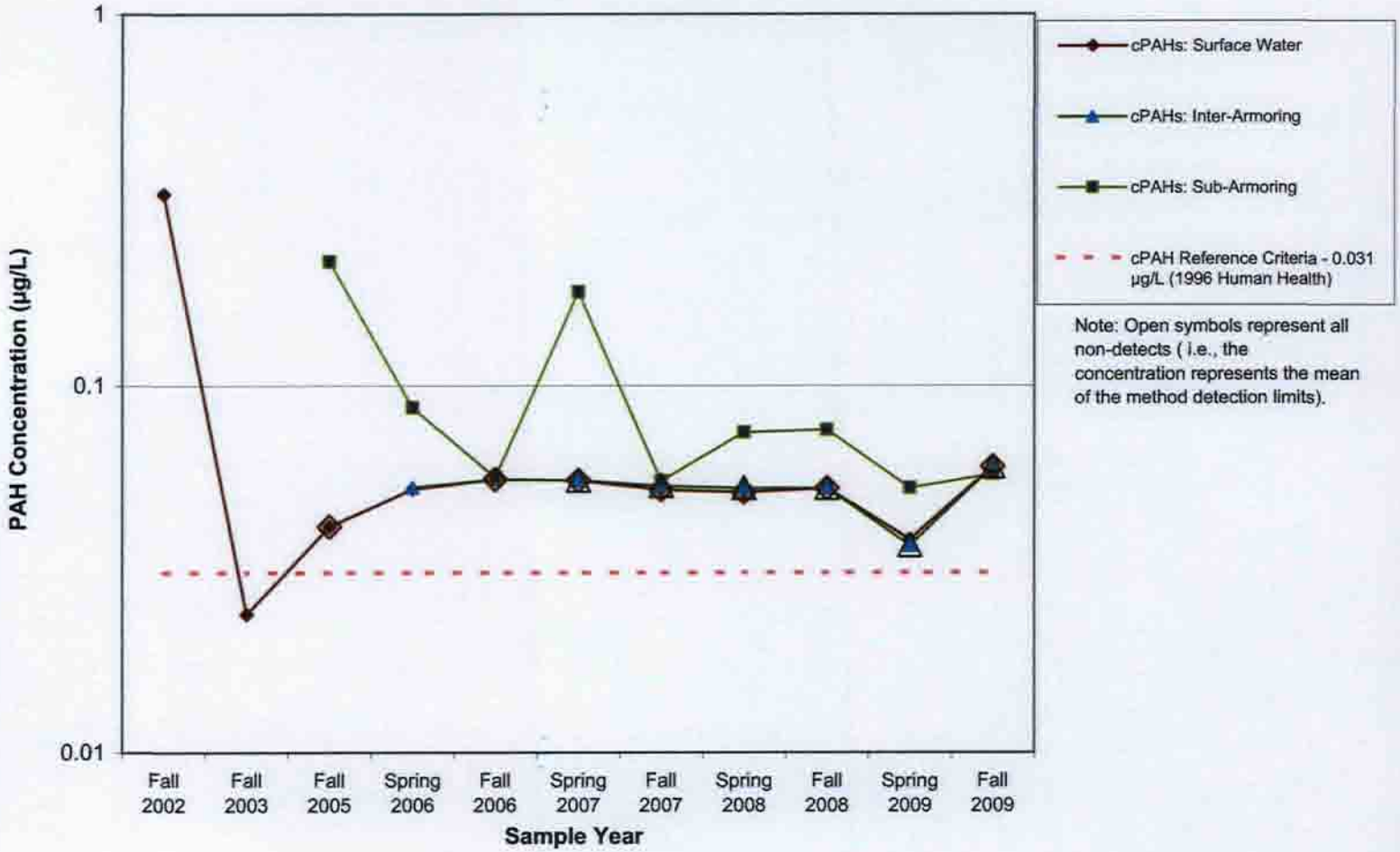
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-22



McCormick and Baxter Superfund Site
Portland, Oregon

Mean Concentrations for Total cPAHs in Surface, Inter-Armoring, and Sub-Armoring Water Samples (Log Scale)

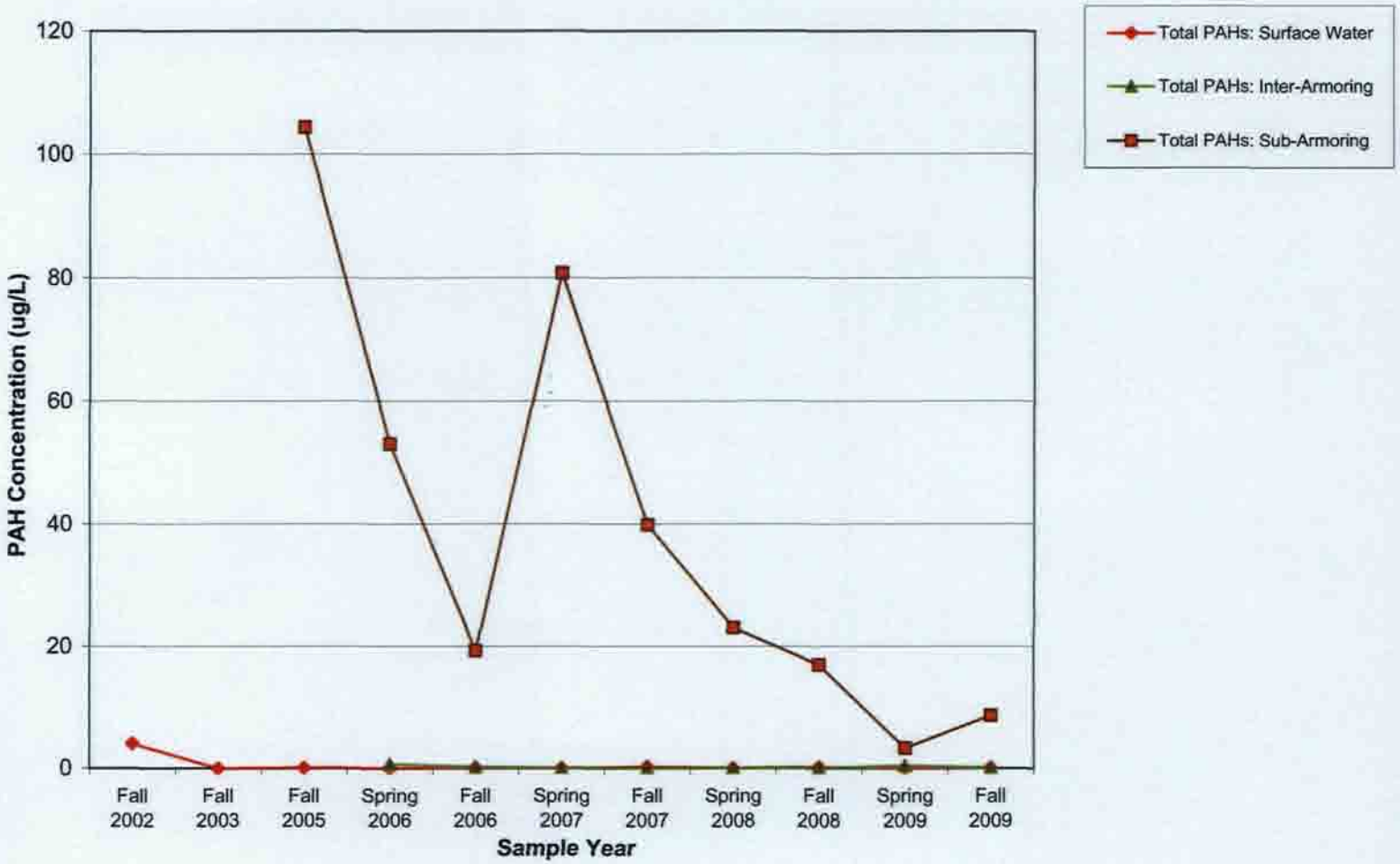
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-22a



McCormick and Baxter Superfund Site
Portland, Oregon

Concentrations for Total PAHs in Surface, Inter-Armoring, and Sub-Armoring Water Samples

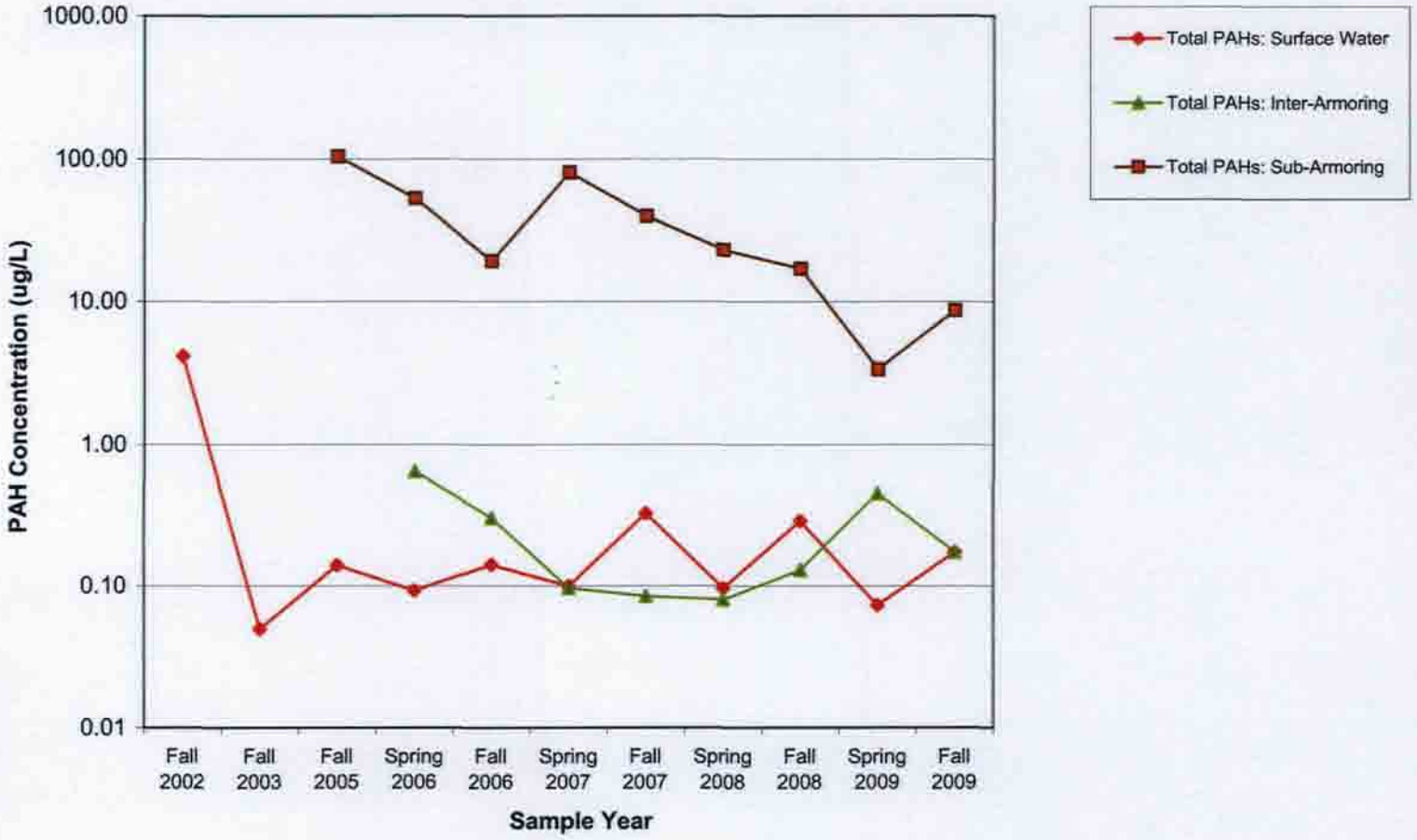
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-23



McCormick and Baxter Superfund Site
Portland, Oregon

Mean Concentrations for Total PAHs in Surface, Inter-Armoring, and Sub-Armoring Water Samples (Log Scale)

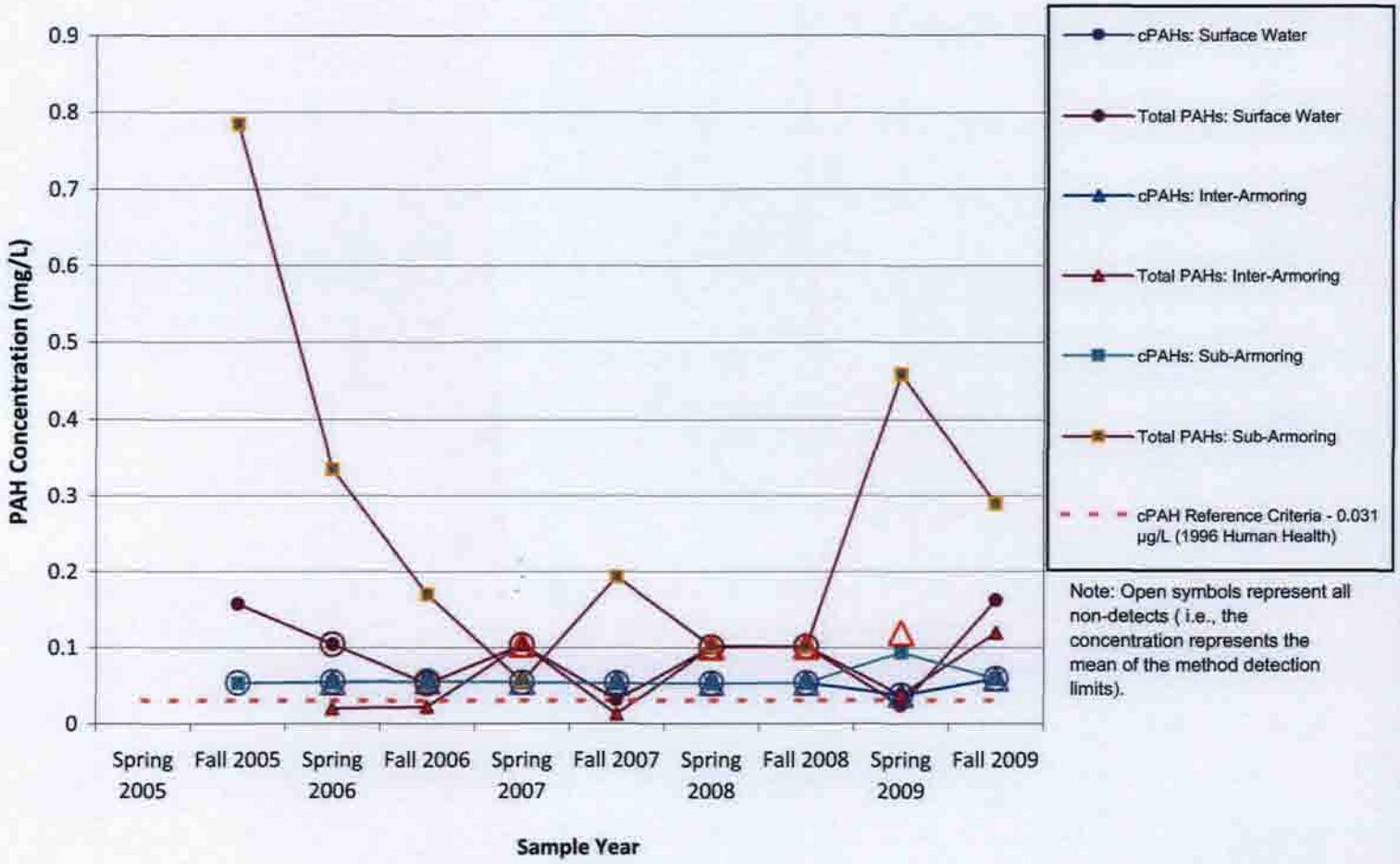
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-23a



Note: Open symbols represent all non-detects (i.e., the concentration represents the mean of the method detection limits).

McCormick and Baxter Superfund Site
Portland, Oregon

Location 10 Concentrations for Total Arsenic and Copper in Surface, Inter-Armoring, and Sub-Armoring Water Samples

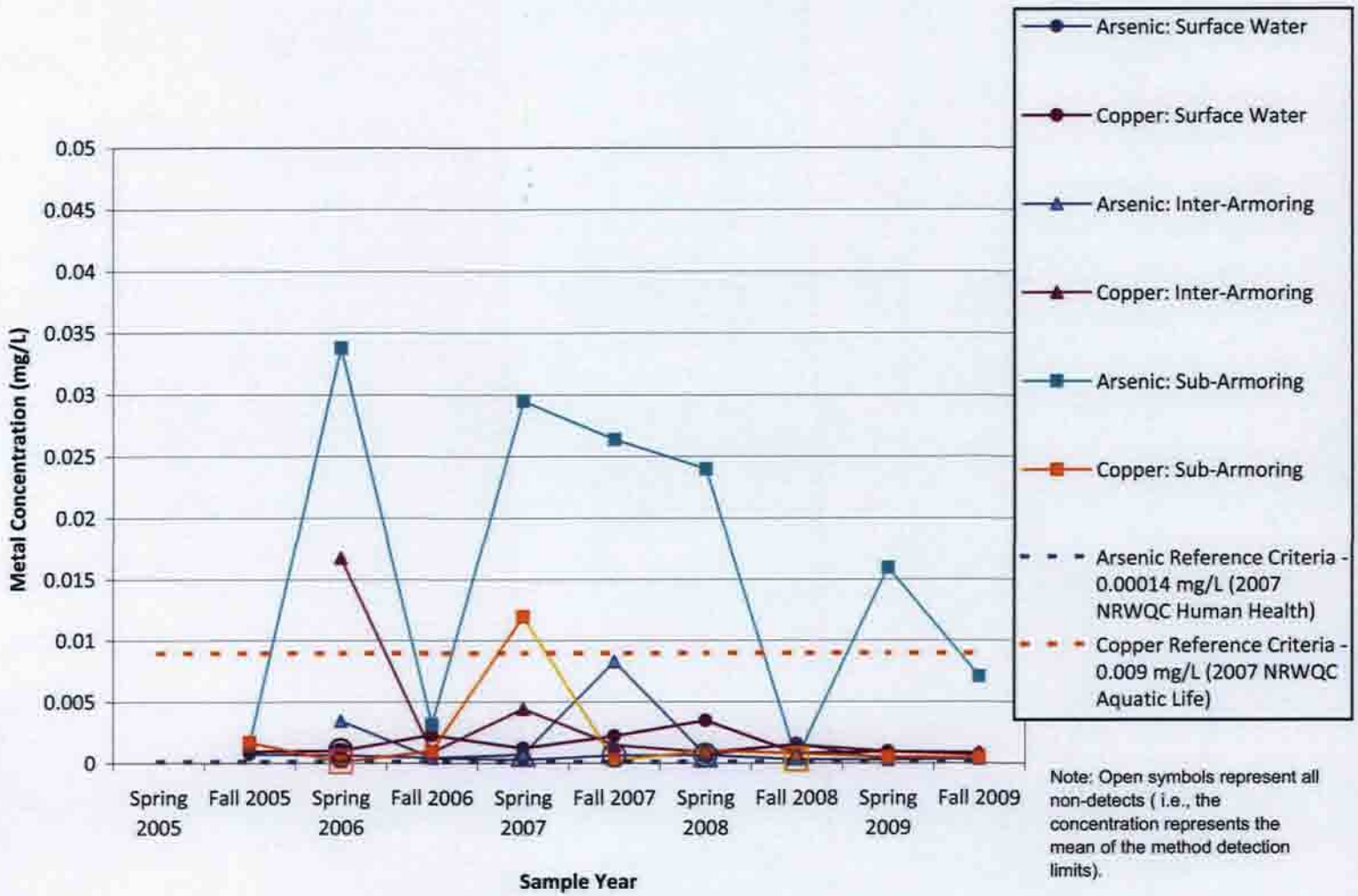
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-24



Note: Open symbols represent all non-detects (i.e., the concentration represents the mean of the method detection limits).

McCormick and Baxter Superfund Site
Portland, Oregon

Location 12 Concentrations for Total Arsenic and Copper in Surface, Inter-Armoring, and Sub-Armoring Water Samples

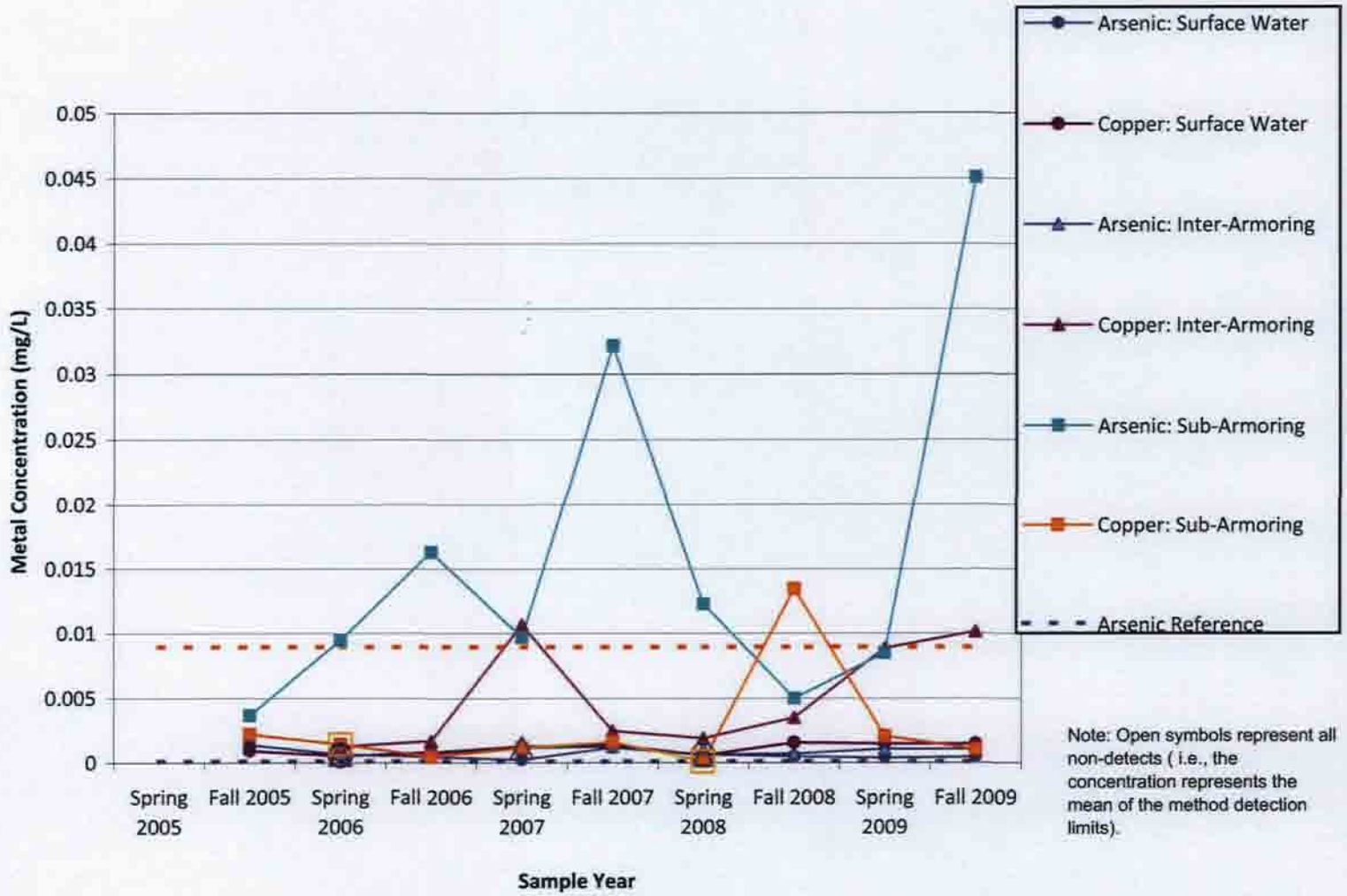
2/10

Figure

D-25

HARTCROWSER

GSI Water Solutions, Inc.



Note: Open symbols represent all non-detects (i.e., the concentration represents the mean of the method detection limits).

McCormick and Baxter Superfund Site
Portland, Oregon

Location 4 Concentrations for Total Arsenic and Copper in Surface, Inter-Armoring, and Sub-Armoring Water Samples

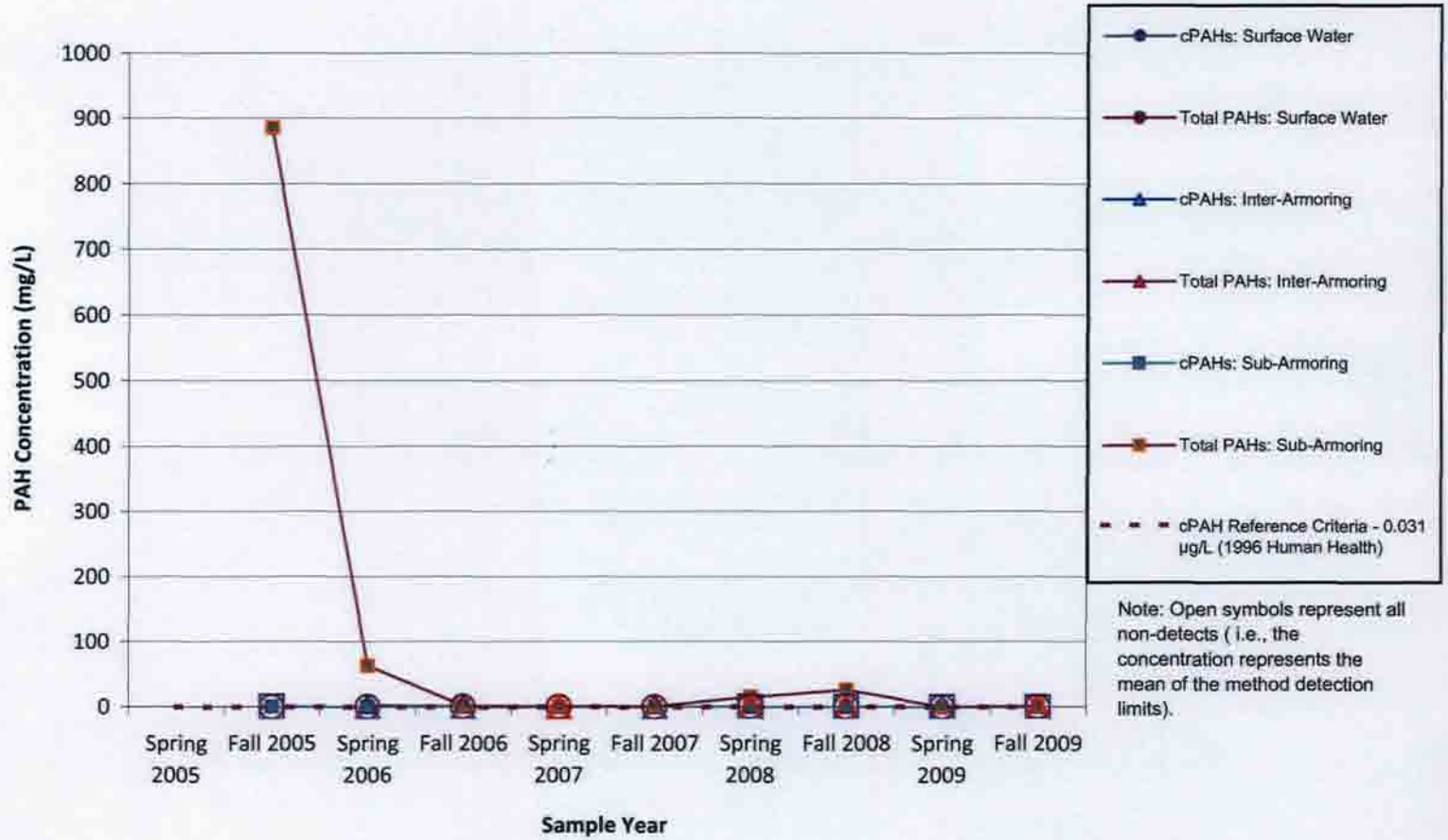
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-26



Note: Open symbols represent all non-detects (i.e., the concentration represents the mean of the method detection limits).

