Bunker Creek Pilot Study Summary

PREPARED FOR: Anne Dailey/USEPA

PREPARED BY: Steve Demus/CH2M HILL

REVIEWED BY: Steve Hicks/CH2M HILL
Jim Stefanoff/CH2M HILL

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1 Introduction

This technical memorandum summarizes methods and results from the Bunker Creek Pilot Study performed between September 29, 2008, and October 10, 2008, in Operable Unit 2 (OU2) of the Bunker Hill Mining and Metallurgical Complex Superfund Site located in Shoshone County, Idaho (Figure 1). The study was performed following the methodology identified in the *Quality Assurance Project Plan Bunker Creek Study Shoshone, Idaho* (QAPP; CH2M HILL, 2008a). The Bunker Hill Water Quality Assessment Team, which consists of representatives from the U.S. Environmental Protection Agency (USEPA), the Idaho Department of Environmental Quality (IDEQ), and their contractors, developed this methodology.

1.1 Purpose

Following the assessment of Phase I remedial actions in OU2 (CH2M HILL, 2007) and the identification of source areas of concern within OU2 (CH2M HILL, 2008b), the Bunker Hill Water Quality Assessment Team identified areas within OU2 where Phase II remedial actions could potentially be conducted to address water quality issues. During the identification of potential Phase II remedial actions, lining Bunker Creek to reduce losses of surface water to underlying groundwater was identified as a high priority action. It is anticipated that lining the creek would significantly benefit the quality of surface water and groundwater in OU2, as well as water quality in the South Fork of the Coeur d'Alene River (SFCDR) as it flows through OU2.

The purposes of the Bunker Creek Pilot Study were to collect data required (1) to evaluate the effectiveness of the remedial action (i.e., lining Bunker Creek) towards improving water quality and (2) for Bunker Creek remedial design. The Bunker Creek Pilot Study focused on simulating conditions in the Bunker Creek area that would be anticipated to occur if the Bunker Creek channel were lined.

During the planning and design of the Bunker Creek Pilot Study, it became apparent that it would not be possible to conduct the pilot study for a sufficient amount of time for the relatively large hydrologic system in the area to reach steady-state conditions. Therefore, the

study and sampling design activities focused on collecting the data necessary to evaluate the effectiveness of the remedial action (i.e., lining Bunker Creek) using a transient numerical groundwater flow model to estimate conditions at steady state. As discussed in Section 2.3, the numerical groundwater flow model is a tool that can be used to estimate or predict changes in groundwater elevations, flow paths, and discharge to surface water. The numerical groundwater flow model is not capable of predicting or estimating changes in water quality. These predictions and estimates must be made using available data and professional judgment. Because the study was designed with this type of evaluation in mind, the data and results presented in this memorandum are only representative of a relatively short time period. A more in-depth evaluation of the potential water quantity and quality impacts resulting from lining the Bunker Creek channel will be presented in future documents that will detail the groundwater modeling results, predicted water quality impacts, and remedial action alternatives analyses.

1.2 Background

Bunker Creek (Figure 2) is a constructed conveyance channel that originates near the Central Treatment Plant (CTP) in Kellogg, Idaho. The water in Bunker Creek flows west along the southern edge of the Central Impoundment Area (CIA). The creek then angles to the north at the western end of the CIA before it flows through a box culvert beneath Interstate-90 (I-90) to its discharge point to the SFCDR.

Bunker Creek receives discharge from several sources. These water sources include:

- Stormwater drainage from the City of Kellogg, the Bunker Hill Mine Yard, the CIA, and the Smelter Closure Area (SCA)
- Excess irrigation water from the City of Kellogg sourced from the Big Creek drainage
- Effluent discharge from the CTP
- Surface water from Portal Gulch, Railroad Gulch, Deadwood Creek, and Magnet Creek (CH2M HILL, 2007)

Originally, the SFCDR flowed along the southern margin of the main SFCDR valley in the vicinity of the CIA. The pre-mining SFCDR channel is closely aligned with the present-day Bunker Creek channel along a majority of its flow path. The SFCDR was in this location until sometime after 1910 but before 1937. At that time, mine operations, commerce, and housing required more space, resulting in the need to move the SFCDR channel to the northern margin of the SFCDR valley (CH2M HILL, 2007).

After the placement of the SFCDR on the north side of the valley, the previous channel located on the southern edge of the valley was filled in with mine and process wastes. A channel (Bunker Creek) was constructed to facilitate drainage from hillside tributaries and to provide a location to discharge decant water from the CIA and process water from Bunker Hill concentrators. Bunker Creek began receiving discharge of treated Bunker Hill Mine acid mine drainage (AMD) from the CTP in May 1974. Prior to 1974, AMD from the CIA was decanted directly to Bunker Creek or the SFCDR (CH2M HILL, 2007).

The 1992 OU2 Record of Decision (1992 OU2 ROD; USEPA, 1992) specified that Bunker Creek was to be re-channelized and lined. However, the ROD did not specify the type of

lining or acceptable liner permeability that was intended. As part of efforts to delineate the extent of contamination in the Bunker Creek corridor, the general geotechnical properties of the materials underlying the channel were evaluated. Based on subsurface exploration and the planned elevation of the creek bottom, the USEPA and the State of Idaho decided that the permeability of the in-place soils was sufficiently low that a constructed lining for Bunker Creek was not recommended (USEPA, 2005).

The 1992 OU2 ROD identified the following remedial action objectives (RAOs) for Bunker Creek:

1. Meet ambient water quality criteria (AWQC) in Bunker Creek at monitoring station BH-BC-0001 (Figure 2)
2. Limit Bunker Creek surface water interaction and potential contaminant migration to the underlying shallow groundwater system

The Bunker Creek Phase I remedial action was conducted in 1996 and 1997. The Phase I remedial action consisted of the reconstruction of approximately 7,600 linear feet of creek channel, including the creation of a low-flow channel and floodplain. For erosion protection, rocks were placed in the low-flow stream channel for Bunker Creek and the floodplain was seeded. Coarse- and fine-grained tailings materials and slimes that were exposed at the surface were removed to reconstruct the Bunker Creek channel. In areas where tailings and slimes were encountered below the designed grade for the channel, the materials were removed to a depth of 2 feet below the designed grade. The excavation was then backfilled to the design grade with clean, compacted backfill materials (USEPA, 2005).

Approximately 77,000 cubic yards of contaminated materials were removed form Bunker Creek and disposed of on the CIA (Terragraphics and Ralston Hydrologic Services, 2006). Non-contaminated materials from the channel excavation were incorporated into the grading of the adjacent floodplain. Following excavation and grading, a 6-inch, clean institutional-controls-program (ICP) barrier was installed on all disturbed areas and was hydroseeded.

The *Phase I Remedial Action Assessment Report* (CH2M HILL, 2007) provided an assessment of the Bunker Creek Phase I remedial action with respect to the RAOs identified in the 1992 OU2 ROD. The findings of this assessment are presented next.

Bunker Creek surface water measured at BH-BC-0001 is not in compliance with the AWQC for dissolved cadmium, and AWQC compliance is variable for dissolved zinc. However, at BH-BC-0001, significant decreases in concentrations of dissolved cadmium and dissolved lead had occurred between the pre-remediation (pre-1996) and post-remediation (2000 to 2006) time periods.

Based on evaluation of discharge data, it appears that Bunker Creek is losing a substantial amount of discharge as it flows along the southern margin of the CIA. The amount of discharge lost suggests that in-place soils under the Bunker Creek channel are not of a sufficiently low permeability to prevent significant losses of discharge from Bunker Creek to the underlying aquifer.

Following implementation of the Phase I remedial action, groundwater quality in the vicinity of Bunker Creek has shown significant improvement. A majority of monitoring

wells in the Bunker Creek corridor exhibit decreases in concentration when pre-remediation concentrations are compared to post-remediation concentrations. A significant number of decreasing post-remediation-time-period concentration trends are present for dissolved cadmium and dissolved zinc.

1.3 Document Organization

This memorandum is organized into eight sections and two attachments:

- **Section 1. Introduction**. This section presents the purpose of the Bunker Creek Pilot Study, a brief discussion of the background of the Bunker Creek area, and document organization.
- **Section 2. Methodology**. This section discusses the study approach and field methodology.
- **Section 3. Study Results**. This section presents an initial evaluation of the results of the Bunker Creek Pilot Study.
- **Section 4. Summary and Path Forward**. This section summarizes the initial evaluation of the Bunker Creek Pilot Study and the path forward for additional evaluations of potential Phase II remedial actions for Bunker Creek.
- **Section 5. References.**
- **Section 6. Acronyms.**
- **Tables.**
- **Figures.**

The following attachments are included with this memo:

- **Attachment A.** Field Parameter Summary Tables
- **Attachment B**. Water Quality Summary Table

2 Methodology

This section briefly summarizes the approach for the Bunker Creek Pilot Study and the field methods employed during the study.

2.1 Study Approach

The Bunker Hill Water Quality Assessment Team developed the Bunker Creek Pilot Study to collect data for evaluating the effectiveness of a potential Phase II remedial action for lining Bunker Creek. As noted earlier, under low-flow conditions, the majority of discharge in Bunker Creek is comprised of effluent from the CTP, and contributions from tributary gulches and other water sources to Bunker Creek are at their minimums. Based on these considerations, it was determined that rerouting the CTP discharge around Bunker Creek would provide a way to simulate the lining of Bunker Creek under low-flow conditions because creek flow would be reduced to zero for some distance downstream from the CTP outfall.

Early in the planning process for the Bunker Creek Pilot Study, it was determined that the CTP effluent could be rerouted around Bunker Creek by piping the CTP effluent in an 8-inch-diameter galvanized steel pipeline. Two Godwin 74-horsepower diesel-powered pumps were installed in parallel. Ferguson Contracting operates these pumps. (Fergus Contracting is a subcontractor to the U.S. Army Corps of Engineers, which operates the CTP.) The pipeline was placed adjacent on the north and parallel to Bunker Creek at the toe of the CIA. The temporary CTP outfall was placed in a Bunker Creek culvert located about 300 feet upgradient of BH-BC-0001 (Figure 2). Ferguson Contracting monitored and maintained the two pumps and pipeline during the study. No significant maintenance and/or pipeline leaking issues were observed during the study. Although pipeline leaks were encountered following the initial startup of the pumps, they were repaired shortly thereafter.

During the OU2 Direct Push Field Investigation (CH2M HILL, 2009), a series of temporary piezometers were installed in the Bunker Creek corridor. These piezometers, coupled with the current Bunker Creek remedial-action effectiveness surface-water and groundwater monitoring network, would allow for collection of a significant amount of data. These data would enable evaluation of the impacts of the pilot study on groundwater and surface water in the vicinity of Bunker Creek.

The Bunker Creek Pilot Study was scheduled to take place following the performance of OU2 Groundwater/Surface Water Interaction Monitoring and the fall OU2 Environmental Monitoring Plan (OU2 EMP) monitoring (CH2M HILL, 2006b). Conducting the Bunker Creek Pilot Study following these monitoring events allowed for data collected during these events to be used as the baseline data-set for comparison with Bunker Creek Pilot Study data. Figure 2 shows the surface-water- and groundwater- monitoring locations employed in the Bunker Creek Pilot Study. Table 1 presents a compilation of events relative to the Bunker Creek Pilot Study.

2.2 Field Measurements and Sample Collection

Data acquisition focused on collecting data that could be used to evaluate the short-term impacts of the pilot study on surface-water and groundwater quality and quantity. Specific data collected as part of the Bunker Creek Pilot Study included the following items:

- Surface-water quality samples, discharge measurements, and field-parameter measurements were collected on each of 6 days during the study at select surface-water monitoring stations on the SFCDR, Bunker Creek, and Bunker Creek tributaries (if applicable).
- Groundwater quality samples and field-parameter measurements were collected from 26 monitoring wells and piezometers during the second week of the study.
- Groundwater levels were measured using automated data-recording devices in the 26 monitoring wells and piezometers, and in 4 stream stage-recording stations along Bunker Creek.

Figure 2 shows surface-water and groundwater monitoring locations sampled during the Bunker Creek Pilot Study. Tables 2 and 3 summarize sample collection dates for surface-water and groundwater monitoring locations, respectively. In addition to surface-water and

groundwater samples, two sediment samples were collected from the Bunker Creek channel for metals analysis. These sediment data will be used to evaluate potential mitigation of the sediment during implementation of the Phase II remedial action. The sediment samples were collected from the channel near surface-water monitoring location BH-BC-0004 and near piezometer BH-SF-E-PZ-22.

During collection of all surface-water and groundwater quality samples, the temperature, pH, specific conductance, dissolved oxygen (DO), and oxidation-reduction potential (ORP) were measured in accordance with the QAPP (CH2M HILL, 2008a), except where noted subsequently. Meters and probes used for field measurements were calibrated at the beginning of each day. These instruments were operated according to the manufacturers' specifications. CH2M HILL input all analytical samples into the Forms II Lite sample-management program. Surface-water samples were submitted for laboratory analysis of dissolved metals, alkalinity, anions, total and dissolved phosphorous, nitrate plus nitrite, dissolved ammonia, and total Kjeldhal nitrogen. Groundwater samples were submitted for laboratory analysis of dissolved metals, anions, alkalinity, nitrate plus nitrite, and total phosphorous.

Surface-water monitoring began at the most downstream station on the SFCDR (BH-SF-LF-0006) and progressed upstream to station BH-SF-LF-0004. Following completion of the SFCDR monitoring, Bunker Creek monitoring was performed similarly, beginning at the downstream location (BH-BC-0001) and progressing upstream. Two Bunker Creek monitoring stations were added for the purposes of the Bunker Creek Pilot Study. One monitoring station was placed about 250 feet upgradient of the temporary CTP-outfall location. The objective of this station was to monitor Bunker Creek water not influenced or hydraulically connected to the CTP effluent discharged downgradient from this location. The second monitoring station was located in Bunker Creek upgradient of Magnet Creek. The objective of this station was to monitor Bunker Creek water prior to its confluence with Magnet Creek. A Magnet Creek monitoring station was also established at the mouth of Magnet Creek.

Surface-water samples were collected at the SFCDR monitoring stations using cross-sectional, depth-integrated sampling techniques (Edwards and Glysson, 1988). At these locations, depth-integrated water samples were collected from 10 equal-width segments across the river. The 10 equal-width samples were collected beginning at the left edge of the water (south bank) then moving to the right edge of the water (north bank). The samples were composited in a churn sample splitter, and the sample was withdrawn for laboratory analysis. Filtered samples were pumped from the churn sample splitter through a 0.45-micron capsule filter using a peristaltic pump into pre-preserved (if applicable) polyethylene bottles. Unfiltered samples were emptied directly into the sample container from the churn sample splitter. Surface-water specific conductance, pH, temperature, DO, and ORP were measured at each of the 10 equal-width segments used for water-quality sampling.

The cross-sectional, depth-integrated sampling technique was not employed for samples collected in Bunker Creek because the creek is shallow and narrow. Equal-volume grab samples were collected across these monitoring locations using one-half-foot increments and composited in the churn sample splitter. Sample containerizing was consistent with methods used for the SFCDR stations.

During the second week of the study, groundwater-quality samples were collected from select monitoring wells and piezometers using low-flow purging methods. Groundwater was purged using a peristaltic pump or a bladder-pump apparatus. Groundwater temperature, pH, specific conductance, DO, and ORP were measured until stabilization criteria were achieved (as defined in the QAPP [CH2M HILL, 2008a]) prior to collection of the sample. Filtered samples were pumped through a 0.45-micron filter and placed in a polyethylene sample container. Unfiltered samples were pumped directly into the sample container. Table 3 provides a list of wells and piezometers sampled as part of this study.

2.3 Numerical Groundwater Flow Model

The groundwater-elevation and stream-leakage data collected during the Bunker Creek Pilot Study will be used as calibration targets for the transient and steady-state groundwater flow model for the SFCDR in the vicinity of the study area (Figure 2). The groundwater flow model will be run in a transient mode, assuming that the leakage from Bunker Creek would be eliminated over the 12-day test period. Model output will be used to prepare groundwater hydrographs at the locations of the existing monitoring wells during and following the test. These simulated water levels will be compared to the groundwater levels measured in the field. Aquifer properties assumed in the model will then be adjusted until acceptable agreement between simulated and measured groundwater levels has been obtained. This process will ensure that the modeling tool provides an accurate depiction of how the groundwater system will respond to changes in Bunker Creek leakage rates. The data will also provide valuable information that can be used to forecast the effects on the groundwater system for other potential channel-lining remedial actions.

Once the SFCDR groundwater model is calibrated, the model will be used to predict the long-term effects of Bunker Creek lining on the overall groundwater-flow directions, water levels, and groundwater-discharge rates to the SFCDR in the study area. As noted previously, the numerical groundwater flow model is not capable of predicting changes in water quality resulting from potential remedial actions. Such predictions will be performed using available data, site knowledge, and professional judgment.

2.4 Bunker Creek Pilot Study Limitations

During the initial planning stages, inherent limitations to the Bunker Creek Pilot Study were identified. The primary limitation was the anticipated flow restrictions at the CTP associated with the size of the pipeline and the available pumps. Because of these limitations, Ferguson Contracting had to reduce the volume of water the CTP treated to prevent overflows of treated water to Bunker Creek. Because there is a limited capacity to store the Kellogg Tunnel water, the time available to conduct the Bunker Creek Pilot Study was 12 days. During this limited time period, the likelihood of reaching steady-state conditions that would represent the long-term impacts from lining the Bunker Creek channel was determined to be low.

To simulate the lining of Bunker Creek, the Bunker Creek Pilot Study was performed during low-flow conditions to reduce water sources to the Bunker Creek channel from tributaries. All tributaries of Bunker Creek were dry for the duration of the study except for Magnet Creek. Magnet Creek contributed the majority of discharge to Bunker Creek from its confluence with Bunker Creek downgradient of the temporary CTP outfall. Impacts to the

underlying aquifer in the reach of Bunker Creek may not be realized because Bunker Creek (sourced from Magnet Creek) loses discharge to the underlying aquifer.

3 Study Results

This section summarizes the short-term data collected during the Bunker Creek Pilot Study. As noted previously, long-term predictions will be presented in future documents.

3.1 Discharge and Groundwater Elevations

This section summarizes discharge and groundwater-elevation data collected prior to and during the Bunker Creek Pilot Study.

3.1.1 Discharge

Table 4 summarizes discharge measurements collected prior to and during the Bunker Creek Pilot Study.

Discharge measurements at SFCDR monitoring locations do not appear to have differed significantly as a result of the implementation of the Bunker Creek Pilot Study. In general, discharge at these locations were relatively consistent prior to and during the study. A slight increase in SFCDR discharge appears to have occurred during the latter part of the study. This increase is likely the result of a precipitation event in Kellogg and upstream areas between October 3 and October 7, 2008. The lack of a significant measurable impact on SFCDR discharge as a result of the Bunker Creek Pilot Study was not unexpected given the relatively short time period during which the study was conducted as well as the inherent error associated with field discharge measurements (plus or minus 10 percent) (Sauer and Meyer, 1992). Additionally, the error associated with measuring discharge in the SFCDR is likely greater than the discharge in Bunker Creek or its leakage. While lining Bunker Creek would likely reduce discharge in the SFCDR, it is likely that it is not possible to quantify this reduction in discharge.

Prior to and during the Bunker Creek Pilot Study, minimal or no discharge was observed in Bunker Creek tributary water sources, with the exception of Magnet Creek (which is discussed in further detail later in this section).

Discharge was observed in Bunker Creek upstream of the CTP outfall (BH-BC-0003) during the Bunker Creek Pilot Study (on September 29, 2008). Excess irrigation water from the City of Kellogg sourced from the Big Creek drainage was discharged to Bunker Creek following the relocation of the CTP outfall. After the City of Kellogg halted this discharge to Bunker Creek, station BH-BC-0003 was dry.

Immediately following the initiation of diverting the CTP effluent, discharge in Bunker Creek began to change considerably downstream of the CTP outfall. Between the location of the CTP outfall and the area approximately 500 feet upstream of the confluence of Bunker Creek and Magnet Creek, no discharge was observed in Bunker Creek.

From the area approximately 500 feet upstream to the confluence of Bunker Creek and Magnet Creek, a small amount of discharge that was too small and diffuse to be measured

was present in the Bunker Creek channel. This discharge, which is believed to be the result of the release of bank storage, is discussed later in this memorandum.