McCormick and Baxter Superfund Site
Portland, Oregon

Location 10 Concentrations for Total cPAHs and Total PAHs in Surface, Inter-Armoring, and Sub-Armoring Water Samples

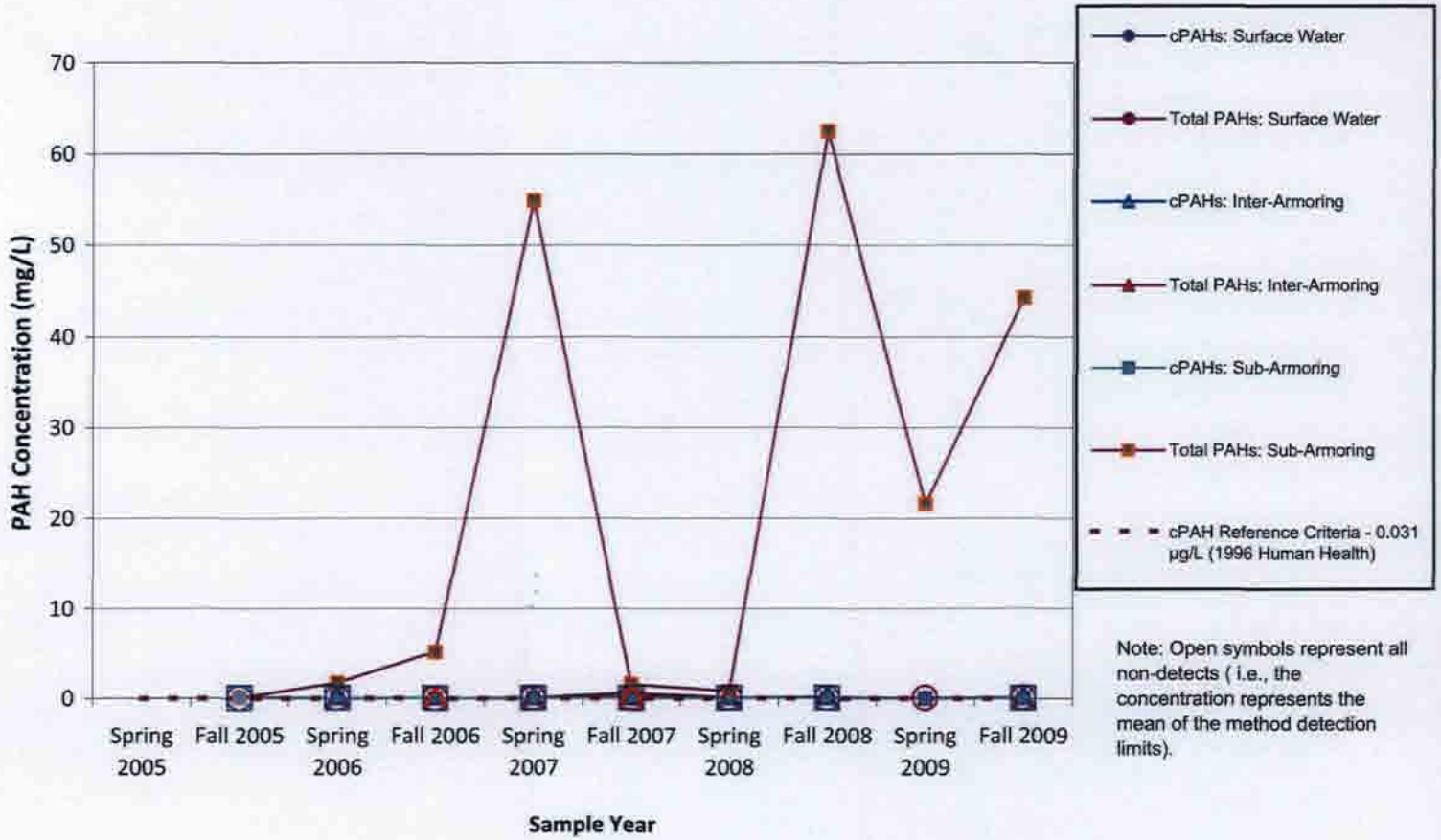
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-27



Note: Open symbols represent all non-detects (i.e., the concentration represents the mean of the method detection limits).

McCormick and Baxter Superfund Site
Portland, Oregon

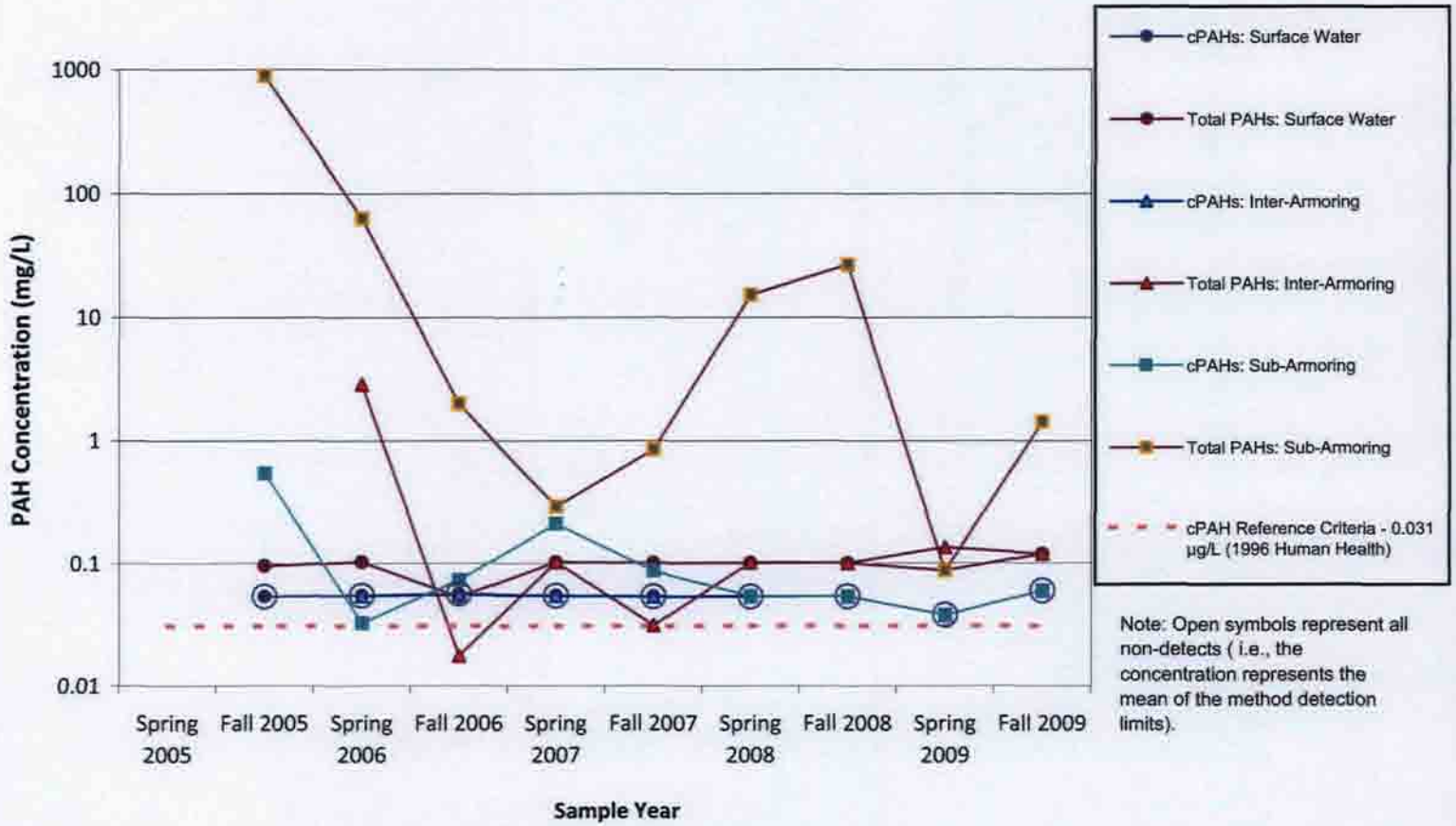
Location 12 Concentrations for Total cPAHs and Total PAHs in Surface, Inter-Armoring, and Sub-Armoring Water Samples

2/10

Figure **D-28**

HARTCROWSER

GSI Water Solutions, Inc.



Note: Open symbols represent all non-detects (i.e., the concentration represents the mean of the method detection limits).

McCormick and Baxter Superfund Site
Portland, Oregon

Location 10 Concentrations for Total cPAHs and Total PAHs in Surface, Inter-Armoring, and Sub-Armoring Water Samples (Log Scale)

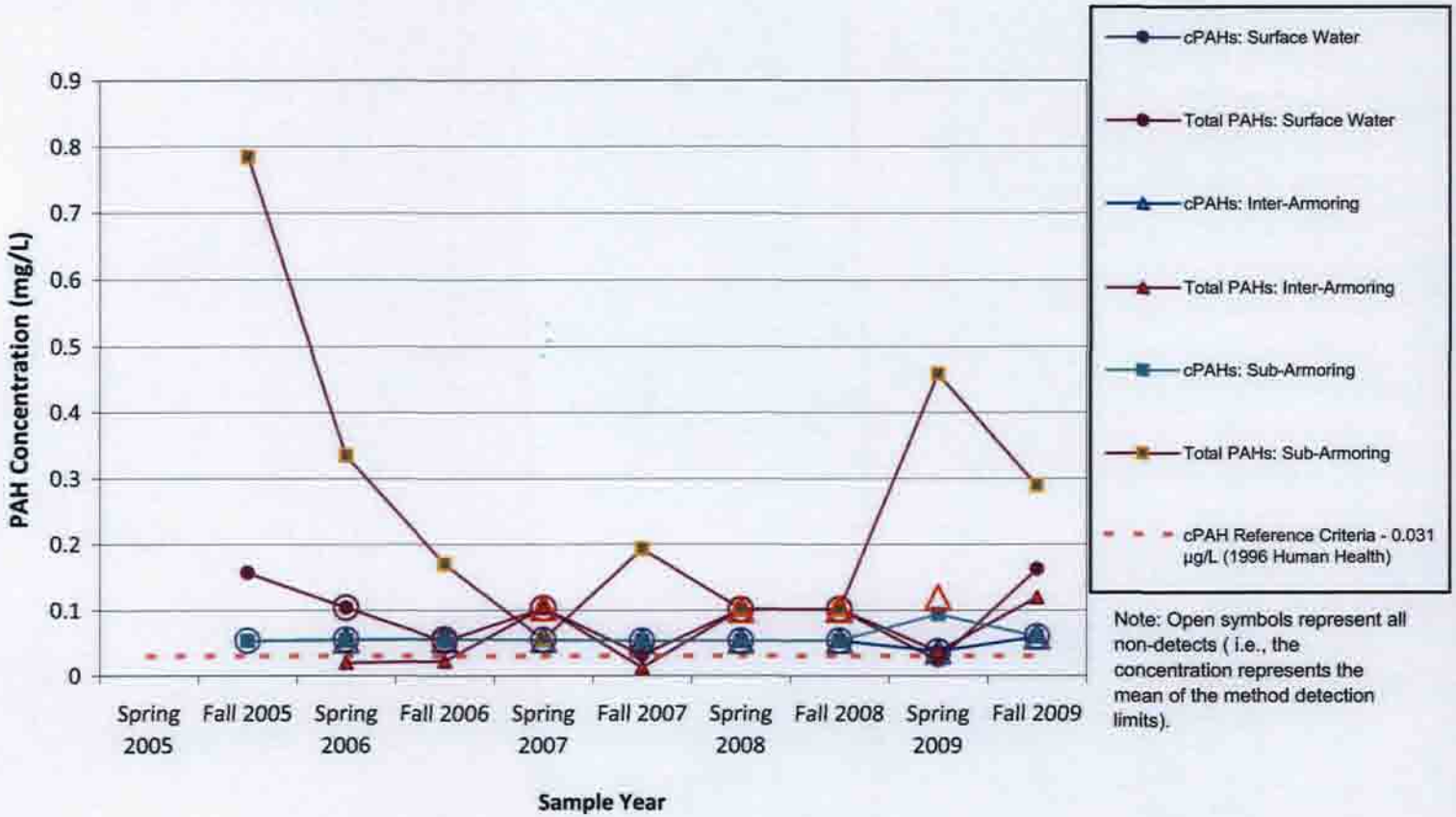
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-28a



Note: Open symbols represent all non-detects (i.e., the concentration represents the mean of the method detection limits).

McCormick and Baxter Superfund Site
Portland, Oregon

Location 4 Concentrations for Total cPAHs and Total PAHs in Surface, Inter-Armoring, and Sub-Armoring Water Samples

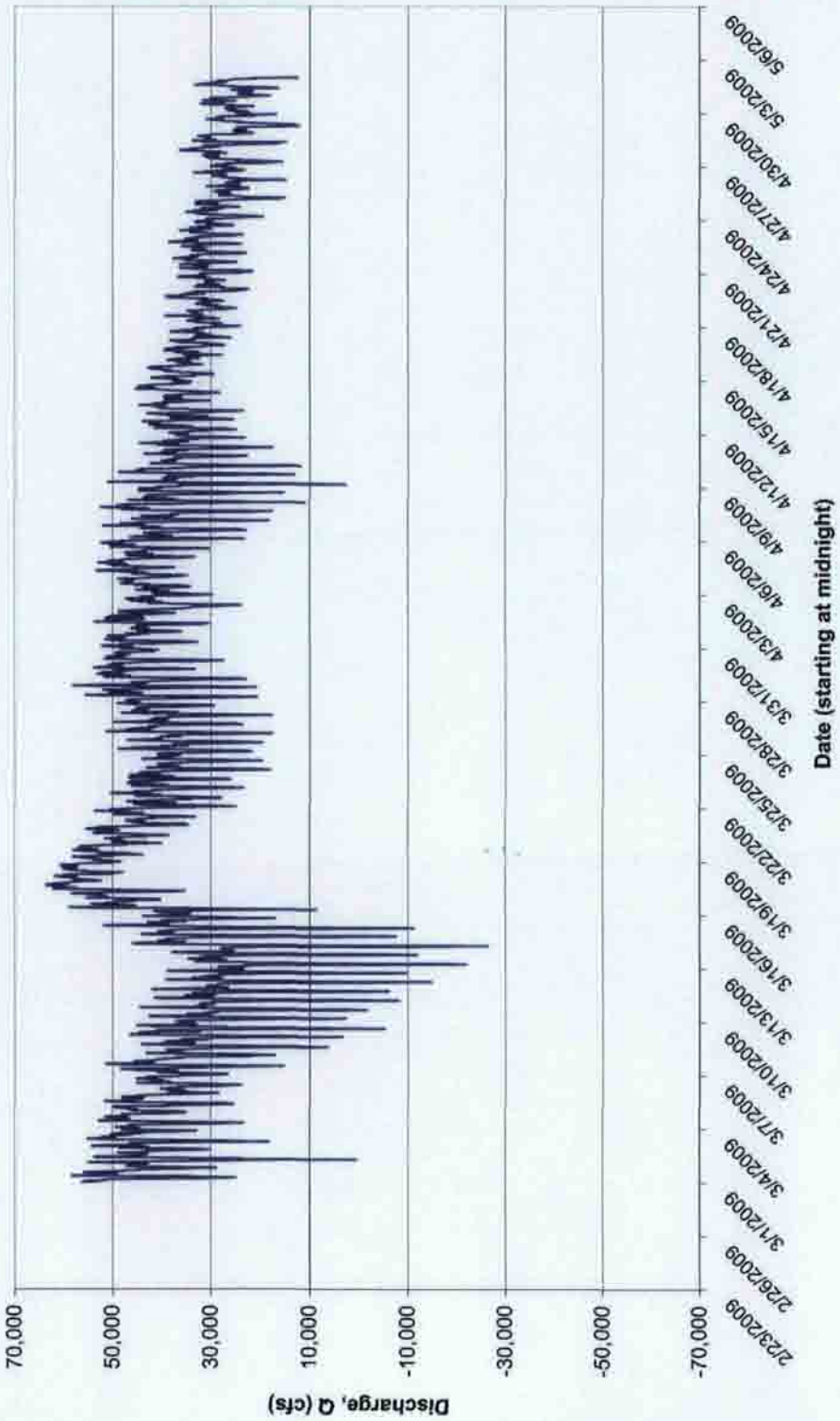
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-29



McCormick and Baxter Superfund Site
Portland, Oregon

Discharge Rate Willamette River, Portland, OR (Morrison Bridge) Spring 2009

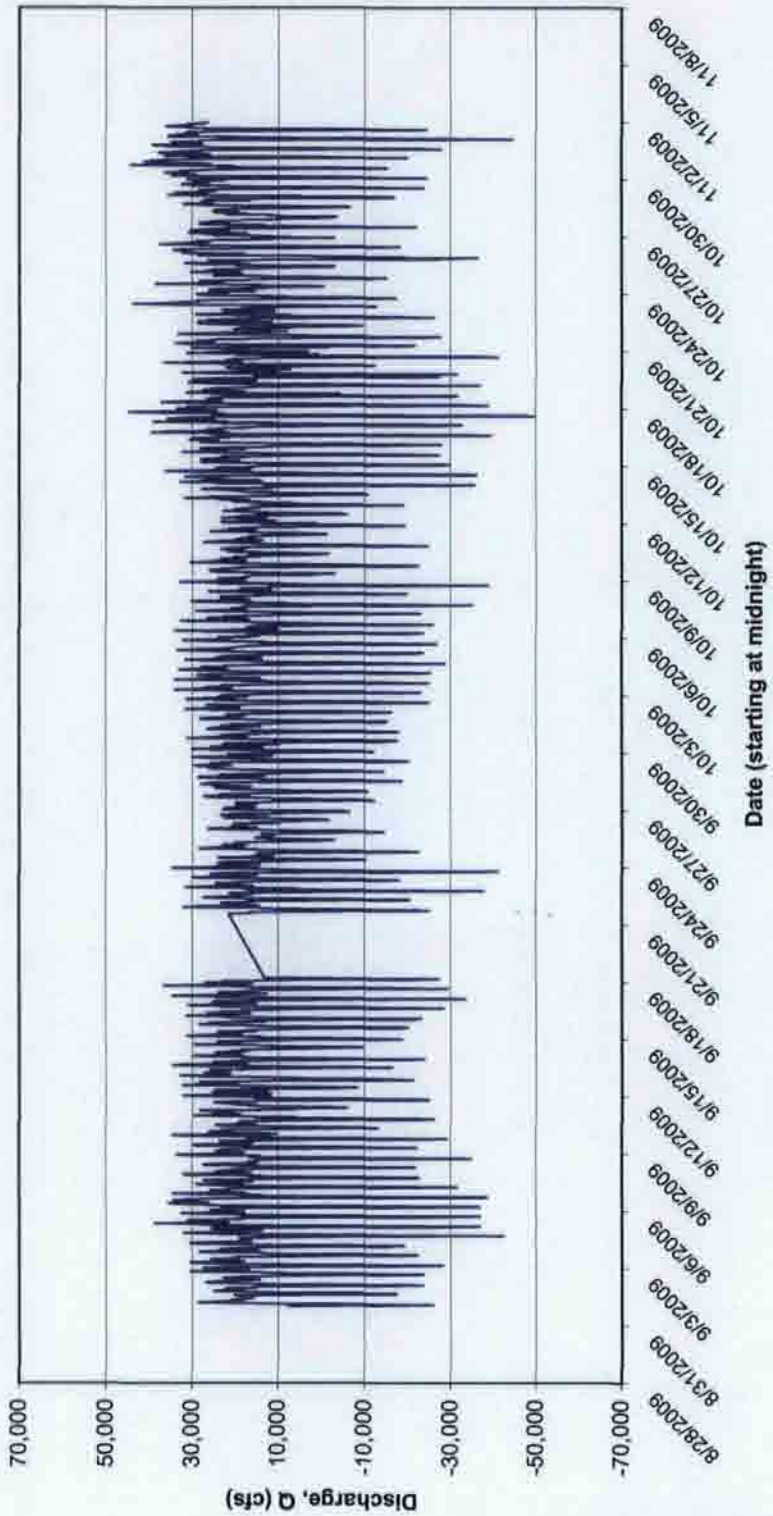
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-30



McCormick and Baxter Superfund Site
Portland, Oregon

Discharge Rate Willamette River, Portland, OR (Morrison Bridge) Fall 2009

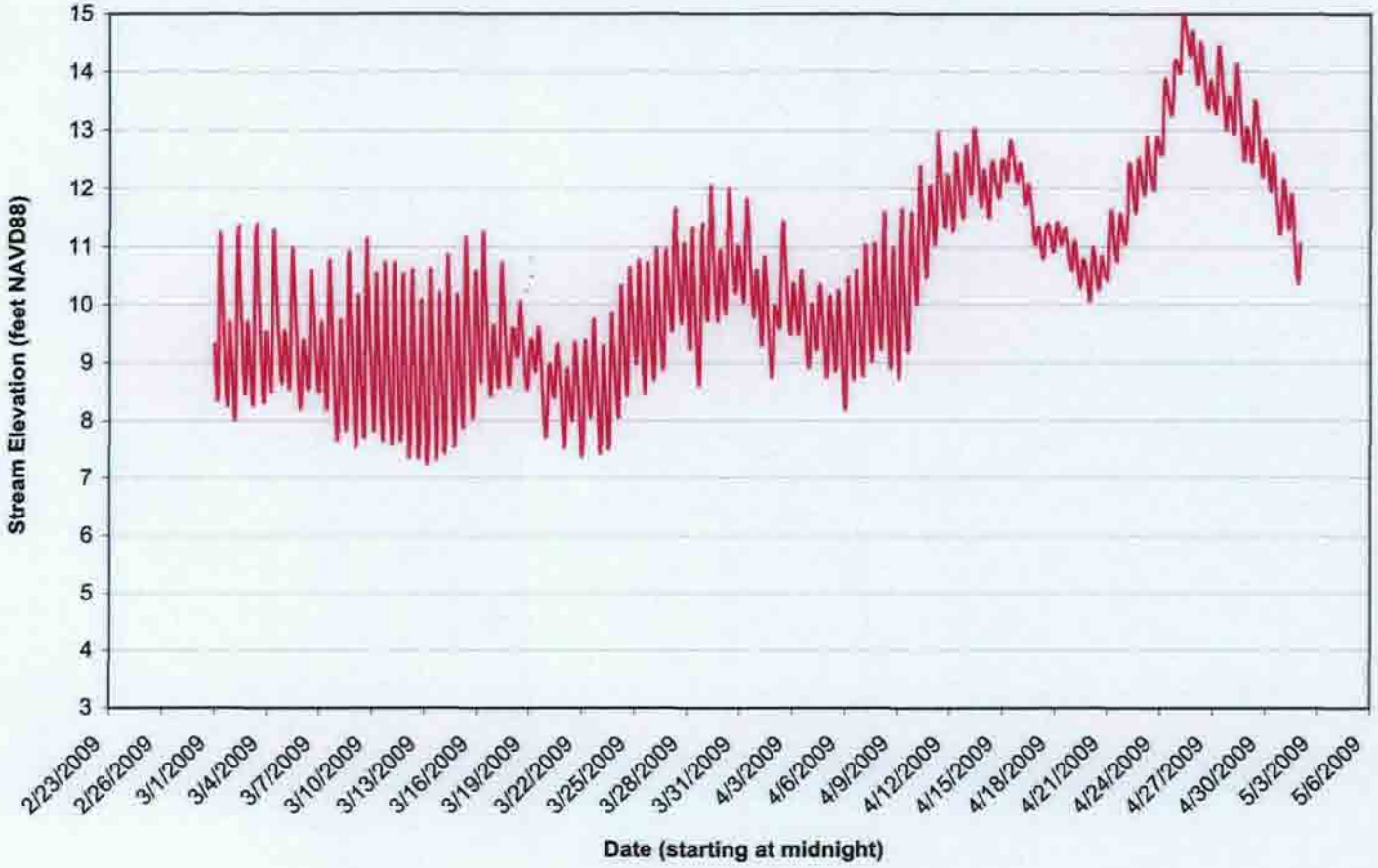
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-31



McCormick and Baxter Superfund Site
Portland, Oregon

Stream Elevation Willamette River, Portland, OR (Morrison Bridge) Spring 2009

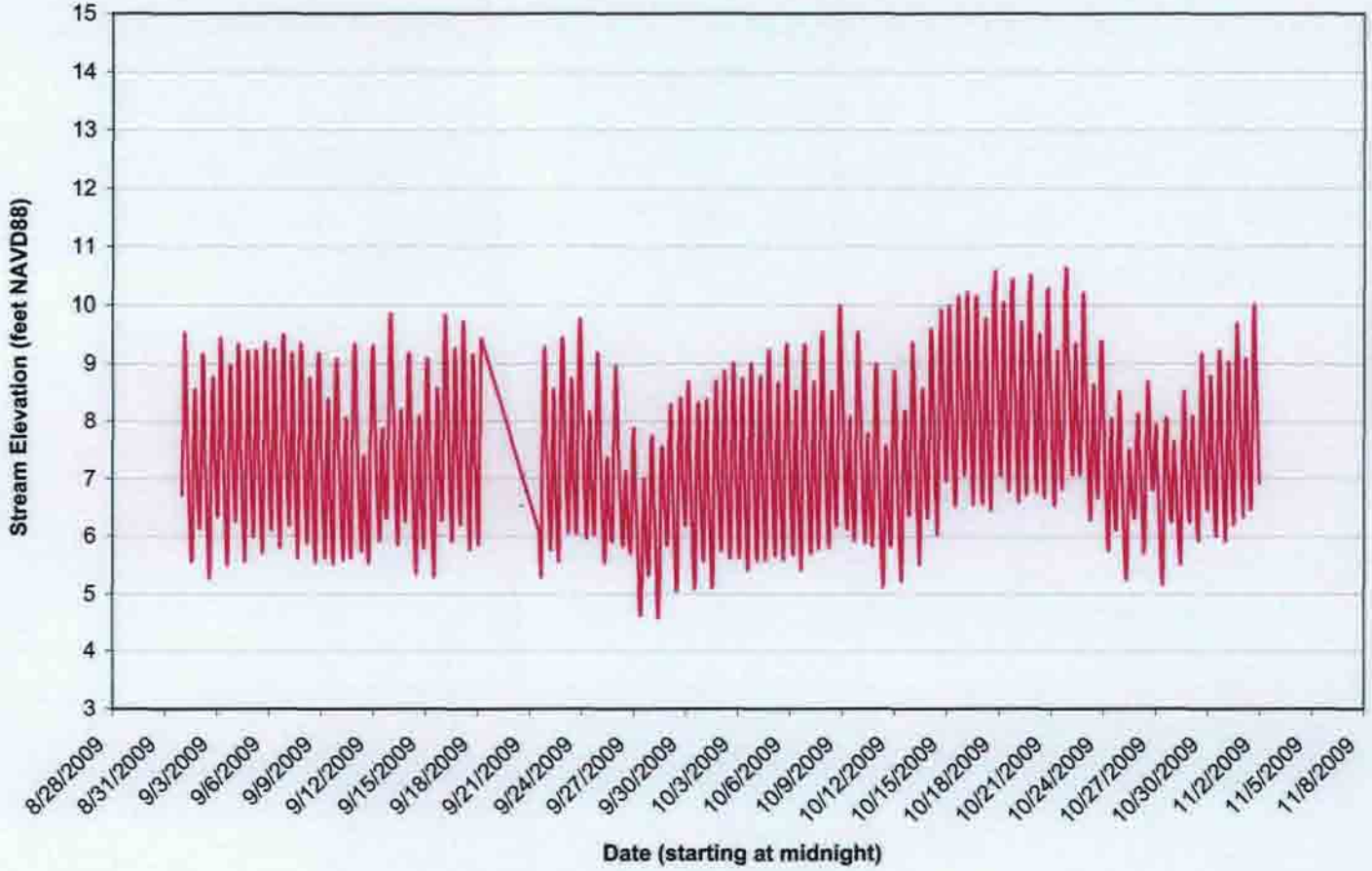
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-32



McCormick and Baxter Superfund Site
Portland, Oregon

Stream Elevation Willamette River, Portland, OR (Morrison Bridge) Fall 2009

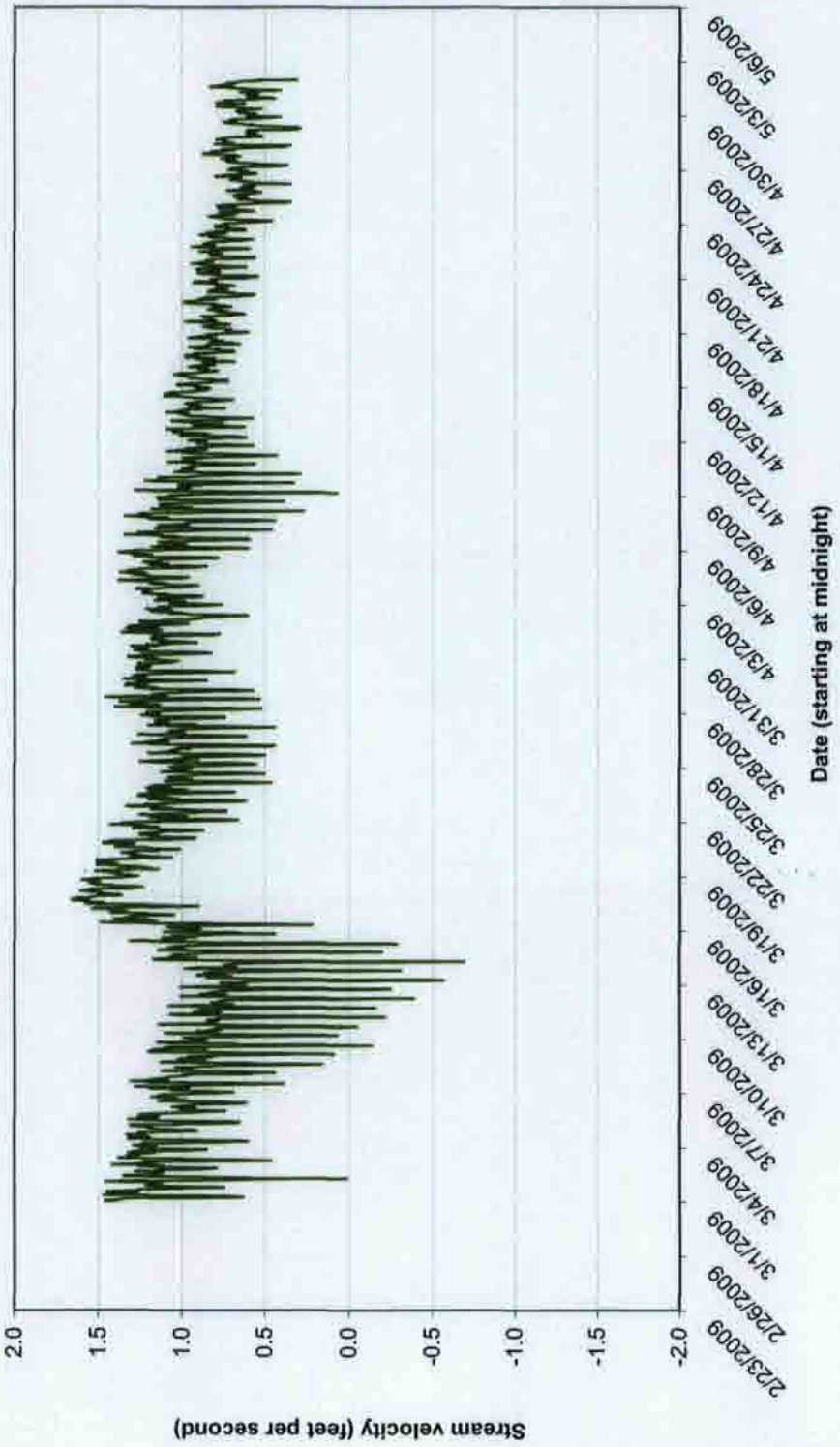
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-33