Prior to the Bunker Creek Pilot Study, a small amount of discharge (0.10 cubic foot per second [cfs]) was observed in Magnet Creek at BH-MG-0001 located upstream of its confluence with Bunker Creek near McKinley Avenue. During the Bunker Creek Pilot Study, the Magnet Creek channel appeared to be dry until discharge was observed again upstream of its confluence with Bunker Creek. Discharge from this area of Magnet Creek ranged between 0.06 and 0.15 cfs over the duration of the study. The source of this discharge is likely associated with the discharge of groundwater from a French drain located at the toe of the A-4 Gypsum Pond that emerges in this area.

Downstream of the confluence of Magnet Creek with Bunker Creek, discharge measured at BH-BC-0006 ranged between 0.03 and 0.08 cfs. The discharge measured at BH-BC-0006 is believed to be from Magnet Creek, not sourced from groundwater discharge.

A temporary discharge-monitoring station in Bunker Creek was established immediately upstream of the temporary CTP outfall (Figure 2). Discharge measured at this location ranged between 0.03 and 0.20 cfs over the duration of the study. Discharge at this location was typically close in magnitude or slightly below the measured discharge input from Magnet Creek.

As noted earlier, at low-flow conditions, Bunker Creek discharge consists primarily of the CTP effluent. The amount of effluent discharged from the CTP to Bunker Creek is directly related to how much water the CTP treats. When the CTP treats higher volumes of water, increased effluent is discharged to Bunker Creek. This can result in a highly variable component to the overall discharge of Bunker Creek. This variability was observed prior to and during the study. Bunker Creek discharge at BH-BC-0001 prior to the study was 3.5 cfs (September 25, 2008). At the onset of the study (September 29, 2008), discharge at BH-BC-0001 was measured at 1.82 cfs. This is a result of the coordinated efforts by the CTP operator and the Bunker Hill Mine Owner to reduce the volume of water requiring treatment at the CTP during the study to allow the effluent to be temporarily piped. However, the volume of water pumped to the temporary CTP outfall was increased during the study as discharge at BH-BC-0001 increased to 3.34 cfs at the end of the study. The temporary CTP-outfall discharge rate was not measured because the pipe was placed within a culvert. However, the approximate CTP-outfall discharge rate can be calculated using the difference between discharge at BH-BC-0001 and in Bunker Creek upgradient of the temporary CTP outfall. The estimated CTP-outfall discharge rate during the study ranged from 1.62 to 3.26 cfs.

3.1.2 Groundwater Elevations

Water levels were measured in 26 monitoring wells and piezometers located within the Bunker Creek Pilot Study area (Table 3 and Figure 2). Water levels were measured continuously (that is, at 5-minute intervals) using automated data-recording pressure transducers. In-field manual water-level measurements were taken to complement and verify the automated stage- and groundwater-level-device operation. Water-level data were collected prior to the Bunker Creek Pilot Study during the semi-annual OU2 EMP monitoring.

Groundwater elevations for the 26 monitoring wells and piezometers were calculated using water-level data from the pressure transducers, where applicable. Measured groundwater elevations at most wells and piezometers showed a slight decrease over time based on pre-study and end-of-study data. The groundwater-elevation decrease ranged from 0.02 to 0.87 foot for the study period. Post-study (October 11 to October 18, 2008) groundwater elevations also showed a decline from elevations measured at the end of the study. The groundwater-elevation decrease ranged from 0.01 foot to 1.11 feet. It is more likely that the decreases in groundwater elevations during and after the study result from seasonal changes to groundwater elevations rather than any response to the Bunker Creek Pilot Study.

Figure 3 presents continuous water-level data collected at select monitoring wells and piezometers in the Bunker Creek corridor. As shown on Figure 3, groundwater elevations steadily decline and do not appear to be affected from the process of piping the CTP effluent and bypassing Bunker Creek and reintroducing the CTP effluent to Bunker Creek near I-90. Groundwater levels were examined in detail from the 26 monitoring wells and piezometers included as part of this study. No groundwater-level response occurred in any of the 26 monitoring wells/piezometers as a result of the hydraulic changes to Bunker Creek during the study. A groundwater-level response was observed from well BH-SF-E-0410-U (Figure 3) on October 8, 2008. However, this response corresponded to the groundwater sampling of this well and is likely resulted from moving the transducer.

These data indicate that the Bunker Creek lining simulation did not affect groundwater elevations in the underlying alluvial aquifer. This is likely a result of the relatively high hydraulic conductivity of the aquifer materials that prevent groundwater mounding resulting from losses of discharge from Bunker Creek.

3.2 Water Quality

This section summarizes surface-water and groundwater quality data collected during the Bunker Creek Pilot Study. Attachment A includes field-parameter data collected for groundwater and surface water. Attachment B includes laboratory analytical results for groundwater and surface water.

3.2.1 Field Parameters

This section discusses the groundwater and surface-water field parameters (pH, specific conductance, DO, and ORP) collected during the Bunker Creek Pilot Study.

Surface Water

Measured pH in the three SFCDR stations decreased between the upstream station BH-SF-LF-0004 and the downstream station BH-SF-LF-0006. The pH ranged from 7.0 and 7.6 at monitoring station BH-SF-LF-0004. The pH ranged from 7.0 to 7.3 at station BH-SF-LF-0005 and from 6.4 to 7.1 at monitoring station BH-SF-LF-0006.

Measured pH at Bunker Creek monitoring station BH-BC-0001 ranged from 6.9 to 7.3 during the study. The pH declined at each monitoring station upstream in Bunker Creek until Magnet Gulch. The pH ranged from 6.5 to 6.7 in Bunker Creek upstream of the temporary CTP outfall and from 6.2 to 6.6 at BH-BC-0006. The pH in Magnet Creek ranged from 5.8 to 6.0.

The specific conductance at the SFCDR monitoring stations increased from upstream station BH-SF-LF-0004 to the downgradient station BH-SF-LF-0006. Specific conductance at station BH-SF-LF-0004 ranged from 168 to 243 microsiemens per centimeter (µS/cm). Specific conductance ranged from 176 µS/cm to 233 µS/cm at station BH-SF-LF-0005 and from 215 µS/cm to 654 µS/cm at station BH-SF-LF-0006. The higher values at these stations were measured near the south bank of the SFCDR. The specific conductance at Bunker Creek station BH-BC-0001 ranged from about 1,700 µS/cm to 2,000 µS/cm. The specific conductances in Bunker Creek upgradient of the temporary CTP outfall and at BH-BC-0006 were about 1,800 µS/cm and 1,300 µS/cm at the onset of the study, but declined to about 600 µS/cm at the end of the study. Magnet Creek specific conductance ranged from about 650 µS/cm to 800 µS/cm.

DO increased over time at the three SFCDR stations during the 12-day study. Measured DO was similar at the three SFCDR stations, ranging from 10.8 milligrams per liter (mg/L) to 12.7 mg/L. The DO in Bunker Creek station BH-BC-0001 increased from 10.3 mg/L at the onset of the study to 12.6 mg/L at the end of the study. DO at BH-BC-0006 ranged from 11.4 mg/L to 14.3 mg/L. DO in Magnet Creek ranged from 9.1 mg/L to 12.0 mg/L.

Measured ORP in the two SFCDR stations (BH-SF-LF-0004 and BH-SF-LF-0005) consistently increased during the study period. Measured values were higher towards the south bank of the SFCDR at both stations. ORP ranged from -36 millivolts (mV) to 80 mV at BH-SF-LF-0004, and from -28 mV to 96 mV at BH-SF-LF-0005. The ORP at BH-SF-LF-0006 was variable during the study, measuring -8 mV to 181 mV. The ORP at Bunker Creek station BH-BC-0001 increased during the study, ranging from about 130 mV to 160 mV. The ORP values in Bunker Creek upgradient of the temporary CTP outfall and at BH-BC-0006 were slightly variable during the study—values ranged from 176 mV to 200 mV and from 197 mV to 228 mV, respectively. Magnet Creek ORP ranged from 220 mV to 258 mV.

Groundwater

The pH in groundwater prior to the study and at the end of the study was similar for most monitoring wells and piezometers sampled. Only slight pH differences were observed. Measured pH in groundwater ranged from 4.7 to 6.2 within the study area.

Conductivity increases and decreases were observed in groundwater prior to and at the end of the study. The largest difference between pre- and post-study data was a conductivity decline in piezometers and wells near the CTP, in the lower portion of Bunker Creek, and in the CIA and Slag Pile areas. The conductivity in several of these wells exhibited a decrease of 100 µS/cm to 200 µS/cm. The largest declines were from BH-SF-E-PZ-16 (-240 µS/cm), BH-SF-E-PZ-14 (-189 µS/cm), BH-SF-E-PZ-21 (-187 µS/cm), and BH-SF-E-PZ-22 (-155 µS/cm).

DO increases were observed in most monitoring wells and piezometers monitored for this study. These increases occurred primarily in piezometers located in the lower portion of Bunker Creek and in the CIA and Slag Pile areas. The greatest increases were from BH-SF-E-PZ-26 (+3.74 mg/L) and from BH-SF-E-PZ-20 (+2.87 mg/L). Appreciable DO declines were observed from monitoring well BH-SF-E-0407-U (-1.25 mg/L) and from piezometer BH-SF-E-PZ-18 (-1.24 mg/L). It is unclear whether these DO differences were caused by the simulated lining of Bunker Creek.

3.2.2 Surface Water Quality

Table 5 summarizes dissolved-cadmium, dissolved-lead, and dissolved-zinc concentrations measured in surface water prior to and during the Bunker Creek Pilot Study.

In general, dissolved lead was either not detected or detected at relatively low concentrations in surface water during the study. Therefore, given the positive relationship observed between dissolved cadmium and dissolved zinc in water within OU2 (CH2M HILL, 2006a), this discussion of surface water quality focuses on dissolved-zinc concentrations, AWQC ratios, and loading as indicators of dissolved-metal contamination. Because hardness is used in the calculation of AWQC for dissolved zinc and is an indicator of CTP effluent water, it is also discussed in this section.

Dissolved-zinc concentrations measured in the three SFCDR stations remained consistent prior to the study (on September 25, 2008) and for the duration of the study. Dissolved-zinc concentrations at the upgradient SFCDR monitoring station (BH-SF-LF-0004) ranged from 1.07 mg/L to 1.25 mg/L. Dissolved-zinc concentrations at the downgradient SFCDR monitoring station (BH-SF-LF-0006) ranged from 1.26 mg/L to 1.43 mg/L.

The dissolved-zinc concentration at BH-BC-0001 prior to the study (on September 25, 2008) was 0.85 mg/L. This concentration declined steadily to 0.33 mg/L (on October 6, 2008), then increased to 0.69 mg/L (on October 10, 2008). It is important to note that dissolved-metal concentrations at this monitoring location are variable and depend on the fluctuating CTP-outfall discharge. These dissolved-metal concentrations are described in subsequent paragraphs.

Dissolved-zinc concentrations at two Bunker Creek monitoring stations increased from September 29, 2008, to the end of the study (on October 10, 2008). The dissolved-zinc concentration in Bunker Creek upgradient of the temporary CTP outfall increased from 1.03 mg/L to 6.10 mg/L. The dissolved-zinc concentration at station BH-BC-0006, located downstream from Magnet Creek, increased from 3.95 mg/L to 7.58 mg/L. The dissolved-zinc concentration in Bunker Creek at BH-BC-0006 prior to the study was 0.84 mg/L, and significantly less than concentrations observed during the study. The increased concentrations at this location are indicative of concentrations measured at Magnet Creek during the study, which ranged from 8.6 mg/L to 10 mg/L. During normal conditions, the CTP-outfall discharge is much greater than the discharge from Magnet Creek. In addition, the cleaner CTP effluent dilutes the concentration. The total zinc concentration from the CTP outfall ranged from 0.19 mg/L to 0.47 mg/L during the study. Dissolved-zinc concentrations in Bunker Creek above Magnet Gulch ranged from 0.78 mg/L (on October 6, 2008) to 0.89 mg/L (on October 3, 2008).

Sampling of Magnet Gulch prior to the study was performed at station BH-MG-0001, located near McKinley Avenue. The pre-Bunker Creek Pilot Study dissolved-zinc concentration in Magnet Gulch was significantly less (0.86 mg/L) at BH-MG-0001 than the concentrations measured at its confluence with Bunker Creek during the study. This large concentration difference in Magnet Creek from McKinley Avenue to its confluence with Bunker Creek is attributable to the French drain at the toe of the A-4 Gypsum Pond that discharges groundwater to Magnet Creek at relatively high concentrations. The French drain discharge is presumed to be located south of the Trail of the Coeur d'Alenes at the toe

of the A-4 Gypsum Pond. Dissolved-zinc concentrations in groundwater beneath the A-4 Gypsum Pond have been measured at concentrations as high as 199 mg/L.

Table 6 provides hardness concentrations in surface water measured prior to and during the study. Hardness concentrations calculated for the three SFCDR stations remained relatively consistent for the duration of the study, except for a slight decrease between October 1 and October 6, 2008 (which was likely caused by the precipitation event that occurred in the area during this time). Hardness concentrations at the upgradient SFCDR monitoring station BH-SF-LF-0004 ranged from 63 mg/L to 81 mg/L. Hardness concentrations at the downgradient SFCDR monitoring station ranged from 105 mg/L to 147 mg/L. Monitoring station BH-SF-LF-0006 is located downgradient of the confluence of Bunker Creek and the SFCDR. The high hardness CTP effluent discharged to Bunker Creek results in the hardness increase between BH-SF-LF-0005 and BH-SF-LF-0006. Hardness concentrations calculated from data obtained prior to the study (on September 25, 2008) were about 20 mg/L higher at all three SFCDR stations. It is not known whether these concentration differences are directly related to the simulated lining of Bunker Creek.

The highest hardness concentrations were detected at Bunker Creek monitoring station BH-BC-0001. These concentrations ranged from 1,161 mg/L to 1,634 mg/L prior to, and for the duration of, the study. As discussed previously, these elevated hardness concentrations in Bunker Creek are attributed to CTP effluent. These concentrations are also highly variable and fluctuate with the CTP effluent-discharge rate.

Hardness concentrations in Bunker Creek above the temporary CTP outfall and at monitoring station BH-BC-0006 significantly declined following the removal of the CTP effluent discharge to Bunker Creek. The hardness concentration in Bunker Creek upgradient of the temporary CTP outfall declined from 1,313 mg/L to 348 mg/L. The hardness concentration at station BH-BC-0006 declined from 877 mg/L to 348 mg/L. The pre-study hardness concentration at BH-BC-0006 was 1,520 mg/L, similar to the hardness calculated for all Bunker Creek monitoring stations prior to the study.

The hardness concentration in Bunker Creek above Magnet Gulch remained over 1,000 mg/L during the study. This hardness concentration, which is indicative of CTP effluent, supports the theory that the small amount of discharge observed in this area is associated with the release of bank storage and is not associated with groundwater discharge. The hardness of groundwater discharge from the French drain in Magnet Gulch remained near 350 mg/L over the duration of the study. If the discharge observed in Bunker Creek above Magnet Gulch were associated with groundwater discharge, hardness concentrations would be expected to be closer to this value.

Table 7 provides total-phosphorous concentrations in surface water measured during the study. Slight increases of total-phosphorous concentrations measured between the upgradient and downgradient SFCDR stations were measured during most days of the study. Most total-phosphorous concentrations in the SFCDR ranged from 0.03 mg/L to 0.04 mg/L. However, a two-fold increase was observed at station BH-SF-LF-0005 on October 3, 2008.

Total-phosphorous concentrations in Bunker Creek on September 29, 2008, indicate that the largest concentration increase occurs between stations BH-BC-0005 and BH-BC-0006. Total-phosphorous concentrations remained over 1.0 mg/L in Bunker Creek at station

BH-BC-0006 for most of the study. This total-phosphorous concentration increase in Bunker Creek resulted from the higher concentrations measured in Magnet Creek; these concentrations measured over 2.0 mg/L for all samples. The pre-study total-phosphorous concentration from station BH-MG-0001 (located near McKinley) was 0.04 mg/L and significantly less than concentrations in the lower portion of Magnet Creek. This large concentration difference is attributable to the French drain discharging groundwater from the A-4 Gypsum Pond to Magnet Creek as described previously. The A-4 Gypsum Pond monitoring-well network was sampled by the potentially responsible party in October 2008 (LFR, 2008). At that time, total-phosphorous concentrations were detected as high as 11 mg/L.

Table 8 presents the dissolved-metal loads estimated at all stations sampled during the Bunker Creek Pilot Study for dissolved cadmium, dissolved lead, and dissolved zinc. Figures 4 and 5 present dissolved-zinc loads for the days of the study when sampling occurred.

Dissolved-zinc loads at the three SFCDR monitoring stations were variable prior to and during the Bunker Creek Pilot Study. The dissolved-zinc load at the upgradient SFCDR station BH-SF-LF-0004 ranged from 539 pounds per day (lb/day) to 639 lb/day. Dissolved-zinc loads at monitoring station BH-SF-LF-0005 ranged from 552 lb/day to 644 lb/day. The dissolved-zinc load at the downgradient SFCDR monitoring location ranged from 533 lb/day to 691 lb/day. Although dissolved-zinc loads were variable, the pre-study load is similar to estimated loads from the end of the study.

The dissolved-zinc load at Bunker Creek monitoring station BH-BC-0001 was variable throughout the study period—the load ranged from 4.8 lb/day to 16 lb/day. The variability associated with loading at BH-BC-0001 was mostly a result of the fluctuation of discharge from the CTP during the study. The total-zinc load from the temporary CTP outfall ranged from 1.7 lb/day to 8.2 lb/day. Dissolved-zinc loads at the Bunker Creek monitoring station upgradient of the temporary CTP outfall and BH-BC-0006 were relatively consistent during the study and ranged from 0.1 lb/day to 0.3 lb/day. The dissolved-zinc load in Magnet Gulch during the study ranged from 2.9 lb/day to 7.2 lb/day.

Table 7 provides estimated total-phosphorous loads. Total-phosphorous loads in the SFCDR indicated a slight increase between monitoring stations BH-SF-LF-0004 and BH-SF-LF-0006 during most days of the study. The total-phosphorous load at the upgradient SFCDR station BH-SF-LF-0004 ranged from about 14 lb/day to 20 lb/day. The total-phosphorous load at the downgradient SFCDR monitoring location ranged from about 15 lb/day to 20 lb/day. Total-phosphorous loads at Bunker Creek monitoring stations were slightly variable during the study. Loads were below 1.0 lb/day and 0.5 lb/day at monitoring station BH-BC-0001 and BH-BC-0006, respectively. Magnet Gulch total-phosphorous loads ranged from 0.8 lb/day to 1.8 lb/day.

Table 9 presents the dissolved-metal AWQC ratios at all stations sampled during the Bunker Creek Pilot Study for dissolved cadmium, dissolved lead, and dissolved zinc. The dissolved-zinc AWQC ratios showed slight variability at the three SFCDR monitoring stations during the study period. Pre-study AWQC ratios were about one ratio unit less prior to the study at the three stations. The variability in AWQC ratios in the SFCDR during this time period is not likely the result of impacts from the Bunker Creek Pilot Study.

The dissolved-zinc AWQC ratio at Bunker Creek station BH-BC-0001 showed slight variability over the study. However, the dissolved-zinc AWQC ratio at BH-BC-0001 was consistently less than prior to the study. The AWQC ratios at the Bunker Creek monitoring station above the temporary CTP outfall and at BH-BC-0006 increased significantly during the study. The AWQC ratio increased from 0.71 (pre-study) to 17 at the end of the study. These increases are attributed to the majority of the discharge present at these locations being sourced from the A-4 French drain groundwater and the loss of dilution from the much cleaner CTP effluent. The dissolved-zinc AWQC ratio at Magnet Gulch remained near 20 for the duration of the study.

3.2.3 Groundwater Quality

Table 10 summarizes dissolved-cadmium, dissolved-lead, dissolved-zinc, and hardness concentrations measured in groundwater monitoring wells and piezometers in the Bunker Creek area.

In general, dissolved-cadmium, dissolved-lead, and dissolved-zinc concentrations in groundwater monitoring wells in the Bunker Creek area were relatively consistent when comparing pre-study to during-study concentrations. Figure 5 presents dissolved-zinc concentrations in Bunker Creek area groundwater monitoring wells and piezometers.

A decline in hardness concentrations was observed in all monitoring wells and piezometers between pre-study groundwater monitoring and groundwater monitoring performed at the end of the study (October 8 and 9, 2008). The highest hardness-concentration difference (over 200 mg/L) was observed in piezometers BH-SF-E-PZ-14, BH-SF-E-PZ-16, BH-SF-E-PZ-21, and BH-SF-E-PZ-22 located near Bunker Creek. Other significant declines in hardness concentration were observed in wells BH-SF-E-0503-U and BH-SF-E-0504-U, and in piezometers BH-SF-E-PZ-20 and BH-SF-LF-E-PZ-23. These sites are located along Bunker Creek except for BH-SF-E-PZ-23, which is located between the CIA and I-90 at the eastern end of the CIA. Because declines in hardness were observed in the majority of monitoring wells, it is not possible to determine if the decreases were a result of the Bunker Creek study in some areas or if they were the result of a larger site-wide change in hardness concentrations similar to water-level decreases observed at this time. Figure 5 presents hardness concentrations in groundwater.

Attachment B provides total-phosphorous concentrations measured in groundwater at the end of the study. The highest total-phosphorous concentrations were detected in monitoring wells and piezometers located at the mouth of Magnet Creek, downgradient of Magnet Creek near Bunker Creek monitoring station BH-BC-0006, and in the vicinity of the CIA and Slag Pile areas. Total-phosphorous concentrations were measured at 5.3 mg/L in well BH-SF-E-0427-U, 4.3 mg/L in well BH-SF-E-0423-U, 3.7 mg/L in piezometer BH-SF-E-PZ-20, 3.5 mg/L in piezometer BH-SF-E-PZ-23, and 3.1 mg/L in piezometer BH-SF-E-PZ-18. Concentrations ranging from 1.0 mg/L to 3.0 mg/L were measured in monitoring wells BH-SF-E-0402-U, BH-SF-E00403-U, and BH-SF-E-0425-U; and in piezometer BH-SF-E-PZ-25.

3.3 Bunker Creek Sediment

Two sediment samples were collected from the Bunker Creek channel—one from the upstream portion of the channel near surface-water monitoring location BH-BC-0004 and one from the downstream portion of the channel near piezometer BH-SF-E-PZ-22.

Cadmium was detected at a concentration of 70 milligrams per kilogram (mg/kg) in the upstream sediment sample and at 195 mg/kg in the downstream sediment sample. Lead was detected at 2,700 mg/kg and 2,240 mg/kg in the upstream and downstream samples, respectively. Zinc was detected at relatively high concentrations in both the upstream and downstream samples (10,500 mg/kg and 10,800 mg/kg, respectively).

4 Summary and Path Forward

This section summarizes the key findings based on review of data collected during the 12-day Bunker Creek Pilot Study. As noted previously, these data will be used to further refine predictions of the effectiveness of lining the Bunker Creek channel and other potential actions using a numerical groundwater flow model (Section 2.3). In addition, these data will provide needed information to begin design of a remedial action for the Bunker Creek area. The following items are key findings from the review of the Bunker Creek Pilot Study data:

- The diversion of the CTP effluent from Bunker Creek resulted in no discharge being present in Bunker Creek from the CTP outfall downgradient to approximately 500 feet above the confluence with Magnet Gulch. The discharge measured in Bunker Creek below Magnet Gulch was predominantly from the A-4 Gypsum Pond French drain in Magnet Gulch.
- Elevated metals concentrations in Bunker Creek corridor subsurface soils were observed from the comprehensive soil sampling conducted during the 2008 OU2 Direct Push Field Investigation (CH2M HILL, 2009). Elevated metals concentrations were also detected in Bunker Creek channel sediments. The metals-contaminated soils likely serve as the source of dissolved-metals contamination to the underlying alluvial aquifer when infiltration of surface water occurs.
- Dissolved-metal concentrations significantly increased from monitoring station BH-MG-0001 to the mouth of Magnet Gulch at Bunker Creek. It is presumed that dissolved-metals-contaminated groundwater routed through a French drain at the toe of the A-4 Gypsum Pond to the lower end of Magnet Gulch caused the significant increase in dissolved-metal concentrations. Dissolved metals from Magnet Gulch may be the largest source of dissolved metals in Bunker Creek surface water under low-flow conditions.
- The Bunker Creek simulated lining study did not hydrologically affect the shallow alluvial aquifer. Groundwater elevations declined throughout the study, but no significant changes occurred following pumping of the CTP effluent to the downgradient discharge location and following reintroduction of the CTP effluent into Bunker Creek. The lack of effect on the shallow alluvial aquifer is likely the result of the high-hydraulic conductivity of subsurface and aquifer materials that do not allow groundwater mounding to occur because of losses from Bunker Creek.

- The simulated lining of Bunker Creek did not appear to affect dissolved-metal concentrations in groundwater. Dissolved-cadmium, dissolved-lead, and dissolved-zinc concentrations were consistent between sampling performed during the week of September 22, 2008 (prior to the study) and sampling performed at the end of the study (on October 8 and 9, 2008). However, it has been recognized that the study may not have been sufficiently long to allow these types of changes to occur and be observed.
- Hardness declined in groundwater in the Bunker Creek corridor and in the vicinity of the CIA and Slag Pile areas during the simulated lining of Bunker Creek. The difference between pre-study hardness concentrations and hardness concentrations measured during the study may be indicators of (1) the losing sections of Bunker Creek and (2) groundwater flow pathways from the Bunker Creek corridor to the SFCDR. However, the decrease in hardness, which was observed in the majority of monitoring wells, may be more indicative of large-scale processes within the aquifer.
- Dissolved-cadmium and dissolved-zinc concentrations measured from the three SFCDR monitoring stations were consistent for the duration of the study. The Bunker Creek lining simulation did not affect these concentrations in the SFCDR. Dissolved-lead concentrations declined at these stations during the study.

As noted at the beginning of this memorandum, infrastructure limitations prevented the design of a Bunker Creek Pilot Study that would achieve steady-state conditions indicative of lining the Bunker Creek channel. Therefore, the decision was made to collect enough data to allow for the simulation to be carried out to steady state using a numerical groundwater flow model. The numerical groundwater flow modeling work is in process. The model documentation will present the results of the simulation of lining Bunker Creek, as well as additional alternatives for Bunker Creek and other areas within OU2.

5 References

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6 Acronyms

µS/cm	microsiemens per centimeter
1992 OU2 ROD	*Record of Decision, Bunker Hill Mining and Metallurgical Complex [Non-Populated Areas], Shoshone County, Idaho* (USEPA, 1992)
AMD	acid mine drainage
AWQC	water quality criteria
cfs	cubic feet per second
CIA	Central Impoundment Area
CTP	Central Treatment Plant
DO	dissolved oxygen
I-90	Interstate 90
ICP	institutional-controls-program
IDEQ	Idaho Department of Environmental Quality
lb/day	pound(s) per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mV	millivolts
ORP	oxidation-reduction potential

OU2	Operable Unit 2
OU2 EMP	OU2 Environmental Monitoring Plan
QAPP	*Quality Assurance Project Plan Bunker Creek Study Shoshone, Idaho* (CH2M HILL, 2008)
RAO	remedial action objective
SCA	Smelter Closure Area
SFCDR	South Fork Coeur d'Alene River
USEPA	U.S. Environmental Protection Agency

Tables

TABLE 1
Temporal Summary of Events
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Date	Time	Event
pre-study	--	Ferguson Contracting performed setup of pump and pipeline system for Bunker Creek Study.
22-Sep-08 to 25-Sep-08	--	Pre-Bunker Creek Study groundwater and surface water monitoring as part of the OU2 groundwater/surface water interaction monitoring and the fall OU2 Environmental Monitoring Plan.
29-Sep-08	10:00	Pump startup. Begin pumping CTP effluent from polishing pond into pipeline downgradient to relocated effluent outfall location.
	10:35	CTP effluent ceased discharging into the Bunker Creek channel.
	14:00	Excess irrigation water discharging in Bunker Creek near BH-BC-0003 from the City of Kellogg sourced from the Big Creek drainage was turned off.
	--	Conducted surface water monitoring.
1-Oct-08	--	Conducted surface water monitoring.
3-Oct-08	--	Kellogg received 0.04 inches of rain.
	--	Conducted surface water monitoring.
4-Oct-08	--	Kellogg received 0.1 inches of rain.
6-Oct-08	--	Kellogg received 0.03 inches of rain.
	--	Conducted surface water monitoring.
7-Oct-08	--	Kellogg received 0.12 inches of rain.
8-Oct-08	--	Conducted groundwater and surface water monitoring.
9-Oct-08	--	Conducted groundwater monitoring.
10-Oct-08	--	Conducted surface water monitoring.
	14:15	Pumps used to reroute the CTP effluent outfall through the pipeline turned off.
	15:35	CTP effluent discharging to Bunker Creek channel.

Notes:

-- = Not applicable

Precipitation data for Kellogg, Idaho obtained from the National Weather Service (www.weather.gov/climate)

CH2M HILL performed all surface water monitoring.

Terragraphics performed groundwater sampling on October 8, 2008. CH2M HILL and Terragraphics performed groundwater sampling on October 9, 2008.

TABLE 2

Summary of Bunker Creek Pilot Study Surface Water Monitoring Locations

Bunker Creek Pilot Study

Bunker Hill Superfund Site OU2

Location	9/29/2008	10/1/2008	10/3/2008	10/6/2008	10/8/2008	10/10/2008
SFCDR Monitoring Locations						
BH-SF-LF004	X	X	X	X	X	X
BH-SF-LF005	X	X	X	X	X	X
BH-SF-LF006	X	X	X	X	X	X
Bunker Creek Monitoring Locations						
BH-BC-0003	Dry	Dry	Dry	Dry	Dry	Dry
BH-BC-0004	X	Dry	Dry	Dry	Dry	Dry
BH-BC-0005	X	Dry	Dry	Dry	Dry	Dry
Bunker Creek - Upgradient of Magnet Gulch	--	--	X	X	X	X
BH-BC-0006	X	X	X	X	X	X
Bunker Creek-Upgradient of Temporary CTP Outfall	X	X	X	X	X	X
BH-BC-0001	X	X	X	X	X	X
Bunker Creek Tributaries						
Portal Gulch/Mine Yard	Dry	Dry	Dry	Dry	Dry	Dry
Railroad Gulch	Dry	Dry	Dry	Dry	Dry	Dry
Deadwood Gulch	Dry	Dry	Dry	Dry	Dry	Dry
Magnet Gulch	--	--	X	X	X	X

Notes:

X = Data colleted at monitoring location

-- = not measured

The Magnet Gulch discharge was taken from Bunker Creek below the mount of Magnet Gulch. These measurements are representative of Magnet Gulch since Bunker Creek flow upgradient of Magnet Gulch was negligible and too low for instrument measurement.

TABLE 3
Summary of Bunker Creek Pilot Study Groundwater Monitoring Locations
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Location	Pre-Study	10/8/2008	10/9/2008
BH-SF-E-0301-U	X	X	
BH-SF-E-0320-U	X	X	
BH-SF-E-0402-U	X	X	
BH-SF-E-0403-U	X	X	
BH-SF-E-0407-U	X		X
BH-SF-E-0410-U	X	X	
BH-SF-E-0423-U	X	X	
BH-SF-E-0425-U	X		X
BH-SF-E-0427-U	X	X	
BH-SF-E-0429-U	X	X	
BH-SF-E-0503-U	X		X
BH-SF-E-0504-U	X		X
BH-SF-E-PZ-12	X		X
BH-SF-E-PZ-13	X		X
BH-SF-E-PZ-14	X		X
BH-SF-E-PZ-15	X		X
BH-SF-E-PZ-16	X		X
BH-SF-E-PZ-17	X		X
BH-SF-E-PZ-18	X		X
BH-SF-E-PZ-20	X		X
BH-SF-E-PZ-21	X		X
BH-SF-E-PZ-22	X		X
BH-SF-E-PZ-23	X		X
BH-SF-E-PZ-24	X		X
BH-SF-E-PZ-25	X		X
BH-SF-E-PZ-26	X		X

Notes:
X = Data colleted at monitoring location

TABLE 4

Bunker Creek Pilot Study Measured Discharge

Bunker Creek Pilot Study

Bunker Hill Superfund Site OU2

Location	Discharge (cfs)						
	Pre-Study[1]	**9/29/2008**	**10/1/2008**	**10/3/2008**	**10/6/2008**	**10/8/2008**	**10/10/2008**
BH-SF-LF004	90	89	83	85	95	94	100
BH-SF-LF005	83	83	84	86	91	95	81
BH-SF-LF006	90	85	89	75	96	94	95
BH-BC-0001	3.5	1.82	1.48	2.74	2.67	3.07	3.34
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--	0.20	0.12	0.03	0.11	0.10	0.08
BH-BC-0006	3.3	--[3]	0.06	0.05	0.08	0.05	0.03
Bunker Creek - Upgradient of Magnet Gulch[2, 4]	--	--	0.0	--	--	--	--
BH-BC-0005	2.7	--[3]	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	1.8	--[3]	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[5]	0.10	--	0.13	0.06	0.15	0.08	0.13
CTP Outfall[6]	2.97	1.62	1.36	2.71	2.56	2.97	3.26

Notes:

Monitoring station BH-BC-0003 and the Bunker Creek tributaries Deadwood Gulch, Railroad Gulch, and Portal Gulch/Mine Yard were dry during the study, thus no monitoring was performed at these locations.

[2] = The Bunker Creek monitoring stations upgradient of the relocated CTP outfall discharge pipe and upgradient of Magnet Creek were established for the purpose of the Bunker Creek Study. No pre-study data is available for these locations.

[3] = Discharge not measured due to sensor malfunction

[4] = Velocity too low for sensor measurement at this location on October 1, 2008. Discharge was not measured during subsequent monitoring due to this low flow.

[5] = The Magnet Gulch discharge was taken from Bunker Creek below the mount of Magnet Gulch. These measurements are representative of Magnet Gulch since Bunker Creek flow upgradient of Magnet Gulch was too low for instrument measurement. Discharge was not measured during the first day of the study. The pre-study Magnet Gulch discharge was measrued at BH-MG-0001, located near McKinley Avenue.

[6] = Pre-study data was collected by Ferguson Contracting. Discharge measured during the study is estimated based on the difference between discharge at BH-BC-0001 and in Bunker Creek upgradient of the relocated CTP outfall.

TABLE 5
Surface Water Dissolved Metal Concentrations
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Location	Pre-Study[1]	Bunker Creek Study					
		9/29/2008	10/1/2008	10/3/2008	10/6/2008	10/8/2008	10/10/2008
Dissolved Cadmium (mg/L)							
BH-SF-LF004	0.007	0.008	0.008	0.008	0.006	0.008	0.007
BH-SF-LF005	0.008	0.008	0.008	0.008	0.007	0.008	0.008
BH-SF-LF006	0.010	0.010	0.011	0.010	0.009	0.010	0.010
BH-BC-0001	0.015	0.007	0.008	0.007	0.006	0.008	0.012
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--[2]	0.017	0.034	0.041	0.040	0.047	0.048
BH-BC-0006	0.015	0.046	0.076	0.075	0.070	0.082	0.079
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--[2]	--	--	0.006	0.005	0.005	0.004
BH-BC-0005	0.005	0.002	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	0.006	0.002	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3,4]	0.038	--	--	0.13	0.12	0.13	0.13
CTP Outfall[5]	<.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dissolved Lead (mg/L)							
BH-SF-LF004	0.006	0.006	0.006	0.010	0.01	0.003	0.003
BH-SF-LF005	0.006	0.006	0.005	0.004	0.003	0.002	0.003
BH-SF-LF006	0.005	0.007	0.005	0.004	0.003	0.003	0.004
BH-BC-0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--[2]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BH-BC-0006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--[2]	--	--	<0.001	<0.001	<0.001	<0.001
BH-BC-0005	<0.001	<.001	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	<0.001	0.002	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3,4]	<0.001	--	--	0.003	0.003	0.003	0.003
CTP Outfall[5]	<0.05	<0.05	<0.05	<0.05	0.067	<0.05	<0.05
Dissolved Zinc (mg/L)							
BH-SF-LF004	1.1	1.2	1.3	1.2	1.1	1.2	1.2
BH-SF-LF005	1.3	1.2	1.4	1.2	1.1	1.3	1.3
BH-SF-LF006	1.3	1.3	1.4	1.3	1.3	1.3	1.4
BH-BC-0001	0.85	0.37	0.65	0.47	0.33	0.43	0.69
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--[2]	1.0	3.9	4.4	4.2	5.1	6.1
BH-BC-0006	0.84	4.0	6.8	6.7	6.0	6.8	7.6
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--[2]	--	--	0.89	0.78	0.81	0.76
BH-BC-0005	0.22	0.06	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	0.26	0.24	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3,4]	0.86	--	--	9.0	8.6	9.0	10.2
CTP Outfall[5]	0.20	0.19	0.24	0.47	0.22	0.25	0.47

Notes:

Monitoring station BH-BC-0003 and the Bunker Creek tributaries Deadwood Gulch, Railroad Gulch, and Portal Gulch/Mine Yard were dry during the study, thus no monitoring was performed at these locations.

[1] = Pre-study surface water monitoring was conducted between September 23 and 25, 2008.

[2] = The Bunker Creek monitoring stations upgradient of the temporary CTP outfall discharge pipe and upgradient of Magnet Creek were established for the purpose of the Bunker Creek Study. No pre-study data is available for these locations.

[3] = Magnet Gulch and Bunker Creek upgradient of Magnet Gulch were not sampled on September 29, 2008 and October 1, 2008.

[4] = Pre-study surface water monitoring at Magnet Gulch was performed at BH-MG-0001. Bunker Creek study monitoring of Magnet Gulch was performed at its confluence with Bunker Creek.

[5] = Monitoring performed by Ferguson Contracting. Results shown are for total metals.

TABLE 6
Hardness in Surface Water
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Location	Hardness (mg/L)						
	Pre-Study[1]	**9/29/2008**	**10/1/2008**	**10/3/2008**	**10/6/2008**	**10/8/2008**	**10/10/2008**
BH-SF-LF004	96	81	71	65	63	84	78
BH-SF-LF005	101	81	72	68	64	88	79
BH-SF-LF006	163	147	105	122	111	137	139
BH-BC-0001	1,528	1,634	1,298	1,161	1,275	1,381	1,357
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--	1,313	427	400	325	351	348
BH-BC-0006	1,520	877	398	363	313	350	348
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--	--	--	1,368	1,190	1,311	1,341
BH-BC-0005	1,570	1,068	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	1,569	260	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3, 4]	90	--	--	355	334	357	361

Notes:
Monitoring station BH-BC-0003 and the Bunker Creek tributaries Deadwood Gulch, Railroad Gulch, and Portal Gulch/Mine Yard were dry during the study, thus no monitoring was performed at these locations.

[1] = Pre-study surface water monitoring was conducted between September 23 and 25, 2008.

[2] = The Bunker Creek monitoring stations upgradient of the temporary CTP outfall discharge pipe and upgradient of Magnet Creek were established for the purpose of the Bunker Creek Study. No pre-study data is available for these locations.

[3] = Magnet Gulch and Bunker Creek upgradient of Magnet Gulch were not sampled on September 29, 2008 and October 1, 2008.

[4] = Pre-study surface water monitoring at Magnet Gulch was performed at BH-MG-0001. Bunker Creek study monitoring of Magnet Gulch was performed at its confluence with Bunker Creek.

TABLE 7
Total Phosphorous in Surface Water
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Location	Concentration (mg/L)						
	Pre-Study[1]	**9/29/2008**	**10/1/2008**	**10/3/2008**	**10/6/2008**	**10/8/2008**	**10/10/2008**
BH-SF-LF004	0.035	0.029	0.031	0.036	0.038	0.036	0.037
BH-SF-LF005	0.037	0.031	0.035	0.064	0.049	0.036	0.037
BH-SF-LF006	0.056	0.035	0.034	0.036	0.034	0.04	0.038
BH-BC-0001	0.152	0.042	0.070	0.054	0.046	0.047	0.042
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--	0.162	0.732	0.914	0.837	0.988	0.825
BH-BC-0006	0.162	0.6	1.17	1.27	1.08	1.25	1.20
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--	--	--	0.02	0.023	0.022	0.021
BH-BC-0005	0.0059	0.0027	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	0.0061	0.0046	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3, 4]	0.04	--	--	2.51	2.28	2.36	2.29
	Load (lb/day)						
	Pre-Study[1]	**9/29/2008**	**10/1/2008**	**10/3/2008**	**10/6/2008**	**10/8/2008**	**10/10/2008**
BH-SF-LF004	17.0	13.9	13.8	16.4	19.6	18.2	16.8
BH-SF-LF005	16.5	13.9	15.9	30	24	18.4	16.1
BH-SF-LF006	27	16.1	16.3	14.5	17.5	20	19.5
BH-BC-0001	2.9	0.41	0.56	0.8	0.66	0.78	0.76
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--	0.17	0.47	0.15	0.50	0.53	0.36
BH-BC-0006	2.80	--	0.38	0.34	0.47	0.34	0.19
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--	--	--	--	--	--	--
BH-BC-0005	0.09	--	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	0.06	--	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3, 4]	0.02	--	--	0.81	1.8	1.0	1.6

Notes:

Monitoring station BH-BC-0003 and the Bunker Creek tributaries Deadwood Gulch, Railroad Gulch, and Portal Gulch/Mine Yard were dry during the study, thus no monitoring was performed at these locations.