McCormick and Baxter Superfund Site
Portland, Oregon

Stream Velocity Willamette River, Portland, OR (Morrison Bridge) Spring 2009

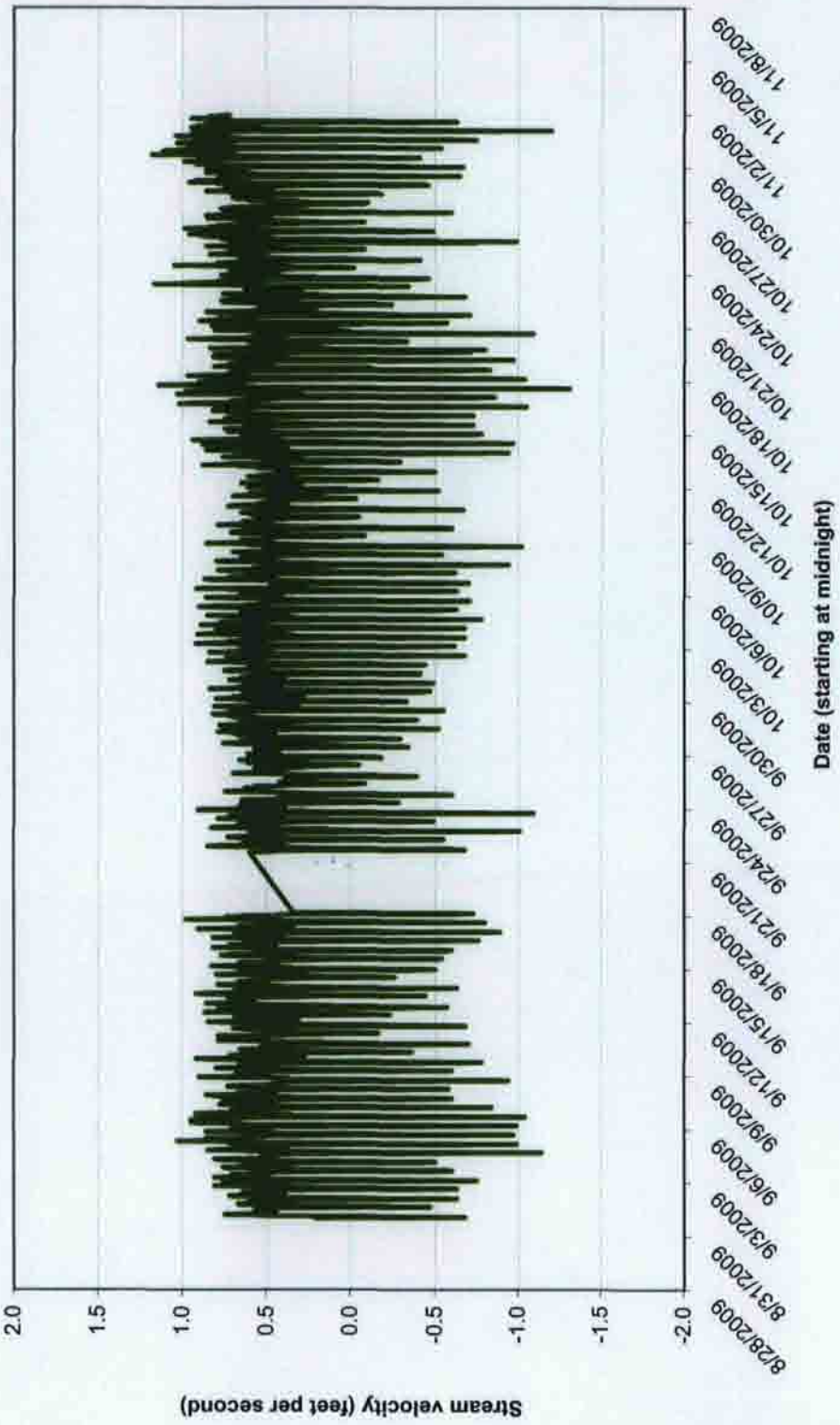
2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-34



McCormick and Baxter Superfund Site
Portland, Oregon

Stream Velocity Willamette River, Portland, OR (Morrison Bridge) Fall 2009

2/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure

D-35

ATTACHMENT A
PHOTOGRAPH DOCUMENTATION

OPERATION AND MAINTENANCE REPORT
JANUARY 2009 TO DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE
PORTLAND, OREGON

Photograph 1 – Surface, inter-armoring, and sub-armoring water sampling using low-flow peristaltic pumps with a multi-parameter probe.

Photograph 2 – Northwest Underwater Construction preparing for dive.

Photograph 3 – Inter-armoring and sub-armoring sampling using Henry Sampler from shoreline.

Photograph 4 – Using divers for retrieval of the SPME samplers, October, 2009.

Photograph 5 – Extraction of the PDMS fiber from the sampler. David Lambert/University of Texas at Austin, October, 2009.

Photograph 6 – Cutting the SPME fibers into 2-cm segments to insert into vials with extraction solvent prior to shipping. Liz Kuriakose/University of Texas at Austin, October, 2009.

Photograph 7 – Placing SPME fiber into vial with solvent for extraction.

ATTACHMENT B
LABORATORY ANALYTICAL REPORTS AND QA MEMORANDA FOR SURFACE, INTER-ARMORING, AND SUB-ARMORING WATER SPRING 2009 SAMPLING EVENT

Included only on the O&M Report DVD

ATTACHMENT C
LABORATORY ANALYTICAL REPORTS AND QA MEMORANDA FOR SURFACE, INTER-ARMORING, AND SUB-ARMORING WATER FALL 2009 SAMPLING EVENT

Included only on the O&M Report DVD

ATTACHMENT D.
NW CONSTRUCTION SPRING AND FALL 2009 SAMPLING VIDEOS

Included only on the O&M Report DVD

ATTACHMENT E
UNIVERSITY OF TEXAS FINAL SAMPLING AND ANALYSIS PLAN FOR SPMES AND THE DRAFT SPME METHODOLOGY AND RESULTS REPORT

Included only on the O&M Report DVD

Appendix E

APPENDIX E
INFILTRATION POND MW-59s
GROUNDWATER QUALITY ASSESSMENT

OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009

Hart Crowser/GSI
15670-05/Task 7 May 25, 2010

APPENDIX E
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2.0 SAMPLING METHODOLOGY, HANDLING, AND ANALYSIS	E-2
2.1 Sample Methodology	E-2
2.2 Sample Handling and Analysis	E-3
3.0 SAMPLING RESULTS	E-3
3.1 Total Metals	E-3
3.2 Pentachlorophenol	E-4
3.3 Polynuclear Aromatic Hydrocarbons	E-4
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5.0 REFERENCES	E-6

TABLE

E-1 Groundwater Analytical Results: MW-59s

FIGURE

E-1 Groundwater Monitoring Well MW-59s and Infiltration Pond Location Map

ATTACHMENT

A Data Quality Review and Laboratory Analytical Report for Quarterly MW-59s Sampling (DVD)

ACRONYMS

ACL	Alternate Concentration Limits
COC	contaminant of concern
CPAH	carcinogenic polynuclear aromatic hydrocarbons
DEQ	Oregon Department of Environmental Quality
E&E	Ecology & Environment, Inc.
EPA	U.S. Environmental Protection Agency
HPAH	high molecular weight polynuclear aromatic hydrocarbons
LPAH	low molecular weight polynuclear aromatic hydrocarbons
lpm	liters per minute
McCormick and Baxter	McCormick and Baxter Creosoting Company
MCL	Primary Drinking Water Standard Maximum Contaminant Levels
mg/L	milligram per liter
mS/cm	milliSiemens/centimeter
NAPL	nonaqueous phase liquid
O&M	Operation and Maintenance
ORP	oxidation-reduction potential
PAH	polynuclear aromatic hydrocarbons
PCP	pentachlorophenol
ROD	Record of Decision
SEC	specific electrical conductance
Site	McCormick and Baxter Superfund Site
µg/L	microgram per liter

APPENDIX E
INFILTRATION POND GROUNDWATER QUALITY ASSESSMENT
OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE

1.0 INTRODUCTION

This Appendix to the *January 2009 through December 2009 Operation and Maintenance (O&M) Report* summarizes Summer 2009 groundwater sampling activities and analytical results for the groundwater sampling of monitoring well MW-59s at the McCormick and Baxter Superfund Site (Site). The location of the Site, the Site layout, and surface elevations are shown on Figures 1 through 3 in the main section of the O&M Report.

In 2005, a soil cap was installed at the Site as part of the remedial action. One component of the soil cap is an infiltration pond constructed at the southeast corner of the Site to collect surface water runoff from the Site. A groundwater monitoring well, MW-59s, was installed downgradient from the infiltration pond to monitor contaminant levels in groundwater. Figure E-1 shows the location of monitoring well MW-59s relative to the infiltration pond and the drainage ditch leading to the infiltration pond. During storm events, stormwater from the upland soil cap, excluding the area within the barrier wall, drains to the infiltration pond. During typical precipitation events, stormwater infiltrates directly without appreciable runoff reaching the infiltration pond.

In accordance with the Site *O&M Plan* (DEQ, 2007) groundwater samples were to be collected from MW-59s to evaluate the potential for subsurface contaminants to be mobilized by the infiltration pond. Previously, five groundwater sampling events have been completed to collect data from MW-59s (April 2006, November 2006, February 2007, October 2007, and August 2008). Although concentrations are below EPA's maximum contaminant levels (MCLs) with the exception of arsenic which is at background levels, concentrations from these previous sampling events did not provide a clear understanding of whether the data show an increasing trend in concentrations in groundwater downgradient from the infiltration pond. Therefore, the decision to continue to sample MW-59s was made during the July 2009 technical team meeting. The well was sampled on August 31, 2009.

Samples were analyzed for the groundwater contaminants of concern (COCs) as identified in the *Record of Decision* (ROD) (EPA, 1996). COCs include:

- Metals (arsenic, chromium, copper, and zinc);
- Pentachlorophenol (PCP); and
- Polynuclear aromatic hydrocarbons (PAH).

2.0 SAMPLING METHODOLOGY, HANDLING, AND ANALYSIS

This section describes the methodology for sampling monitoring well MW-59s on August 31, 2009. The sampling methodology for the sampling events between April 2006 and October 2007 are described in Attachment 1 of the *Operation and Maintenance Report October 2005 through December 2006* (E&E, 2007). During those first 4 sampling events, a submersible pump was employed using a low-flow sampling approach. The following sections describe the sampling methodology, sample handling procedures, and laboratory analyses for the sample collected on August 31, 2009. Last year's sampling event (August 21, 2008) was collected in a similar manner to this year's groundwater sample.

2.1 Sample Methodology

Groundwater samples were collected from monitoring well MW-59s using a variable-speed peristaltic pump. The pump intake was lowered into the screened interval of the well so that water withdrawn was representative of the aquifer. The initial pumping rate was set at no more than 0.5 liter per minute (lpm) and slowly increased such that drawdown in the well did not exceed 4 inches. A water quality meter equipped with a flow-through cell was used to monitor the following water quality parameters: pH, specific electrical conductance (SEC), temperature, and oxidation-reduction potential (ORP). Dissolved oxygen and turbidity sensors malfunctioned and as a result data was not collected.

Disposable polyethylene tubing was used to collect the groundwater samples. A minimum of one tubing volume (including the volume of water in the pump and the flow-through cell) was purged before recording water quality parameters. Field water quality parameters were recorded in approximately 5-minute intervals for the remainder of the purge. The final field water quality parameters are included in Table F-1.

Purge water was collected in a 5-gallon bucket and transferred to a 55-gallon steel drum containing other Site purge water for appropriate disposal. Collection proceeded after water quality parameters had stabilized to within the following criteria: pH ±0.1 pH units, SEC ±3% milliSiemens/centimeter

(mS/cm); ORP ±10 millivolts. Although turbidity was not measured during purging, visual observations indicated groundwater during sampling was clear with no visible sediment. After parameters had stabilized, groundwater samples were collected directly from the pump tubing into sample containers.

2.2 Sample Handling and Analysis

Upon collection, samples were labeled, sealed in plastic bags, and placed on ice in a cooler for transport to the contract laboratory. Analytical services were provided by Pace Analytical of Seattle, Washington, under contract to the Oregon Department of Environmental Quality (DEQ). Proper chain-of-custody procedures were followed from sample collection to analysis; however, PCP analysis was accidentally omitted from the chain-of-custody and was not analyzed. Groundwater samples were analyzed using the following methods:

- Total metals (arsenic, copper, chromium, and zinc) by EPA Method 6020; and
- PAHs by EPA Method 8270-SIM.

3.0 SAMPLING RESULTS

This section describes the analytical results for groundwater samples collected for the six sampling events. Laboratory results from August 2009 are provided in Attachment A. A summary of analytical results from the August 2009 and five previous sampling events are presented in Table E-1.

Alternate Concentration Limits (ACL) were established in the *Record of Decision* (EPA, 1996) as protective cleanup levels for groundwater at the Site as the result of the technical impracticability of restoring groundwater to drinking water standards. However, as described in the *Second Five-Year Review* (DEQ, 2006), the EPA has determined that ACLs are not valid as substitutes for Primary Drinking Water Standard Maximum Contaminant Levels (MCLs) in groundwater at any site. Therefore, MCLs are provided as a "point of reference" in Table E-1 until the ROD is amended with appropriate protective levels for groundwater at the Site.

3.1 Total Metals

Groundwater from MW-59s was analyzed for total arsenic, chromium, copper, and zinc by EPA Method 6020. The results for August 2009 are summarized below.

Total arsenic concentration in groundwater was reported as 0.0301 mg/L. During the Spring 2006 Site-wide groundwater sampling event, arsenic was detected in 72 of the 79 Site wells at concentrations ranging from 0.000664 to 0.145 mg/L in groundwater from monitoring wells without nonaqueous phase liquid (NAPL). Total arsenic in MW-59s has gradually increased since the Spring 2006 sampling event, but appears to have stabilized at 0.0301 mg/L in 2008 and 2009. Results are consistently above the MCL of 0.01 mg/L.

Total chromium concentration was reported as 0.00073 mg/L. During the Spring 2006 Site-wide groundwater sampling, chromium was detected in groundwater from 72 of the 79 Site wells with concentrations ranging from 0.0006 to 0.0635 from monitoring wells without NAPL. Total chromium in groundwater from MW-59s is consistent with concentrations prior to the infiltration pond installation and is well below the MCL for chromium of 0.10 mg/L.

Total copper concentration was reported as 0.0011 mg/L. During the Spring 2006 Site-wide groundwater sampling, copper was detected in 67 of the 79 Site wells at concentrations ranging from 0.0003 to 0.023 mg/L from monitoring wells without NAPL. Higher concentrations of total copper (0.0584 mg/L) were detected in August 2008 likely due to high turbidity during sampling. As such, the lower total copper concentration in 2009 (0.0011 mg/L) is likely due to lower turbidity as compared to 2008, as field indications during sampling were clear with no visible sediment. Results are consistently below the MCL of 1.30 mg/L.

Total zinc concentration was reported as 0.0102 mg/L. During the Spring 2006 Site-wide groundwater sampling, zinc was detected in 49 of the 79 Site wells at concentrations ranging from 0.0014 to 0.034 mg/L in monitoring wells without NAPL. Similar to copper, a higher level of total zinc (0.140 mg/L) was detected in August 2008 likely due to high turbidity during sampling. Results are consistently below the MCL of 5.00 mg/L.

3.2 Pentachlorophenol

Groundwater samples were not analyzed for PCP in August 2009. PCP was not detected above low level method detection limits in the four previous events for which PCP was analyzed. PCP was also not analyzed for in April 2006.

3.3 Polynuclear Aromatic Hydrocarbons

Groundwater samples were analyzed for PAHs by EPA Method 8270-SIM. The method reporting limits for PAHs ranged from 0.019 to 0.11 µg/L.

During the August 2009 sampling event, five low-molecular weight PAHs (LPAHs) were detected including anthracene at 0.064 µg/L, fluorene at 0.026 µg/L, naphthalene at 0.042 µg/L, and phenanthrene at 0.085 µg/L. Total LPAH concentrations (0.1750 µg/L) exceeded those from 2008, but were below results from 2007 (0.2950 µg/L).

Six high-molecular weight PAHs (HPAHs) were detected including benz(a)anthracene at 0.033 µg/L , benzo(k)fluoranthene at 0.021 µg/L, benzo(g,h,i)perylene at 0.035 µg/L, chrysene at 0.033 µg/L, fluoranthene at 0.041 µg/L, and pyrene at 0.032 µg/L. Total HPAHs at 0.221 µg/L, total carcinogenic PAHs (CPAHs) at 0.122 µg/L, and total PAHs at 0.396 µg/L are the highest detected to date. HPAHs and CPAHs had not previously been detected. Benz(a)pyrene, the only PAH with an MCL, has not been detected in groundwater from MW-59s (the detection limit has been an order of magnitude below the 0.2 ug/L MCL).

Due to lower detection limits used during sampling events in October 2007, August 2008, and August 2009, more PAHs are now routinely being detected at lower concentrations. Although more PAHs are being detected due to the lower detection limits, there is no clear trend in the PAH concentrations in MW-59s.

4.0 SUMMARY

During 2009, concentrations for chromium, copper, and zinc decreased compared to previous sampling events. Arsenic concentrations increased slightly from 2007 levels, but appear to have stabilized since 2008. Five LPAHs and six HPAHs (including four CPAHS) were detected at low levels in August 2009. Total PAHs detected in August 2009 were the highest to date. PAHs were not detected during the first three sampling events; however, the detection limit for PAHs was higher during these events. Currently, there is not a clear trend in PAH concentrations.

In the August 2008 Technical Team meeting, a decision was made to sample monitoring well MW-59s on an annual basis through 2010. Although metals concentrations have generally decreased compared with 2008 results and total PAHs have been detected more frequently in recent sampling events, there is not enough data to support a clear pattern regarding the potential for subsurface contaminants to be mobilized by the infiltration pond.

Continued sampling of monitoring well MW-59s would provide a more comprehensive data set to show trends in contaminant levels over time. We

recommend one additional sampling event of MW-59s in August 2010 to observe whether there is a trend developing as a result of Site conditions.

5.0 REFERENCES

E&E, 2007. *Operation and Maintenance Report (October 2005 through December 2006), McCormick & Baxter Creosoting Company, Portland, Oregon.* March 2007.

DEQ, 2006. *Second Five-Year Review, McCormick and Baxter Creosoting Company Superfund Site, Portland, Oregon.* September 2006.

DEQ, 2007. *Draft Final Operation and Maintenance Plan, McCormick and Baxter Creosoting Company Superfund Site, Portland, Oregon.* March 2007.

EPA, 1996. *Record of Decision, McCormick and Baxter Creosoting Company, Portland, Oregon.* March 1996.

Table E-1 - Groundwater Analytical Results: MW-59s
McCormick and Baxter Superfund Site
Portland, Oregon

SAMPLE LOCATION		EPA Primary Drinking Water Standard Maximum Contaminant Levels (for reference only)	MW-59s (2nd Quarter 2006)	MW-59s (4th Quarter 2006)	MW-59s (1st Quarter 2007)	MW-59s (3rd Quarter 2007)	MW-59s (3rd Quarter 2008)	MW-59s (3rd Quarter 2009)
Sample Date			4/26/2006	11/3/2006	2/28/2007	10/3/2007	8/21/2008	8/31/2009
Sample Time			18:01	14:47	12:00	9:58	9:50	17:19
Well Depth			shallow	shallow	shallow	shallow	shallow	shallow
CONTAMINANT OF CONCERN		MCL						
Total Metals (mg/L)								
Arsenic		0.01	**0.0080**	**0.0197**	**0.0122**	**0.0225**	**0.0301**	**0.0301**
Chromium		0.10	**0.0011**	**0.0015**	**0.00319**	**0.00474**	**0.0466**	**0.00073**
Copper		1.30	**0.0005** J	**0.0011** J	**0.000520** J	**0.00107** J	**0.0584**	**0.0011**
Iron		NA	**NA**	**NA**	**NA**	**NA**	**NA**	**52.6**
Zinc		5.00	**0.0056**	**0.0075**	**0.00707**	**0.00845**	**0.140**	**0.0102**
PAHs (µg/L)								
Acenaphthene	L		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0476 U	0.019 U
Acenaphthylene	L		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0476 U	0.019 U
Anthracene	L		0.0472 U	0.0500 U	0.0495 U	**0.0121** J	**0.0397**	**0.064**
Benz (a) anthracene	H, C		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0119 U	**0.033**
Benzo (a) pyrene	H, C	0.2	0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0119 U	0.078 U
Benzo (b) fluoranthene	H, C		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0119 U	0.11 U
Benzo (k) fluoranthene	H, C		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0119 U	**0.021**
Benzo (ghi) perylene	H, C		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0119 U	**0.035**
Chrysene	H, C		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0119 U	**0.033**
Dibenzo (a,h) anthracene	H, C		0.0943 U	0.1000 U	0.0990 U	0.0238 U	0.0238 U	0.019 U
Fluoranthene	H		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0119 U	**0.041**
Fluorene	L		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0476 U	**0.026**
Indeno (1,2,3-cd) pyrene	H, C		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0119 U	0.064 U
Naphthalene	L		0.0472 U	0.0500 U	0.0495 U	**0.257**	0.0119 U	**0.042** J
Pentachlorophenol	L	1	NA	1.0000 U	0.9900 U	0.238 U	0.238 U	NA
Phenanthrene	L		0.0472 U	0.0500 U	0.0495 U	**0.0259**	**0.0357**	**0.085**
Pyrene	H		0.0472 U	0.0500 U	0.0495 U	0.0119 U	0.0119 U	**0.032**
Total LPAHs			0.1416 U	0.6500 U	0.6435 U	**0.2950** J	**0.0754**	**0.175**
Total HPAHs			0.2596 U	0.2750 U	0.2723 U	0.0655 U	0.0655 U	**0.221**
Total Carcinogenic PAHs			0.2124 U	0.2250 U	0.2228 U	0.0536 U	0.0536 U	**0.122**
Total PAHs			0.4012 U	0.9250 U	0.9158 U	**0.2950** J	**0.0774**	**0.396**
FIELD PARAMETERS								
Groundwater Elevation (ft NAVD88)			**17.10**	**12.01**	**16.52**	**23.73**	**14.63**	**13.06**
Temperature (°C)			**14.60**	**14.02**	**10.51**	**14.43**	**15.21**	**17.4**
Oxidation-Reduction Potential (mV)			**-20.00**	**13.60**	**44.7**	**-19.50**	**-15.69**	**-33**
pH			**5.94**	**5.77**	**5.89**	**5.90**	**6.09**	**6.23**
Specific Conductance (mS/cm)			**0.54**	**0.36**	**0.264**	**0.52**	**0.559**	**0.480**
Turbidity (NTU)			**40.80**	**11.60**	**3.42**	**9.15**	**78.70**	**NA**
Dissolved Oxygen (mg/L)			**0.00**	**0.40**	**0.7**	**0.32**	**0.78**	**NA**

Notes:

MCL = Primary Drinking Water Standard Maximum Contaminant Level
bold = Indicates the analyte was detected above MDL
bold and shaded = Indicates the analyte was detected in excess of MCL
J = Estimated Value
U = Value Below MDL (value represents MDL)
L = Low Molecular Weight PAH (LPAH)
PAH = polynuclear aromatic hydrocarbon
NA = Not available

H = High Molecular Weight PAH (HPAH)
C = Carcinogenic PAH
µg/L = micrograms per liter
mg/L = milligrams per liter
mS/cm = milliSiemens/centimeter
mV = millivolts
NTU = nephelometric turbidity unit

LEGEND

- Groundwater Monitoring Wells
- Infiltration Pond
- Subsurface Barrier Wall

NOTE: Aerial photo taken on September 22, 2006

0 200 400

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Groundwater Monitoring Well MW-59s and Infiltration Pond Location Map

2/10

HARTCROWSER GSI Water Solutions, Inc.

Figure **E-1**

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2009_Annual_Report\FigureE-1_GW_Monitoring_Well_MW-59s_Location_Map.mxd, Date: January 28, 2010 9:21:51 AM

ATTACHMENT A
DATA QUALITY REVIEW AND LABORATORY ANALYTICAL REPORT FOR QUARTERLY MW-59S SAMPLING

Included only on the O&M Report DVD

Appendix F

APPENDIX F
EBULLITION AND SHEEN INVESTIGATION AND CHARACTERIZATION SUMMARY

OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009

Hart Crowser/GSI
15670-05/Task 7 May 25, 2010

APPENDIX F
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FIGURE

F-1 Sheen Sampling Site Plan

ATTACHMENTS

A Photograph Documentation
B Laboratory Data (DVD)
C Portland State University Ebullition Study (DVD)
D University of Texas Organophilic Clay and SPME Report (DVD)
E Montana State University Biogenic Report (DVD)

ACRONYMS

ACB	articulated concrete block
cPAH	carcinogenic PAH
DEQ	Oregon Department of Environmental Quality
DGGE	denaturing gradient gel electrophoresis
DQO	data quality objective
E&E	Ecology & Environment, Inc.
EPA	U.S. Environmental Protection Agency
GC/MS	Gas chromatography/mass spectrometry
GSI	GSI Water Solutions, Inc.
HEM	hexane extractable material
HPAH	high molecular weight PAH
mg/L	milligrams per liter
lb	pound
LNAPL	light non-aqueous phase liquid
liters/m^2-day	liters per square meter per day
LPAH	low molecular weight PAH
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/ml	milligrams per milliliter
MSU	Montana State University
NAPL	non-aqueous phase liquid
NAVD	North American Vertical Datum
ng/L	nanograms per liter
nM/day	nanomoles per day
NWTPH-HCID	Northwest TPH-hydrocarbon identification
O&M	Operation and Maintenance
PAH	polynuclear aromatic hydrocarbon
PCP	pentachlorophenol
PCR	polymerase chain reaction
PPE	personal protective equipment
q/PCR	quantitative polymerase chain reaction

ACRONYMS (CONTINUED)

RCM	Reactive Core Mat
ROD	Record of Decision
Site	McCormick & Baxter Creosoting Company Superfund Site
SPME	solid phase micro-extraction
SVOC	semi-volatile organic compound
TFA	Tank Farm Area
TOC	total organic carbon
TPH	total petroleum hydrocarbon
WC	Willamette Cove

APPENDIX F
EBULLITION AND SHEEN INVESTIGATION AND CHARACTERIZATION SUMMARY
OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE
PORTLAND, OREGON

1.0 INTRODUCTION

Appendix F to the *January 2009 through December 2009 Operation and Maintenance (O&M) Report* summarizes the ebullition and sheen investigation activities from 2008 including analyses that were completed in 2009, rationale for additional sheen characterization work, and the sampling activities and analytical and biological results for the 2009 sheen characterization completed at the McCormick and Baxter Superfund Site (Site) in Portland, Oregon.