[1] = Pre-study surface water monitoring was conducted between September 23 and 25, 2008.

[2] = The Bunker Creek monitoring stations upgradient of the temporary CTP outfall discharge pipe and upgradient of Magnet Creek were established for the purpose of the Bunker Creek Study. No pre-study data is available for these locations.

[3] = Magnet Gulch and Bunker Creek upgradient of Magnet Gulch were not sampled on September 29, 2008 and October 1, 2008.

[4] = Pre-study surface water monitoring at Magnet Gulch was performed at BH-MG-0001. Bunker Creek study monitoring of Magnet Gulch was performed at its confluence with Bunker Creek.

TABLE 8
Dissolved Metal Loads
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Location	Pre-Study[1]	Bunker Creek Study					
		9/29/2008	10/1/2008	10/3/2008	10/6/2008	10/8/2008	10/10/2008
Dissolved Cadmium (lb/day)							
BH-SF-LF004	2.9	3.8	3.6	3.4	3.3	3.9	4.0
BH-SF-LF005	3.6	3.6	3.8	3.5	3.4	4.1	3.3
BH-SF-LF006	5.0	4.7	5.2	4.2	4.8	5.1	5.2
BH-BC-0001	0.30	0.07	0.06	0.11	0.08	0.13	0.22
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--[2]	0.02	0.02	0.01	0.02	0.03	0.02
BH-BC-0006	0.26	--	0.02	0.02	0.03	0.02	0.01
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--[2]	--	--	--	--	--	--
BH-BC-0005	0.07	--	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	0.06	--	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3, 4]	0.02	--	--	0.04	0.10	0.05	0.09
CTP Outfall[5]	--	--	--	--	--	--	--
Dissolved Lead (lb/day)							
BH-SF-LF004	4.9	2.9	2.7	4.4	3.9	1.6	1.7
BH-SF-LF005	2.7	2.7	2.5	2.0	1.6	1.2	1.2
BH-SF-LF006	2.2	3.0	2.4	1.7	1.6	1.6	2.0
BH-BC-0001	--	--	--	--	--	--	--
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--[2]	--	--	--	--	--	--
BH-BC-0006	--	--	--	--	--	--	--
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--[2]	--	--	--	--	--	--
BH-BC-0005	--	--	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	--	--	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3, 4]	--	--	--	0.001	0.002	0.001	0.002
CTP Outfall[5]	--	--	--	--	--	--	--
Dissolved Zinc (lb/day)							
BH-SF-LF004	628	556	557	539	551	613	639
BH-SF-LF005	567	558	613	554	561	644	552
BH-SF-LF006	634	587	686	533	650	679	691
BH-BC-0001	16	3.7	5.2	6.9	4.8	7.1	13
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--	1.1	2.5	0.71	2.5	2.7	2.6
BH-BC-0006	15	--	2.2	1.8	2.6	2.0	1.2

TABLE 8
Dissolved Metal Loads
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Location	Pre-Study[1]	Bunker Creek Study					
		9/29/2008	10/1/2008	10/3/2008	10/6/2008	10/8/2008	10/10/2008
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--	--	--	--	--	--	--
BH-BC-0005	3.2	--	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	2.5	--	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3, 4]	0.5	--	--	2.9	6.9	3.9	7.2
CTP Outfall[5]	3.3	1.7	1.8	6.9	3.1	3.9	8.2

Notes:

Monitoring station BH-BC-0003 and the Bunker Creek tributaries Deadwood Gulch, Railroad Gulch, and Portal Gulch/Mine Yard were dry during the study, thus no monitoring was performed at these locations.

Dissolved metal loads are calculated using the concentration and discharge. Load estimates are not present for monitoring stations where at least one of these parameters were not measured.

[1] = Pre-study surface water monitoring was conducted between September 23 and 25, 2008.

[2] = The Bunker Creek monitoring stations upgradient of the temporary CTP outfall discharge pipe and upgradient of Magnet Creek were established for the purpose of the Bunker Creek Study. No pre-study data is available for these locations.

[3] = Magnet Gulch and Bunker Creek upgradient of Magnet Gulch were not sampled on September 29, 2008 and October 1, 2008.

[4] = Pre-study surface water monitoring at Magnet Gulch was performed at BH-MG-0001. Bunker Creek study monitoring of Magnet Gulch was performed at its confluence with Bunker Creek.

[5] = Monitoring performed by Ferguson Contracting. Results shown are for total metals.

TABLE 9
Dissolved Metal AWQC Ratios
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Location	Pre-Study[1]	Bunker Creek Study					
		9/29/2008	10/1/2008	10/3/2008	10/6/2008	10/8/2008	10/10/2008
Dissolved Cadmium AWQC Ratio							
BH-SF-LF004	7.3	9.0	10	10	8.8	8.5	8.5
BH-SF-LF005	7.8	9.1	10	9.8	9.4	8.7	8.9
BH-SF-LF006	6.9	7.4	10	8.7	8.5	7.7	7.8
BH-BC-0001	1.9	0.84	1.1	1.1	0.86	1.1	1.7
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--	2.4	11	14	16	18	19
BH-BC-0006	2.0	8.9	27	28	29	31	30
Bunker Creek - Upgradient of Magnet Gulch[2]	--	--	--	0.89	0.77	0.71	0.59
BH-BC-0005	0.64	0.34	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	0.77	0.77	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3, 4]	40	--	--	49	47	48	47
Dissolved Lead AWQC Ratio							
BH-SF-LF004	0.22	0.26	0.29	0.52	0.41	0.13	0.14
BH-SF-LF005	--	0.26	0.26	0.22	0.18	0.09	0.12
BH-SF-LF006	0.10	0.16	0.17	0.12	0.10	0.08	0.09
BH-BC-0001	--	--	--	--	--	--	--
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--	--	--	--	--	--	--
BH-BC-0006	--	--	--	--	--	--	--
Bunker Creek - Upgradient of Magnet Gulch[2]	--	--	--	--	--	--	--
BH-BC-0005	--	--	DRY	DRY	DRY	DRY	DRY
BH-BC-0004	--	0.03	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3, 4]	--	--	--	0.03	0.03	0.03	0.03
Dissolved Zinc AWQC Ratio							
BH-SF-LF004	5.7	6.8	8.0	8.1	7.5	7.0	7.1
BH-SF-LF005	6.4	7.3	8.6	7.9	7.8	7.0	7.6
BH-SF-LF006	4.8	5.1	7.1	5.9	6.0	5.6	5.6
BH-BC-0001	0.71	0.30	0.61	0.47	0.31	0.38	0.63
Bunker Creek-Upgradient of Temporary CTP Outfall[2]	--	0.96	7.6	9.0	9.7	11	14
BH-BC-0006	0.71	4.8	14	15	14	15	17
Bunker Creek - Upgradient of Magnet Gulch[2,3]	--	--	--	0.81	0.77	0.75	0.69
BH-BC-0005	0.18	0.07	DRY	DRY	DRY	DRY	DRY

TABLE 9

Dissolved Metal AWQC Ratios

Bunker Creek Pilot Study

Bunker Hill Superfund Site OU2

Location	Pre-Study[1]	Bunker Creek Study					
		9/29/2008	10/1/2008	10/3/2008	10/6/2008	10/8/2008	10/10/2008
BH-BC-0004	0.21	0.65	DRY	DRY	DRY	DRY	DRY
Magnet Gulch[3, 4]	4.7	--	--	20	20	20	22

Notes:

Monitoring station BH-BC-0003 and the Bunker Creek tributaries Deadwood Gulch, Railroad Gulch, and Portal Gulch/Mine Yard were dry during the study, thus no monitoring was performed at these locations.

Dissolved metal AWQC rations are not present for monitoring stations if the dissolved metal was not detected in the sample or if the monitoring station was not sampled.

[1] = Pre-study surface water monitoring was conducted between September 23 and 25, 2008.

[2] = The Bunker Creek monitoring stations upgradient of the temporary CTP outfall discharge pipe and upgradient of Magnet Creek were established for the purpose of the Bunker Creek Study. No pre-study data is available for these locations.

[3] = Magnet Gulch and Bunker Creek upgradient of Magnet Gulch were not sampled on September 29, 2008 and October 1, 2008.

[4] = Pre-study surface water monitoring at Magnet Gulch was performed at BH-MG-0001. Bunker Creek study monitoring of Magnet Gulch was performed at its confluence with Bunker Creek.

TABLE 10

Bunker Creek Pilot Study Groundwater Quality Data

Bunker Creek Pilot Study

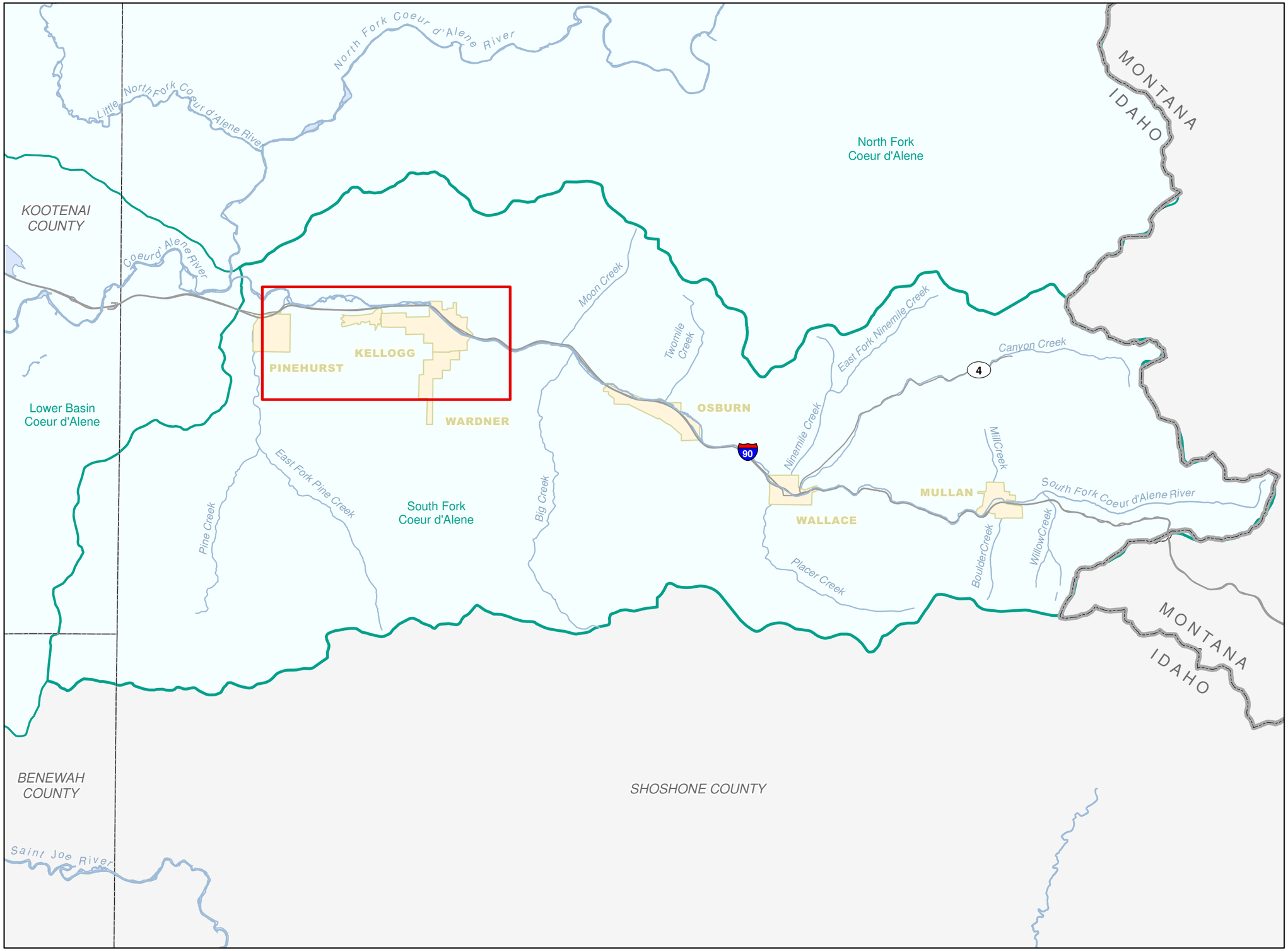
Bunker Hill Superfund Site OU2

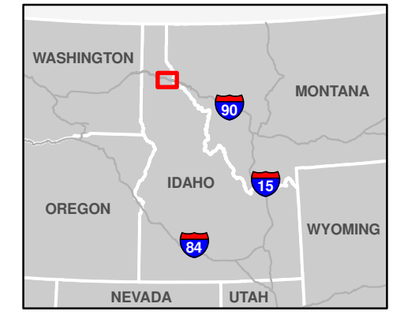
Location	Dissolved Cadmium (mg/L)		Dissolved Lead (mg/L)		Dissolved Zinc (mg/L)		Hardness (mg/L)	
	Pre-Study	Study	Pre-Study	Study	Pre-Study	Study	Pre-Study	Study
BH-SF-E-0301-U	0.03	0.04	0.04	0.04	8.6	9.1	110	92
BH-SF-E-0320-U	0.05	0.05	0.01	0.01	12	12	335	274
BH-SF-E-0402-U	0.17	0.17	<0.001	<0.001	27	28	351	292
BH-SF-E-0403-U	0.24	0.23	<0.001	<0.001	22	22	326	261
BH-SF-E-0407-U	0.85	0.75	0.06	0.06	21	26	272	212
BH-SF-E-0410-U	0.18	0.19	0.001	0.001	28	30	533	458
BH-SF-E-0423-U	0.01	0.01	<0.001	<0.001	28	29	658	582
BH-SF-E-0425-U	0.09	0.10	<0.001	<0.001	24	26	553	502
BH-SF-E-0427-U	0.13	0.14	0.003	0.01	8.8	9.2	583	505
BH-SF-E-0429-U	0.05	0.05	0.003	0.003	24	24	559	487
BH-SF-E-0503-U	0.52	0.50	<0.001	<0.001	9.0	8.9	952	782
BH-SF-E-0504-U	0.18	0.29	<0.001	<0.001	7.9	8.7	865	745
BH-SF-E-PZ-12	0.03	0.03	0.29	0.25	8.3	7.1	174	145
BH-SF-E-PZ-13	<0.001	0.04	0.02	0.01	0.03	0.03	335	289
BH-SF-E-PZ-14	0.15	0.14	2.22	2.14	25	22	820	619
BH-SF-E-PZ-15	0.09	0.10	<0.001	<0.001	8.2	7.3	158	139
BH-SF-E-PZ-16	0.25	0.22	0.02	0.001	24	19	728	523
BH-SF-E-PZ-17	0.06	0.06	0.03	0.03	14	16	337	333
BH-SF-E-PZ-18	0.11	0.11	0.002	0.001	9.3	9.7	373	326
BH-SF-E-PZ-20	0.15	0.15	0.002	0.01	9.4	8.9	794	665
BH-SF-E-PZ-21	0.30	0.31	0.004	0.002	15	15	1097	883
BH-SF-E-PZ-22	0.01	0.01	0.003	<0.001	4.1	3.3	855	650
BH-SF-E-PZ-23	0.48	0.44	0.003	<0.001	25	23	430	319
BH-SF-E-PZ-24	0.04	0.05	0.001	<0.001	27	29	641	562
BH-SF-E-PZ-25	0.07	0.08	0.03	0.01	25	23	507	465
BH-SF-E-PZ-26	0.13	0.13	0.003	0.002	8.1	8.6	665	578

Notes:

Pre-study groundwater monitoring was conducted between September 22 and 25, 2008. Groundwater monitoring during the study was conducted on October 8-9, 2008.

Figures





OU2 Field Investigation Area
Coeur d'Alene Subbasin Boundary
City Limit

N 0 1 2 4 Miles

Source: IDWR (5th & 6th Level HUC); NHDPlus (Rivers, Waterbodies); ESRI base data (Interstates 2006, Major Highways 2008).

Figure 1.
OU2 Vicinity Map
Bunker Creek Pilot Study
BUNKER HILL SITE OU2

CH2MHILL

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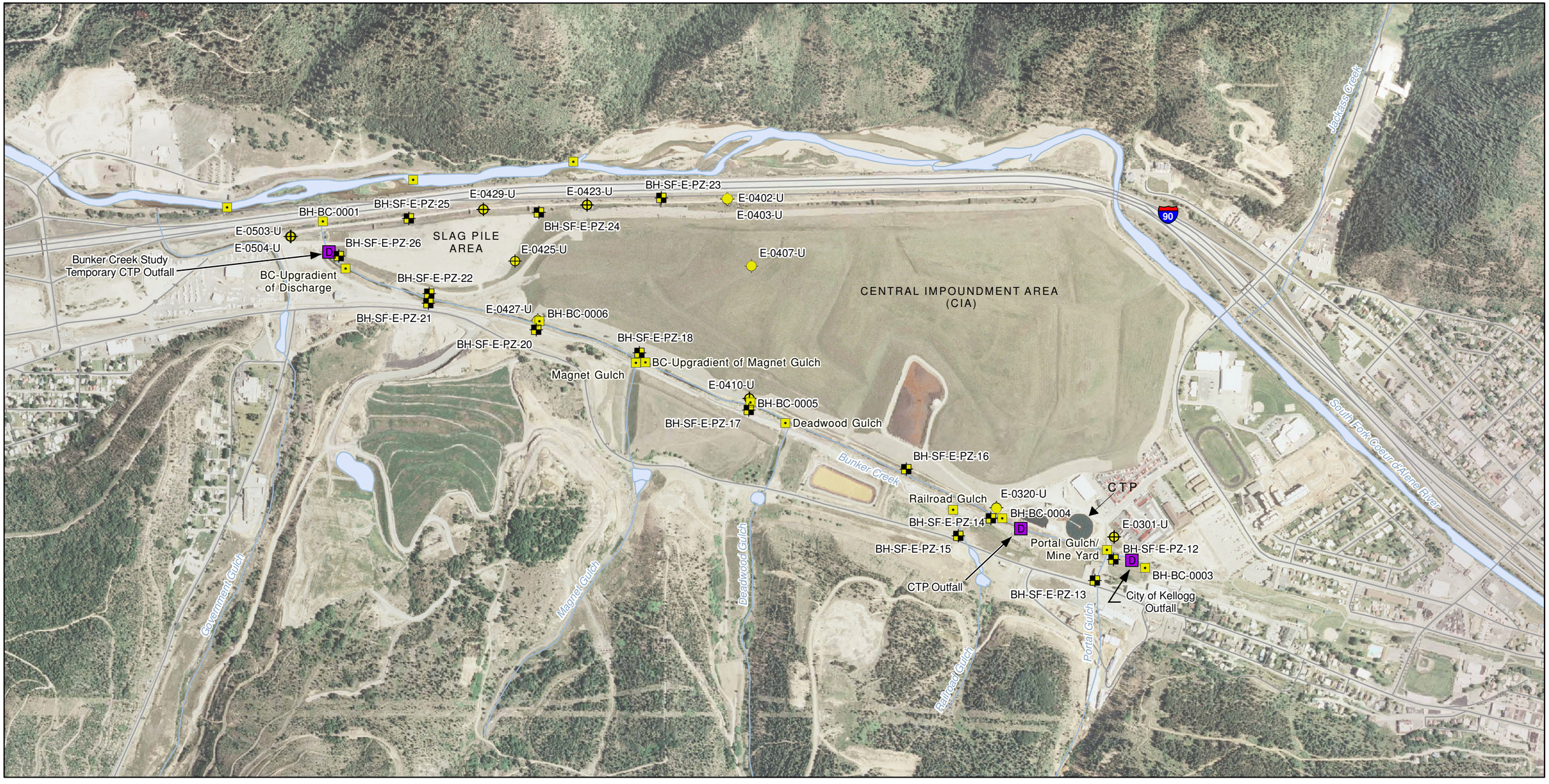

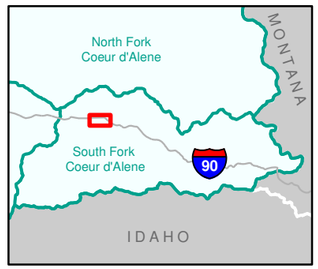

- Surface Water Monitoring Location
- Groundwater Monitoring Well
- Piezometer
- Outfall

N 0 250 500 1,000 Feet

Source: NHDPlus (Rivers, Waterbodies); Idaho Geospatial Data Clearinghouse (Roads 2008, City Limits 2003).

Figure 2.
Bunker Creek Study Monitoring Locations
Bunker Creek Pilot Study
BUNKER HILL SITE OU2

CH2MHILL

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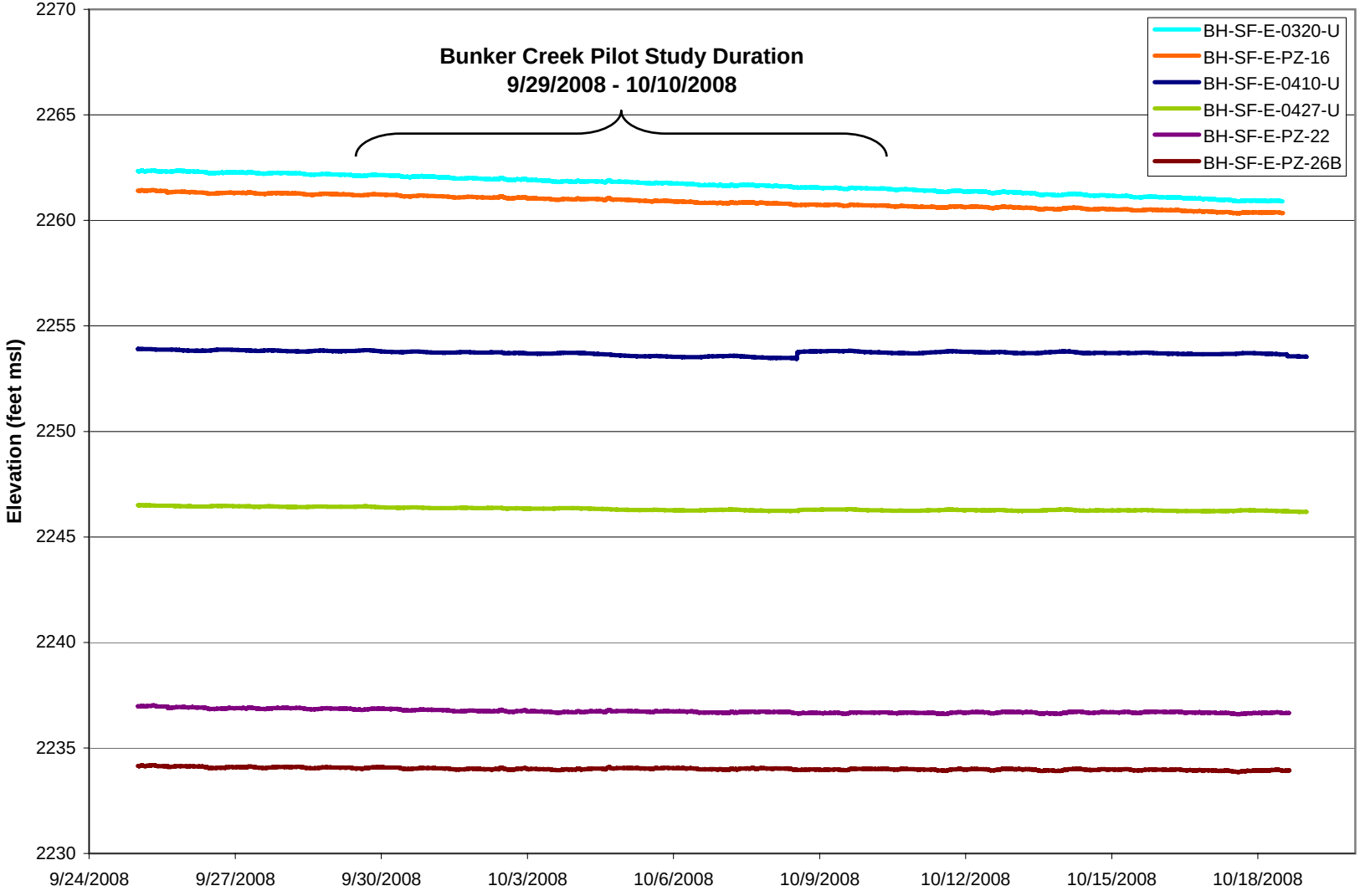
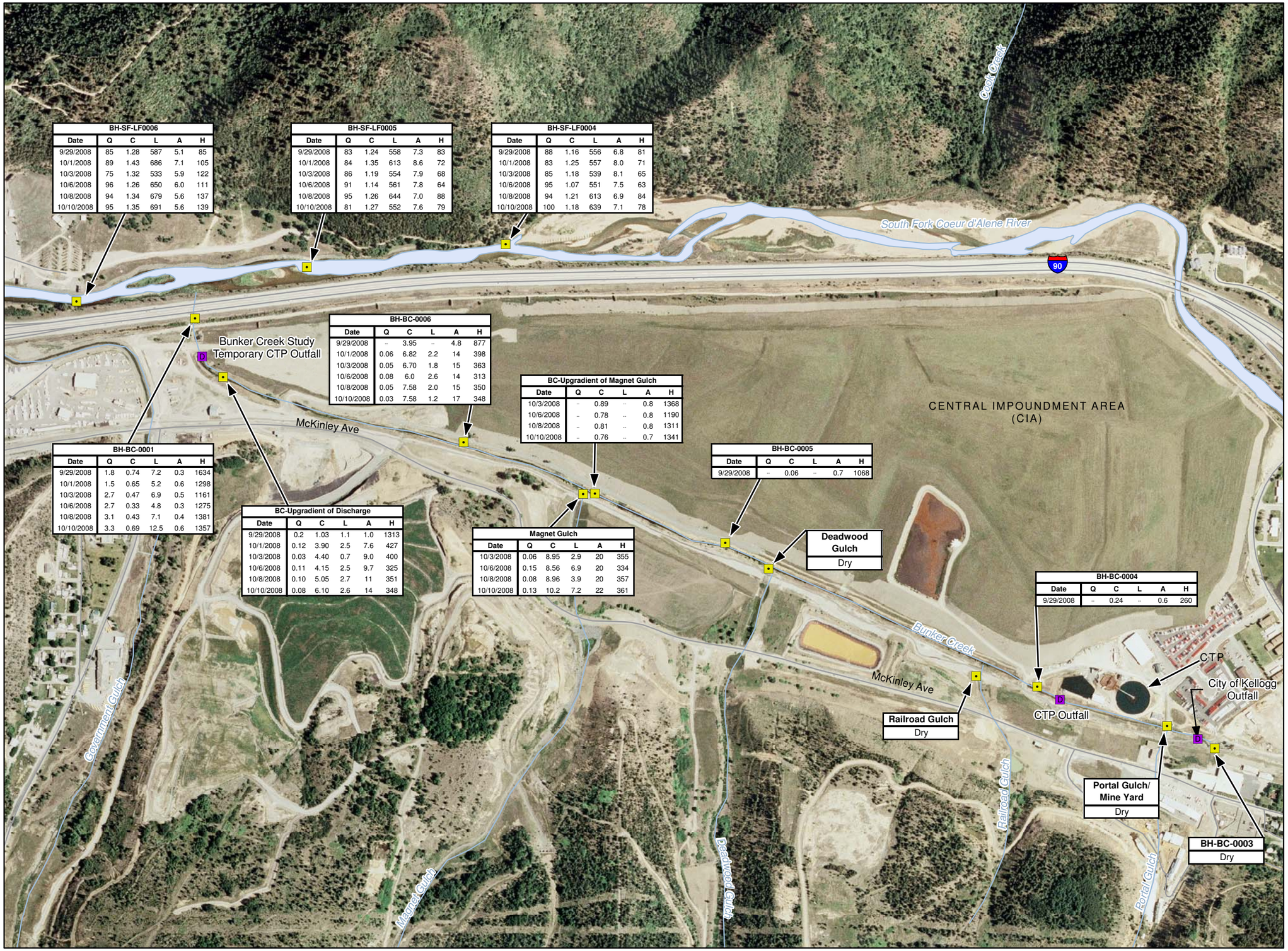
Figure 3: Hydrograph of Select Wells in the Bunker Creek Corridor
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2





BH-SF-LF0006					
Date	Q	C	L	A	H
9/29/2008	85	1.28	587	5.1	85
10/1/2008	89	1.43	686	7.1	105
10/3/2008	75	1.32	533	5.9	122
10/6/2008	96	1.26	650	6.0	111
10/8/2008	94	1.34	679	5.6	137
10/10/2008	95	1.35	691	5.6	139

BH-SF-LF0005					
Date	Q	C	L	A	H
9/29/2008	83	1.24	558	7.3	83
10/1/2008	84	1.35	613	8.6	72
10/3/2008	86	1.19	554	7.9	68
10/6/2008	91	1.14	561	7.8	64
10/8/2008	95	1.26	644	7.0	88
10/10/2008	81	1.27	552	7.6	79

BH-SF-LF0004					
Date	Q	C	L	A	H
9/29/2008	88	1.16	556	6.8	81
10/1/2008	83	1.25	557	8.0	71
10/3/2008	85	1.18	539	8.1	65
10/6/2008	95	1.07	551	7.5	63
10/8/2008	94	1.21	613	6.9	84
10/10/2008	100	1.18	639	7.1	78

BH-BC-0006					
Date	Q	C	L	A	H
9/29/2008	--	3.95	--	4.8	877
10/1/2008	0.06	6.82	2.2	14	398
10/3/2008	0.05	6.70	1.8	15	363
10/6/2008	0.08	6.0	2.6	14	313
10/8/2008	0.05	7.58	2.0	15	350
10/10/2008	0.03	7.58	1.2	17	348

BC-Upgradient of Magnet Gulch					
Date	Q	C	L	A	H
10/3/2008	--	0.89	--	0.8	1368
10/6/2008	--	0.78	--	0.8	1190
10/8/2008	--	0.81	--	0.8	1311
10/10/2008	--	0.76	--	0.7	1341

BH-BC-0001					
Date	Q	C	L	A	H
9/29/2008	1.8	0.74	7.2	0.3	1634
10/1/2008	1.5	0.65	5.2	0.6	1298
10/3/2008	2.7	0.47	6.9	0.5	1161
10/6/2008	2.7	0.33	4.8	0.3	1275
10/8/2008	3.1	0.43	7.1	0.4	1381
10/10/2008	3.3	0.69	12.5	0.6	1357

BH-BC-0005					
Date	Q	C	L	A	H
9/29/2008	--	0.06	--	0.7	1068

BC-Upgradient of Discharge					
Date	Q	C	L	A	H
9/29/2008	0.2	1.03	1.1	1.0	1313
10/1/2008	0.12	3.90	2.5	7.6	427
10/3/2008	0.03	4.40	0.7	9.0	400
10/6/2008	0.11	4.15	2.5	9.7	325
10/8/2008	0.10	5.05	2.7	11	351
10/10/2008	0.08	6.10	2.6	14	348

Magnet Gulch					
Date	Q	C	L	A	H
10/3/2008	0.06	8.95	2.9	20	355
10/6/2008	0.15	8.56	6.9	20	334
10/8/2008	0.08	8.96	3.9	20	357
10/10/2008	0.13	10.2	7.2	22	361

BH-BC-0004					
Date	Q	C	L	A	H
9/29/2008	--	0.24	--	0.6	260

Surface Water Monitoring Location

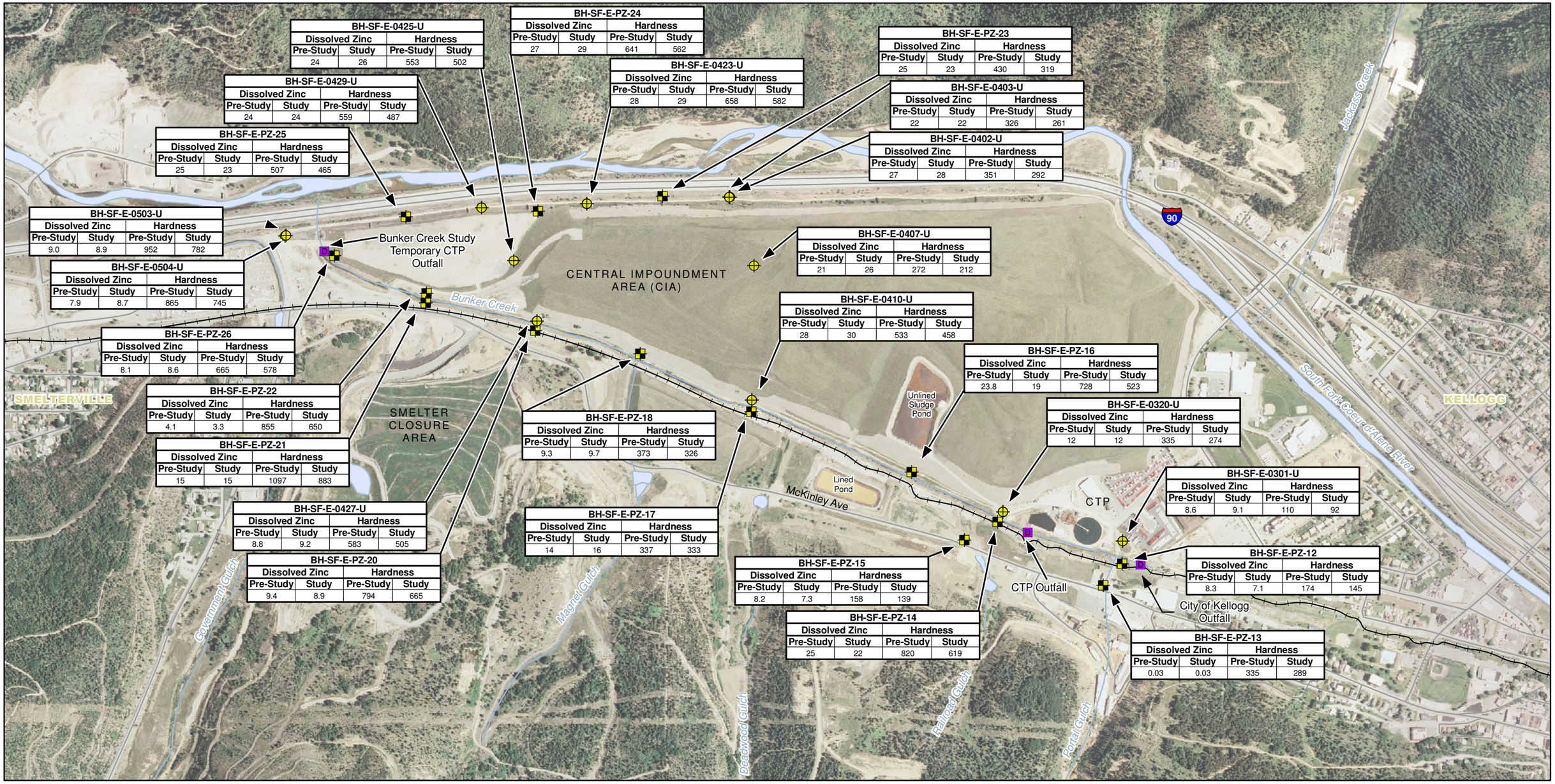
D Outfall

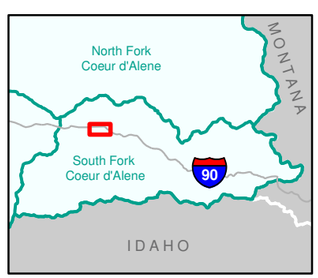
NOTES:
Q = Discharge (cfs)
C = Concentration (mg/L)
L = Load (lbs/day)
A = AWQC Ratio
H = Hardness
-- = Not Measured or Quantified

N 0 250 500 1,000 Feet

Figure 4.
Dissolved Zinc Data Summary
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

CH2MHILL





Groundwater Monitoring Well

Piezometer

Union Pacific RR (now Trail of the Coeur d'Alenes)

Outfall

Source: NHDPlus (Rivers, Waterbodies); Idaho Geospatial Data Clearinghouse (Roads 2008, City Limits 2003).

NOTES:
Concentrations shown in milligrams per liter (mg/L).

N 0 250 500 1,000 Feet

Figure 5.
Groundwater Analytical Data
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

CH2MHILL

\\CASTAIC\PROJ\EPA\CDABASIN_382081\GIS\MAPFILES\GROUNDWATER\ZINCBYDATE\FIG5_BCS_ZNHARD.MXD FIG5_BCS_ZNHARD.MXD RDEMARIS 2/20/2009 11:54:25

ATTACHMENT A

Field Parameter Summary Tables

Attachment A
Surface Water Field Parameters - BH-SF-LF-0004
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 29, 2008						
1.5	--	--	--	--	--	--
4.5	210	7.1	14.7	10.8	--	-36
10.5	203	7.1	14.5	10.9	--	-37
16.5	192	7.0	14.6	10.9	--	-34
22.5	185	7.1	13.7	10.9	--	-32
28.5	180	7.1	13.7	10.9	--	-27
34.5	173	7.3	14.7	10.9	--	-20
40.5	173	7.4	14.8	10.9	--	-8
46.5	173	7.3	15.0	10.8	--	2
52.5	171	7.3	14.8	10.9	--	7
58.5	171	7.3	14.8	11.0	--	4
61.3	--	--	--	--	--	--
October 1, 2008						
1.5	--	--	--	--	--	--
4.5	220	7.2	12.3	11.0	1.6	-20
10.5	210	7.3	12.4	11.0	2.0	-17
16.5	203	7.3	12.4	11.1	2.0	-14
22.5	192	7.4	12.4	11.0	2.3	-10
28.5	188	7.4	12.4	11.1	1.5	-4
34.5	184	7.4	12.5	11.1	1.5	5
40.5	182	7.4	12.5	11.1	1.0	12
46.5	181	7.5	12.9	10.9	3.0	18
52.5	180	7.4	12.6	11.1	3.5	20
58.5	179	7.4	12.6	11.0	3.2	22
61.2	--	--	--	--	--	--
October 3, 2008						
1.7	--	--	--	--	--	--
4.7	208	7.3	12.5	11.1	1.8	-15
10.7	198	7.3	12.5	11.1	1.2	-12
16.7	190	7.4	12.5	11.1	1.1	-7
22.7	183	7.4	12.5	11.1	0.0	-3
28.7	177	7.5	12.5	11.1	0.5	2
34.7	173	7.5	12.6	11.2	0.0	9
40.7	172	7.5	12.7	11.1	0.0	16
46.7	172	7.5	13.0	11.0	0.8	26
52.7	170	7.5	12.7	11.1	0.0	27
58.7	170	7.5	12.7	11.1	4.8	28
61.3	--	--	--	--	--	--

Attachment A
Surface Water Field Parameters - BH-SF-LF-0004
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
October 6, 2008						
2.5	--	--	--	--	--	--
5.5	207	7.3	9.8	11.8	3.3	-2
11.5	195	7.3	9.7	11.8	3.2	3
17.5	186	7.3	9.7	11.8	4.1	7
23.5	181	7.3	9.7	11.9	3.1	13
29.5	175	7.4	9.7	11.8	3.4	22
35.5	172	7.4	9.7	11.8	2.7	30
41.5	170	7.4	9.8	11.8	2.4	43
47.5	170	7.4	9.9	11.8	2.0	47
53.5	169	7.4	9.8	11.8	2.8	49
59.5	168	7.3	9.7	11.8	2.0	52
62	--	--	--	--	--	--
October 8, 2008						
1.5	--	--	--	--	--	--
4.5	243	7.3	8.8	12.1	1.5	2
10.5	232	7.3	8.8	12.2	2.0	7
16.5	226	7.3	8.8	12.2	1.7	11
22.5	218	7.4	8.8	12.2	0.5	17
28.5	213	7.4	8.9	12.2	1.8	26
34.5	212	7.4	8.9	12.2	0.0	37
40.5	212	7.4	9.0	12.2	0.7	52
46.5	212	7.4	9.2	12.2	0.9	56
52.5	211	7.4	9.0	12.2	0.0	59
58.5	210	7.4	9.0	12.2	0.0	61
61	--	--	--	--	--	--
October 10, 2008						
2	--	--	--	--	--	--
5	225	7.4	7.5	12.5	0.0	17
11	217	7.5	7.4	12.5	0.0	28
17	210	7.5	7.4	12.6	0.0	35
23	203	7.5	7.4	12.6	0.0	46
29	198	7.5	7.4	12.6	0.0	63
35	195	7.6	7.4	12.7	0.0	71
41	194	7.6	7.5	12.6	0.0	76
47	193	7.6	7.6	12.5	0.0	77
53	192	7.6	7.5	12.6	0.0	79
59	191	7.6	7.5	12.5	0.0	80
62	--	--	--	--	--	--