In 2009, the Oregon Department of Environmental Quality (DEQ) directed Hart Crowser/GSI Water Solutions, Inc. (GSI), to characterize sheen observed along discrete portions of the Willamette River shoreline at the Site. The sheen characterization focused on determining the nature of the sheen and included the following activities:

- Weekly shoreline sheen observations for 3 months (late July through late October);
- Laboratory controlled sheen simulation using Site creosote for chemical analysis; and
- Sampling sheen with Teflon® nets and pads with co-located ambient surface water samples collected using a peristaltic pump, and sampling sheen and collocated ambient surface water using C-18 cartridges. Samples were analyzed for chemical and biological attributes.

The investigation was funded by the DEQ through a Cooperative Agreement with U.S. Environmental Protection Agency (EPA). The location of the Site, Site layout, and surface elevations are on Figures 1 through 3 in the main section of the O&M Report.

1.1 Purpose

Sheen has been observed at the Site since the sediment cap was installed in 2004 and completed in 2005. The initial sheen observed were small sheen bursts on the surface water associated with ebullition (ebullition-induced sheen). Sheen, not

associated with ebullition, is observed in late summer/early fall along the shoreward side of the Organoclay™ mats in the Tank Farm Area (TFA), over the top of the granular organophilic clay along the Willamette Cove (WC) shoreline, and at the southern end of the Site (Figure F-1).

In 2008, extensive investigative work was conducted to determine whether sheen was caused by creosote migrating through the sediment cap either vertically by tidal pumping or laterally associated with groundwater discharge. The results indicated that creosote is not migrating through the sediment cap to create the sheen; however, the origin and nature of the sheen were not determined. A summary of the 2008 investigations is included in Section 2 of this Appendix.

The purpose of the additional 2009 characterization is to identify the nature of the sheen with the objective of understanding whether the sheen presence is related to site contamination, hazardous, or just biogenic or metallic sheen associated with groundwater discharge from the Site.

Detailed descriptions of the shoreline sheens are provided in the *Operation and Maintenance (O&M) Report October 2005 through December 2006* (E&E, 2007), the *Post Remedial Action Conceptual Site Model for NAPL Transport* (GSI, 2007), and the *O&M Report January 2007 through December 2007* (E&E, 2008), and the *O&M Report January 2008 through December 2008* (Hart Crowser/GSI, 2009a).

1.2 Report Organization

The content of each section in this Appendix and the Attachments to this Appendix are summarized below.

Section 1 presents the purpose, objectives, and report contents.
Section 2 presents a summary of the 2008 ebullition and sheen investigation results as well as new information from testing that was completed in 2009 from the 2008 samples.
Section 3 presents the data quality objectives for the sheen methodology for the sheen characterization.
Section 4 presents the sampling methodology for the sheen characterization.
Section 5 presents the sheen simulation methodology and analytical chemistry results of the sheen and ambient water samples.
Section 6 presents a summary of Dr. Camper's biogenic methodology and results.
Section 7 presents conclusions and recommendations.

Attachment A contains the photograph log of sheen sampling and sheen surveys.
Attachment B contains the laboratory data reports.

Attachment C contains the Final Portland State University Ebullition Study Report.
Attachment D contains the Final University of Texas Organophilic Clay and SPME Report.
Attachment E contains the Final Montana State University Biogenic Report.

1.3 Scope of Work

The work conducted in 2009 to characterize the sheen consisted of the following general tasks.

- Laboratory simulation of thin creosote sheen, which was sampled in a similar manner to field samples with Teflon® nets and pads, and analyzed for total petroleum hydrocarbon (TPH), polynuclear aromatic hydrocarbons (PAHs), and select metals.
- Collection of sheen from 4 locations across 3 discrete weeks for biogenic and chemical analyses.
- Use XAD C-18 chamber, glass wool, and Teflon®-fluorocarbon polymer nets to isolate sheen (to the extent practicable).
- Collect ambient water samples co-located with sheen samples for biogenic and chemical analyses.
- Dr. Anne Camper/University of Montana performed a biogenic characterization of the sheen and co-located surface water.

In addition, Kiara Smith/Portland State University completed her research regarding the microbial activity related to ebullition from the organophilic clay within the sediment cap, and Dr. Reible/University of Texas at Austin completed his analyses on the organophilic clays used at the Site and final reporting for the solid phase micro-extraction (SPME) samples. Their work is summarized in Section 2 of this Appendix and their final reports are included as Attachments C and D, respectively.

2.0 EBULLITION AND SHEEN INVESTIGATION SUMMARY - 2007/2008

Extensive investigations were conducted at the Site in 2008 to determine whether:

- Creosote or PAH contamination is migrating through the sediment cap resulting in a sheen on surface water;

- Ebullition is a significant pathway for contaminant transport through the sediment cap;
- The Organoclay™ reactive core mats (RCM) are performing as designed;
- The origin of the gas is from methanogenesis within the bulk organophilic clay layer of the sediment cap; and
- The granular bulk organophilic clay is breaking down, and if so, will that adversely affect the longevity of the sediment cap life.

Methodology and preliminary results of the 2008 investigation were reported in Appendix G of the *Operation and Maintenance Report January 2008 through December 2008* (Hart Crowser/GSI, 2009). This section summarizes the 2008 investigation and provides results for analyses that were completed in 2009 from the 2008 investigation that were not reported in Hart Crowser/GSI (2009). The final reports for the Portland State University Ebullition Study and University of Texas at Austin Organophilic clay/SPME studies are included as Attachments C and D, respectively, in this Appendix.

2.1 Ebullition and Organophilic Clay Performance

This section summarized the final results from the ebullition and organophilic clay investigations from 2008. As mentioned above, the methodology and preliminary results were presented in Appendix G of the *Operation and Maintenance Report January 2008 through December 2008* (Hart Crowser/GSI, 2009). This section summarizes the main points and includes the results of laboratory analyses conducted in 2009 on 2008 field samples.

Ebullition Appearance and Rates. In 2005, the summer after the sediment cap was installed, ebullition was observed in the near-shore environment within the sediment cap boundary. In a few discrete areas, where residual creosote is present beneath the cap, the gas bubbles entrained creosote which resulted in a sheen burst at the water's surface. These areas were capped with CETCO Organoclay™ RCMs. No ebullition-induced sheen has been observed since 2007 when the last RCM was emplaced. Figure F-1 shows the locations where RCMs were placed.

During routine monitoring, it was observed that ebullition (without sheen) appeared to be more prolific in areas where the one foot of bulk organophilic clay (Aqua Technologies, ET-1) was placed as part of the sediment cap. Hart Crowser/GSI conducted two ebullition surveys in 2009, which showed that ebullition was clearly more prolific in the areas with bulk organophilic clay. It also showed that in the early summer, ebullition was only observed in areas with

organophilic clay while in the early fall, ebullition occurs throughout the sediment cap area remaining most prolific in areas with bulk organophilic clay. The amount of ebullition raised concern whether the gas pathways could be a significant pathway for contaminant transport through the sediment cap and whether the integrity of the bulk organophilic clay could be compromised by the degradation that was assumed to be the origin of the gas formation.

In order to address whether the ebullition was a significant contaminant pathway through the sediment cap, gas and water associated with gas pathways were compared to water samples taken adjacent (within a 5-10 feet) to gas pathways. Results indicate that the ebullition, although a contaminant pathway, is not a significant pathway for contaminant transport through the sediment cap. Gas production rate was estimated to be between 2.5 and 5.0 liters per square meter per day (liters/m^2-day) within the bulk organophilic clay footprint and between 0.02 to 0.09 liters/m^2-day in areas of the sediment cap where no bulk organophilic clay is present. Yuan and Reible (2009, in review) report ebullition rates ranging from 3×10^{-4} to 2.64 liters/m^2-day because of different site conditions. The ebullition rate outside of the organophilic clay footprint falls within this range. The lower estimates for ebullition rates over the granular organophilic clay are at the high end of the literature range, while the higher estimates exceed the literature range.

Flux Chamber Sampling. In 2008, water and gas samples were collected from flux chambers placed over the top of discrete gas pathways and adjacent to gas pathways in 10 locations (9 of which remained in place for sampling). Water from the flux chambers was collected over a one week timeframe by pumping a few liters per day through XAD columns. The XAD columns were analyzed for the mass of PAHs. The mass was converted to a concentration (microgram per liter [µg/L]) in water by dividing the PAH mass by the liters of water pumped through the XAD column. PAHs were detected in each sample.

The total low molecular weight PAHs (LPAHs) detected in water from the flux chambers placed over gas pathways ranged from 0.089 µg/L to 97.0 µg/L with a median of 1.298 µg/L while the range of total LPAHs in water from the flux chambers, located where no gas pathway was observed, ranged from 0.107 µg/L to 7.05 µg/L with a median of 1.004 µg/L.

The total high molecular weight PAHs (HPAHs) detected in water from the flux chambers placed over gas pathways ranged from 0.0139 µg/L to 0.137 µg/L with a median of 0.0211 µg/L while the range of total HPAHs in water from the flux chambers, located where no gas pathway was observed, ranged from 0.0071 µg/L to 0.0736 µg/L with a median of 0.0121 µg/L.

PAHs detected for both LPAHs and HPAHs are consistently higher in water from the flux chambers with a gas pathway relative to chambers placed where no gas pathway was observed. Total LPAHs by individual locations are only 1.2 to 21 times higher in water from the flux chambers located over ebullition pathways than in water from the flux chambers where no gas pathways were observed. Total HPAHs by individual locations are 1.5 to 277 times higher than the chamber placed where no gas pathways were observed. Because HPAHs are more likely to be associated with particulate matter via adsorption, this difference in ratios suggests that the gas pathways act more as a pathway for particulate matter than for porewater (where LPAHs are more likely to be present dissolved in water). The carcinogenic PAH (cPAH) concentrations in water from FC-1G and FC-5G (0.07067 µg/L and 0.0667 µg/L, respectively) exceed the Record of Decision (ROD) sediment cap performance goal (0.031 µg/L); however, this ambient water quality goal is based on cPAHs dissolved in water, while the above data suggest that the cPAHs may be sorbed to particulate matter. The ambient water quality criteria that are used as the comparison criteria are based on constituents dissolved in water.

In general, although PAH concentrations were higher in water from the flux chambers located over the top of ebullition pathways, the PAH concentrations detected in water from the flux chambers are generally below comparison criteria.

The flux chamber gas sampling showed that methane comprised nearly 100% of the gas composition in the areas overlying the bulk organophilic clay while the gas composition in areas without organophilic clay was 9 to 13% carbon dioxide and only 36 to 45% methane. These results suggest that the primary degradation processes occurring in the bulk organophilic clay is methanogenesis while other processes such as sulfate reduction may be occurring in other areas of the sediment cap.

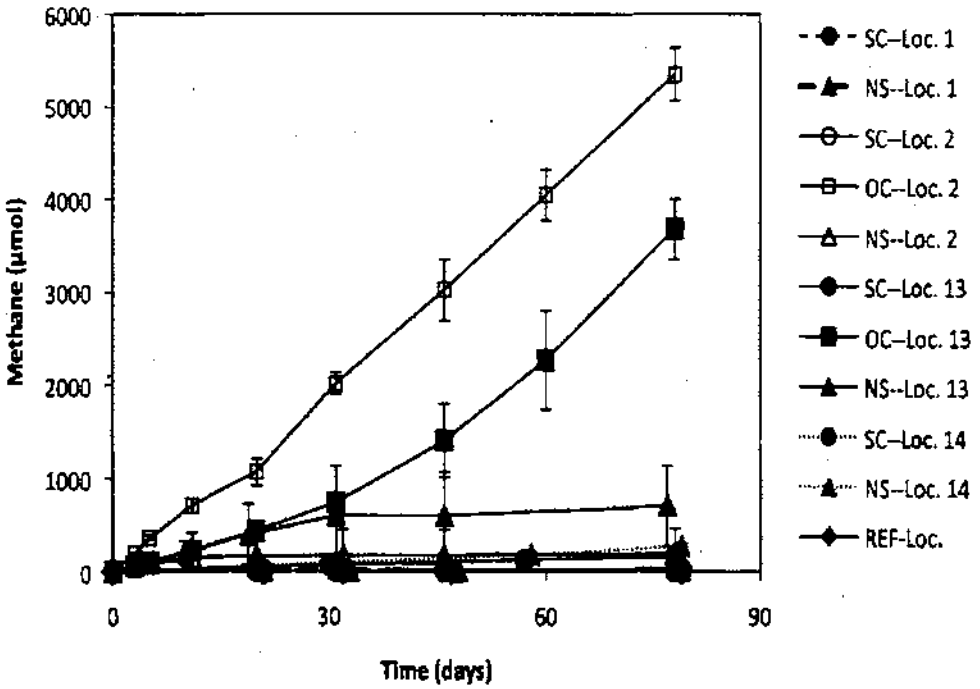
Capping Material Evaluation. Kiara Smith, a PhD student at Portland State University, conducted a study to determine the rate of gas production from the various sediment cap layers, and to determine whether the organophilic clay was degrading. Her final report is included as Attachment C to this Appendix.

Sediment cores and porewater were collected from the sediment cap to investigate microbial activity and the possible causes of methane ebullition from the sediment cap, particularly in areas with bulk organophilic clay. Samples were collected from three sediment cap layers: 1) sediment cap containing a sand layer underlain by a bulk organophilic clay layer (AquaTech ET-1); 2) sand layer of the sediment cap where no organophilic clay was present but within the area where residual creosote was suspected to be present beneath the cap; and 3) a reference location (sand cap layer away from the highly contaminated

native sediment and organophilic clay). Porewater samples were collected from the sand cap layer, and below the organophilic clay.

Porewater samples were analyzed for inorganic and organic constituents as well as for putative metabolites that indicate anaerobic biodegradation of PAHs. The general chemistry and contaminant results are presented in Attachment C of this appendix. This summary focuses on the metabolites that were analyzed in 2009. Metabolites were found in four out of five samples suggesting widespread degradation of naphthalene and potentially other PAHs within the sediments at the Site. A degradation rate of 31 nanomoles per day (nM/day) was measured in push-pull tests conducted at upland well MW-45s (located outside the barrier wall).

Capping materials (sand and bulk organophilic clay) and native sediment were incubated in the lab to assess the contribution of the layers to overall methane production observed at the Site. Bulk organophilic clay layers of the sediment cap produced up to 1,500 times more methane over an 80-day period than the other layers incubated under the same conditions (see graph below). These results suggested the bulk organophilic clay stimulates methanogenesis (as was suspected by the prolific ebullition in areas where bulk organophilic clay was present).



Methane Production in Incubations (Kiara Smith/Portland State University). SC = sediment cap; NS = native sediment; OC = organophilic clay (Aqua Technologies, Inc – ET-1 from the Site); REF-Loc. = reference location

Quantitative polymerase chain reaction (qPCR) was performed on DNA extracted from the sediment and cap materials after 215 days to quantify the number of methanogens in each incubated sample. Generally, greater numbers of methanogens were present in the native sediment incubations when compared to sand cap incubations. The organophilic clay incubation expressed a methanogen number comparable to the native sediment incubations. However, based on the rates of methane production, the methanogens in the organophilic clay are remarkably more active than the methanogens in the native sediment. The presence of a syntrophic organism in the bulk organophilic clay, as revealed using denaturing gradient gel electrophoresis (DGGE) coupled with genetic sequencing, suggests a synergistic relationship between methanogens and the bacterial organism, *Syntrophus* sp., known to breakdown long-chain hydrocarbons and fatty acids. Acetate, hydrogen (H_2), carbon dioxide (CO_2),and other one-carbon compounds can be converted directly by methanogenic bacteria into methane and carbon dioxide. For degradation of fatty acids longer than two carbon atoms, alcohols longer than one carbon atom, and branched-chain and aromatic fatty acids, another group of fermenting bacteria is needed. These bacteria convert their substrates to acetate, H_2, and CO_2 which are subsequently removed by methanogens. So, in other words, the methanogens remove inhibitory levels of H_2 and acetate, allowing the oxidation of hydrocarbons and fatty acids to be energetically favorable for the syntrophic bacteria (*Syntrophus* sp.). Because the bulk organophilic clay is synthesized from clay treated with long-chain (C12-18) quaternary amine (Aqua Technologies, Inc. Website), *Syntrophus* sp., may be able to use the long-chain hydrocarbon component of the organophilic clay as a carbon source. Thus, the syntrophic relationship between the bacteria and methanogens may be the cause of the high rates of methanogenesis observed in the bulk organophilic clay.

Organic Carbon in Organophilic Clay. Both Kiara Smith and Dr. Danny Reible analyzed the organophilic clays used at the Site for organic carbon to determine whether the bulk organophilic clay is being degraded (i.e., losing carbon). Ms. Smith measured the total organic carbon content of fresh Aqua Technologies ET-1 organophilic clay and organophilic clay samples retrieved from the sediment cores, in addition to changes in the total carbon content of both brands of bulk organophilic clays incubated for 300 days. A significant loss of total organic carbon was noted. The rates of loss were in the same order of magnitude as the molar rates of methane production measured in the incubation tests. This suggests that the carbon originating from the bulk organophilic clay is ultimately

converted to methane gas. The greatest loss of carbon was measured in the WC bulk organophilic clay incubations, corresponding to a half-life of 1.4 years. It is expected that the conditions within the incubations allow for faster degradation rates than under natural conditions.

Dr. Reible measured and then compared the fraction of organic matter in the Aqua Technologies ET-1 and CETCO PM-199 organophilic clays collected from the Site to fresh samples of the same materials to estimate an organic matter degradation rate (see table on Page F-9). The estimated half-life of organic matter is 6.6 years for the ET-1 organophilic clay collected from the Site, and in excess of 30 years for the CETCO 199 Organoclay™. Note that these estimates are potentially more uncertain than suggested by the standard deviation of the measurements due to the variability in the ET-1 organophilic clay not reflected in the small number of samples analyzed (because only 2 cores were collected from each the TFA and WC bulk granular organophilic clay areas and the standard deviation is based on numerous subsamples from single cores reducing the variability relative to what might be seen from multiple cores in each area). Therefore, additional sampling should be conducted periodically to provide a more reliable estimation of the rate of the bulk organophilic clay degradation. He also measured the sorption capacity of the bulk organophilic clay from the cores and found that, although the organic matter responsible for the sorption characteristics of the organophilic clay is degrading in the ET-1, there remains substantial sorption capacity which is far greater than the amount of non-aqueous phase liquid (NAPL) detected at the surface of the sediments in the areas where organophilic clay is present. It is important to note that, because NAPL migration is controlled and contained by the barrier wall; the rate of degradation of the organic matter in the bulk organophilic clay becomes less of a factor in controlling the release of NAPL in areas where organophilic clay is present. NAPL is not migrating into the bulk granular organoclay, and thus is not likely to be released.

Organophilic Clay Sample	Organic Matter (%)	Standard Deviation (%)
Fresh ET-1 Aqua Technologies, Inc.	24.13	0.16
Site bulk ET-1 organophilic clay (after 4 years in situ)		
WC (MSDS0802; bottom of organophilic clay layer)	16.24	0.14
WC (MSDS0810; bottom of organophilic clay layer)	18.16	2.78
WC (MSDS0805; 3.5" above bottom of organophilic clay layer)	13.15	0.28
Average of field samples	15.85	2.60
Half-life of organic matter in ET-1 samples	**6.6 yrs**	
Fresh CETCO 199/200	34.67	0.07
Organoclay™ extracted from the mat (3-years *in situ*)	32.41	0.37
Half-life of organic matter in CETCO samples	**31 yrs**	

Organic Matter Degradation in Aqua Technologies ET-1 and CETCO PM 199 Organophilic Clays (Dr. Reible/University of Texas).

2.2 Previous Investigations Related to Site Sheen

In 2007 and 2008, DEQ conducted sheen sampling at the Site to determine whether the sheen was related to creosote NAPL migration through the sediment cap. This section summarizes these investigations and references where more detailed information is provided.

2.2.1 2007 Sheen Investigations

The sheen investigations conducted in the summer and fall of 2007 are described in detail in Attachment C of the *O&M Report January 2007 through December 2007* (E&E, 2008). The locations and timing of the sheens are also described.

Two sampling events were conducted in response to sheen observations at the Site in 2007. During the first event, June 26, 2007, surface water samples were collected from eight locations surrounding Organoclay™ Mat #2. Sheen was visible at four of the eight sampling locations at the time of collection. Shoreward of the Organoclay™ Mat #2, PAHs were detected above the comparison criteria at two locations. A second sampling event took place on September 27, 2007. The purpose was to determine whether contaminant concentrations in porewater

increase as water drains from the shoreline bank near the locations of the shoreward PAH detections from samples collected on June 26, 2007. Time-series samples were collected during a complete tidal cycle. No correlation was observed between the tidal level and porewater concentrations. No comparison criteria were exceeded during the September 27, 2007, sampling event.

2.2.2 2008 Sheen Investigations

The sheen investigations conducted in the summer and fall of 2008 are described in detail in *Attachment B of the O&M report January 2008 through December 2008* (HartCrowser/GSI, 2009a). Sheen surveys along the shoreline were initiated in early July 2008, after the Willamette River level dropped below approximately 7.5 feet North America Vertical Datum, 1988 (NAVD88), and were completed through late October 2008. Shoreline sheens were not observed after the first week of October 2008.

2.2.2.1 Sampling Activities and Analysis

Sheen samples in sediment cap sand and adjacent surface water were collected from the WC on July 16, 2008, and were also collected on July 17, 2008, from the former TFA shoreward of Organoclay™ Mat #2, along the shoreline adjacent to the McCormick and Baxter outfall, and near the southern end of the Site adjacent to the Triangle Park property (locations shown on Figure F-1). The samples were analyzed for the following constituents:

- PAHs and pentachlorophenol (PCP) by EPA Method 8270-SIM;
- Hydrocarbon identification by Northwest Method NWTPH-HCID (with and without silica gel cleanup); and
- Total organic carbon (TOC) by EPA Method 415.1.

Additional sheen samples from the surface water were collected by University of Portland on August 28, 2008, and placed onto slides to visually determine if bacteria were present. Bacteria were identified in the sample; however, no interpretation of the relationship of the bacteria to the sheen could be provided.

2.2.2.2 Analytical Sheen Sample Results

Willamette Cove. Sheen was present within articulated concrete block (ACB), both floating on water and in sediment where the water table had dropped below the sediment. A sample of the sediment with sheen showed no detection of PAHs (<18 micrograms per kilogram [µg/kg]), where as the sample of sheen associated with water within an ACB showed low level detections of

acenaphthene, fluorene, and naphthalene at 0.478 µg/L, 0.106 µg/L, and 1.01 µg/L, respectively. Ambient surface water collected from approximately 5 feet from the location where sheen was present contained acenaphthalene and fluorene at 0.43 µg/L and 0.135 µg/L, respectively. There were no detections of TPH in either the sediment with sheen, sheen with water, or ambient water sample; and therefore no silica gel clean-up was conducted on these samples. The TOC concentration in the sheen with water sample was 3.2 milligrams per liter (mg/L) while the ambient water sample was 1.1 mg/L. The additional 2.1 mg/L organic carbon in the sheen should have been detected by the NWTPH-HCID analyses if it were due to hydrocarbons. Thus, the additional organic carbon may have a biogenic source (such as bacteria or naturally-occurring organic matter as tannins). In addition, the PAHs present in the sheen are similar to the PAHs present in the ambient water, in both types, LPAHs, and in concentration. This data suggests that the PAHs present in the sheen may have partitioned from the surface water. The surface water concentrations are reflective of dissolved PAHs present in Site groundwater.

TFA. Along the former TFA, sheen sampling was targeted between Organoclay™ Mat #2 and the riverbank. No TPH was detected in the sediment with sheen sample in this location, while benzo(b)fluoranthene at 18.6 µg/kg, chrysene at 30.4 µg/kg, fluoranthene at 49 µg/kg, phenanthrene at 26.5 µg/kg, and pyrene at 37 µg/kg were detected. The surface water sample with sheen had no detections of TPH or PAHs and the ambient surface water adjacent to the sheen contained acenaphthene at 0.126 µg/L and naphthalene at 0.283 µg/L. No TPH was detected in the ambient surface water sample. Because no TPH was detected in these samples, silica gel cleanup was not conducted. However, the TOC in the sheen with water sample was 1.9 mg/L while the ambient water sample only contained 1.2 mg/L TOC. Thus, the 0.7 mg/L TPH present in the sheen with water sample is not accounted for based on the PAH and TPH result. Thus, the organic matter present in these samples may be attributable to biogenic material. In addition, the ambient surface water sample contained higher concentrations of PAHs than the surface water with sheen, indicating that the sheen does not contain PAH concentrations above that observed in nearby surface water. The sediment sample contained low level PAHs in sediment, which is 2 orders of magnitude below the total cPAHs ROD Cleanup Goal of 2,000 µg/kg.

Between TFA and Southern End of Site. A sample of sediment with sheen was collected from a location along the riverbank between Organoclay™ Mat #2 and the southern edge of the Site. This is a location where sheen frequently has been observed. No TPH was present in either the sediment with sheen or the adjacent ambient surface water sample. Therefore, silica gel cleanup was not performed on these samples. The sediment with sheen sample contained

160 µg/kg acenaphthene and 44.8 µg/kg fluoranthene. The ambient surface water sample adjacent to the sediment contained acenaphthene at 0.155 µg/L. A surface water sample with sheen was not observed and therefore, not collected at this location, and no comparison could be made between the TOC concentrations. However, the TOC concentration in the ambient surface water sample is similar in concentration to the other surface water samples (with the exception of the surface water sample from the southern end of the Site which was slightly higher). The PAH concentrations in the ambient surface water sample are well below concentrations expected to be present in a sheen produced by creosote from the Site.

Southern End of Site. The fourth sheen sample (sediment with sheen) was collected in the area encompassing the southern end of the Site adjacent to the Triangle Park site. The sediment sample contained benzo(b)fluoranthene (26.5 µg/kg), benzo(k)fluoranthene (18.3 µg/kg), chrysene (26.9 µg/kg), fluoranthene (58.4 µg/kg), and pyrene (46.6 µg/kg). The surface water with sheen sample contained acenaphthene at 0.153 µg/L, and the ambient surface water sample contained acenaphthene at 0.328 µg/L. The surface water with sheen and ambient samples were very similar, suggesting that the sheen is not creosote contamination in the form of sheen migrating from the bank. These low level concentrations more likely are associated with the low-level dissolved phase PAHs in groundwater that discharges from the Site, and therefore, are present in ambient surface water near shore.

From the HCID testing, TPH was only detected in one sample, the surface water with sheen sample collected from the southern end of the Site. TPH was not detected in any of the other sheen with water, sheen in sediment, or ambient water samples. The surface water with sheen sample from the southern end of the Site was analyzed for TPH-gasoline and TPH-diesel based on the HCID testing. TPH-gasoline was not detected at a detection limit of 80 ug/L and TPH-diesel was detected at 7.54 mg/L and at 7.44 mg/L after silica gel cleanup indicating that the TPH-diesel is related to diesel range hydrocarbons. In 2003, a study of the TPH concentration associated with the Site creosote sheen bursts was investigated. It shows the concentration of TPH associated with a creosote sheen burst to be 2,500 milligrams per milliliter (mg/ml) of sheen. The post-sediment cap sheen concentrations from the samples collected from the Site in 2008 are not indicative of creosote sheen.

Summary of Findings. Concentrations of LPAHs found in surface water samples are due, in part, to low levels of PAHs in groundwater discharging from the Site. These concentrations, as described in Appendix D of the *O&M Report, January 1, 2008, to December 31, 2008, McCormick & Baxter Superfund Site Portland, Oregon* (Hart Crowser/GSI, 2009a), are well below comparison

criteria used for the Site and similar to the results from semi-annual water sampling, when sheens are not present. In summary, the analytical samples of sheen do not suggest that the sheen is associated with creosote migrating from the Site. It is more likely that low level dissolved PAHs in water partition into the organic sheen resulting in similar concentrations between the sheen and the adjacent surface water, or that the PAHs in the sheen are present from the accumulation of low level PAHs in water as the water evaporates in the stagnant late summer shallow pools where the sheen is observed.

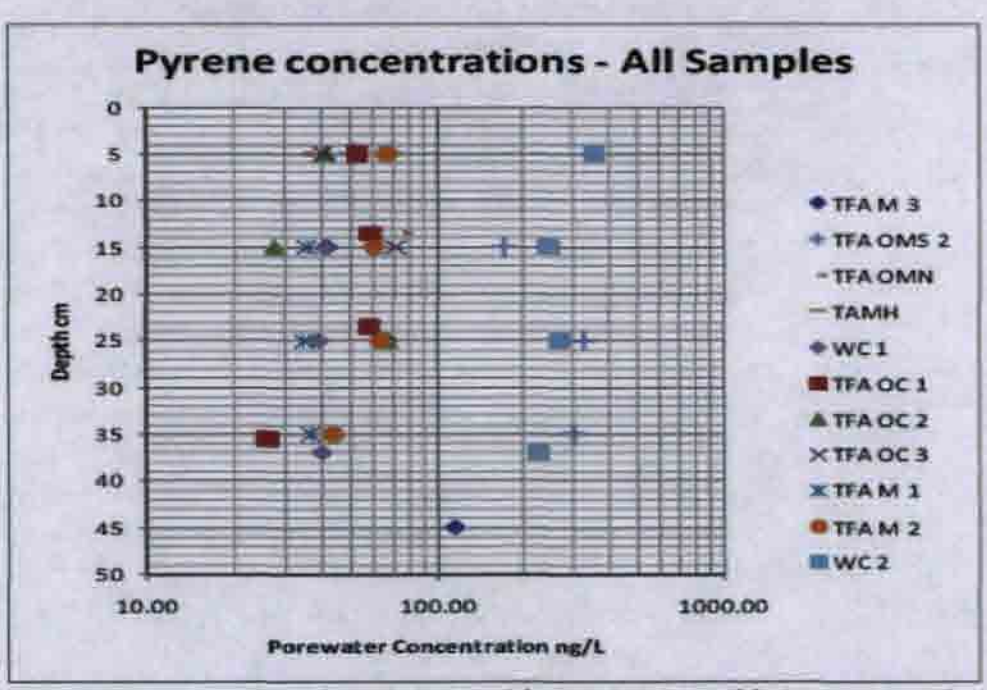
2.2.2.3 Sediment Cap Core and Porewater Sampling

In order to determine whether contaminants capable of producing a sheen might be migrating through the sediment cap, 32 push probes for sediment sampling, 12 SPME samplers for porewater analysis, and 16 conventional porewater samples using Henry Samplers were collected from areas where sheen has regularly sheen observed. The results are presented in Appendix G of the *O&M Report, January 1, 2008, to December 31, 2008, McCormick & Baxter Superfund Site Portland, Oregon, Annual Report* (Hart Crowser/GSI, 2009a). The sediment analytical results and field observations were not supportive of contaminant migration through the sediment cap capable of producing a sheen. PAH concentrations in the cap sand material were over an order of magnitude below the ROD sediment cleanup criteria and were not at concentrations indicative of creosote migrating through the sediment cap.

Dr. Reible conducted SPME analyses of porewater in several locations where conventional porewater samples were collected by Hart Crowser/GSI. Results of Dr. Reible's final report are presented in Attachment D. The measured concentration behavior in the SPME samples is shown on the graph below for the contaminant pyrene because this contaminant was found at the highest concentrations of those detected (except for phenanthrene which was affected by laboratory contamination). In most samples, pyrene concentrations were relatively uniform with depth and low in concentration (<100 nanogram per liter [ng/L]). This is further illustrated by profiles for all contaminants (except phenanthrene) in sample TFA OC 1, shown in Figure 11 of Dr. Reible's final report (Attachment D); results for TFA OC 2 and TFA OC 3, where substantial gas ebullition has been noted, show similar contaminant profiles. Concentrations of contaminants in these areas are not elevated suggesting little or no contaminant migration into the upper layers of the cap in these areas. The fact that the SPME-measured porewater concentration of all constituents was effectively uniform indicates that tides or seasonal water level fluctuations had spread contaminants over the entire layer monitored by the SPME (i.e., the layer above the organophilic clay cap materials). In a number of profiles, the lowest concentrations were detected close to the sediment, suggesting that the source

of the PAH contaminants was not the sediments as shown for locations WC-2, TFA M2, and TFA-OC1 in the figure below (i.e., the source is likely from the overlying water).

Direct comparison of SPME and conventional porewater extraction concentrations was limited due to the small number of co-located samples, subsurface heterogeneity, the focus on selected PAHs with the SPMEs, and higher detection limits of the conventional approach. Conventional porewater results, reported in last year's annual report, are similar where co-located to the SPME results. SPME results reflect only the dissolved phase, and consistently show lower concentrations than conventional sampling methods.



Pyrene Concentrations from SPMEs with Depth (Dr. Reible/University of Texas).

The following conclusions were based on the porewater (both conventional and SPME) sample results:

- Low level LPAH concentrations near the surface within the sand portion of the sediment cap are likely the result of lateral groundwater discharge;
- Conventional porewater results collected as part of the ebullition and sheen investigation were consistent with the semi-annual sampling results;
- No connection could be made between contaminants from the native sediment beneath the cap and the observed sheen; and

- SPME data showed no evidence of contaminant migrating upward through the sediment cap.

2.3 Conclusions from Ebullition and Sheen Investigations

Detailed conclusions based on the data quality objectives (DQOs) for the ebullition and sheen investigation are provided in Appendix G of the *O&M Report, January 1, 2008, to December 31, 2008, McCormick & Baxter Superfund Site Portland, Oregon, Annual Report* (Hart Crowser/GSI, 2009a). This section describes the overall conclusions based on the results of the 2008 investigations. The lines of evidence suggest that the shoreline sheens observed along the riverbank in the summer and early fall are not a result of contaminant (creosote) migration through the sediment cap.

Analyses on samples of the organophilic clay indicate that it retains substantial capacity to protect against NAPL migration and release. The results of hexane extractible material (HEM) analyses, a measure of organic matter not bound to the clay, show insignificant accumulation of NAPL in the bulk organophilic clay. Reductions in total organic matter content, a measure of HEM and remaining organics within the organophilic clay product, in the ET-1 organophilic clay suggest that its capacity may be significantly less than when originally placed but there remains substantial NAPL capacity. The loss in carbon content suggests a half life of approximately 6.6 years which could mean that the ET-1 organophilic clay could nearly completely degrade in less than 50 years; however, there is a large amount of uncertainty related to this estimate of half-life and periodic monitoring should be conducted to ensure that the organoclay continues to function. In addition, we have not observed significant concentrations of PAHs and no NAPL migrating into the bulk organophilic clay layer. The reduction in total organic matter and the relatively high HEM content (compared for example to CETCO Organoclay™) suggests that the ET-1 organophilic clay is degrading and likely responsible for the increased gas ebullition in the TFA. The HEM fraction was both higher and more variable than that of CETCO Organoclay™. The high HEM in the ET-1 is thought to represent aliphatic surfactant, present in the original ET-1 product, which has detached from the organophilic clay molecule. The organic content and residual NAPL sorption capacity of the bulk organophilic clay should be tested periodically to ensure that the material continues to perform for the design life of the sediment cap.

Dissolved PAHs in porewater generally showed little or no migration into the bulk organophilic clay based on the concentrations measured in the bulk organophilic clay. In those locations where some migration had occurred, the bulk organophilic clay was effectively retaining the PAHs as indicated by the lack of odor or the lack of visual detection of free phase NAPL in the bulk clay

samples. PAH concentrations were also generally lower in the organophilic clay than in the underlying sediment; because the organophilic clay is a better sorbent than the sediment, this suggests that the organophilic clay retains significant sorption capacity for dissolved PAH contaminants and the underlying PAHs are not mobile.

One organoclay core (MBSD0810) showed higher PAH contamination concentrations than in the underlying sediment; however, total PAH concentrations were less than 1 milligram per kilogram (mg/kg) which is well below ROD standards. In this core, lighter PAHs (naphthalene to phenanthrene) showed similar concentrations throughout the organoclay layer indicating that the organoclay was effectively equilibrated with the low dissolved PAH concentrations for these mobile contaminants. Higher molecular weight PAHs (pyrene and higher) showed effectively no penetration of dissolved contaminants beyond the bottom layer of organoclay in contact with underlying sediment in this core indicating that significant retention of HPAHs will continue. There was also no evidence of decreasing NAPL sorption capacity for this organophilic clay.

These conclusions were further supported by the SPME analyses of porewater. Porewater concentrations near the surface of the sand cap remain low throughout the Site, including in those locations where higher concentrations of contaminants were detected at depth within the sand cap. One of the WC SPMEs did show elevated concentrations of PAHs throughout the sand cap and armoring layer and a core (mentioned above) in this area showed dissolved LPAHs throughout the organophilic clay layer. Periodic monitoring in this area in WC is recommended to ensure the cleanup goals for the sediment cap are maintained.

In summary, the results of this study show that the organophilic clay cap at the Site retains NAPL sorption capacity. In addition, gas-induced contaminant migration or dissolved phase contaminant migration through the sediment cap is minimal, and is below water quality comparison criteria. Periodic monitoring of these potential migration pathways is recommended to ensure that they do not increase with time. Cores from the ET-1 organophilic clay should also be collected periodically to ensure they retain sufficient NAPL absorption capacity and/or PAHs are equilibrating at concentration below the sediment cap comparison criteria.

The 2008 and previous investigations provide sufficient evidence to conclude that the sheen is not a result of creosote or contaminant transport through the sediment cap. The specific origin and nature of the sheen was not determined from these studies, but was addressed in additional sheen characterization study in 2009. The following sections describe the 2009 sheen characterization data quality objectives, sampling methodology, results, conclusions, and recommendations.

3.0 DATA QUALITY OBJECTIVES

This section describes the data quality objectives for the sheen characterization. The DQO process for this project followed the EPA document, *Guidance for the Data Quality Objectives Process* (EPA, 2000). The DQO process is an important tool to guide the type, quantity, and quality of data needed to support project decisions. These are also described in detail in the *Sheen Characterization Work Plan* (Hart Crowser/GSI, 2009b). The following summarizes the DQO elements for the sheen characterization.

- State the Problem: The 2008 data collection did not definitively identify the nature of the sheen. The chemical/biological nature of the sheen is unknown.
- Identify the Decision: Determine the character of the sheen-biogenic, creosote, or other.
- Identify Inputs to the Decision: The sheen was previously analyzed for TPH, TOC, and PAHs. These analyses suggested that the hydrocarbon constituents within the sheen are similar to the adjacent ambient surface water. Either these constituents do not make up the majority of the sheen (i.e., the sheen is made up of something other than petroleum hydrocarbons such as biogenic material), or the 2007 and 2008 sample collection methodologies did not appropriately isolate the Site surface water from the sheen. Therefore, isolated samples of sheen and ambient surface water were analyzed for TPH, PAHs, As, Cr, Cu, Zn, Fe, and Mn. The ambient water samples were analyzed for both total and dissolved metals while the sheen samples could only be analyzed for total metals. The gas chromatography/mass spectrometry (GC/MS) chromatograms from the sheen samples were compared to chromatograms from a sheen generated from site creosote. A biological assessment of the sheen was conducted by Dr. Anne Camper/University of Montana. This broad spectrum of analytes coupled with the chromatogram comparison and biological assessment should adequately characterize the sheen. The isolation of the sheen was achieved by using a C-18 chamber, through which sheen was collected over a longer period of time, and highly porous Teflon®-fluorocarbon polymer nets and pads to which sheen preferentially adheres as compared to water (ASTM D4489-2006; Plourde, et al., 1995).
- Define the Study Boundaries: The sheen appears in the late summer and early fall. Sufficient sheen was collected to obtain representative samples for sheen composition. Sheen from 4 discrete locations was sampled over 3 separate weeks. During each week, sheen from each discrete location was composited over the week to obtain sufficient sheen for both chemical and

biological analysis. The 3 weeks occurred between August 3 and August 27, 2009, before the sheen no longer appeared at the Site.

- Develop a Decision Rule: Sufficient number of samples were collected (10 discrete composited samples) to be able to conduct statistical analysis and have a high level of confidence in the chemical and biological data. The chromatograms were compared to the site creosote chromatograms to determine the difference between the sheen and creosote from the Site. The data identified the character of the sheen. Ultimately, this will complete our answer to the question of whether the sediment cap remedy is protective. The sheen concentrations were compared to ambient water quality criteria to assist in that decision.

- Specify Limits on Decision Errors: Because there is an expectation that the organic constituents present in the surface water will partition into a biogenic sheen, it is not unexpected that the PAHs present in the sheen are similar in nature and concentration to those present in the surface water. Therefore, the presence or absence of PAHs alone will not allow us to determine the nature of the sheen. In addition, there is also biogenic material in surface water; therefore, the presence of biogenic material in the sheen, does not preclude the sheen from being a petroleum hydrocarbon sheen. The data will need to be used in a weight-of-evidence approach to determine the primary nature of the sheen.

- Optimize the Design for Obtaining Data: The use of Teflon® nets/pads, and C-18 cartridges to collect the sheen in a manner that best differentiates the sheen from the adjacent surface water was proposed to optimize the sampling design. In addition, the collection of sheen over a four to five day period for each analysis optimized the volume of sheen available for analysis. And finally, collection of sheen from 4 discrete locations during 3 discrete sampling events increased the confidence in the data.

These DQOs were developed through discussions with Dr. Anne Camper; Kent Patton,chemist at Pace Analytical Laboratory; the DEQ project manager, Scott Manzano; and the project team of Hart Crowser/GSI. The field and sampling activities used to gather the data are described below. The location and number of samples, and the analytical approach were developed to obtain sufficient data to make decisions regarding the character of the sheen, and as a result, the protectiveness of the sediment cap.

4.0 INVESTIGATION AND SAMPLING METHODOLOGY

This section presents the sampling methodology employed during the additional sheen investigation activities. Sheen investigation activities were conducted from July 23, 2009, through October 20, 2009. Activities included shoreline sheen observations, a laboratory-controlled sheen simulation, and collecting sheen and adjacent ambient surface water for chemical and biological analysis. The discussion below summarizes the field activities and deviations from the *Sheen Characterization Work Plan* (Hart Crowser/GSI, 2009b). Photographs of the sheen characterization activities are included as Attachment A.

In addition to the sheen investigation, two sediment cap cores were collected from Willamette Cove for analysis of the carbon content and HEM in the organophilic clay. Previous studies by both Dr. Reible and Kiara Smith, as described above, indicate that the Aqua Technologies ET-1 granular organophilic clay used at the site is losing carbon content. The objective was to determine whether there is a continued loss in carbon content suggesting ongoing breakdown of the organophilic clay.

4.1 Investigation Activities

Weekly sheen survey activities began the week of July 23, 2009, and extended through October 21, 2009, until no sheen was observed for three consecutive weeks. A laboratory sheen simulation was completed by Kent Patton of Pace Analytical, the DEQ contract laboratory, in August and September 2009. Three separate, one-week sheen and ambient surface water sampling events at the Site were completed the weeks of August 3 through August 6, 2009, August 10 through 13, 2009, and August 24 through 27, 2009.

Two sediment cap cores were collected from Willamette Cove in October 2009. The cores were shipped to University of Texas at Austin. The University of Texas preliminary report describing the sampling and analyses as well as the results is included as Attachment E in Appendix D, Surface, Inter-armoring, and Sub-armoring Water Quality Assessment.

4.2 Sample Management

Sheen characterization activities included sampling for sheen using 2 methods: passing Teflon® nets/pads through the sheen and pumping sheen through C-18 cartridges. Collection of adjacent ambient surface water was conducted using a peristaltic pump for co-located water samples to the sheen collected with pads and nets. C-18 cartridges were used to collected co-located water samples next to sheen collected using the C-18 cartridges for clear comparison.

During each sampling event, clean Teflon® nets/pads, C-18 cartridges, and/or water containers were provided by Pace Analytical ready for sample collection, including autoclaved Teflon® pads and water containers for the biological assessment. A sample label was affixed to each sample container and was marked with a unique sample number. Samples were labeled as follows:

- Project: MB = McCormick & Baxter
- Sample Type: SHG = Sheen collected using Teflon® nets/pads
  SHC18 = Sheen collected using C-18 cartridge
  SW = Ambient surface water
  SWC18 = Ambient surface water using C-18 cartridge
- Date: 080609 = August 6, 2009, or appropriate week end of sampling
- Location: WC = Willamette Cove
  TFA-1 = Tank Farm Area 1
  TFA-2 = Tank Farm Area 2
  SES = South End of Site
- Analysis: CHEM = Chemical Analysis
  BIO = Biological Analysis

For example, MBSW080609-WC-BIO would be the surface water sample collected for biological assessment from Willamette Cove during the week ending August 6, 2009.

Samples were placed in a cooler with ice until transported to Pace Analytical for chemical analysis or to Montana State University (MSU) for biological analysis. Chain of custody was maintained at all times.

4.3 Sheen Surveys

Sheen surveys along the shoreline were initiated in mid-July 2009, after the Willamette River level dropped below approximately 7.5 feet NAVD88, and were completed through late October 2008. Sheen observations were recorded weekly during or near low tide, and are summarized in Table F-1. The surveys were conducted according to the *O&M Manual* sheen observation methodology (Hart Crowser/GSI, 2008a). Weekly sheen observations also are presented on Figure F-1.

4.4 Sheen Simulation

Kent Patton of Pace Analytical conducted the sheen simulation using LNAPL, collected from EW-23s and EW-18s on August 6, 2009. Product sheens were

prepared in the laboratory on the surface of laboratory grade blank water. The procedure is outlined below.

- Clean Pyrex® baking pan, measuring 12"L x 8"W x 2.25H" was filled with clean laboratory grade blank water. Using a glass pipette approximately 0.1mg of product was past through the surface of the water and deposited in the center of the pan against the Pyrex® glass. With removal of the pipette a thin surface sheen was formed on the water surface. The sheen spread over the entire surface and had visible blue, violet, and reddish hues. The majority of the product remained adhered to the bottom of the Pyrex®.
- The sheen was sampled following *Standard Practices for Sampling of Waterborne Oils ASTM D4489 (Reapproved 2006).* From the ASTM method Practice B - TFE-Fluorocarbon Polymer sampler procedures were followed. This method is applicable to all types of oil by preferential adherence of the oil to a film or sheet of TFE-Fluorocarbon material. Oil Spill Sampling Kits were provided at the recommendation of U.S. Coast Guard Marine Safety Laboratory from General Oceanics. Separate sheen samples were collected for metals and organics analyses.
- For metals sheen sampling, a Teflon® double mesh pad was removed from the Oceanic package. The pad was held with clean metal forceps and gently dragged over the water surface. Nitrile gloves were worn during sampling and new gloves and forceps exchanged between each round of sampling.
- Sheen immediately adhered on the surface of the pad and was removed from the surface. Once the original sheen was removed the pad was placed in a clean 4 oz jar and closed with Teflon lined screw cap lid.
- A clean pipette was placed into the pan and lightly touched to the surface of the product droplet adhering to the bottom of the Pyrex® pan. This process formed a new sheen on the water's surface.
- The original 4 oz glass jar was opened and the Teflon® double mesh pad was removed with clean forceps and slowly swept over the surface of the water to collect the second sheen. The sheen adhered to the pad. This process was repeated a total of 5 times to mimic the number of collections that could occur in the field during 5 days of sampling small sheens.
- In between each sampling the sheen would be reformed with a clean pipette. After the fifth sampling the pad was placed in a 4 oz jar for storage and extraction.
- During the sampling of the metals sheen sample an identical blank control was set up. This control pan was penetrated with a clean glass pipette. No

sheen was visible on the blank control surface. The control was sampled five times with a clean Teflon® double mesh pad. After the fifth sampling the pad was placed in a 4 oz jar for storage and extraction.

- During the sampling of the metals sheen sample an identical blank control was set up. This control pan was penetrated with a clean glass pipette. No sheen was visible on the blank control surface. The control was sampled five times with a clean Teflon® double mesh pad. After the fifth sampling the pad was placed in a 4 oz jar for storage and extraction.
- For organics analyses of PAHs and Hydrocarbon Identification and NWTPH-Dx, a new set of Pyrex® pans were set up identical to those used to sample sheens for metals.
- The pans with sheen were sampled with a 4" Teflon® net following ASTM D4489 procedures. Both sheen sample and blank sample were alternately collected 5 times to duplicate daily sampling of sheens in the field.
- The pads and nets became darker after each round of sheen sampling. The multicolored product sheen appeared brown once it was collected on the Teflon material and removed from the water's surface.
- Sheen and blank samples collected on Teflon® nets/pads were extracted for organics analyses with methylene chloride using EPA 3550 sonication extraction. Extracts were analyzed by NWTPH-HCID and 8270 SIM.
- Sheen and blank samples collected on Teflon® pads for metals analyses were digested for metals using a hot block digester. Metals were digested following EPA Method 3550 and were analyzed by EPA Methods 6010/6020.

Kent sampled the sheen provided from the Site using lab-cleaned Teflon® nets/pads identical to those used in the field. He passed the net with a pad inside through the sheen 5 times simulating the same manner of multiday sampling that was conducted in the field. The Teflon® net/pads was separated into two portions; one was extracted in a solvent and the other digested for metals. The organic solvent extracted sheen was analyzed by Pace Analytical for the following:

- Hydrocarbon identification by Northwest Method NWTPH-HCID (with and without silica gel cleanup) to obtain the sheen's chromatographic signature; and
- Polynuclear aromatic hydrocarbons (PAHs) and pentachlorophenol (PCP) by EPA Method 8270-SIM.

The acid digested portion was analyzed by Pace Analytical for total metals (iron, manganese, arsenic, chromium, copper, and zinc), by EPA Method 6010/6020.

4.5 Sheen Sampling

Three separate, one-week sheen sampling events including collection of sheen and adjacent ambient surface water for chemical and biological analyses. During each event, sheen and adjacent ambient surface water samples were collected from four discrete locations as shown on Figure F-1.

Teflon® Nets/Pads. At each location, two pieces of pre-cleaned, Teflon® nets/pads (autoclaved pads for biological samples) was used to collect portions of the sheen, if observed, over a four day period. Due to the lack of consistently observed sheen, sheen was not collected at each location on each day. A summary of the frequency of sheen sampling is included in Table F-2. The location-specific Teflon® nets/pads were stored on ice in laboratory supplied containers between daily sheen sampling. Teflon® pad samples were sent to Dr. Anne Camper (MSU) for a biological assessment and to Pace Analytical for analysis of the following constituents:

- Hydrocarbon identification by NWTPH-HCID (with and without silica gel cleanup);
- PAHs and PCP by EPA Method 8270-SIM;
- Total metals (iron, manganese, arsenic, chromium, copper, and zinc), by EPA Method 6010/6020; and
- GC/MS chromatogram - entire semi-volatile organic compound (SVOC) range (only if TPH is identified in the TPH-HCID).

Ambient Water. In conjunction with the sheen samples collected using Teflon® nets/pads, ambient water samples were collected once per week during the three separate, one-week periods from the four discrete locations. Ambient water samples were collected using a peristaltic pump and disposable polyethylene tubing from surface water directly adjacent to observed sheen locations. Water quality parameters were recorded in conjunction with the collection of each ambient water sample. A YSI 650 Sonde multiparameter meter with a flow-through cell was utilized to monitor surface water conditions during the sheen sampling events. One set of parameters was recorded prior to collection of a surface water sample. Ambient surface water quality parameters are included in Table F-3. Ambient water samples were sent to Dr. Anne Camper (MSU) for a biological assessment and to Pace Analytical for analysis of the following constituents:

- Hydrocarbon identification by NWTPH-HCID (with and without silica gel cleanup);
- PAHs and PCP by EPA Method 8270-SIM;
- Total metals (iron, manganese, arsenic, chromium, copper, and zinc), by EPA Method 6010/6020
- Dissolved metals (iron, manganese, arsenic, chromium, copper, and zinc) by EPA SW-846 Method 6010/6020; and
- GC/MS chromatogram – entire SVOC range (only if TPH is identified in the TPH-HCID).

C-18 Cartridges. During the second sampling week (August 10 through 13, 2009), additional sheen samples were collected from the same four discrete locations (Figure F-1) using C-18 cartridges. These cartridges absorb the organic matter in the sheen and water samples onto the C-18 absorptive material in the cartridge. At each location, sheen (including a limited amount of the surrounding water) was pumped through the location-designated cartridge using a peristaltic pump and disposable polyethylene tubing. The same amount of surface water was pumped into another cartridge designated for that location for adjacent ambient surface water. Samples of sheen and water were pumped through the designated cartridges daily for one week, if sheen was observed, to obtain sufficient sample to differentiate the sheen samples from the ambient water samples. The volume of sheen with water pumped through the cartridge was noted in the field notebook. A summary of the C-18 cartridge sampling including volume pumped during each event are included in Table F-2. The location-specific C-18 cartridges were stored on ice in laboratory supplied containers between daily sheen sampling.

The C-18 cartridges were submitted to Pace Analytical to analyze the mass of TPH and PAHs from each cartridge in addition to the GS/MS chromatogram if TPH was detected.

4.6 Investigation-Derived Waste

Investigation-derived waste for the field activities was limited to disposal tubing and personnel protective equipment (PPE). Disposable tubing and PPE were placed in existing disposal receptacles and stored onsite for later disposal as solid waste.

5.0 SAMPLING RESULTS

This section describes the analytical results for the simulated sheen, and sheen and water samples collected during the 3 sampling events completed on August 6, August 12, and August 27, 2009. The following subsections provide sampling results, organized by sample type and constituent. Laboratory results are provided in Attachment B.

5.1 Sheen Observations

Sheen was first observed last summer on July 23, 2009, when the Willamette River stage dropped to approximately 7.5 feet NAVD88. Sheen was observed regularly between July 23 and August 24, 2009, along the shoreline in WC in the vicinity of the bulk organophilic clay, in the TFA, and at the southern end of the Site. It was observed on one additional occasion in WC and a few occasions in the TFA. On August 3, sheen was also observed along the shoreline by the former waste disposal area and near the Site stormwater discharge area (see Figure F-1).

The observed sheen was a thin, blocky film that did not re-coalesce upon probing (Photographs 1, 3, 4, 10, and 12 in Attachment A). There was no hydrocarbon-like odor associated with the sheen. Dr. Camper noted the presence of a sharp metallic odor when the sheen came into contact with skin. The metallic odor results from a metal-induced oxidation of skin lipids, and is actually the odor of aldehydes and ketones, and not any iron-containing compounds.

Sheen was consistently (and has been historically) present on warm days when the elevation of the river stage was low. The sheen appeared in very shallow stagnant water areas along the shoreline as the tide went out (Photographs 1 through 5, 7, 8, 10, and 12 in Attachment A). When the river stage fell below the beach level, the sheen would adhere to the sand cap material as shown in Photographs 6, 7, 9, 11, and 13 in Attachment A. The sheen's appearance on the sand was a silvery to bronze color with a metallic luster. When the tide came in, the sheen washed away quickly. There were no differences noted in the sheen's appearance or odor between shoreline locations. No ebullition was associated with the sheen.

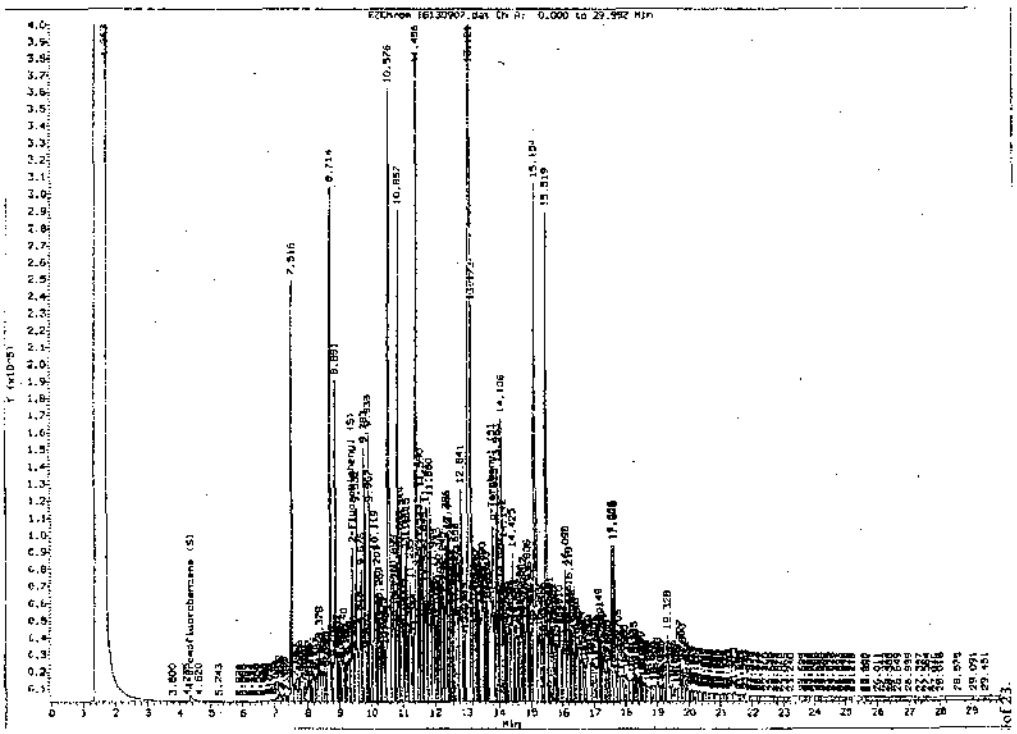
5.2 Analytical Results on Sheen Samples

This section summarizes the analytical results for the laboratory simulated sheen, and sheen and ambient water samples collected at the Site. Laboratory results are presented in Attachment B. Table F-3 summarizes the field parameter results for the ambient surface water samples. Tables F-4 through F-6 summarize the

analytical chemistry results. The results for the nets/pads are presented in mg/kg; however, this is an artifact of the laboratory instrumentation. The actual samples measure mass (in µg for PAHs and mg for TPH and total metals and the instrument was given a relative unit of kilogram for the automated program to work. Therefore, the laboratory reports show results in a "per kg" while the actual result should be divided by 1,000 to calculate the actual mg or µg of the constituent measured on the net or pad. The tables show the results in mass units.