Notes:
-- = Not measured

Attachment A
Surface Water Field Parameters - BH-SF-LF-0005
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 29, 2008						
1.8	--	--	--	--	--	--
5	198	7.0	14.0	11.1	0.0	-26
11.3	195	7.0	14.0	11.1	0.0	-27
17.6	194	7.0	14.0	11.1	0.0	-28
23.9	190	7.0	14.0	11.1	0.0	-27
30.2	186	7.1	14.0	11.1	0.0	-25
36.5	185	7.1	14.1	11.1	0.0	-23
42.8	184	7.1	14.1	11.1	0.0	-21
49.1	183	7.1	14.1	11.1	3.0	-19
55.4	182	7.1	14.1	11.1	0.0	-17
Braided Section	176	7.2	14.8	11.1	0.0	-17
October 1, 2008						
1.9	--	--	--	--	--	--
3.3	202	7.2	11.2	11.2	2.5	-3
9.6	204	7.2	11.2	11.2	1.5	-3
15.9	199	7.2	11.3	11.0	0.0	-2
22.2	200	7.2	11.3	11.2	0.0	-1
28.5	196	7.2	11.3	11.2	0.0	0
34.8	194	7.2	11.3	11.2	0.0	5
41.1	191	7.2	11.4	11.2	0.0	8
47.4	190	7.2	11.4	11.2	3.4	10
53.7	190	7.2	11.4	11.1	13.9	13
Braided Section	183	7.3	12.1	11.4	20.0	13
October 3, 2008						
2.2	--	--	--	--	--	--
5	199	7.3	12.0	11.1	4.1	-2
10.7	196	7.3	12.0	11.1	3.9	-2
16.4	195	7.3	12.0	11.1	3.3	-1
22.1	194	7.3	12.0	11.1	2.9	0
27.8	191	7.3	12.0	11.1	2.6	2
33.5	188	7.3	12.0	11.1	2.2	6
39.2	185	7.3	12.0	11.1	2.4	9
44.9	185	7.3	12.0	11.1	2.8	11
50.6	184	7.3	12.0	11.1	3.2	15
56.3	184	7.3	12.0	11.0	3.8	19
Braided Section	184	7.5	12.0	11.1	2.4	46

Attachment A
Surface Water Field Parameters - BH-SF-LF-0005
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
October 6, 2008						
3	--	--	--	--	--	--
5.8	198	7.2	9.5	11.9	2.1	7
10.5	196	7.2	9.5	11.9	1.5	8
16.2	194	7.2	9.5	11.9	1.6	8
21.9	193	7.2	9.5	11.9	2.0	8
27.6	191	7.1	9.5	11.9	2.7	12
33.3	188	7.2	9.5	11.9	2.0	15
39	184	7.2	9.5	11.9	1.8	19
44.7	184	7.2	9.5	11.9	1.1	22
50.4	182	7.2	9.5	11.9	2.9	23
56.1	182	7.2	9.5	11.9	2.0	26
Braided Section	179	7.2	9.8	11.9	1.5	33
October 8, 2008						
2	--	--	--	--	--	--
4.8	233	7.1	8.2	12.3	1.7	14
10.5	230	7.1	8.2	12.3	1.8	15
16.2	228	7.1	8.2	12.3	1.8	17
21.9	227	7.1	8.2	12.3	2.4	19
27.8	225	7.1	8.2	12.3	1.3	23
33.5	223	7.2	8.2	12.3	1.6	24
39.2	221	7.1	8.2	12.3	3.0	28
44.9	221	7.1	8.2	12.3	0.9	32
50.6	221	7.1	8.2	12.2	3.0	34
56.3	222	7.1	8.2	12.2	0.5	37
Braided Section	215	7.3	8.6	12.3	1.2	96
October 10, 2008						
2	--	--	--	--	--	--
4.8	213	7.3	6.8	12.5	0.0	34
10.5	210	7.3	6.8	12.5	0.0	35
16.2	209	7.3	6.8	12.5	0.0	38
21.9	208	7.3	6.8	12.5	0.1	40
27.6	206	7.3	6.8	12.5	0.0	46
33.3	204	7.3	6.8	12.5	0.0	49
39	201	7.3	6.8	12.5	0.0	52
44.7	201	7.3	6.8	12.5	0.0	54
50.4	200	7.3	6.8	12.5	0.0	56
56.1	200	7.3	6.8	12.4	0.0	60
Braided Section	198	7.1	7.1	12.7	0.0	61

Notes:
-- = Not measured

Attachment A
Surface Water Field Parameters - BH-SF-LF-0006
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 28, 2008						
2	--	--	--	--	--	--
4.8	654	6.8	14.0	10.9	--	39
10.4	698	7.0	13.8	10.8	--	31
16	332	7.0	13.6	10.9	--	21
21.6	324	7.0	13.5	11.0	--	6
27.2	263	7.0	13.5	11.1	--	-5
32.8	239	6.9	13.5	11.1	--	-8
38.4	231	6.9	13.4	11.1	--	-8
44	226	6.9	13.4	11.1	--	-7
49.6	224	6.9	13.3	11.1	--	-5
55.2	223	6.9	13.3	11.0	--	0
58	--	--	--	--	--	--
October 1, 2008						
59.8	--	--	--	--	--	--
57.4	512	6.5	10.8	11.4	12.1	110
51.8	524	6.5	10.7	11.4	15.8	81
46.2	427	6.6	10.7	11.3	8.8	62
40.6	332	6.5	10.6	11.3	7.2	50
35	241	6.6	10.6	11.3	9.1	48
29.4	222	6.6	10.7	11.3	1.8	43
23.8	218	6.6	10.7	11.2	3.8	47
18.2	216	6.7	10.8	11.1	7.2	54
12.6	214	6.7	11.0	11.1	11.3	57
7	215	6.7	11.0	11.0	11.7	61
4.2	--	--	--	--	--	--
October 3, 2008						
2	--	--	--	--	--	--
4.8	542	7.0	12.3	10.9	14.5	69
10.4	546	6.8	12.4	10.8	0.8	62
16	475	6.7	12.1	10.9	1.1	57
21.6	410	6.9	12.0	10.9	0.8	52
27.2	250	7.0	11.9	11.1	1.2	41
32.8	231	7.1	11.9	11.1	1.6	43
38.4	225	7.0	11.9	11.1	0.6	53
44	223	7.0	11.9	11.1	1.6	71
49.6	221	7.0	11.9	11.2	0.6	89
55.2	221	7.0	11.9	11.3	22.3	181
57.8	--	--	--	--	--	--

Attachment A
Surface Water Field Parameters - BH-SF-LF-0006
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
October 6, 2008						
3	--	--	--	--	--	--
5.8	631	6.7	10.0	11.7	3.7	131
11.3	700	6.7	10.1	11.6	2.7	108
16.8	536	6.6	10.0	11.6	1.9	92
22.3	389	6.6	9.4	11.8	1.6	75
27.8	257	6.7	9.3	11.8	1.6	65
33.3	233	6.6	9.3	11.9	1.5	58
38.8	226	7.0	9.3	11.9	1.7	53
44.3	224	6.5	9.2	12.0	1.9	50
49.8	222	6.4	9.2	11.9	1.8	48
55.3	221	6.4	9.2	11.9	2.2	46
58	--	--	--	--	--	--
October 8, 2008						
2	--	--	--	--	--	--
4.8	562	6.6	8.6	12.0	3.0	73
10.4	557	6.0	8.4	12.0	4.8	67
16	457	6.7	8.2	12.0	4.9	59
21.6	342	6.9	7.9	12.2	3.9	52
27.2	282	6.8	7.8	12.3	4.5	51
32.8	271	6.8	7.8	12.3	5.1	51
38.4	263	6.7	7.7	12.3	4.1	55
43	259	6.7	7.7	12.4	15.0	61
48.6	258	6.6	7.7	12.4	16.3	92
54.2	257	6.5	7.8	12.6	3.6	79
58	--	--	--	--	--	--
October 10, 2008						
2.1	--	--	--	--	--	--
4.9	466	6.9	7.3	12.3	0.0	72
10.5	468	7.0	7.0	12.2	0.0	67
16.1	428	6.9	6.9	12.4	0.0	65
21.7	287	7.1	6.6	12.5	0.0	59
27.3	258	7.1	6.5	12.5	0.0	57
32.9	243	7.1	6.5	12.5	0.0	58
38.5	236	7.1	6.5	12.5	0.0	59
44.1	233	7.0	6.5	12.5	0.0	60
50.7	230	7.0	6.5	12.5	0.0	62
56.3	231	6.9	6.5	12.4	0.0	63
57.8	--	--	--	--	--	--

Notes:
-- = Not measured

Attachment A
Surface Water Field Parameters - BH-BC-0001
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 29, 2008						
1.3	--	--	--	--	--	--
2	1833	6.9	18.7	10.3	108	133
3	1874	6.9	18.7	10.3	91.6	131
4	2038	7.0	18.7	10.3	78.0	130
5	2109	7.1	18.8	10.3	78.0	130
6	2119	7.0	18.7	10.3	--	130
7	2133	7.1	18.7	10.3	--	126
7.2	--	--	--	--	--	--
October 1, 2008						
0	--	--	--	--	--	--
0.5	1858	7.1	17.1	10.2	18.6	150
1.5	1864	7.1	17.0	10.3	28.0	146
2.5	1875	7.0	17.0	10.2	28.7	142
3.5	1884	7.0	17.0	10.1	65.5	143
4.5	1891	7.0	17.0	10.1	36.1	137
5.5	1895	7.1	17.0	10.0	8.2	137
6	--	--		--	--	--
October 3, 2008						
0	--	--	--	--	--	--
0.5	1685	7.3	16.0	11.2	15.6	154
1.5	1721	7.3	16.0	11.4	107	154
2.5	1741	7.3	16.0	11.4	15.6	153
3.5	1749	7.3	16.0	11.4	76.9	152
4.5	1752	7.3	16.0	11.5	10.0	151
5.5	1759	7.3	16.0	11.4	7.8	151
6	--	--		--	--	--
October 6, 2008						
0	--	--	--	--	--	--
0.5	2013	7.1	14.7	10.7	1.1	156
1.5	2018	7.1	14.7	11.4	1.0	148
2.5	2021	7.1	14.7	11.4	1.1	151
3.5	1993	7.1	14.7	11.5	0.5	146
4.5	1958	7.1	14.7	11.5	0.0	150
5.5	1738	7.1	14.6	11.6	1.0	150
6	--	--		--	--	--

Attachment A
Surface Water Field Parameters - BH-BC-0001
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
October 8, 2008						
0	--	--	--	--	--	--
0.5	1953	7.1	14.1	11.0	1.1	151
1.5	1963	7.1	14.1	11.5	1.2	153
2.5	1961	7.1	14.1	11.8	0.9	152
3.5	1948	7.1	14.1	12.0	0.5	151
4.5	1937	7.1	14.1	12.1	0.0	151
5.5	1900	7.1	14.0	12.0	0.0	152
6	--	--		--	--	--
October 10, 2008						
0	--	--	--	--	--	--
0.5	1867	7.23	12.5	12.6	0.0	155
1.5	1867	7.23	12.5	12.7	0.0	158
2.5	1860	7.23	12.5	12.6	0.0	158
3.5	1851	7.21	12.5	12.6	0.0	159
4.5	1831	7.22	12.5	12.6	0.0	159
5.5	1835	7.18	12.5	12.5	0.0	159
6	--	--		--	--	--

Notes:
-- = Not measured

Attachment A
Surface Water Field Parameters - Bunker Creek Upgradient of the Relocated CTP Outfall
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 28, 2008						
2.5	--	--	--	--	--	--
3	1,828	6.7	18.8	10.3	--	188
4	1,838	6.7	18.8	10.4	--	186
5	1,841	6.7	18.8	10.6	--	183
6	1,841	6.6	18.7	10.7	--	181
October 1, 2008						
1.9	--	--	--	--	--	--
2	858	6.5	16.5	11.3	11.3	177
3	857	6.5	16.4	11.6	16.3	177
4	858	6.5	16.2	11.6	6.2	176
5	856	6.5	16.1	11.8	10.9	176
October 3, 2008						
4.2	--	--	--	--	--	--
5	808	6.5	15.2	11.0	0.6	182
6	803	6.5	15.2	11.4	0.7	183
7	804	6.5	15.1	11.5	0.7	183
7.8	--					
October 6, 2008						
LEW	668	6.6	12.5	11.9	7.7	179
MID	666	6.6	12.4	12.0	21.5	179
REW	666	6.6	12.4	12.1	8.2	180
October 8, 2008						
LEW	648	6.5	10.1	12.4	6.3	189
MID	650	6.5	10.2	12.3	1.3	188
REW	649	6.6	10.4	12.4	1.5	188
October 10, 2008						
2.3	--	--	--	--	--	--
3	593	6.7	8.3	12.7	--	200
4	594	6.7	8.7	12.4	--	199
5	594	6.7	8.9	12.5	2.8	198
6	598	6.7	9.0	12.6	--	197

Notes:
-- = Not measured

Attachment A
Surface Water Field Parameters - BH-BC-0006
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 29, 2008						
3.1	--	--	--	--	--	--
4	1320	6.2	15.7	11.4	--	209
5	1,318	6.2	15.6	11.4	--	208
6	1,312	6.2	15.6	11.4	--	208
7	1,312	6.2	15.5	11.6	--	209
8	1,310	6.2	15.5	11.6	4.0	208
9	1311	6.2	15.5	11.7	--	208
9.3	--	--	--	--	--	--
October 1, 2008						
3.4	--	--	--	--	--	--
4	815	6.3	15.1	12.8	19.8	206
5	810	6.3	15.2	12.8	9.7	201
6	811	6.4	15.1	13.2	9.4	202
7	812	6.4	15.0	13.5	6.5	202
8	811	6.4	15.0	13.7	3.3	202
9	812	6.4	14.9	13.6	7.9	202
9.7	--	--	--	--	--	--
October 3, 2008						
2	784	--	--	--	--	--
3	781	6.4	14.2	13.5	4.1	197
4	779	6.4	14.2	13.6	1.2	198
5	780	6.4	14.2	13.7	2.5	199
6	690	6.4	14.2	13.8	0.2	199
7	781	6.4	14.2	14.0	32.4	200
8	780	6.4	14.2	13.8	6.2	201
8.3	--	6.4	14.2	13.4	5.8	202
October 6, 2008						
LEW	654	6.6	12.9	14.0	16.5	205
5	659	6.6	12.9	14.1	15.0	206
7	659	6.6	12.8	14.2	0.5	210
9	657	6.6	13.0	14.3	76.2	205
REW	658	6.6	13.1	14.3	32.9	205
October 8, 2008						
LEW	644	6.5	11.7	13.2	17.2	228
5	643	6.5	11.5	13.2	0.9	228
7	646	6.5	11.3	13.7	2.5	225
REW	650	6.5	11.1	13.6	11.4	226

Attachment A
Surface Water Field Parameters - BH-BC-0006
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
October 10, 2008						
2.3	--	6.5	9.5	13.7	76.9	201
3	600	6.5	9.7	13.8	92.4	199
4	604	6.5	9.8	13.9	28.2	202
5	610	6.5	9.8	14.0	14.9	202
6	609	6.5	9.9	14.0	16.5	202
7	611	6.5	10.2	13.8	1.6	203
8	612	--	--	--	--	--
8.7	--	--	--	--	--	--

Notes:
-- = Not measured

Attachment A
Surface Water Field Parameters - Bunker Creek Downgradient of Magnet Gulch
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 28, 2008						
Not Measured	--	--	--	--	--	--
October 1, 2008						
Not Measured	--	--	--	--	--	--
October 3, 2008						
4.2	--	--	--	--	--	--
5	704	5.8	11.6	9.6	2.7	225
6	705	5.8	11.4	9.7	1.8	225
7	706	5.8	11.4	9.5	2.1	225
8	713	5.8	11.4	9.4	1.7	225
9	811	5.8	12.0	9.1	2.8	225
10.1	--	--	--	--	--	--
October 6, 2008						
3.1	664	6.0	10.9	12.0	14.4	221
5	662	6.0	10.6	11.5	16.8	224
7	670	6.0	10.6	10.9	16.3	225
9.5	682	6.0	11.0	10.4	21.0	228
October 8, 2008						
LEW	640	6.1	9.5	11.6	2.7	258
MID	645	6.0	9.7	11.2	0.6	257
REW	653	6.0	9.8	10.4	4.2	253
October 10, 2008						
3	--	--	--	--	--	--
4	662	--	--	--	--	--
5	664	5.9	9.0	10.5	13.1	220
6	665	5.9	8.9	10.5	16.5	221
7	669	5.8	8.9	10.3	3.6	221
8	668	5.9	9.0	10.2	0.0	221
9	666	5.9	9.4	10.2	0.0	221
9.3	--	5.9	9.6	10.0	31.2	220

Notes:
-- = Not measured

Attachment A
Surface Water Field Parameters - Bunker Creek Upgradient of Magnet Gulch
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 28, 2008						
Not Measured	--	--	--	--	--	--
October 1, 2008						
Not Measured	--	--	--	--	--	--
October 3, 2008						
3.5	--	--	--	--	--	--
4	2,079	6.0	17.9	10.2	19.5	196
5	2,085	6.1	17.9	10.6	2.1	195
6	2,092	6.1	17.7	10.8	1.1	195
7	2,087	6.2	17.8	10.6	0.3	194
8	2,088	6.2	18.0	10.5	0.3	193
8.6	--	--	--	--	--	--
October 6, 2008						
LEW	1814	6.2	13.9	10.8	3.6	226
MID	1850	6.2	14.0	11.1	2.5	222
REW	1855	6.3	14.4	11.2	2.1	218
October 8, 2008						
Grab	1814	6.3	10.5	11.7	1.5	244
--	--	6.3	10.5	11.7	1.5	244
October 10, 2008						
Grab	1889	6.0	9.1	12.0	0.0	218
--	1889	6.0	9.1	12.0	0.0	218

Notes:
-- = Not measured

Attachment A
Surface Water Field Parameters - BH-BC-0005
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 29, 2008						
0	--	--	--	--	--	--
1.1	1,619	6.7	20.4	9.8	69.3	195
2.1	1,592	6.7	20.3	10.0	--	193
3.1	1,589	6.7	20.3	10.0	--	191
4.1	1,588	6.8	20.3	10.0	--	188
5.1	1,568	6.8	20.3	10.0	--	187
5.8	--	--	--	--	--	--
October 1, 2008						
Dry	--	--	--	--	--	--
October 3, 2008						
Dry	--	--	--	--	--	--
October 6, 2008						
DRY	--	--	--	--	--	--
October 8, 2008						
Dry	--	--	--	--	--	--
October 10, 2008						
Dry	--	--	--	--	--	--

Notes:
-- = Not measured

Attachment A
Surface Water Field Parameters - BH-BC-0004
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Distance from Left Edge of Water (ft)	Specific Conductivity (uS/cm)	pH	Temperature (ºC)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation Reduction Potential (mV)
September 29, 2008						
Grab	507	7.26	17.6	11.5	--	178
October 1, 2008						
Dry	--	--	--	--	--	--
October 3, 2008						
Dry	--	--	--	--	--	--
October 6, 2008						
DRY	--	--	--	--	--	--
October 8, 2008						
Dry	--	--	--	--	--	--
October 10, 2008						
Dry	--	--	--	--	--	--

Notes:

-- = Not measured

Attachment A
Groundwater Field Parameters
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Location	Sample Date	Depth to Water (ft btoc)	pH	Conductivity (uS/cm)	Temperature (ºC)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)
BH-SF-E-0301-U	9/24/2008	13.5	4.9	300	13.0	0.42	188
	10/8/2008	14.5	4.9	298	12.7	0.37	225
BH-SF-E-0320-U	9/24/2008	14.2	5.4	713	13.3	0.43	195
	10/8/2008	15.0	5.4	661	12.7	0.27	212
BH-SF-E-0402-U	9/25/2008	12.2	5.5	852	11.1	0.39	227
	10/8/2008	12.5	5.5	812	10.8	0.25	157
BH-SF-E-0403-U	10/8/2008	12.4	5.6	716	10.4	0.29	149
BH-SF-E-0407-U	9/24/2008	69.4	5.6	657	10.3	2.0	223
	10/9/2008	69.7	5.5	602	10.7	0.70	152
BH-SF-E-0410-U	9/24/2008	11.7	4.8	1054	12.3	0.91	211
	10/8/2008	12.1	4.7	1067	12.5	1.1	222
BH-SF-E-0423-U	9/25/2008	14.3	5.6	1439	10.3	0.25	187
	10/8/2008	14.3	5.6	1395	10.1	0.19	155
BH-SF-E-0425-U	9/25/2008	15.3	5.5	1193	10.6	0.34	158
	10/9/2008	15.5	5.6	1247	9.4	0.78	156
BH-SF-E-0427-U	9/24/2008	5.6	5.6	1149	10.5	0.33	175
	10/8/2008	5.9	5.5	1163	10.1	0.29	173
BH-SF-E-0429-U	9/25/2008	14.1	5.6	1164	11.6	0.36	175
	10/8/2008	14.3	5.7	1216	11.0	0.31	154
BH-SF-E-0503-U	9/25/2008	13.3	5.4	1570	12.8	0.33	167
	10/9/2008	13.4	5.4	1600	11.1	0.53	205
BH-SF-E-0504-U	9/25/2008	13.0	5.3	1570	12.3	0.20	150
	10/9/2008	13.1	5.3	1580	10.9	0.25	190
BH-SF-E-PZ-12	9/22/2008	11.5	5.8	482.9	14.1	0.31	48
	10/9/2008	12.7	5.8	471.1	13.7	0.62	35
BH-SF-E-PZ-13	9/24/2008	26.2	6.1	980.8	12.1	0.69	-37
	10/9/2008	26.3	6.2	1016	12.1	0.69	-52
BH-SF-E-PZ-14	9/22/2008	13.7	5.4	1676	15.0	0.36	157
	10/9/2008	14.6	5.4	1487	14.5	0.6	167
BH-SF-E-PZ-15	10/1/2008	28.9	6.1	494.5	13.0	10	383
	10/9/2008	29.0	--	--	--	--	--
BH-SF-E-PZ-16	9/23/2008	10.4	4.7	1528	13.3	0.44	219
	10/9/2008	11.0	5.0	1288	13.4	2.3	280
BH-SF-E-PZ-17	9/22/2008	9.5	5.4	829.8	12.7	0.28	185
	10/9/2008	9.8	5.3	898.1	12.9	0.37	186
BH-SF-E-PZ-18	9/23/2008	9.3	5.5	878.5	12.0	2.4	215
	10/9/2008	9.5	5.6	877.9	11.7	1.2	204
BH-SF-E-PZ-20	9/22/2008	9.4	5.7	1609	13.4	0.31	36
	10/9/2008	9.6	5.7	1590	13.0	3.2	40
BH-SF-E-PZ-21	9/22/2008	15.7	5.2	2037	14.1	0.76	194
	10/9/2008	16.0	5.3	1850	14.0	3.5	234

Attachment A
Groundwater Field Parameters
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Location	Sample Date	Depth to Water (ft btoc)	pH	Conductivity (uS/cm)	Temperature (ºC)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)
BH-SF-E-PZ-22	9/22/2008	13.6	5.9	1715	12.1	0.22	-20
	10/9/2008	13.8	6.2	1560	12.3	3.2	-53
BH-SF-E-PZ-23	9/23/2008	13.6	5.7	1056	10.8	2.3	36
	10/9/2008	13.7	5.6	932	8.9	4.8	26
BH-SF-E-PZ-24	9/23/2008	13.6	5.7	1499	12.9	3.9	28
	10/9/2008	13.7	5.7	1350	11.0	5.1	16
BH-SF-E-PZ-25	9/23/2008	15.5	5.8	1232	13.0	2.2	56
	10/9/2008	15.7	5.7	1130	10.5	4.5	61
BH-SF-E-PZ-26	9/22/2008	15.7	5.6	1365	10.5	0.29	182
	10/9/2008	15.8	5.5	1220	10.1	4.0	173

Notes:

-- = Not measured

Pre-Bunker Creek Study groundwater monitoring performed between September 22 and 25, 2008.

Bunker Creek Study groundwater monitoring performed on October 8 and 9, 2008.

ATTACHMENT B

Water Quality Summary Table

Attachment B
Water Quality Summary Table - Dissolved Metals
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Parameter:			ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM Run1	CALCIUM Run 2	CHROMIUM	COBALT	COPPER	IRON	LEAD	MAGNESIUM Run 1	MAGNESIUM Run 2	MANGANESE	NICKEL	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
Units:			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
STATION	QC Type	Sample Date																								
Surface Water																										
BH-SF-LF-0004	N1	09/29/08	200	5.2	0.67 J	56	1.0 U	7.9	20,700	---	2.0 U	0.42 UJ	0.81 J	165	6.1	7,120	---	211	1.6	1,200	5.0 U	1.0 U	4,590	1.0 U	0.38 J	1,160
	N1	10/01/08	200 U	5.1	0.60 UJ	58	1.0 U	8.0	18,200	21,300	0.056 UJ	0.45 UJ	0.79 J	165	6.0	6,250	6,830	236	1.8	1,140 UJ	5.0 U	1.0 U	4,400 J	1.0 U	0.29 J	1,250
	N1	10/03/08	31 J	4.8	0.74 UJ	52	1.0 U	7.5	16,600	20,200	0.089 UJ	0.43 UJ	0.87 J	161	9.7	5,630	6,890	252	1.6	1,160 UJ	5.0 U	1.0 U	3,370 UJ	1.0 U	0.44 J	1,180
	N1	10/06/08	52 UJ	4.6	0.68 UJ	52	1.0 U	6.4	16,200	18,700	0.070 UJ	0.50 UJ	0.63 J	149	7.5	5,440	6,390	318	1.5	1,070 UJ	5.0 U	1.0 U	3,570 UJ	0.038 UJ	0.57 J	1,070
	N1	10/08/08	200 U	5.6	0.78 UJ	58	1.0 U	7.7	19,700	21,100	0.064 UJ	0.47 UJ	0.67 J	123	3.2	8,520	9,230	246	1.7	1,370 J	5.0 U	1.0 U	4,500 J	1.0 U	0.84 J	1,210 J
	N1	10/10/08	200 U	5.3	0.83 J	55	1.0 U	7.3	18,700	20,500	0.11 UJ	0.44 UJ	0.69 J	133	3.2	7,600	8,310	221	1.6	1,260 UJ	5.0 U	1.0 U	4,270 J	1.0 U	0.89 J	1,180
BH-SF-LF-0005	N1	09/29/08	200	5.2	0.83 J	55	1.0 U	8.0	20,600	---	0.054 UJ	0.51 UJ	0.75 J	202	6.1	7,090	---	262	1.8	1,200	5.0 U	1.0 U	4,510	1.0 U	2.1 J	1,240
	N1	10/01/08	200 U	5.1	0.67 UJ	57	1.0 U	8.4	18,400	21,500	0.054 J	0.54 UJ	0.81 J	209	5.4	6,240	6,870	291	1.9	1,130 UJ	5.0 U	1.0 U	4,380 J	1.0 U	0.38 J	1,350
	N1	10/03/08	200 U	5.2	0.68 UJ	56	1.0 U	7.6	17,500	20,700	0.070 UJ	0.44 UJ	0.82 J	140	4.3	5,870	7,110	230	1.6	1,190 UJ	5.0 U	1.0 U	3,130 UJ	1.0 U	0.31 J	1,190
	N1	10/06/08	200 U	4.8	0.64 UJ	53	1.0 U	7.0	16,700	19,900	0.078 UJ	0.43 UJ	0.78 J	214	3.3	5,530	6,450	220	1.7	1,130 UJ	5.0 U	1.0 U	3,560 UJ	1.0 U	0.54 J	1,140
	N1	10/08/08	200 U	5.6	0.77 UJ	58	1.0 U	8.1	20,600	21,800	0.072 UJ	0.52 UJ	0.80 J	160	2.3	8,850	9,780	262	1.9	1,430 J	5.0 U	1.0 U	4,530 J	1.0 U	0.66 J	1,260 J
	N1	10/10/08	200 U	5.2	0.78 J	55	1.0 U	7.7	19,100	22,500	0.087 UJ	0.53 UJ	0.64 J	191	2.8	7,730	9,180	276	1.9	1,390 UJ	5.0 U	1.0 U	4,540 J	1.0 U	0.77 J	1,270
BH-SF-LF-0006	N1	09/29/08	49	4.9	0.63 J	54	1.0 U	10	39,300	---	2.0 U	0.65 UJ	0.70 J	176	6.5	12,000	---	679	2.1	1,470	5.0 U	1.0 U	4,510	0.043 UJ	5.0 U	1,280
	N1	10/01/08	200 U	4.9	0.66 UJ	56	1.0 U	11	28,100	31,400	0.046 J	0.66 UJ	0.74 J	168	5.1	8,540	8,880	486	2.2	1,230 UJ	5.0 U	1.0 U	4,230 J	0.041 UJ	0.47 J	1,430
	N1	10/03/08	55 UJ	5.0	0.68 UJ	53	1.0 U	10	33,700	39,100	0.079 UJ	0.61 UJ	0.80 J	156	4.2	9,120	10,900	433	2.1	1,300 UJ	5.0 U	1.0 U	3,420 UJ	0.064 UJ	0.26 J	1,320
	N1	10/06/08	38 UJ	4.6	0.76 UJ	52	1.0 U	9.4	30,000	36,700	0.051 J	0.58 UJ	0.77 J	153	3.1	8,730	10,700	417	2.0	1,360 UJ	5.0 U	1.0 U	3,910 UJ	0.049 UJ	0.29 J	1,260
	N1	10/08/08	200 U	5.3	0.85 UJ	57	1.0 U	10	34,600	37,600	0.13 UJ	0.70 UJ	0.76 J	148	3.2	12,400	13,800	696	2.3	1,640 J	5.0 U	1.0 U	4,540 J	0.057 UJ	0.95 J	1,340 J
	N1	10/10/08	200 U	5.0	0.85 J	54	1.0 U	10	35,200	39,800	0.11 UJ	0.79 UJ	0.77 J	177	3.8	12,400	13,700	1,240	2.4	1,590 UJ	5.0 U	1.0 U	4,460 J	0.052 UJ	0.90 J	1,350
BH-BC-0001	N1	09/29/08	200	0.60 UJ	0.78 J	19	1.0 U	6.8	457,000	---	0.064 UJ	2.2	1.0 J	37	0.79 UJ	120,000	---	11,200	5.6	6,670	0.34 J	1.0 U	2,190	0.61 UJ	1.7 J	373
	N1	10/01/08	49 J	0.65 UJ	1.3	18	1.0 U	7.6	372,000	447,000	0.23 UJ	2.5	1.0 J	47 UJ	0.73 UJ	89,700	97,900	7,300	6.0	5,530	0.43 J	1.0 U	2,150 J	0.57 UJ	0.58 J	651
	FD1	10/01/08	200 U	0.53 UJ	1.3	18	1.0 U	7.4	381,000	424,000	0.20 UJ	2.6	1.0 J	36 J	0.71 UJ	91,100	92,800	7,370	6.2	5,210	0.53 J	1.0 U	2,050 J	0.58 UJ	0.34 J	650
	N1	10/03/08	44 J	0.52 UJ	1.1	20	1.0 U	7.2	347,000	420,000	0.31 UJ	2.0	1.1 J	29 UJ	0.40 UJ	71,700	87,400	2,910	4.7	4,830 UJ	0.71 UJ	1.0 U	1,860 UJ	0.66 UJ	0.49 J	469
	FD1	10/03/08	200 U	0.31 J	1.1	20	1.0 U	7.3	339,000	410,000	0.33 UJ	2.0	0.99 J	51 UJ	0.51 UJ	68,500	86,600	2,870	4.3	4,750 UJ	0.52 UJ	1.0 U	1,630 UJ	0.66 UJ	0.47 J	463
	N1	10/06/08	40 UJ	0.25 J	0.93 UJ	19	1.0 U	5.8	364,000	439,000	0.23 UJ	1.7	1.1 J	36 UJ	0.32 UJ	89,100	109,000	4,290	5.0	6,350	0.52 UJ	1.0 U	1,460 UJ	0.73 UJ	0.57 J	330
	N1	10/08/08	200 U	0.40 UJ	0.96 UJ	20	1.0 U	7.8	385,000	414,000	0.18 UJ	3.4	1.1 J	12 UJ	0.39 UJ	102,000	111,000	12,000	6.8	6,060	0.33 J	1.0 U	2,240 J	0.73 UJ	0.70 J	426 J
	N1	10/10/08	200 U	0.39 UJ	1.1	22	1.0 U	12	364,000	399,000	0.21 UJ	6.0	0.98 J	14 J	0.43 UJ	109,000	118,000	23,600	8.5	6,170	0.56 J	1.0 U	2,090 J	0.76 UJ	0.35 J	692
BC-UP-DISCHARGE-PIPE (upgradient of the relocated CTP outfall)	N1	09/29/08	67	1.2 UJ	2.2	20	1.0 U	17	373,000	---	0.30 UJ	0.88 UJ	2.2	100	0.61 UJ	92,800	---	6,620	6.6	5,510	1.9 J	1.0 U	2,450	0.50 UJ	0.74 J	1,030
	N1	10/01/08	339	4.0	9.3	9.0 J	0.089 J	34	150,000	170,000	0.90 UJ	0.27 UJ	2.2	100 U	0.28 UJ	12,600	13,800	1,230	12	2,590 UJ	7.1	1.0 U	3,390 J	0.23 UJ	1.9 J	3,900
	N1	10/03/08	439	4.4	12	7.7 UJ	0.073 J	41	143,000	162,000	0.97 UJ	0.21 UJ	2.2	100 U	0.21 UJ	10,300	12,100	808	11	2,620 UJ	8.1	1.0 U	1,720 UJ	0.20 UJ	2.6 J	4,400
	N1	10/06/08	309	4.6	12	8.0 UJ	1.0 U	40	117,000	142,000	0.97 UJ	0.18 UJ	2.1	100 U	0.12 UJ	7,870	9,570	439	9.9	2,420 UJ	7.0	1.0 U	2,140 UJ	0.15 UJ	2.9 J	4,150
	N1	10/08/08	331	5.1	12	7.8 J	1.0 U	47	128,000	141,000	1.1 UJ	0.30 UJ	2.0 J	100 U	0.18 UJ	7,560	8,560	406	11	2,210 J	8.6	1.0 U	3,670 J	0.15 UJ	3.2 J	5,050 J
	FD1	10/08/08	321	4.8	12	7.5 J	1.0 U	47	127,000	138,000	1.1 UJ	0.25 UJ	2.0	100 U	0.17 UJ	7,560	8,140	408	11	2,190 J	8.4	1.0 U	3,730 J	0.14 UJ	3.0 J	5,060 J
	N1	10/10/08	336	5.0	13	7.0 UJ	1.0 U	48	127,000	140,000	1.2 UJ	0.24 UJ	2.0 J	100 U	0.15 UJ	7,460	8,200	350	11	2,140 UJ	8.5	1.0 U	3,460 J	0.14 UJ	2.9 J	6,100
BH-BC-0006	N1	09/29/08	360	3.0	6.8	22	1.0 U	46	269,000	---	0.79 UJ	0.89 UJ	4.6	100	0.30 UJ	49,800	---	3,400	11	4,040	5.0	1.0 U	3,140	0.35 UJ	2.6 J	3,950
	N1	10/01/08	694	5.4	14	18	1.0 U	76	144,000	164,000	1.1 UJ	0.57 UJ	5.7	100 U	0.12 UJ	9,240	9,580	915	16	2,320 UJ	9.4	1.0 U	3,450 J	0.23 UJ	4.5 J	6,820
	N1	10/03/08	674	5.8	15	16	0.072 J	75	132,000	154,000	1.2 UJ	0.47 UJ	5.7	100 U	0.082 UJ	8,000	9,620	676	15	2,480 UJ	11	1.0 U	1,410 UJ	0.20 UJ	5.2	6,700
	N1	10/06/08	552	5.5	15	17	0.075 J	70	114,000	142,000	1.1 UJ	0.44 UJ	5.4	7.3 UJ	0.12 UJ	6,790	8,680	434	13	2,450 UJ	9.8	0.026 UJ	2,160 UJ	0.17 UJ	5.0	6,000
	N1	10/08/08	585	6.2	14	17	0.080 J	82	129,000	140,000	1.1 UJ	0.47 UJ	5.7	100 U	0.10 UJ	6,780	7,470	405	14	2,140 J	9.6	1.0 U	3,610 J	0.17 UJ	5.0 J	6,820 J
	N1	10/10/08	607	6.0	15	17	0.081 J	79	128,000	136,000	1.3 UJ	0.50 UJ	5.8	100 U	0.14 UJ	6,790	7,150	394	14	2,090 UJ	10	1.0 U	3,420 J	0.17 UJ	5.4	7,580
BC-ABOVE MAGNET	N1	10/03/08	157 J	0.26 J	0.44 UJ	15	1.0 U	6.3	392,000	451,000	0.090 UJ	1.3	1.8 J	15 UJ	0.45 UJ	94,700	112,000	4,020	8.4	7,000	5.0 U	1.0 U	2,380 UJ	0.36 UJ	0.21 J	892
	N1	10/06/08	142 UJ	0.15 J	0.35 UJ	12	1.0 U	4.9	341,000	412,000	0.10 UJ	1.1	1.8 J	100 U	0.49 UJ	82,400	102,000	3,090	7.6	5,990	5.0 U	1.0 U	1,020 UJ	0.28 UJ	0.42 J	776
	N1	10/08/08	72 UJ	0.23 J	0.45 UJ	12	1.0 U	4.9	376,000	405,000	0.043 J	0.81 UJ	1.5 J	100 U	0.48 UJ	90,500	98,500	2,290	8.0	5,240	5.0 U	0.019 UJ	2,620 J	0.27 UJ	0.24 J	807 J
	N1	10/10/08	79 UJ	0.26 J	0.51 J	13	1.0 U	4.1	382,000	406,000	0.086 UJ	0.76 UJ	1.7 J	100 U	0.39 UJ	94,300	100,000	1,710	8.6	4,990 UJ	5.0 U	0.020 UJ	2,510 J	0.27 UJ	5.0 U	756
	FD1	10/10/08	76 UJ	0.24 J	0.51 J	13	1.0 U	4.0	376,000	494,000	0.11 UJ	0.82 UJ	1.7 J	100 U	0.41 UJ	92,800	131,000	1,720	9.3	5,740	5.0 U	0.019 UJ	2,770 J	0.27 UJ	0.27 J	750
BH-BC-0005	N1	09/29/08	200	0.72 UJ	0.28 J	16	1.0 U	2.0	307,000	---	2.0 U	0.64 UJ	0.86 J	100	0.52 UJ	73,300	---	3,190	3.4	4,900	5.0 U	1.0 U	3,270	0.48 UJ	5.0 U	61
BH-BC-0004	N1	09/29/08	200	3.0	0.25 J	44	1.0 U	1.6	84,500	---	0.054 UJ	0.18 UJ	0.63 J	100	1.8	11,800	---	456	1.5	1,340	5.0 U	1.0 U	4,600	0.080 UJ	0.74 J	237
Magnet Gulch	N1	10/03/08	1,770	6.8	18	41	0.14 UJ	128	132,000	163,000	2.9	2.0	24	100 U	3.0	6,100	7,720	654	18	2,350 UJ	13	1.0 U	789 UJ	0.21 UJ	8.6	8,950
	N1	10/06/08	1,600	6.5	18	40	0.14 UJ	118	124,000	150,000	2.7	1.8	22	6.4 UJ	2.5	5,830	7,330	579	17	2,380 UJ	12	1.0 U	1,120 UJ	0.19 UJ	8.2	8,560
	N1	10/08/08	1,540	6.9	17	40	0.15 J	127	133,000	144,000	2.8	1.9	23	100 U	2.5	6,040	6,560	600	18	2,130 J	12	1.0 U	3,630 J	0.20 UJ	8.8	8,960 J
	N1	10/10/08	1,670	7.0	18	40	0.13 UJ	126	134,000	161,000	2.9	2.0	25	100 U	2.7	6,270	7,340	609	19	2,350 UJ	13	1.0 U	3,760 J	0.21 UJ	9.1	10,200
Ground Water																										
BH-SF-E-0301-U	N1	10/08/08	34 J	0.22 J	0.10 J	19	1.0 U	38	16,300	18,300	0.057 UJ	4.6	0.49 J	100 U	39	12,500	14,300	1,590	11	2,050 J	5.0 U	1.0 U	2,830 UJ	0.038 UJ	0.77 J	9,070
BH-SF-E-0320-U	N1	10/08/08	53 J	0.25 J	0.16 UJ	15	1.0 U	50	67,800	73,100	0.057 UJ	0.30 UJ	1.9 J	4.2 J	5.0	25,500	27,500	598	17	3,020 J	5.0 U	1.0 U	3,280 UJ	0.48 UJ	0.39 J	11,600
BH-SF-E-0402-U	N1	10/08/08	3,360	5.7	34	9.4 J	0.31 J	166	67,100	72,300	0.14 UJ	20	33	6,090	0.047 UJ	30,300	33,200	18,500	43	5,250 J	5.0 U	1.0 U	2,450 UJ	0.71 UJ	15	27,700
BH-SF-E-0403-U	N1	10/08/08	752	0.30 J	37	22	0.10 J	232	57,200	62,800	0.099 UJ	11	0.75 J	8,150	0.43 UJ	28,900	32,300	3,700	28	3,620 J	5.0 U	1.0 U	3,620 UJ	0.71 UJ	0.96 J	21,800
BH-SF-E-0407-U	N1	10/09/08	412	0.92 UJ	14	22	0.076 J	754	42,200	46,500	0.042 J	8.7	0.78 J	4,090	60	26,100	28,600	4,540	19	2,530 J	5.0 U	1.0 U	1,890 UJ	1.6	0.25 J	26,000
BH-SF-E-0410-U	N1	10/08/08	495	2.0 U	0.23 UJ	15	0.12 J	194	123,000	135,000	0.14 UJ	3.2	6.7	100 U	0.55 UJ	36,600	40,400	2,230	35	5,410 J	5.0 U	0.064 UJ	2,160 UJ	0.29 UJ	0.16 J	30,400
	FD1	10/08/08	470	0.17 J	0.29 UJ	14	0.14 J	182 J	113,000	132,000	0.14 UJ	2.9 J	5.7 J	100 U	0.67 UJ	33,400	38,800	2,330 J	32 J	4,790 J	5.0 R	0.050 UJ	6,670	0.27 UJ	0.92 UJ	26,300 J
BH-SF-E-0423-U	N1	10/08/08	3,190	2.0 U	46	7.5 J	0.21 J	7.2	120,000	136,000	0.074 UJ	25	0.94 J	22,200	0.17 UJ	68,700	78,800	12,400	42	7,060 J	5.0 U	1.0 U	2,730 UJ	0.96 UJ	0.46 J	29,400
BH-SF-E-0425-U	N1	10/09/08	1,070	0.15 J	30	15	0.098 J	104	132,000	148,000	0.099 UJ	22	0.92 J	13,700	0.52 UJ	41,900	47,400	13,000	42	7,050 J	5.0 U	1.0 U	3,670 UJ	0.40 UJ	0.52 J	25,900
BH-SF-E-0427-U	N1	10/08/08	5,230	0.61 UJ	64	1.8 J	0.29 J	138	165,000	186,000	0.095 UJ	16	0.63 J	4,590	5.8	22,600	25,500	10,400	29	5,770 J	5.0 U	1.0 U	5,190	0.20 UJ	0.36 J	9,200
BH-SF-E-0429-U	N1	10/08/08	183 J	0.16 J	24	12	0.098 J	53	124,000	135,000	0.058 UJ	23	0.88 J	18,000	3.0	43,200	46,900	14,400	45	6,080	5.0 U	1.0 U	6,860	0.80 UJ	0.79 J	24,300 J
BH-SF-E-0503-U	N1	10/09/08	1,280	1.2 UJ	1.1	24	0.17 J	498	232,000	262,000	0.081 UJ	0.63 UJ	2.5	100 U	0.19 UJ	49,200	56,900	591	21	7,840	5.0 U	1.0 U	5,790	0.38 UJ	0.93 J	8,890 J
BH-SF-E-0504-U	N1	10/09/08	1,260	0.81 UJ	1.0 U	16	0.19 J	285	219,000	252,000	0.035 J	0.59 UJ	1.5 J	39 J	0.056 UJ	48,200	54,600	1,020	20	8,680 J	5.0 U	1.0 U	4,860 UJ	0.21 UJ	0.30 J	8,710
BH-SF-E-PZ-12	N1	10/09/08	200 U	0.45 UJ	0.20 UJ	20	1.0 U	32	33,600	37,400	2.0 U	1.0 U	0.29 J	4,270	248	14,900	16,800	2,960	9.3	2,930 J	5.0 U	1.0 U	5,450	0.075 UJ	0.22 J	7,050 J
BH-SF-E-PZ-13	N1	10/09/08	200 U	1.0 UJ	20	186	1.0 U	0.041 UJ	65,600	75,300	0.25 UJ	0.64 UJ	0.28 J	73,100	6.7	30,500	34,900	7,330	1.2	3,940 J	5.0 U	1.0 U	13,200	1.0 U	0.96 UJ	25 J
BH-SF-E-PZ-14	N1	10/09/08	200 U	0.28 J	0.17 UJ	12	1.0 U	138	171,000	186,000	0.043 J	2.9	1.5 J	620	2,140	46,800	49,900	6,530	29	5,250	5.0 U	1.0 U	5,460	0.30 UJ	0.76 UJ	22,300 J
	FD1	10/08/08	200 U	0.19 J	0.18 UJ	11	1.0 U	135	167,000	184,000	0.037 J	2.8	1.3 J	587	2,140	45,200	50,500	6,620	29	5,100	5.0 U	1.0 U	5,230	0.30 UJ	0.54 UJ	22,200 J
BH-SF-E-PZ-15	N1	10/09/08	200 U	0.17 J	0.19 UJ	13	1.0 U	95	36,200	39,100	0.52 UJ	1.5	2.3	100 U	0.34 UJ	11,800	13,100	451	28	4,500 J	5.0 U	1.0 U	5,170	1.0 U	0.68 UJ	7,310 J
BH-SF-E-PZ-16	N1	10/09/08	181 J	0.69 UJ	0.42 UJ	12	0.097 J	223	141,000	159,000	0.097 UJ	0.80 UJ	8.5	100 U	1.1	41,500	47,300	2,510	33	4,560 J	5.0 U	1.0 U	2,290 UJ	0.76 UJ	0.38 J	19,000
BH-SF-E-PZ-17	N1	10/09/08	8,260	2.9	2.2	22	0.78 J	58	114,000	131,000	0.15 UJ	9.7	2.4	136	32	11,700	13,600	2,890	27	3,750 J	5.0 U	1.0 U	2,430 UJ	0.077 UJ	1.1 J	16,400
BH-SF-E-PZ-18	N1	10/09/08	5,730	8.4	37	2.5 J	0.56 J	114	120,000	135,000	0.15 UJ	12	6.6	3.6 J	1.2	6,320	7,190	2,630	19	4,040 J	3.3 J	1.0 U	2,770 UJ	0.077 UJ	8.7	9,720
BH-SF-E-PZ-20	N1	10/09/08	3,550	0.72 UJ	61	5.4 UJ	0.24 J	146	217,000	238,000	0.13 UJ	17	0.79 J	7,890	7.9	30,000	33,700	9,640	27	5,680	5.0 U	1.0 U	6,750	0.37 UJ	0.51 UJ	8,930 J