5.2.1 Simulated Sheen Results

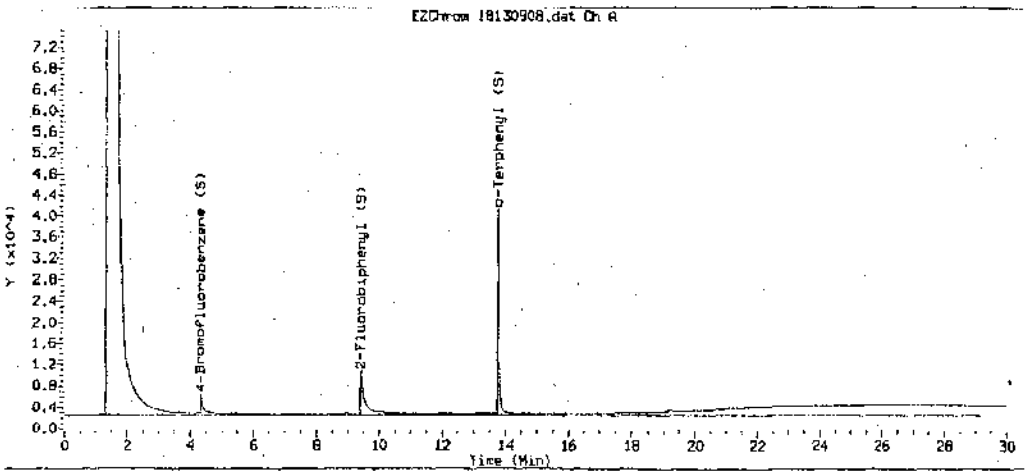
The simulated sheen results are presented in Table F-4. The percentages of individual PAHs relative to total PAHs was similar between the sample analyzed from the Teflon® net and pad. Both samples had high concentrations of PAHs on the net and pad from the simulated sheen. The following chromatogram shows the chromatogram of the sample collected using a Teflon® net.



Chromatogram of simulated sheen collected using a Teflon® net.

Diesel-range hydrocarbons are the predominant TPH carbon range with TPH also present in the motor and gasoline ranges. The predominant PAHs include acenaphthene, fluorene, fluoranthene, and phenanthrene with a moderate naphthalene presence comprising together over 50% of the total PAHs in the creosote. Chromium is the predominant metal in the simulated creosote sheen.

The blank samples for the Teflon® net and pad both showed a similar pattern on the chromatogram. The blank Teflon® chromatogram (see chromatogram on Page 26) shows the chromatogram for the Teflon® net blank. Both the pad and nets had detections of naphthalene. Kent Patton was uncertain whether the PAHs were detected because of transfer of contaminants in the laboratory in working with creosote sheen, or were detectable concentrations in the actual pads and nets. Because the field samples show similar concentrations of naphthalene and phenanthrene, it appears as if the PAHs are a contaminant in the Teflon® nets and pads. Because these constituents were present in both the nets and pads, the average mass present for naphthalene and phenanthrene were calculated and multiplied by 5 times to obtain a concentration to use for qualifying the field samples collected using the Teflon® nets and pads – per standard laboratory procedure (2.68 µg and 6.7 µg for naphthalene and phenanthrene, respectively). Detections below those concentrations were qualified with a UB (not detected, present in the blank).



Chromatogram of blank Teflon® net.

The blank for the Teflon® net also was reported to contain motor oil. However, the low mound present at the late time on the chromatogram does not display a signature characteristic of motor oil. The low mound present in the blanks was also present in the sheen samples. Five times the reported concentration for motor oil present in the blank was used to qualify the samples for what the laboratory characterized as motor oil (5.95 mg) in the field samples.

5.2.2 Sheen and Ambient Water Results – Teflon® Net/Pad Collection Method

Sheen samples collected using the Teflon® nets/pads and associated ambient water samples collected using a peristaltic pump are reported in Table F-5. Note

that the sheen concentrations are reported in mass units while the ambient water samples are reported in mass/volume.

The field parameter data for the ambient surface water are presented in Table F-3. The temperature of the surface water during the time of sampling ranged from 23° centigrade to 25.6° centigrade. The specific conductance in the TFA and SES locations was generally lower than in WC suggesting there may be a higher component of groundwater discharge in WC. The pH varied between 7 and 8 with no clear pattern by location. Oxidation reduction potential ranged from 12 to 88 mV which is in the range of iron and manganese reduction. Iron is in the Fe^{+2} speciation (dissolved) at the oxidation reduction potential and a pH between 7 and 8. Dissolved oxygen was only measured during the first sampling event on August 6, 2009; concentrations ranged from 7.6 to 7.92 mg/L. This is slightly low for surface water at the top of the water column; however, surface water may be influenced by groundwater discharge.

Only one PAH was detected in the sheen samples collected on the shoreline. Two sheen samples, out of the 4 samples collected on August 6, 2009, contained fluorene, estimated at 0.494 and 0.474 µg. Fluorene was not detected in the associated surface water samples, although fluorene was detected at low concentrations (<0.029 µg/L) on other surface water samples from the Site. Several low level PAHs were also present in surface water samples.

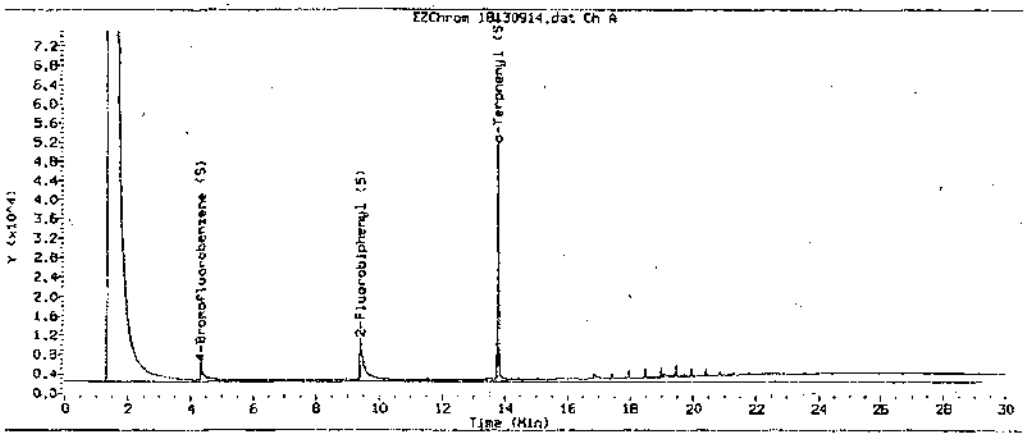
The most notable result when comparing the sheen to ambient water sample concentrations was that iron was clearly concentrated relative to other metals in the sheen, which was not the case in the surface water samples. The ratio of the average mass of iron to manganese in the sheen samples was 54 while the average concentration of iron to manganese in surface water was 9. This indicates a concentration of the iron in the sheen samples relative to the surface water suggesting that as the stagnant water evaporates, iron is concentrating in the water. Another suggestion (Dr. Anne Camper) is that the iron is chelating with organic matter. The chromatogram for a sheen sample is presented in Section 5.2.3 and is representative of all the sheen sample chromatograms. This chromatogram closely resembles the chromatogram for the Teflon® net blank above (Page F-26) and Teflon® pad blank. There is no resemblance in the chromatograms between the sheen samples collected in the field and the simulated sheen sample using Site creosote.

Another observation is that the most prevalent metal in the simulated sheen (Site creosote) was chromium while iron is clearly the dominant metal of those analyzed in the field sheen samples.

These results provide an additional, strong line of evidence that the sheen is not creosote migrating through the sediment cap. This information is supportive of the 2008 sediment cap porewater and core sample results where no evidence of creosote migration into the sediment cap was observed. The data also strongly suggest that the sheen is related to the higher concentrations of iron present in the sheen samples.

5.2.3 Sheen and Ambient Water Results – C-18 Cartridge Method

Sheen and ambient water were also collected the week of August 13, 2009, using C-18 cartridges as described in Section 4. These samples are valuable because a direct comparison of sheen contaminant concentration to surface water contaminant concentration can be made. However, the C-18 cartridges only sorb organic compounds and therefore, metals can not be analyzed using this sampling technique. Results are presented in Table F-6.



Chromatogram of sheen from the TFA-1 on August 6, 2009, using a Teflon® net and pad.

Acenaphthene, acenaphthylene, fluorene, and naphthalene were detected in the sheen at low concentrations. The PAHs detected in the ambient surface water samples collected adjacent to the sheen in WC and in the TFA-1 appear at slightly higher concentrations than the PAHs detected in the sheen samples. This is consistent with the interpretation of stagnant water experiencing evaporation of the water resulting in a concentration of the constituents in the water. The sheen vs. surface water sample result comparison from samples collected from the southern end of the Site does not follow the same pattern. At the southern Site location, more PAH constituents are detected at very low levels in the surface water while only acenaphthene and fluorene are detected in the sheen with little difference in concentration between the sheen and the surface water for the one acenaphthene, the one common constituent. However, with such low PAH concentrations in all sampling locations and a one-time sampling event,

consistent patterns are difficult to establish. No TPH was detected in sheen or surface water samples from any of the sampled locations.

5.2.4 Sheen and Ambient Water Results – General Conclusions

This sampling was conducted with an objective of collecting isolated sheen samples from the shoreline, then making a comparison to simulated creosote sheen of similar thickness emanating from the Site. The chromatograms of simulated creosote sheen contain a high mass of all but one PAH, while the actual sheen collected from the Site contains few PAHs at mass and ratios indicative of creosote product. PAHs in the sheen samples collected from the shoreline contain similar PAHs at similar concentrations to what is detected in ambient surface water. The data clearly demonstrate that the sheen samples collected in the field do not contain PAHs in sufficient concentration indicative of sheen film caused by creosote migrating through the sediment cap with groundwater or entrained on gas bubbles.

The elevated iron concentrations relative to other metals in the sheen as compared to the surface water strongly suggest that the periodically observed shoreline sheen is related to iron and not creosote contaminant migration through the sediment cap.

6.0 BIOLOGICAL SHEEN CHARACTERIZATION

This section describes the results of Dr. Camper's biogenic evaluation of the sheen and associated surface water. This work was conducted under an Intergovernmental Agreement (IGA) between the DEQ and MSU. During the weeks ending August 7 and August 14, 2009, surface water and sheen samples were collected using the same technology as described above (Teflon® pads and nets and surface water grab samples) for biogenic analysis. Samples were sent or transported to the laboratory at MSUs Center for Biofilm Engineering for analysis. In addition, Dr. Camper collected samples of shoreline sand with and without sheen on August 4, 2009, during an initial site visit.

This study was conducted to determine if the sheen was biological in origin. The investigation included culturable microbial counts from sheen samples collected on mesh and parallel water samples, and direct microscopic visualization for evidence of bacterial cells. Particular emphasis was placed on examining samples for bacteria that had morphologies characteristic of iron oxidizing bacteria because prior results (and current data) indicate that the sheen is enriched in iron. An additional characterization of one pair of sheen/mesh and water samples was done to compare the overall microbial ecology using

polymerase chain reaction (PCR) and DGGE analyses. The microbial ecology describes the types of bacteria and their relationship to their environment (i.e., are they the type of bacteria that would thrive on iron or hydrocarbons).

Although bacteria were present in sheen samples, there is no evidence to support the concept that the sheen is a biofilm or microbial in origin. Using culturing methods, it was found that bacterial numbers were enhanced in the sheen, but this could be fortuitous and not causative. There was no overall difference in colony types of bacteria cultured from the sheen and parallel water samples. By microscopy, there was no evidence for the presence of iron oxidizing bacteria. Additionally, the sheen samples on the mesh did not appear to have organisms that were integrated into the collected material. The microbial ecology by DGGE did show some differences between the water and the sheen, but these were not remarkable.

Chemical data again indicate that the sheen is substantially enriched for iron when compared to the water. The appearance and behavior of the sheen *in situ* suggests that it is composed of iron, and this is supported by chemical data.

6.1 Field Observations

Dr. Camper visited the Site on August 4, 2009. Sheen was visible on the river surface at the four sampling locations and at other shoreline locations. The sheen observed on the water surface would fracture and disperse when disturbed; this was not indicative of a hydrocarbon sheen which should easily re-coalesce and would not fracture. The behavior was more indicative of an extremely thin solid film. Dr. Camper noted that the material had a sharp, metallic odor (the metallic odor results from a metal-induced oxidation of skin lipids; the compounds people smell are actually aldehydes and ketones, and not any iron-containing compounds). As the sheen dried on the shore, it often became more metallic in appearance and changed from a reddish tint to a shiny bronze color. Sand particles coated with the sheen adhered to each other to a greater extent than uncoated sand.

6.2 Culturable Cell Counts

The method used to provide culturable cell counts enumerates heterotrophic bacteria (those that use an organic carbon and energy source). The methods used had been optimized in prior research where similar counts were needed from drinking water, surface water, and deposits associated with drinking water distribution systems. The table below provides a summary of the data, while all of the information is included in Attachment E.

	Willamette Cove		TFA-1		TFA-2		SES	
	Sheen[1]	Water[2]	Sheen[1]	Water[2]	Sheen[1]	Water[2]	Sheen[1]	Water[2]
August 7	9.3+08	2.5+05	7.2+07	1.5+05	3.0+06	2.0+05	1.4+08	1.6+05
August 14	5.3+07	2.7+04	3.9+04	4.3+04	4.0+07	3.9+04	6.0+07	3.6+04

[1] colony forming units per mL

[2] colony forming units per mesh

The numbers of organisms in the water (ca. 10^4 to 10^5) are comparable to what is typically seen in surface waters. The mesh counts varied over two orders of magnitude from 10^6 to 10^8. There were also some differences between the two sampling times per date. These differences are not of major significance because the number of passes of the mesh through the sheen was not standardized and there is no mechanism for normalizing the counts to a unit of mass per mesh. What was revealing, however, is that the mesh did accumulate organisms, suggesting that there were bacteria associated with the sheen. Because the counts cannot be normalized to an equivalent mass or volume, there cannot be direct comparisons between the water and the mesh samples to indicate how many bacteria were sheen-associated.

To ensure that reproducible results were being obtained, another quadrant of the same mesh (from the week ending August 7, 2009) was processed on August 14, 2009. The comparable counts indicate that the method of sampling only one quarter of the mesh and normalizing the count to the entire mesh surface was reasonable.

Bacterial colony morphologies were compared between the water and mesh samples. There were no major differences between colony morphologies in the water and mesh, from the four sampling sites, or from the two sampling times. This suggests that there was no preferential segregation of bacterial types between any of these variables.

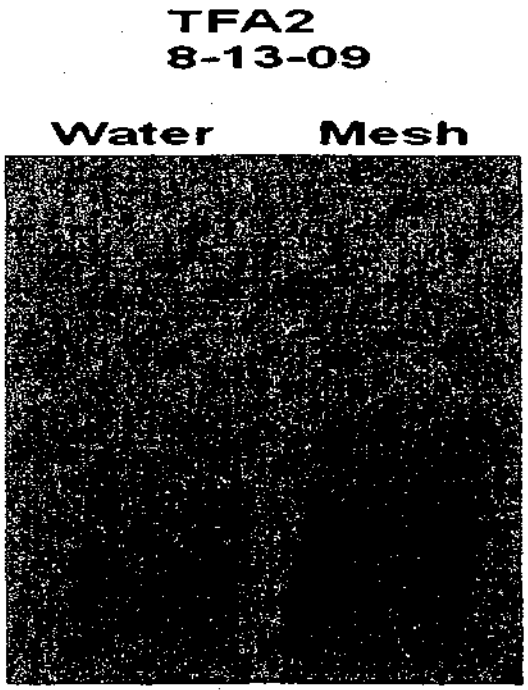
6.3 Microbial Ecology by Denaturing Gradient Gel Electrophoresis

DGGE profiles are an indication of the microbial diversity of a sample. The universal bacterial primer amplifies the 16S rDNA in the bacterial genome. There are slight evolutionary changes in this conserved gene that then are an indication of different species of organisms. Because there are slight differences in the mobility of these fragments, they migrate at different rates through the denaturing gradient of the gel and become immobilized. Although the identity of an organism cannot be directly ascertained by looking at the gel, it is possible to obtain a general indication of the diversity of the population by the number of bands (ideally, one band equals one species). The intensity of the band is also an indication of the relative abundance of a particular species, although this

must be interpreted with caution. It is also possible to compare two samples by comparing the banding patterns.

DNA was collected from all of the mesh and water samples to process by DGGE. Unfortunately, the DNA concentration was very low in all samples. This prohibited further downstream processing, creates artifacts, and weak DGGE profiles. There was sufficient quantity and quality of DNA generated from one pair of samples, TFA2 water and mesh, collected on August 13, 2009, to create an acceptable gel.

The DGGE profile obtained from this pair is shown below. Overall, the two samples are quite similar, although there are some differences between the banding patterns (number of bands and intensities). If there were substantial differences between the two populations, much more dramatic disparities in the banding patterns would be expected than what is seen in the figure. Based on these results, it is reasonable to say that there is no major difference in the microbial ecology between the water and the collected sheen in this sample.



Denaturing gradient gel electrophoresis image of mesh and water samples (Dr. Camper/Montana State University).

6.4 Direct Microscopy

To further determine if the sheen was microbial in origin, microscopy of the mesh was done using a variety of stains. Stains were: (1) cell mask orange, which is believed to stain for the extracellular matrix produced by bacteria;

(2) Syto 9, which stains the DNA of bacteria; and (3) Sr, which is also a bacterial stain. We also used the live/dead staining technique, which uses Syto 9 (green stain) for live cells and propidium iodide (red) for dead cells. Extensive efforts were taken to optimize the samples for microscopy as well as for subsequent image analysis.

In spite of all of these efforts, the mesh samples were inconclusive, with no evidence for the growth of bacteria in the sheen or the distinctive, characteristic cell morphologies (sheathed or coiled) for iron oxidizing bacteria. These same microscopy methods have provided excellent results on environmental samples from other studies. The lack of good images of bacteria for the samples collected at the Site, however, strongly suggests that the sheen on the mesh samples was not the product of bacterial biofilms or iron bacteria. The images are in Attachment E on the report CD.

A set of samples of the sand from the river bank with and without sheen were also observed using a stereomicroscope (low magnification) and the confocal microscope, with and without staining. Numerous bacteria were visible in these samples. However, there were no major differences in the morphologies of the organisms between samples with and without sheen, and no indication of the presence of iron oxidizing bacteria.

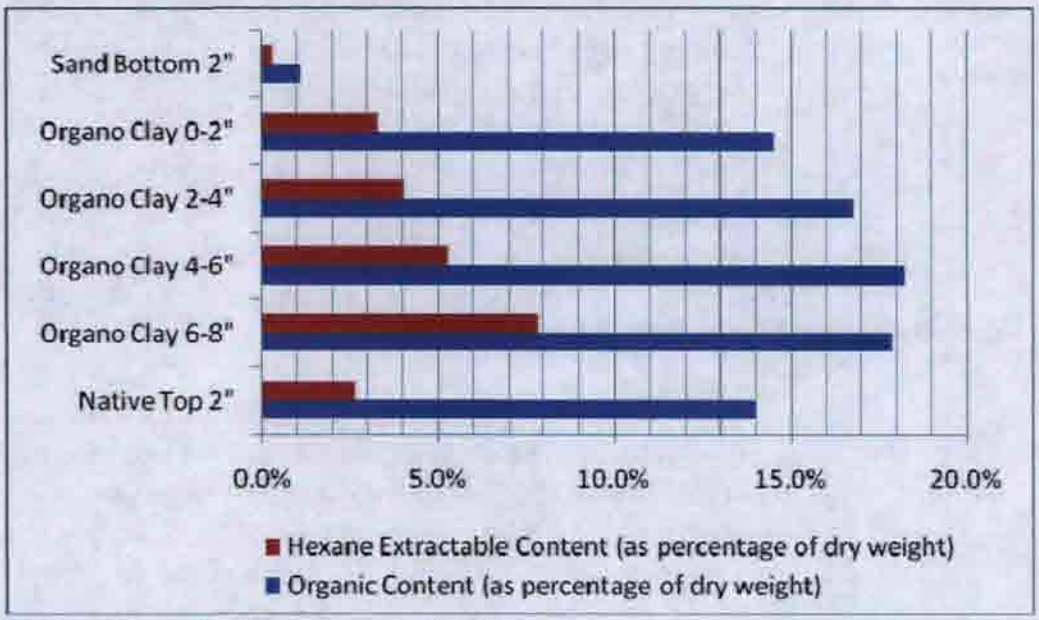
6.5 Biogenic Study Conclusions

The results from the MSU study do not support a role for bacteria/bacterial biofilms in the creation of the shoreline sheens observed at the Site. There was no substantial difference in colony morphologies between the water and sheen associated bacteria, no evidence for biofilm formation or iron oxidizing bacteria in the direct microscopy images, and no major differences in the microbial ecology between the water and sheen samples.

A more probable conclusion is that these sheens are composed of metals, particularly iron. Visual observation of sheen at the Site supports this conclusion; sheen film on surface water fractures when probed, and sheens on the shoreline sand look metallic when moist and dry. Dr. Camper noted that the material also had a sharp, metallic odor. The elevated level of iron in the material collected on the mesh (chemical results presented above in Section 5) suggests that the iron and other detected metals were in a solid form since ions should not be retained by the Teflon®. The oxidation state of the metals in the sheens is unknown; however, and it is also unknown if they are chelated with organics.

7.0 ORGANOPHILIC CLAY ANALYSIS

This section summarizes the HEM and organic carbon content results from the two sediment cap cores collected from Willamette Cove in October 2009. A previous study conducted at the University of Texas concluded that fresh ET-1 organophilic clay has an average HEM of 2.1% and a maximum of 3.4% after being saturated with Site water for 7 days. HEM can increase when placed in the field because of degradation of organic components of the clay, sorption of natural organics, or dissolved organic contaminants present in porewater at the Site, and migration of NAPL into the organophilic clay in addition to the residual HEM present from production of the ET-1 organophilic clay. Spike tests showed recovery of approximately 85% of NAPL from the ET-1 and therefore, very high HEM could be used as a surrogate for NAPL penetration into the clay.

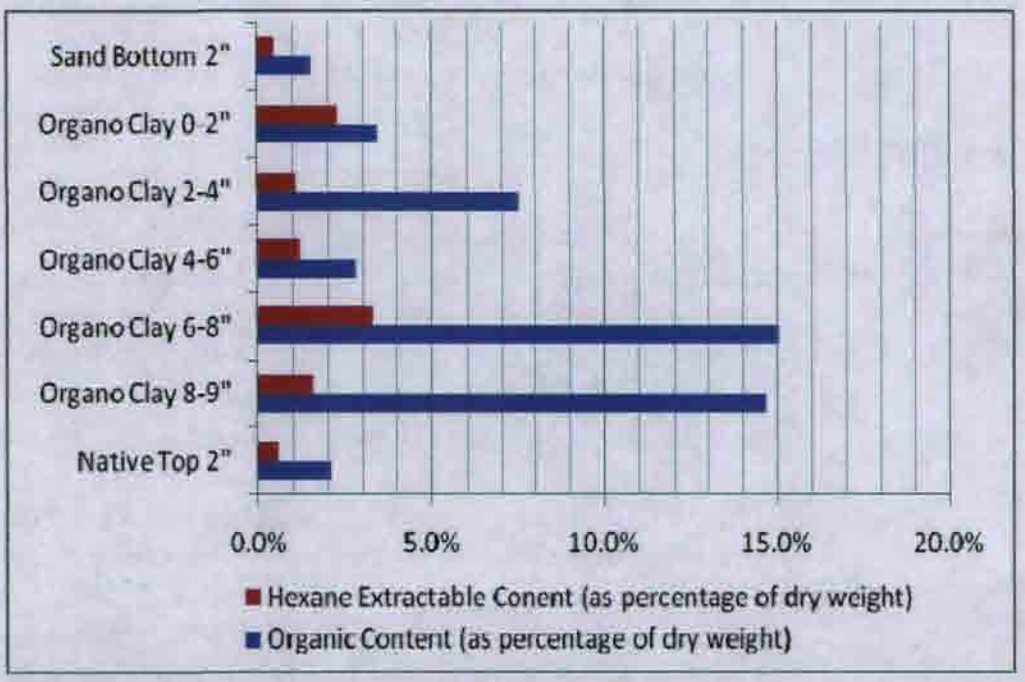


HEM and Organic Matter Content of WC-02

Percent dry HEM results for the two cores from Willamette Cove are shown above. At WC-02 the native sediment has 3.5% HEM and 14% organic matter content; and the trend through the organophilic clay cap is a clear profile of decreasing concentrations with increasing distance from the sediment interface. The HEM immediately next to the sediment was highest at about 8%; this is a somewhat higher value than measured previously. Additionally, the HEM in the highest layer adjacent to the sand cap is at 3.32%.

At WC-01, the native sediment is 0.5% HEM and 2% organic content, considerably lower than at WC-02. Here there is no distinguishable trend in the HEM through the cap, but rather the HEM concentration profile seems to remain relatively constant between 1% and 3%. It appears that at WC-01 there

is heterogeneity of the organophilic clay cap throughout its depth due to intermixing with the sand cap. This was originally speculated because the samples of depths 0-2", 2-4", and 4-6" had a considerably sandier texture than at the other depths which had a texture consistent with the texture of the organophilic clay cap at WC-02. This is also reflected in the relatively low organic matter content of the 0-6" segment of WC-01.



HEM and Organic Matter Content of WC-01

The HEM measurements do not suggest NAPL contamination of the organoclay. As indicated above, HEM can be influenced by factors other than NAPL penetration. Of particular concern is the potential for biodegradation of the organic components of the organophilic clay. Elevated values of HEM could indicate more bioavailable organic matter in the clay and potentially more biodegradation of that organic matter. The organic matter content in the organophilic clay has been monitored periodically to assess degradation over time. The average organic content of several samples of ET-1 organophilic clay from the Site. 15.9 ±2.6%, was compared to the organic content of fresh samples of the ET-1 organophilic clay, 24.1 ±0.16%, to estimate an organic matter degradation rate (Reible, 2009). The estimated half-life of clay organic matter was 6.6 years, with an estimated rate constant of 0.105 $year^{-1}$.

The organic content of organophilic clay from WC-02 varied from 14.5 to 18% which is similar to that of previous samples from 2008. WC-01 may not be representative of ET-1 clay as it appears to be mixed with sand. Because the differences year to year are small compared to the variability in samples within a

year, we recommend additional sampling in five years in sufficient locations to determine whether the ET-1 organophilic clay is functioning as designed or has continued to degrade.

8.0 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the conclusions regarding sediment cap protectiveness and provides recommendations for ongoing monitoring.

8.1 Conclusions

The conclusions provided below are based on the DQOs presented in the *Ebullition and Sheen Investigation Work Plan* (Hart Crowser/GSI, 2008) (note DQO #5 has been revised to include the 2009 sheen characterization activities). These conclusions consider field observations, data compiled from the 2008 ebullition and sheen investigation, previous sheen investigations, the 2009 sheen characterization, and the additional organophilic clay core results from 2009.

DQO #1: Determine whether the sediment cap is protective of surface water; specifically in the areas of concern. Determine whether the sediment cap is effective in preventing NAPL seeps to the river.

Conclusions for DQO #1: The low PAH concentrations from porewater samples collected in the sediment cap combined with the lack of any evidence of NAPL migration into and through the bulk organophilic clay demonstrate that the sediment cap is protective and that surface water is protected not only broadly across the sediment cap as demonstrated by the semi-annual sampling, but also in the specific areas of concern addressed by these investigations.

Porewater and SPME data collected from the sediment cap sand along the shoreline in the WC are below ROD and risk-based comparison criteria. Porewater samples, collected in 2008 as part of the sheen investigation, from the shoreline of the TFA and south of the TFA were non-detect or below comparison criteria for PAHs, with the exception of some low level cPAH detections exceeding comparison criteria in porewater from two conventionally collected samples located shoreward of the granular bulk organophilic clay. The cPAH concentrations in these samples were 0.0971 µg/L and 0.2154 µg/L and total PAH concentrations were 0.6749 µg/L and 0.5756 µg/L, respectively. One other porewater sample collected from just outside the southern corner of the Organoclay RMC in the TFA contained low level cPAH concentrations (0.115 µg/L). Total PAHs in the porewater samples ranged from not detected to 77 µg/L. Porewater concentrations in the cap sand between the bank and the

native sediment in the bank in the TFA would be expected to have significantly higher concentrations of PAHs if sheen were migrating from residual creosote in the bank though the cap sand into surface water. These low level concentrations would not be expected to result in shoreline sheen. In addition, the low level cPAHs detected in the porewater within the cap sand is from 8 to 10 inches into the cap sand which is over 1.5 feet below the surface water interface when the armoring thickness is taken into account.

Sediment samples, collected in select locations from the WC and TFA were analyzed for PAHs. Sample results were well below ROD sediment cleanup goals and DEQ's sediment bioaccumulation screening level values (DEQ, 2007). Samples collected from the native sediment beneath the sediment cap material were elevated as expected, demonstrating the ability of the sediment cap to attenuate PAHs.

Sheen is frequently observed at the shoreline in areas where residual creosote is known to be present beneath the sediment cap, in areas where there has been no evidence of residual creosote, and along the shoreline of the Triangle Park property, south of the Site. Sheen in each of these areas has common characteristics: metallic luster/iridescent, blocky, and does not re-coalesce when disturbed. The fact that it does not re-coalesce when disturbed suggests that it is not hydrocarbon sheen. Sheen samples collected in 2009 in the WC and the TFA do not contain elevated PAH concentrations above the adjacent surface water, and are significantly lower than sampling data from pre-cap sheens. In general, observed sheens are odorless. However, there appears to be a naphthalene odor occasionally associated with sheen in WC. This odor is likely associated with upland groundwater discharging over the sediment cap, and not related to observed sheen. This odor is present in late summer when the river levels drop and the upland groundwater levels are still high. Isolated sheen samples collected in 2009 show elevated levels of iron relative to the ambient surface water suggesting that the sheen is related to a concentration of iron in a solid phase.

Dioxin concentrations from crayfish sampling in 2006 and 2008 are below the Oregon Department of Human Services health advisory level, and well below the average for Portland Harbor. Prior to installation of the sediment cap, dioxin concentrations in crayfish were well above advisory levels.

An extensive amount and variety of data, as described above and elsewhere in this report, has been collected over the past 5 years, all of which indicate that the sediment cap is protective of surface water, and is performing as designed.

DQO #2: Determine whether or not the degradation is breaking down the organophilic clay, and if so, determine how/whether it significantly affects the life of the organophilic clay as it pertains to the Site.

Conclusions for DQO #2: The high HEM levels in the ET-1 organophilic clay samples suggest that there is a significant amount of organic matter within the organophilic clay that is potentially degradable. This is supported by the reduction in the percent of organic matter content within the ET-1 organophilic clay since placement based on testing by the University of Texas (2006, 2008, and 2009 cores) and Portland State University (2006 and 2008 cores). Degradation of this organic matter appears to be contributing to the ebullition noted in the TFA organoclay cap area. Substantial organic matter remains in the ET-1 organophilic clay suggesting that it has adequate capacity to sorb creosote should creosote migrate into the sediment cap. In addition, since creosote migration is arrested by the presence of the barrier wall, reliance on the ET-1 to sorb creosote indefinitely is not expected. Creosote sorption capacity was most important immediately after remedy implementation when consolidation and redistribution of creosote may have occurred. Finally, any organophilic clay saturated with creosote during these initial stages is likely degrading much more slowly, if at all, due to the negative impact of the NAPL on microbial activity. Thus, there is no evidence that the observed reduction in organic matter in the ET-1 organophilic clay samples will result in creosote release through the sediment cap in the future.

Results from the flux chamber sampling also support the preliminary conclusion that the granular organophilic clay is performing as designed. The PAH concentrations in water from flux chambers located on top of the granular organophilic clay in the TFA were below the comparison criteria with the exception of water from FC-5G where chrysene measured at 0.058 µg/L exceeded the comparison criteria (0.018 µg/L) which is consistent with the determination that the ebullition pathways do allow for limited migration of particulate matter through the sediment cap. No other water samples collected from the 6 flux chambers placed on top of the granular organophilic clay in the TFA exceeded any comparison criteria. The flux chambers in WC were placed just outside of the organophilic clay footprint because of low Willamette River levels; and therefore, did not measure contaminants moving through the granular organophilic clay.

DQO #3: Determine whether the ebullition is a significant contaminant migration pathway through the sediment cap.

Conclusions for DQO #3: Two co-located flux chambers were placed in 10 locations. In each location, one flux chamber was placed over an ebullition

pathway and the other adjacent where no ebullition was observed. During the course of the sampling event, one set of flux chambers "washed away" and therefore, water and gas samples were collected from nine co-located chambers.

Gas was only collected from the chambers placed over the ebullition pathways. Generally, gas collected from flux chambers placed over the top of granular organophilic clay contained high relative concentrations of methane, while gas generated outside the organophilic clay footprint included a lower ratio of methane to other gases. This suggests that methanogenesis is the primary process occurring within the granular organophilic clay, and other degradation processes, including methanogenesis, are occurring elsewhere.

Porewater from each flux chamber was collected daily for four days through an XAD column. Analytical results of porewater collected from flux chambers placed over ebullition locations have higher concentrations of COCs relative to porewater collected from adjacent chambers. However, with the exception of at FC-5G where chrysene was measured at 0.058 µg/L, which is slightly above the comparison criteria, all porewater concentrations are well below comparison criteria. The total cPAHs from FC-01G exceeded the ROD comparison criteria of 0.031µg/L; however, none of the individual cPAHs in that sample exceeded the individual comparison criteria for cPAHs. The results of the water sampling from the flux chambers indicate that ebullition creates a preferential pathway for contaminant migration but not a significant pathway threatening the protectiveness of the sediment cap.

The inability to identify significant contaminant migration through the cap via the cores, conventional porewater, or SPME analyses that exceeds the cleanup goals for the sediment cap suggests that ebullition is not having a dramatic effect on contaminant release. The two SPME samples placed over the top of the granular organophilic clay where ebullition is prevalent, do not show dissolved PAH concentrations significantly different than elsewhere on the Site and well below Site comparison criteria.

DQO #4: Determine whether gas is passing through the organophilic clay mats or accumulating beneath the mats.

Conclusions for DQO #4: There is no evidence to suggest that gas is not passing through the Organoclay™ RCM. The ebullition survey did not demonstrate that ebullition was significantly greater in water surrounding the mats. The rates of ebullition were relatively low overtop and surrounding the Organoclay™ mats. Ebullition has been consistently observed from the northeast corner of Organoclay™ Mat #2 suggesting that the RCM in that area may be blocking the movement of gas through the mat. However, when pulling back the

corner of the RCM to collect a mat sample, the sand placed over the rock armoring beneath the mat was noticeably missing; the sand had apparently been washed into the rock armoring, providing a higher permeability material directly beneath that area of the mat. Dependent on the extend of this sand washing beneath Mat #2, a preferential pathway for gas to migrate toward the edges of the mat in lieu of migration through the mat is created. Visual inspection of the back side of the pulled back corner of the mat did not reveal any staining or signs that suggest contamination is penetrating the mat. No visual sign of sheens associated with the ebullition surrounding the mats was observed.

Certified testing by CETCO of the RMC after two years in the field (exhumed August 2008) showed that the PM199 Organoclay™ RMC retains sufficient oil capacity and permeability to perform as designed. The adsorption capacity resulted in a capacity of 0.5387 lb creosote/lb Organoclay™ showing no decrease in sorptive capacity from the minimum of 0.5 lb creosote/lb Organoclay™ for fresh Organoclay™. The permeability was measured at 6.3×10^{-2} cm/sec which is greater than the minimum permeability of fresh RCM of 1×10^{-3} cm/sec. Dr. Reible tested the HEM and found that PM-199 Organoclay™ exhibited an HEM of 1.25 ± 0.77% (95% confidence interval) for fresh material and 1.25 ± 0.28% (standard deviation) for material removed from the RCM.

DQO #5: Determine nature and origin of sheen and whether sheen poses a threat to the environment.

Conclusions for DQO #5: The resulting data from the samples collected for DQO#1 support a strong argument that the periodically observed shoreline sheen is not the result of PAH migration through the sediment cap at the Site. Porewater results from samples collected within the sediment cap sand in multiple locations in the TFA and the WC riverbank, downgradient from the most likely source of a potential residual creosote source; do not support the suggestions that the origin and nature of the sheen is associated with contamination from the Site.

PAH concentrations in the four surface water samples collected in July 2008 are significantly lower than concentrations that would be indicative of, or produce, sheen. Concentrations of the surface water with sheen were similar to the adjacent surface water without sheen and, in one case; the concentration in the surface water without sheen was higher than the concentration of the surface water with sheen. There were no detections of TPH in the sheen samples or adjacent surface water samples.

Sheen-inducing contaminant migration was not observed in samples collected or collection locations in the 2008 and 2009 investigations. In addition, NAPL was

not observed in core samples in locations where SPME samplers were placed, which was generally where sheens had been observed or suspected.

The results from the biogenic evaluation by MSU of the sheen samples from the Site do not support a role for bacteria/bacterial biofilms in the creation of the sheens. There was no substantial difference in colony morphologies between the water and sheen associated bacteria, no evidence for biofilm formation or iron oxidizing bacteria in the direct microscopy images, and no major differences in the microbial ecology between the water and sheen samples were seen.

The analytical chemistry of sheen samples show that the sheen is not related to creosote migration through the cap but more probably a composite film composed of metals, including iron with low concentrations of PAHs and relatively low bacterial counts. Observation of the sheens at the Site suggested that this may be the case because the material fractured and did not re-coalesce on the water surface. Sheens on the bank sands looked metallic as they dried. The material also had a sharp, metallic odor. Other evidence is elevated level of iron in the material collected on the mesh. Collection of iron on the mesh suggests that the metals were in a solid form since ions should not be retained by the Teflon®. The oxidation state of the metals in the sheens is unknown (iron in the ambient surface water is Fe^{+2}), and it is also unknown if the iron is chelated with organics.

The signature of the chromatograms of sheen collected at the Site mimic the Teflon blank chromatogram signature. The chromatograms of simulated creosote sheen from the Site show numerous peaks forming a distinctive mound from 6 to 20 minutes elution. The analytical chemistry results show that the laboratory simulated sheen samples contains a high mass of PAHs with all but one of the analyzed PAHs represented in the sheen, while the actual sheen from the Site contains few PAHs at levels and ratios compared to the laboratory simulated sheen samples, and are therefore not indicative of creosote product. PAHs in the field-sampled sheen contain similar PAHs at similar levels to what is detected in ambient surface water samples. The data clearly demonstrate that the sheen does not contain PAH concentrations indicative of a sheen resulting from a surficial film of creosote migrating through the sediment cap as the surface water surface moves upward through the residual creosote contamination or entrained on gas bubbles.

The elevated iron levels relative to other metals in the sheen as compared to the surface water coupled with the field observations suggestive of metallic characteristics strongly suggest that the sheen is related to iron and not contaminant migration through the sediment cap.

Overall Conclusion Regarding Sediment Cap Protectiveness: Extensive investigations and studies have been conducted related to the protectiveness of the sediment cap since its construction completion in 2005. As described above in the conclusions to individual DQOs, the sediment cap is functioning as designed and is protective of surface water quality.

8.2 Recommendations

Extensive study to determine that cause and nature of periodically observed shoreline sheens at the Site demonstrates that the sheen is not related to Site contaminants migrating through the sediment cap. Further characterization of the nature of the sheens would require more rigorous and sophisticated analytical methods, and are not expected to provide more conclusive evidence of the sheen composition than the evidence compiled to date.

Specific additional monitoring of the sediment cap remedy is recommended to include:

- Additional, periodic monitoring of the dissolved contamination in and above the cap layers to ensure that contaminant migration does not lead to unacceptable levels of contaminant in the near surface environment. Profiling SPME can be used to replace or supplement conventional porewater extraction methods and can provide an indication of not only current concentrations but gradients in concentration that may be early warning indicators of contaminant migration; and
- Additional periodic evaluation of ET-1 organophilic clay to ensure that the degradable or extractible organic matter fraction does not compromise the ability of the organophilic clay to retain NAPL and dissolved contaminants. HEM and organic matter content evaluations should be the primary tools to assess the change of ET-1 organophilic clay over time.

9.0 REFERENCES

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Table F-1
Weekly Sheen Observations
McCormick and Baxter Superfund Site
Portland, Oregon

Sheen Inspection Date	Willamette Cove	Former Tank Farm Area	Former Waste Disposal Area	M&B Stormwater Discharge Area	City Stormwater Discharge Area	Notes on Ebullition
23-Jul-09	BS, no odor	BS, no odor	NS	NS	BS, no odor	Ebullition observed in TFA and WC. No odor.
27-Jul-09	NS	BS, no odor	NS	NS	NS	Ebullition observed in TFA and WC. No odor.
3-Aug-09	BS, no odor	BS, no odor	BS, no odor	BS, no odor	BS, no odor	Ebullition observed in TFA and WC. No odor.
10-Aug-09	BS, no odor	BS, no odor	NS	NS	BS, no odor	Ebullition observed in TFA and WC. No odor.
24-Aug-09	BS, no odor	BS, no odor	NS	NS	BS, no odor	Ebullition observed in TFA and WC. No odor.
3-Sep-09	NS	BS, no odor	NS	NS	NS	Moderate ebullition in TFA and WC. No odor.
11-Sep-09	NS	NS	NS	NS	NS	Moderate ebullition in TFA and WC. No odor.
14-Sep-09	Tank Farm Area and Willamette Cove	BS, no odor	NS	NS	NS	Rainbow color sheen observed well into Willamette Cove away from M&B site. No odor.
28-Sep-09	NS	BS, no odor	NS	NS	NS	Ebullition observed in TFA and WC. No odor.
5-Oct-09	NS	NS	NS	NS	NS	Ebullition observed in TFA and WC, no odor
13-Oct-09	NS	NS	NS	NS	NS	Ebullition observed in TFA and WC, no odor
20-Oct-09	NS	NS	NS	NS	NS	Ebullition observed in TFA and WC. No odor.

Notes:
NS = no sheen.
SS = slight sheen.
MS = moderate sheen.
BS = biological sheen.
TFA = Tank Farm Area.
WC = Willamette Cove.
Shading = Observed Sheen.

Table F-2
Sheen Sampling Summary
McCormick and Baxter Superfund Site
Portland, Oregon

Week Ending August 6, 2009					
Sample Location	Ambient Water (SW)	Teflon® Net/Pad (SHG)	C-18 Cartridge Sheen (SH18)	C-18 Cartridge Ambient Water (SWC18)	Notes
Willamette Cove (WC)	Grab sample collected on 08/06	Collected on: 08/03, 08/04, 08/05, 08/06	NS	NS	Sheen collected from ACB voids.
Tank Farm Area 1 (TFA-1)	Grab sample collected on 08/06	Collected on: 08/03, 08/04, 08/05, 08/06	NS	NS	Sheen collected from surface river water.
Tank Farm Area 2 (TFA-2)	Grab sample collected on 08/06	Collected on: 08/03, 08/04, 08/05, 08/06	NS	NS	Sheen collected from pooled surface water.
South End of Site (SES)	Grab sample collected on 08/06	Collected on: 08/03, 08/04, 08/05	NS	NS	Sheen collected from ACB voids and surface river water. No sheen on 08/06.

Week Ending August 13, 2009					
Sample Location	Ambient Water (SW)	Teflon® Net/Pad (SHG)	C-18 Cartridge Sheen (SH18)	C-18 Cartridge Ambient Water (SWC18)	Notes
Willamette Cove (WC)	Grab sample collected on 08/12	Collected on: 08/10, 08/11	Collected on: 08/11 (250 mL)	Collected on: 08/11 (250 mL)	Not enough sheen on 08/10 for C-18 cartridges. No sheen on 08/12, 08/13.
Tank Farm Area 1 (TFA-1)	Grab sample collected on 08/12	Collected on: 08/10, 08/11, 08/12	Collected on: 08/10 (250 mL), 08/11 (50 mL), 08/12 (50 mL)	Collected on: 08/10 (250 mL), 08/11 (50 mL), 08/12 (50 mL)	Sheen collected from surface water. C-18 cartridges clogged from sediment.
Tank Farm Area 2 (TFA-2)	Grab sample collected on 08/12	Collected on: 08/12	NS	NS	Sheen collected from pooled surface water. Not enough sheen for C-18 cartridges.
South End of Site (SES)	Grab sample collected on 08/12	Collected on: 08/10, 08/11, 08/12	Collected on: 08/10 (250 mL), 08/12 (50 mL)	Collected on: 08/10 (250 mL), 08/12 (50 mL)	Sheen collected from ACB voids. C-18 cartridges clogged.

Week Ending August 27, 2009					
Sample Location	Ambient Water (SW)	Teflon® Net/Pad (SHG)	C-18 Cartridge Sheen (SH18)	C-18 Cartridge Ambient Water (SWC18)	Notes
Willamette Cove (WC)	Grab sample collected on 08/27	Collected on: 08/24, 08/25, 08/27	NS	NS	Sheen collected from ACB voids. No sheen on 08/26.
Tank Farm Area 1 (TFA-1)	Grab sample collected on 08/27	Collected on: 08/24, 08/25, 08/26, 08/27	NS	NS	Sheen collected from surface river water.
Tank Farm Area 2 (TFA-2)	NS	NS	NS	NS	Sheen was not observed.
South End of Site (SES)	Grab sample collected on 08/27	Collected on: 08/24, 08/25, 08/26	NS	NS	Sheen collected from ACB voids. No sheen on 08/27

Notes:
NS = Not Sampled.

Table F-3
Ambient Surface Water Quality Parameters
McCormick and Baxter Superfund Site
Portland, Oregon

August 6, 2009				
Field Parameters*	Willamette Cove (WC)	Tank Farm Area 1 (TFA-1)	Tank Farm Area 2 (TFA-2)	South End of Site (SES)
Temperature (°C)	23.34	23.45	24.05	24.51
Specific Conductance (mS/cm)	0.120	0.095	0.089	0.095
Dissolved Oxygen (mg/L)	8.84	8.23	9.03	8.37
pH	7.92	7.60	7.70	7.67
Oxidation Reduction Potential (mV)	56.9	67.8	64.7	75.8

August 12, 2009				
Field Parameters*	Willamette Cove (WC)	Tank Farm Area 1 (TFA-1)	Tank Farm Area 2 (TFA-2)	South End of Site (SES)
Temperature (°C)	23.00	23.4	24.42	NA
Specific Conductance (mS/cm)	NA	0.087	0.096	NA
Dissolved Oxygen (mg/L)	NA	NA	NA	NA
pH	7.55	7.32	7.56	NA
Oxidation Reduction Potential (mV)	64.2	87.8	69.1	NA

August 27, 2009				
Field Parameters**	Willamette Cove (WC)	Tank Farm Area 1 (TFA-1)	Tank Farm Area 2 (TFA-2)	South End of Site (SES)
Temperature (°C)	23.6	25.6	NS	25.6
Specific Conductance (mS/cm)	0.19	0.10	NS	0.10
Dissolved Oxygen (mg/L)	NM	NM	NS	NM
pH	7.3	7.1	NS	7.0
Oxidation Reduction Potential (mV)	12.6	13.5	NS	29.6

Notes:
* = Water quality parameters collected using an YSI 650 Sonde multiparameter probe.
** = Water quality parameters collected using hand held probes.
NA = Not available due to probe malfunction.
NM = Not measured.
NS = Not sampled.

Table F-4
Simulated Sheen and Teflon® Net/Pad Data - August 2009
McCormick and Baxter Superfund Site
Portland, Oregon

Sample Location Sample Date	**Simulated Sheen - Net** **8/6/2009**		**Simulated Sheen - Pad** **8/6/2009**		**Sheen - Net Blank** **8/6/2009**	**Sheen - Pad Blank** **8/6/2009**
Contaminant of Concern						
NWTPH-HCID	**Concentrations in mg**					
Diesel Range	**54.4**		**78.8**		0.5 U	0.25 U
Gasoline Range	**0.913**		**1.96**		0.2 U	0.1 U
Motor Oil Range	**6.59**		**9.63**		**1.19**	0.5 U
Total Metals	**Concentrations in mg/kg**					
Arsenic	NA		**0.00019**		NA	0.000085 U
Chromium	NA		**0.0665**		NA	**0.00023**
Cobalt	NA		0.000005 U		NA	0.000005 U
Copper	NA		**0.00039**		NA	**0.00017**
Iron	NA		**0.0076**		NA	**0.0023**
Manganese	NA		**0.00014**		NA	**0.000051**
Zinc	NA		**0.00021**		NA	**0.0002**
PAHs by 9270 MSSVSIM	**µg/kg**	**%PAH/ Total PAHs**	**µg/kg**	**%PAH/ Total PAHs**	**µg/kg**	**µg/kg**
Acenaphthene	**2,360**	13.27	**3,290**	13.01	0.0011 U	0.0011 U
Acenaphthylene	**34.5**	0.19	**50.2**	0.20	0.001 U	0.001 U
Anthracene	**779**	4.38	**1,070**	4.23	0.0011 U	0.0011 U
Benzo(a)anthracene	**488**	2.74	**763**	3.02	0.0049 U	0.0049 U
Benzo(a)pyrene	**227**	1.28	**297**	1.17	0.0029 U	0.0029 U
Benzo(b)fluoranthene	**354**	1.99	**506**	2.00	0.003 U	0.003 U
Benzo(g,h,i)perylene	**41**	0.23	**56.8**	0.22	0.005 U	0.005 U
Benzo(k)fluoranthene	**137**	0.77	**255**	1.01	0.0038 U	0.0038 U
Chrysene	**475**	2.67	**724**	2.86	0.0054 U	0.0054 U
Dibenz(a,h)anthracene	0.237 U	0.00	0.237 U	0.00	0.0047 U	0.0047 U
Fluoranthene	**2,540**	14.29	**3,700**	14.64	0.0022 U	0.0022 U
Fluorene	**2,360**	13.27	**3,090**	12.22	0.0015 U	0.0015 U
Indeno(1,2,3-cd)pyrene	**114**	0.64	**128**	0.51	0.0073 U	0.0073 U
Naphthalene	**1,280**	7.20	**2,730**	10.80	**0.456**	**0.568**
Phenanthrene	**4,940**	27.78	**6,230**	24.64	**0.462**	**2.26**
Pyrene	**1,650**	9.28	**2,390**	9.45	0.0018 U	0.0018 U

Notes:
Bold = detected.
U = non detect.
NA = not analyzed.

Table F-5
Sheen and Surface Water Data - August 2009 (Grab Samples)
McCormick and Baxter Superfund Site
Portland, Oregon

Sample Location	Willamette Cove - Sheen				Willamette Cove - Surface Water			Tank Farm Area - 1 (TFA-1) - Sheen			Tank Farm Area - 1 (TFA-1) - Surface Water		
Sample Date	8/6/2009	8/13/2009		8/27/2009	8/6/2009	8/13/2009	8/27/2009	8/6/2009	8/13/2009	8/27/2009	8/6/2009	8/13/2009	8/27/2009
Contaminant of Concern	MBSHG080609-WC-CHEM	MBSHG081309-WC-CHEM	MBSHG081309-WC-D-CHEM	MBSHG082709-WC-CHEM	MBSW080609-WC-CHEM	MBSW081309-WC-CHEM	MBSW082709-WC-CHEM	MBSHG080609-TFA1-CHEM	MBSHG081309-TFA1-CHEM	MBSHG082709-TFA1-CHEM	MBSW080609-TFA1-CHEM	MBSW081309-TFA1-CHEM	MBSW082709-TFA1-CHEM
NWTPH-HCID	Concentrations in mg				Concentrations in mg/L			Concentrations in mg			Concentrations in mg/L		
Diesel Range	0.5 U	0.5 U	0.5 U	0.5 U	1.3 U	1.3 U	1.3 U	0.5 U	0.5 U	0.5 U	1.3 U	1.3 U	1.3 U
Gasoline Range	0.2 U	0.2 U	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U
Motor Oil Range	1 U	1 U	1 U	1 U	1.3 U	1.3 U	1.3 U	1 U	2.12 U	1 U	1.3 U	1.3 U	1.3 U
Total Metals	Concentrations in mg				Concentrations in µg/L			Concentrations in mg			Concentrations in µg/L		
Arsenic	0.00009 U	0.00009 U	0.00009 U	0.00009 U	3.5 U	3.5 U	3.5 U	**0.00017 J**	0.00009 U	**0.00029 J**	3.5 U	3.5 U	3.5 U
Chromium	**0.00026 J**	**0.00037 J**	**0.00091 J**	**0.00068**	0.8 U	0.8 U	**1.1 J**	**0.00140**	**0.00032 J**	**0.00260**	0.8 U	0.8 U	0.8 U
Cobalt	**0.00001 J**	**0.00001 J**	0.00001 U	**0.00007 J**	0.3 U	0.3 U	0.3 U	**0.00017 J**	**0.00005 J**	**0.00031 J**	0.3 U	0.3 U	0.3 U
Copper	**0.00035 J**	**0.00048 J**	**0.00021 J**	**0.00038 J**	1.4 U	**2.3 J**	1.4 U	**0.00055 J**	**0.00012 J**	**0.00060 J**	1.4 U	1.4 U	1.4 U
Iron	**0.40300**	**0.06500**	**0.06590**	**0.50900**	**329**	**366**	**220**	**0.61600**	**0.19400**	**0.93900**	**193**	**286**	**269**
Manganese	**0.00720**	**0.00150**	**0.00170**	**0.01350**	**51.7**	**57.3**	**32.6**	**0.01160**	**0.00900**	**0.02580**	**33.3**	**42.5**	**59**
Zinc	**0.00300**	**0.00081 J**	**0.00120 J**	**0.00400**	**3.5 J**	3.3 U	3.3 U	**0.00380**	**0.00150 J**	**0.00500**	**4.4 J**	3.3 U	3.3 U
Dissolved Metals					Concentrations in µg/L						Concentrations in µg/L		
Arsenic	NA	NA	NA	NA	1.3 U	1.4 U	1.3 U	NA	NA	NA	**1.7 J**	1.3 J	1.3 U
Chromium	NA	NA	NA	NA	0.31 U	**0.56 J**	**0.39 J**	NA	NA	NA	**0.94 J**	0.77 J	0.31 U
Cobalt	NA	NA	NA	NA	0.36 U	0.36 U	0.36 U	NA	NA	NA	0.36 U	0.36 U	0.36 U
Copper	NA	NA	NA	NA	0.54 U	0.54 U	**1.9 J**	NA	NA	NA	0.54 U	1.2 J	0.54 U
Iron	NA	NA	NA	NA	**123**	**74.3 J**	**42.4 J**	NA	NA	NA	**72.2 J**	75.2 J	87 J
Manganese	NA	NA	NA	NA	**41.8**	**12.8 J**	**16.5**	NA	NA	NA	**22 J**	29.6	48.3
Zinc	NA	NA	NA	NA	6.6 U	6.6 U	6.6 U	NA	NA	NA	6.6 U	6.6 U	17.6 J
PAHs by 9270 MSSV SIM	Concentrations in µg				Concentrations in µg/L			Concentrations in µg			Concentrations in µg/L		
Acenaphthene	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.094 UJ	0.095 U	0.095 U	0.0011 U	0.0011 U	0.0011 U	0.0018 UJ	0.095 U	0.095 U
Acenaphthylene	0.001 U	0.001 U	0.001 U	0.001 U	**0.0022 J**	0.0016 U	**0.0018 J**	0.001 U	0.001 U	0.001 U	0.0016 UJ	0.0016 U	**0.0033 J**
Anthracene	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.094 UJ	0.095 U	0.0018 U	0.0011 U	0.0011 U	0.0011 U	0.095 UJ	0.095 U	0.095 U
Benz(a)anthracene	0.0049 U	0.0049 U	0.0049 U	0.0049 U	0.0076 U	0.0076 U	0.0076 U	0.0049 U	0.0049 U	0.0049 U	0.0077 UJ	0.0077 U	0.0077 U
Benzo(a)pyrene	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.094 UJ	0.0046 U	0.095 U	0.0029 U	0.0029 U	0.0029 U	0.095 UJ	0.0047 U	0.095 U
Benzo(b)fluoranthene	0.003 U	0.003 U	0.003 U	0.003 U	**0.081 J**	0.0047 U	**0.082 J**	0.003 U	0.003 U	0.003 U	**0.082 J**	0.0048 U	**0.083 J**
Benzo(g,h,i)perylene	0.005 U	0.005 U	0.005 U	0.005 U	**0.0081 J**	0.0078 U	**0.011 J**	0.005 U	0.005 U	0.005 U	**0.011 J**	0.0079 U	**0.012 J**
Benzo(k)fluoranthene	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.006 U	0.006 U	0.006 U	0.0038 U	0.0038 U	0.0038 U	0.0061 UJ	0.0061 U	0.0061 U
Chrysene	0.0054 U	0.0054 U	0.0054 U	0.0054 U	0.0085 U	0.0085 U	0.0085 U	0.0054 U	0.0054 U	0.0054 U	0.0085 UJ	0.0086 U	0.0086 U
Dibenz(a,h)anthracene	0.0047 U	0.0047 U	0.0047 U	0.0047 U	0.0075 U	0.0075 U	0.0075 U	0.0047 U	0.0047 U	0.0047 U	0.0075 UJ	0.0075 U	0.0075 U
Fluoranthene	0.0022 U	0.0022 U	0.0022 U	0.0022 U	0.094 UJ	0.095 U	0.095 U	0.0022 U	0.0022 U	0.0022 U	0.095 UJ	0.095 U	0.095 U
Fluorene	**0.494 J**	0.0015 U	0.0015 U	0.0015 U	0.094 UJ	0.0026 U	0.095 U	**0.474 J**	0.0015 U	0.0015 U	0.0027 UJ	**0.029 J**	0.095 U
Indeno(1,2,3-cd)pyrene	0.0073 U	0.0073 U	0.0073 U	0.0073 U	**0.043 J**	0.011 U	**0.045 J**	0.0073 U	0.0073 U	0.0073 U	**0.046 J**	0.012 U	**0.047 J**
Naphthalene	2.56 UB	0.0059 U	0.0059 U	0.0059 U	0.0092 U	0.0092 U	0.0093 U	2.56 UB	0.0059 U	0.0059 U	0.0093 UJ	**0.056 J**	0.095 U
Phenanthrene	6.7 UB	6.8 UB	6.8 UB	6.8 UB	0.094 UJ	0.095 U	0.095 U	6.8 UB	6.8 UB	6.8 UB	0.095 UJ	0.095 U	0.095 U
Pyrene	0.0018 U	0.0018 U	0.0018 U	0.0018 U	0.094 UJ	0.095 U	0.095 U	0.0018 U	0.0018 U	0.0018 U	0.095 UJ	0.095 U	0.095 U
Ratio iron/zinc	134	80	55	127	94	111	67	162	129	188	44	87	82
Average ratio iron/manganese	54				9								

Please refer to notes at end of this table.

Table F-5
Sheen and Surface Water Data - August 2009 (Grab Samples)
McCormick and Baxter Superfund Site
Portland, Oregon

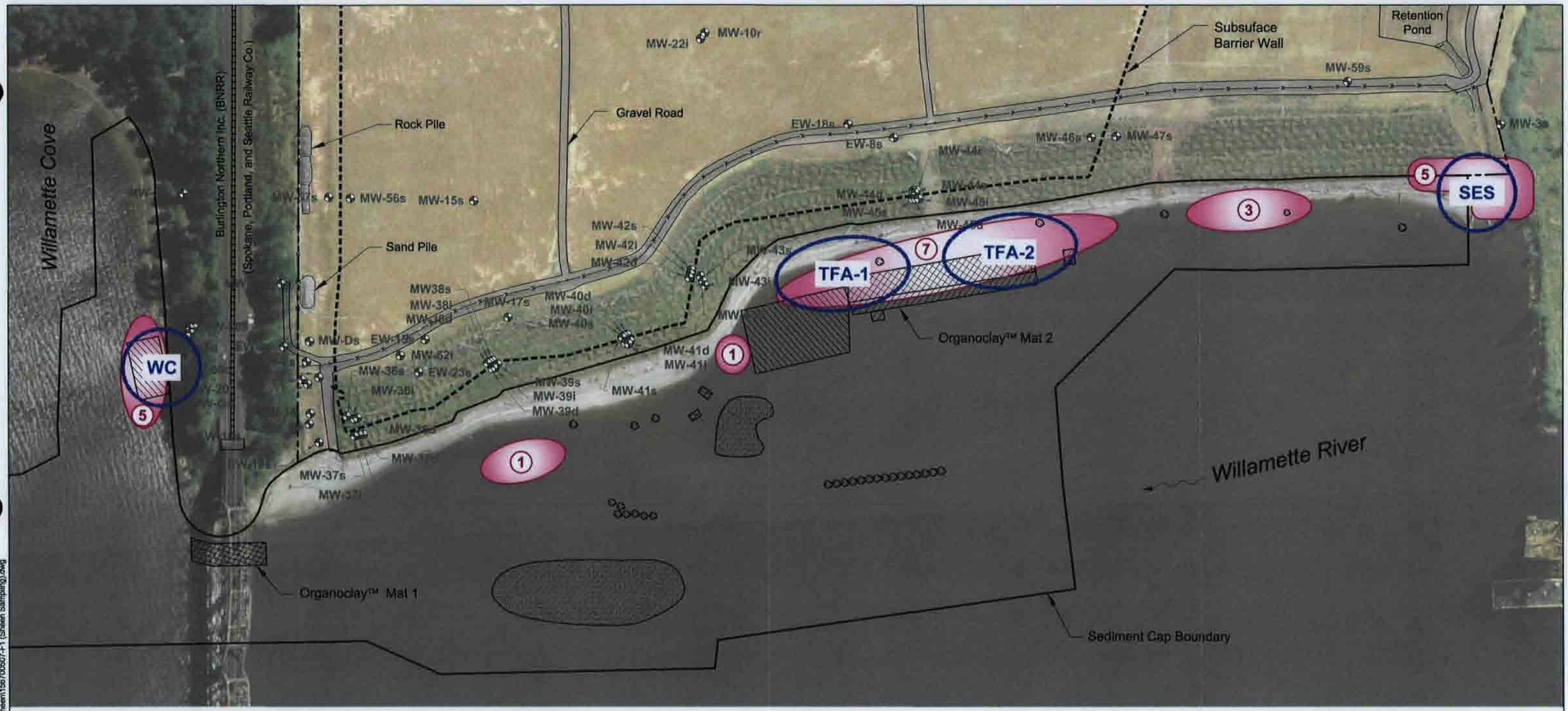
Sample Location	Tank Farm Area - 1 (TFA-2) - Sheen			Tank Farm Area - 1 (TFA-2) - Surface Water			Southeast Site - 1 (SES) - Sheen			Southeast Site - 1 (SES) - Surface Water		
Sample Date	8/6/2009	8/13/2009	8/27/2009	8/6/2009	8/13/2009	8/27/2009	8/6/2009	8/13/2009	8/27/2009	8/6/2009	8/13/2009	8/27/2009
Contaminant of Concern	MBSHG080609-TFA2-CHEM	MBSHG081309-TFA2-CHEM	MBSHG082709-TFA2-CHEM	MBSW080609-TFA2-CHEM	MBSW081309-TFA2-CHEM	MBSW082709-TFA2-CHEM	MBSHG080609-SES-CHEM	MBSHG081309-SES-CHEM	MBSHG082709-SES-CHEM	MBSW080609-SES-CHEM	MBSW081309-SES-CHEM	MBSW082709-SES-CHEM
NWTPH-HCID	Concentrations in mg			Concentrations in mg/L			Concentrations in mg			Concentrations in mg/L		
Diesel Range	0.25 U	0.5 U	NC	1.3 U	1.3 U	NC	0.5 U	0.5 U	0.5 U	1.3 U	1.3 U	1.3 U
Gasoline Range	0.1 U	0.2 U	NC	0.5 U	0.5 U	NC	0.2 U	0.2 U	0.2 U	0.5 U	0.5 U	0.5 U
Motor Oil Range	0.5 U	1.34 J	NC	1.3 U	1.3 U	NC	1 U	1 U	1 U	1.3 U	1.3 U	1.3 U
Total Metals	Concentrations in mg			Concentrations in mg/L			Concentrations in mg			Concentrations in mg/L		
Arsenic	0.00009 U	0.00009 U	NC	3.5 U	3.5 U	NC	**0.00038 J**	**0.00015 J**	**0.00042 J**	3.5 U	3.5 U	3.5 U
Chromium	**0.00027 J**	**0.00022 J**	NC	0.8 U	**0.96 J**	NC	**0.00039 J**	**0.00054**	**0.00200**	**1.4 J**	0.8 U	0.8 U
Cobalt	**0.00013 J**	0.00001 U	NC	0.3 U	0.3 U	NC	**0.00009 J**	**0.00004 J**	**0.00040 J**	**0.31 J**	0.3 U	0.3 U
Copper	**0.00051 J**	**0.00008 J**	NC	1.4 U	1.4 U	NC	**0.00009 J**	**0.00048 J**	**0.00069 J**	1.4 U	1.4 U	1.4 U
Iron	**0.35700**	**0.03480**	NC	**176**	**670**	NC	**1.12000**	**0.57500**	**1.30000**	**1540**	**453**	**506**
Manganese	**0.00700**	**0.00140**	NC	**23**	**50**	NC	**0.00850**	**0.00570**	**0.02620**	**102**	**39.5**	**31.9**
Zinc	**0.00220**	**0.00067 J**	NC	3.3 U	**3.6 J**	NC	**0.00360**	**0.00170 J**	**0.00620**	**4.6 J**	3.3 U	3.3 U
Dissolved Metals				Concentrations in µg/L						Concentrations in µg/L		
Arsenic	NA	NA	NC	1.3 U	1.3 J	NC	NA	NA	NA	**2.1 J**	1.3 U	1.3 U
Chromium	NA	NA	NC	0.6 J	0.53 J	NC	NA	NA	NA	**0.78 J**	**0.78 J**	**0.45 J**
Cobalt	NA	NA	NC	0.36 U	0.36 U	NC	NA	NA	NA	ND U	0.36 U	0.36 U
Copper	NA	NA	NC	0.54 U	0.54 U	NC	NA	NA	NA	ND U	**1.4 J**	0.54 U
Iron	NA	NA	NC	49.4 J	48.6 J	NC	NA	NA	NA	**442**	**84.2 J**	**73.3 J**
Manganese	NA	NA	NC	10.2 J	13.9 J	NC	NA	NA	NA	**75.0**	**25.6**	**22.5**
Zinc	NA	NA	NC	6.6 U	6.6 U	NC	NA	NA	NA	ND U	6.6 U	6.6 U
PAHs by 9270 MSSV SIM	Concentrations in µg			Concentrations in µg/L			Concentrations in µg			Concentrations in µg/L		
Acenaphthene	0.0011 U	0.0011 U	NC	0.094 UJ	0.095 U	NC	0.0011 U	0.0011 U	0.0011 U	**0.01 J**	0.095 U	0.095 U
Acenaphthylene	0.001 U	0.001 U	NC	0.0016 UJ	0.0016 U	NC	0.001 U	0.001 U	0.001 U	0.0016 U	0.0016 U	0.0016 U
Anthracene	0.0011 U	0.0011 U	NC	0.094 UJ	0.095 U	NC	0.0011 U	0.0011 U	0.0011 U	**0.025 J**	0.095 U	0.095 U
Benz(a)anthracene	0.0049 U	0.0049 U	NC	**0.013 J**	0.0077 U	NC	0.0049 U	0.0049 U	0.0049 U	0.0077 U	0.0077 U	0.012 U
Benzo(a)pyrene	0.0029 U	0.0029 U	NC	0.094 UJ	0.0047 U	NC	0.0029 U	0.0029 U	0.0029 U	**0.044 J**	0.0047 U	0.095 U
Benzo(b)fluoranthene	0.003 U	0.003 U	NC	**0.098 J**	0.0048 U	NC	0.003 U	0.003 U	0.003 U	**0.082 J**	0.0048 U	**0.1**
Benzo(g,h,i)perylene	0.005 U	0.005 U	NC	**0.026 J**	0.0079 U	NC	0.005 U	0.005 U	0.005 U	**0.01 J**	0.0079 U	**0.046 J**
Benzo(k)fluoranthene	0.0038 U	0.0038 U	NC	**0.018 J**	0.0061 U	NC	0.0038 U	0.0038 U	0.0038 U	0.0061 U	0.0061 U	0.026 U
Chrysene	0.0054 U	0.0054 U	NC	**0.017 J**	0.0086 U	NC	0.0054 U	0.0054 U	0.0054 U	**0.0091 J**	0.0086 U	0.016 U
Dibenz(a,h)anthracene	0.0047 U	0.0047 U	NC	**0.053 J**	0.0075 U	NC	0.0047 U	0.0047 U	0.0047 U	0.0075 U	0.0075 U	0.078 U
Fluoranthene	0.0022 U	0.0022 U	NC	0.094 UJ	0.095 U	NC	0.0022 U	0.0022 U	0.0022 U	**0.052 J**	0.095 U	0.095 U
Fluorene	0.0015 U	0.0015 U	NC	0.094 UJ	**0.024 J**	NC	0.0015 U	0.0015 U	0.0015 U	**0.0071 J**	**0.0077 J**	0.095 U
Indeno(1,2,3-cd)pyrene	0.0073 U	0.0073 U	NC	**0.058 J**	**0.047 J**	NC	0.0073 U	0.0073 U	0.0073 U	**0.045 J**	**0.045 J**	**0.08 J**
Naphthalene	2.56 UB	0.0059 U	NC	0.0092 UJ	0.0093 U	NC	2.56 UB	0.0059 U	2.56 UB	0.0093 U	0.0093 U	0.0093 U
Phenanthrene	6.8 UB	0.0029 U	NC	0.094 UJ	0.095 U	NC	6.8 UB	6.8 UB	6.8 UB	**0.045 J**	0.095 U	0.095 U
Pyrene	0.0018 U	0.0018 U	NC	0.094 UJ	0.095 U	NC	0.0018 U	0.0018 U	0.0018 U	**0.026 J**	0.095 U	0.095 U
Ratio iron/zinc	162	52		53	186		311	338	210	335	137	153
Average ratio iron/manganese												

Notes:
NA = not analyzed.
U = not detected.
UB = present in blank, not detected at 5 times the level in the blank.
J = estimated.
NC = not collected (no sheen present).
Bold = detected.

Table F-6
Sheen and Surface Water Data - August 2009 (C-18 Cartridges)
McCormick and Baxter Superfund Site
Portland, Oregon

Location	MBSHC81309-WC-CHEM	MBSWC81309-WC-CHEM	MBSHC81309-TFA1-CHEM	MBSWC81309-TFA1-CHEM	MBSHC81309-SES-CHEM	MBSWC81309-SES-CHEM
Contaminant of Concern						
NWTPH-HCID	**Concentrations in mg/L**					
Diesel Range	5 U	5 U	3.6 U	3.6 U	4.2 U	4.2 U
Gasoline Range	2 U	2 U	1.4 U	1.4 U	1.7 U	1.7 U
Motor Oil Range	5 U	5 U	3.6 U	3.6 U	4.2 U	4.2 U
PAHs EPA 8270 SIM	**Concentrations in µg/L**					
Acenaphthene	1.6	0.43 J	1.4	0.12 J	0.2 J	0.12 J
Acenaphthylene	0.0046 J	1.6 U	0.02 J	1.1 U	1.3 U	1.1 U
Anthracene	0.03 U	1.6 U	1.1 U	1.1 U	1.3 U	1.1 U
Benz(a)anthracene	0.13 U	1.6 U	1.1 U	1.1 U	1.3 U	0.26 J
Benzo(a)pyrene	0.078 U	1.6 U	1.1 U	1.1 U	1.3 U	0.74 J
Benzo(b)fluoranthene	0.08 U	1.6 U	1.1 U	1.1 U	1.3 U	1.2 J
Benzo(g,h,i)perylene	0.13 U	1.6 U	1.1 U	1.1 U	1.3 U	0.24 J
Benzo(k)fluoranthene	0.1 U	1.6 U	1.1 U	1.1 U	1.3 U	0.17 J
Chrysene	0.14 U	1.6 U	1.1 U	1.1 U	1.3 U	0.2 J
Dibenz(a,h)anthracene	0.13 U	1.6 U	1.1 U	1.1 U	1.3 U	1.1 U
Fluoranthene	0.058 U	1.6 U	1.1 U	1.1 U	1.3 U	0.2 J
Fluorene	0.55 J	0.086 J	0.22 J	0.038 J	0.06 J	1.1 U
Indeno(1,2,3-cd)pyrene	0.19 U	1.6 U	1.1 U	1.1 U	1.3 U	1.1 U
Naphthalene	0.23 J	1.6 U	0.81 J	0.29 J	1.3 U	1.1 U
Phenanthrene	0.077 U	1.6 U	1.1 U	1.1 U	1.3 U	0.074 J
Pyrene	0.048 U	1.6 U	1.1 U	1.1 U	1.3 U	0.19 J

Notes:
U = not detected.
J = estimated.



MW-48s	Monitoring Well Location and Number
	Boulder Clusters/Rock Mound
	Organoclay™ Mat (Double Layer)
	Organoclay™ Mat (Single Layer)
	Granular Organophilic Clay
	Hot Spot Treatment (Thickened Sand Layer)
2	Sheen Observation and Number of Occurences
SES	Sheen Sampling Location and Designation (8/09)

0 150 300
Scale in Feet

N

McCormick and Baxter Superfund Site
Portland, Oregon

Sheen Sampling Site Plan

2/10

HARTCROWSER GSI Water Solutions, Inc.

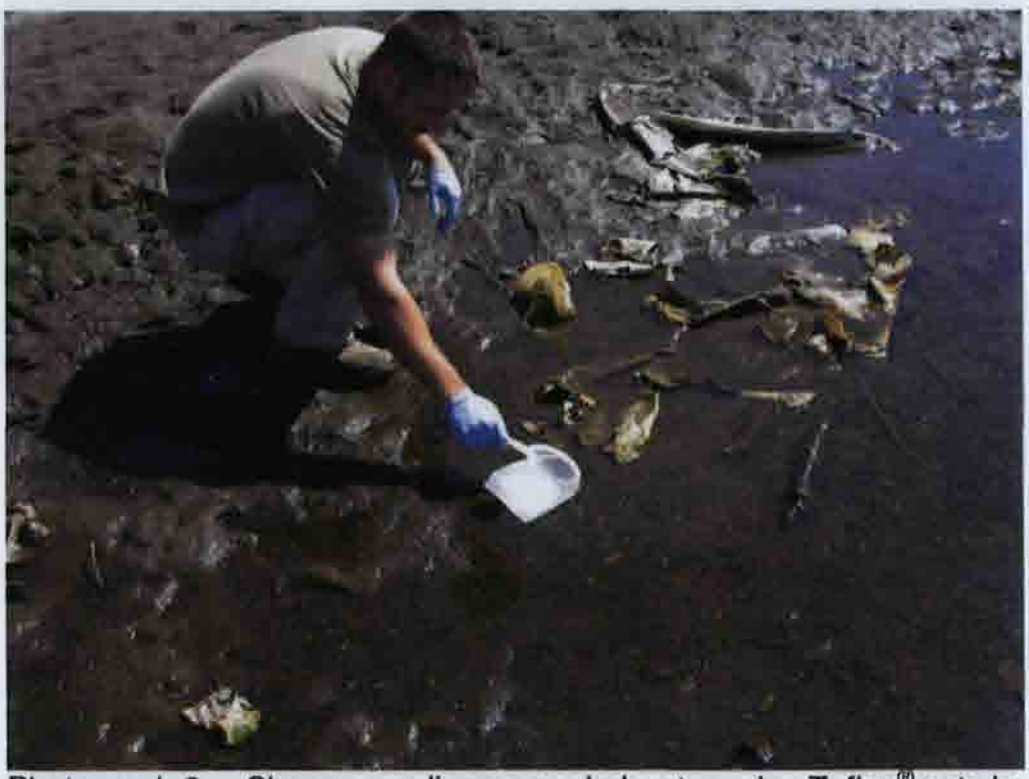
Figure
F-1

F:\Data\Jobs\DEQ\156700.xx M&B\156700-04 Sheen Investigation\Task 3\Figures - Sheen\156700507-F1 (Sheen Sampling).dwg

ATTACHMENT A
PHOTOGRAPH DOCUMENTATION

ATTACHMENT A
PHOTOGRAPH DOCUMENTATION
OPERATION AND MAINTENANCE REPORT
JANUARY 2009 TO DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE
PORTLAND, OREGON

Photograph 1 – Dr. Anne Camper/Montana State University collecting sheen samples from overlying sand at the South End of Site (SES). Photograph looking north. As the water table drops with the tide, the sheen sticks to the sand with a metallic luster. August 2009.



Photograph 2 – Sheen sampling on pooled water using Teflon® nets in Former Tank Farm Area #1 (TFA-1). Photograph looking south. August 2009.

ATTACHMENT A
PHOTOGRAPH DOCUMENTATION
OPERATION AND MAINTENANCE REPORT
JANUARY 2009 TO DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE
PORTLAND, OREGON

Photograph 3 – Sheen sampling between cap gravel using Teflon® nets in TFA-1. August 2009.

Photograph 4 – Sheen sampling between cap gravel using Teflon® nets in TFA-1. August 2009.

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MCCORMICK AND BAXTER SUPERFUND SITE
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Photograph 5 – Moderate sheen observed in Willamette Cove (WC) in articulated concrete blocks (ACB) voids. August 2009.

Photograph 6 – Sheen observed in SES in ACB voids. August 2009.

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PHOTOGRAPH DOCUMENTATION
OPERATION AND MAINTENANCE REPORT
JANUARY 2009 TO DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE
PORTLAND, OREGON

Photograph 7 – Sheen observed in TFA-1. August 2009.

Photograph 8 – Sheen observed in TFA-1. August 2009.

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OPERATION AND MAINTENANCE REPORT
JANUARY 2009 TO DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE
PORTLAND, OREGON

Photograph 9 – Sheen observed in TFA-1. Note: Blocky texture and does not coalesce when disturbed. July 2009.

Photograph 10 – Chris Martin/Hart Crowser and Newt/Clearwater Environmental Services retrieving sediment cap core from Willamette Cove (WC-01), October 2009.

ATTACHMENT A
PHOTOGRAPH DOCUMENTATION
OPERATION AND MAINTENANCE REPORT
JANUARY 2009 TO DECEMBER 2009
MCCORMICK AND BAXTER SUPERFUND SITE
PORTLAND, OREGON

Photograph 11 – Organophilic clay portion of sediment cap core from Willamette Cove (WC-01).

ATTACHMENT B
LABORATORY DATA

Included only on the O&M Report DVD

ATTACHMENT C
PORTLAND STATE UNIVERSITY EBULLITION STUDY

Included only on the O&M Report DVD

ATTACHMENT D
UNIVERSITY OF TEXAS ORGANOPHILIC CLAY AND SPME REPORT

Included only on the O&M Report DVD

MONTANA STATE UNIVERSITY BIOGENIC REPORT

ATTACHMENT E

Included only on the O&M Report DVD

Appendix G

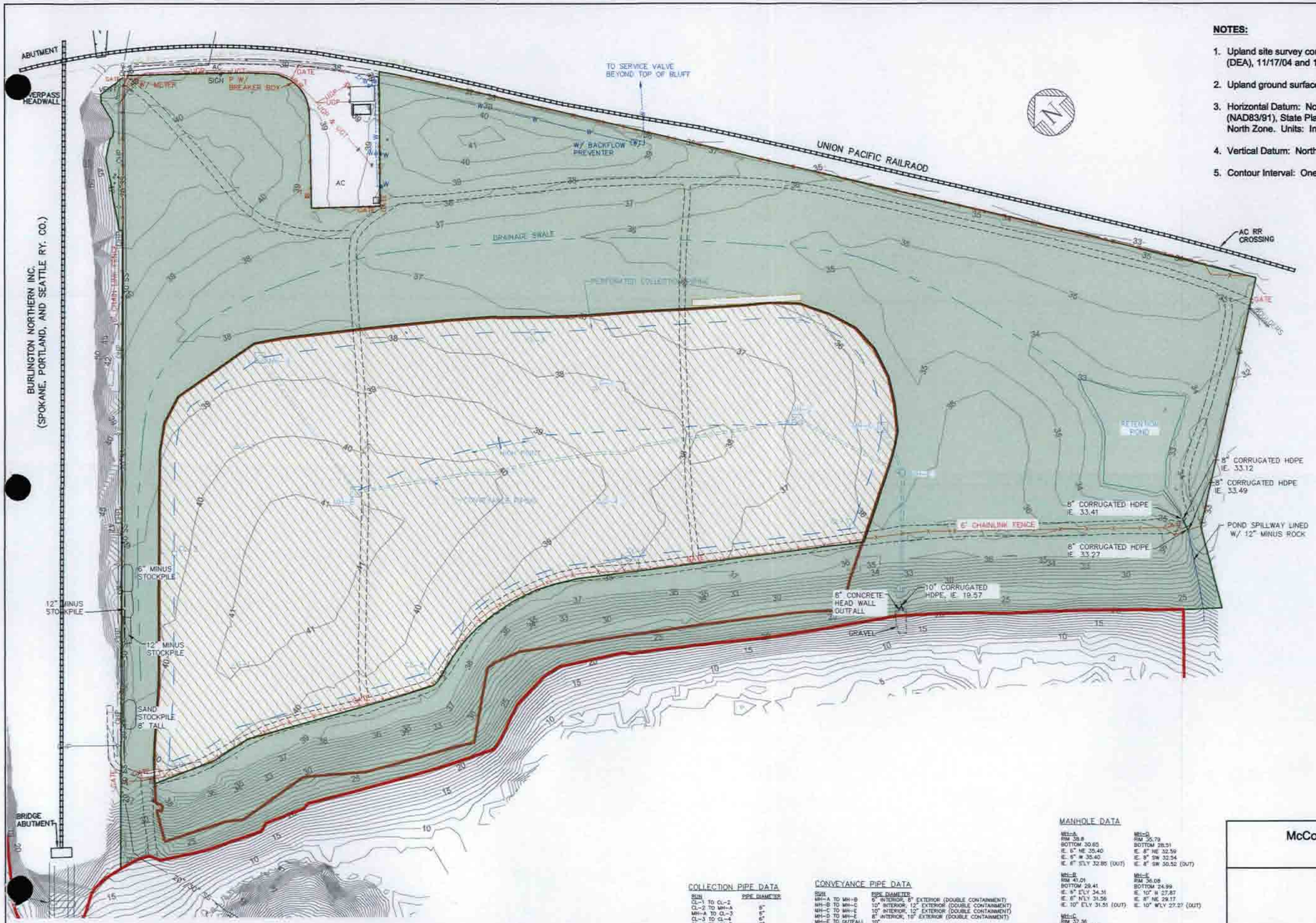
APPENDIX G
UPDATED SITE-WIDE RECORD DRAWINGS

OPERATION AND MAINTENANCE REPORT
JANUARY 2009 THROUGH DECEMBER 2009

Hart Crowser/GSI
15670-05/Task 7 May 25, 2010

NOTES:

1. Upland site survey conducted by David Evans and Associates, Inc. (DEA), 11/17/04 and 1/24/06.
2. Upland ground surface resurveyed by OTAK, Inc., 9/16/08.
3. Horizontal Datum: North American Datum of 1983 - 91 adj. (NAD83/91), State Plane Coordinate System (SPCS), Oregon North Zone. Units: International Feet.
4. Vertical Datum: North American Vertical Datum of 1988 (NAVD88)
5. Contour Interval: One-Foot.



LEGEND:

- PROPERTY LINE
- GROUND SURFACE ELEVATION CONTOUR (FT. NAVD 88)
- HIGH PRESSURE SEWER
- STORM SEWER
- WATER
- WATER VAULT
- VALVE (AS NOTED)
- FIRE HYDRANT
- UNDERGROUND POWER
- OVERHEAD POWER
- UNDERGROUND TELEPHONE
- UNDERGROUND FIBER OPTIC
- FENCE
- GAS VENT
- CLEAN OUT
- MANHOLE
- RISER
- UTILITY RISER
- UTILITY POLE
- GRAVEL ACCESS ROAD
- SUBSURFACE BARRIER WALL
- SEDIMENT CAP BOUNDARY
- IMPERMEABLE CAP
- EARTHEN CAP

COLLECTION PIPE DATA

RUN	PIPE DIAMETER
CL-1 TO CL-2	6"
CL-2 TO MH-A	6"
MH-A TO CL-3	6"
CL-3 TO CL-4	6"
CL-4 TO MH-D	6"
MH-B TO MH-C	6"
CL-1 TO CL-5	6"
CL-5 TO CL-6	6"
CL-6 TO CL-7	6"
CL-7 TO MH-D	6"

CONVEYANCE PIPE DATA

RUN	PIPE DIAMETER
MH-A TO MH-B	6" INTERIOR, 8" EXTERIOR (DOUBLE CONTAINMENT)
MH-B TO MH-C	10" INTERIOR, 12" EXTERIOR (DOUBLE CONTAINMENT)
MH-C TO MH-E	10" INTERIOR, 12" EXTERIOR (DOUBLE CONTAINMENT)
MH-D TO MH-E	8" INTERIOR, 10" EXTERIOR (DOUBLE CONTAINMENT)
MH-E TO OUTFALL	10"

NOTE: CONVEYANCE PIPE LOCATIONS BASED ON DESIGN PLAN AND FIELD OBSERVATIONS

MANHOLE DATA

MH-A
RIM 38.8
BOTTOM 30.65
IE. 6" NE 35.40
IE. 6" W 35.40
IE. 6" S'LY 32.85 (OUT)

MH-B
RIM 43.01
BOTTOM 29.41
IE. 6" E'LY 34.31
IE. 6" N'LY 31.56
IE. 10" E'LY 31.51 (OUT)

MH-C
RIM 37.36
BOTTOM 27.60
IE. 10" NW 29.61
IE. 6" SW 33.81
IE. 10" SW 29.46 (OUT)

MH-D
RIM 35.79
BOTTOM 28.51
IE. 8" NE 32.59
IE. 8" SW 32.54
IE. 8" SW 30.52 (OUT)

MH-E
RIM 36.08
BOTTOM 24.99
IE. 10" N 27.87
IE. 8" NE 29.17
IE. 10" W'LY 27.27 (OUT)

NOTE: ELEVATIONS IN FT. NAVD 88

McCormick and Baxter Superfund Site
Portland, Oregon

Upland Cap Features

3/10

HARTCROWSER

GSI Water Solutions, Inc.

Figure
G-1

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