Attachment B
Water Quality Summary Table - Dissolved Metals
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Parameter:			ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM Run1	CALCIUM Run 2	CHROMIUM	COBALT	COPPER	IRON	LEAD	MAGNESIUM Run 1	MAGNESIUM Run 2	MANGANESE	NICKEL	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
Units:			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
STATION	QC Type	Sample Date																								
BH-SF-E-PZ-21	N1	10/09/08	1,020	1.3 UJ	2.3	11	0.14 J	313	263,000	298,000	0.12 UJ	0.60 UJ	2.4	100 U	1.9	55,100	62,800	719	19	9,950 J	5.0 U	1.0 U	4,460 UJ	0.045 UJ	0.55 J	14,800
BH-SF-E-PZ-22	N1	10/09/08	948	0.62 UJ	7.1	76	0.13 J	11	189,000	211,000	0.14 UJ	2.5	0.57 J	26,500	0.52 UJ	43,300	48,900	7,680	12	5,970 J	5.0 U	1.0 U	5,720	1.0 U	0.68 J	3,320
	FD1	10/09/08	837	0.56 UJ	7.7	78	0.12 J	8.6	193,000	205,000	0.15 UJ	2.6	0.65 J	29,000	0.38 UJ	43,900	48,200	8,300	11	5,900 J	5.0 U	1.0 U	5,750	1.0 U	0.87 J	3,120
BH-SF-E-PZ-23	N1	10/09/08	2,420	0.42 UJ	21	7.4 J	0.16 J	438	64,200	71,900	0.20 UJ	12	0.71 J	9,110	0.80 UJ	38,600	43,000	6,560	28	4,200 J	5.0 U	1.0 U	3,200 UJ	2.1	1.8 J	22,800
BH-SF-E-PZ-24	N1	10/09/08	572	0.54 UJ	86	18	0.18 J	50	138,000	153,000	0.089 UJ	27	1.3 J	22,600	0.67 UJ	52,900	60,000	15,400	60	11,000 J	5.0 U	1.0 U	5,320	0.83 UJ	0.62 J	28,800
BH-SF-E-PZ-25	N1	10/09/08	675	0.14 J	6.6	26	0.12 J	77	127,000	143,000	0.099 UJ	21	0.95 J	9,520	11	35,900	40,700	12,200	39	7,430 J	5.0 U	1.0 U	4,290 UJ	1.0 U	0.62 J	23,100
BH-SF-E-PZ-26	N1	10/09/08	1,930	0.44 UJ	0.99 UJ	15	0.23 J	132	170,000	189,000	0.13 UJ	0.52 UJ	2.1	31 J	2.0	37,300	42,000	2,630	22	6,470 J	5.0 U	1.0 U	5,290	0.11 UJ	0.75 J	8,620

Notes:
J = The analyte was positively identified, the quantitation is an estimation.
U = The analyte was not detected at the specified detection limit.

Attachment B
Water Quality Summary Table - Alkalinity, Anions, Nutrients, Lime Demand, and Solids Formed
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Parameter:			Alkalinity as CaCO3		Diss Ammonia-N		Nitrate+Nitrite as N		Dissolved Phosphorus		Total Phosphorus		Total Kjeldahl Nitrogen		Chloride		Fluoride		Sulfate		Lime Demand as Ca(OH)2		Solids Formed
Units:			mg/L		mg/L		mg/L		ug/L		ug/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L
STATION	QC Type	Sample Date																					
Surface Water																							
BH-SF-LF-0004	N1	09/29/08	48		0.30	U	0.15		20		29		0.51	U	4.2		0.21		42		---		---
	N1	10/01/08	48		0.026	J	0.14		22		31		0.51	U	4.2		0.22		42		---		---
	N1	10/03/08	46		0.30	U	0.13		23		36		0.52	U	3.8		0.22		41		---		---
	N1	10/06/08	46		0.30	U	0.12		22		38		0.51	U	3.8		0.20		36		---		---
	N1	10/08/08	48		0.018	J	0.20		23		36		0.51	U	4.1		0.20		58		---		---
	N1	10/10/08	49		0.30	U	0.19		18		31		0.51	U	4.2		0.21		51		---		---
BH-SF-LF-0005	N1	09/29/08	48		0.30	U	0.14		21		31		0.51	U	4.2		0.23		44		---		---
	N1	10/01/08	48		0.024	J	0.13		23		35		0.51	U	4.2		0.24		45		---		---
	N1	10/03/08	49		0.30	U	0.12		18		64		0.51	U	4.1		0.20		41		---		---
	N1	10/06/08	48		0.30	U	0.13		19		49		0.50	U	4.0		0.19		36		---		---
	N1	10/08/08	48		0.30	U	0.20		21		36		0.51	U	4.2		0.21		59		---		---
	N1	10/10/08	55		0.30	U	0.18		21		37		0.51	U	4.3		0.23		53		---		---
BH-SF-LF-0006	N1	09/29/08	46		0.30	U	0.14		20		35		0.51	U	4.1		0.28		104		---		---
	N1	10/01/08	46		0.30	U	0.13		21		34		0.52	U	4.2		0.30		78		---		---
	N1	10/03/08	47		0.079	J	0.13		22		36		0.51	U	4.0		0.30		98		---		---
	N1	10/06/08	47		0.30	U	0.13		21		34		0.51	U	3.9		0.26		90		---		---
	N1	10/08/08	47		0.30	U	0.19		23		40		0.51	U	4.1		0.26		115		---		---
	N1	10/10/08	47		0.30	U	0.18		21		38		0.51	U	4.1		0.28		117		---		---
BH-BC-0001	N1	09/29/08	8.5		0.080	J	0.060		36		42		0.51	U	1.1		0.11		1,500		---		---
	N1	10/01/08	9.3		0.14	J	0.076		57		70		0.52	U	1.1		0.31		1,410		---		---
	FD1	10/01/08	9.3		0.13	J	0.076		61		73		0.52	U	1.1		0.28		1,420		---		---
	N1	10/03/08	8.6		0.11	J	0.083		45		54		0.52	U	1.2		0.22		1,280		---		---
	FD1	10/03/08	8.5		0.059	J	0.083		46		50		0.50	U	1.2		0.23		1,280		---		---
	N1	10/06/08	8.1		0.086	J	0.073		45		46		0.51	U	1.2		0.19		1,460		---		---
	N1	10/08/08	8.1		0.10	J	0.076		31		47		0.51	U	1.1		0.17		1,550		---		---
	N1	10/10/08	9.3		0.098	J	0.073		37		42		0.51	U	1.1		0.20		1,520		---		---
BC-UP-DISCHARGE-PIPE (upgradient of the relocated CTP outfall)	N1	09/29/08	5.1		0.30	U	0.081		147		162		0.51	U	1.3		0.60		1,270		---		---
	N1	10/01/08	5.0	U	0.30	U	0.16		570		732		0.51	U	1.3		3.6		453		---		---
	N1	10/03/08	6.2		0.30	U	0.16		750		914		0.51	U	1.2		4.1		411		---		---
	N1	10/06/08	8.1		0.30	U	0.16		729		837		0.51	U	1.1		3.9		361		---		---
	N1	10/08/08	8.2		0.30	U	0.16		751		988		0.51	U	1.1		4.1		373		---		---
	FD1	10/08/08	8.0		0.30	U	0.16		776		954		0.51	U	1.1		4.1		374		---		---
	N1	10/10/08	9.0		0.30	U	0.15		734		825		0.51	U	1.2		4.3		375		---		---
BH-BC-0006	N1	09/29/08	8.5		0.30	U	0.12		538		600		0.51	U	1.4		2.1		843		---		---
	N1	10/01/08	8.0		0.031	J	0.084		1,040		1,170		0.51	U	1.3		4.6		423		---		---
	N1	10/03/08	9.8		0.30	U	0.081		1,150		1,270		0.52	U	1.2		4.7		395		---		---
	N1	10/06/08	9.6		0.30	U	0.066		984		1,080		0.51	U	1.1		4.4		359		---		---
	N1	10/08/08	11		0.30	U	0.071		1,140		1,250		0.51	U	1.1		4.7		368		---		---
	N1	10/10/08	10		0.30	U	0.061		1,080		1,200		0.51	U	1.2		4.6		369		---		---
BC-ABOVE MAGNET	N1	10/03/08	7.0		0.30	U	0.050	U	11		20		0.52	U	1.5		1.0		1,460		---		---
	N1	10/06/08	5.9		0.30	U	0.050	U	12		23		0.50	U	1.6		1.1		1,320		---		---
	N1	10/08/08	5.0	U	0.30	U	0.050	U	10	U	22		0.51	U	1.6		1.2		1,370		---		---
	N1	10/10/08	5.0	U	0.30	U	0.050	U	8.4	J	21		0.51	U	1.6		1.2		1,490		---		---
	FD1	10/10/08	5.0	U	0.30	U	0.050	U	8.5	J	40		0.51	U	1.6		1.3		1,500		---		---
BH-BC-0005	N1	09/29/08	7.4		0.30	U	0.051		7.4	J	4.8	J	0.51	U	2.7		0.057		1,060		---		---
BH-BC-0004	N1	09/29/08	33		0.30	U	0.050	U	10	U	10	U	0.51	U	4.6		0.046		240		---		---
Magnet Gulch	N1	10/03/08	16		0.30	U	0.23		2,300		2,510		0.51	U	1.2		5.9		386		---		---
	N1	10/06/08	18		0.30	U	0.21		2,120		2,280		0.51	U	1.1		5.7		366		---		---
	N1	10/08/08	17		0.30	U	0.22		2,160		2,360		0.51	U	1.2		5.9		383		---		---
	N1	10/10/08	20		0.30	U	0.22		2,070		2,290		0.51	U	1.2		6.0		385		---		---
Ground Water																							
BH-SF-E-0301-U	N1	10/08/08	14		---		0.23		---		8.0	J	---		5.2		0.040	U	105		263		343

Water Quality Summary Table - Alkalinity, Anions, Nutrients, Lime Demand, and Solids Formed
Bunker Creek Pilot Study
Bunker Hill Superfund Site OU2

Parameter:			Alkalinity as CaCO3		Diss Ammonia-N		Nitrate+Nitrite as N		Dissolved Phosphorus		Total Phosphorus		Total Kjeldahl Nitrogen		Chloride		Fluoride		Sulfate		Lime Demand as Ca(OH)2		Solids Formed
Units:			mg/L		mg/L		mg/L		ug/L		ug/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L
STATION	QC Type	Sample Date																					
BH-SF-E-0320-U	N1	10/08/08	35		---		0.050	U	---		26		---		4.4		0.15		284		150		269
BH-SF-E-0402-U	N1	10/08/08	20		---		0.050	U	---		1,870		---		5.0		10		354		---		---
BH-SF-E-0403-U	N1	10/08/08	17		---		0.050	U	---		1,260		---		4.9		3.6		302		---		---
BH-SF-E-0407-U	N1	10/09/08	19		---		0.050	U	---		466		---		6.0		1.5		250		---		---
BH-SF-E-0410-U	N1	10/08/08	5.0	U	---		0.53		---		87		---		7.3		0.89		520		200		263
	FD1	10/08/08	5.0	U	---		0.53		---		87		---		7.2		0.88		539		188		263
BH-SF-E-0423-U	N1	10/08/08	26		---		0.050	U	---		4,260		---		6.5		13		664		---		---
BH-SF-E-0425-U	N1	10/09/08	24		---		0.050	U	---		1,360		---		6.6		4.2		581		---		---
BH-SF-E-0427-U	N1	10/08/08	19		---		0.050	U	---		5,300		---		2.2		17		548		175		230
BH-SF-E-0429-U	N1	10/08/08	28		---		0.050	U	---		676		---		6.7		2.7		563		---		---
BH-SF-E-0503-U	N1	10/09/08	19		---		0.077		---		494		---		2.8		4.4		849		---		---
BH-SF-E-0504-U	N1	10/09/08	17		---		0.057		---		349		---		2.8		4.1		839		---		---
BH-SF-E-PZ-12	N1	10/09/08	80		---		0.050	U	---		7.2	J	---		4.1		0.061		122		213		331
BH-SF-E-PZ-13	N1	10/09/08	155		---		0.050	U	---		153		---		18		0.057		266		---		---
BH-SF-E-PZ-14	N1	10/09/08	24		---		0.25		---		4.8	J	---		2.7		0.080		699		200		265
	FD1	10/08/08	24		---		0.26		---		6.4	J	---		2.7		0.086		711		200		296
BH-SF-E-PZ-15	N1	10/09/08	13		---		0.50		---		70		---		1.8		0.042		164		---		---
BH-SF-E-PZ-16	N1	10/09/08	10		---		0.10		---		177		---		3.7		0.24		592		225		319
BH-SF-E-PZ-17	N1	10/09/08	16		---		0.050	U	---		342		---		4.0		27		358		200		282
BH-SF-E-PZ-18	N1	10/09/08	16		---		0.075		---		3,140		---		1.5		18		350		150		168
BH-SF-E-PZ-20	N1	10/09/08	12		---		0.050	U	---		3,650		---		1.8		12		733		150		201
BH-SF-E-PZ-21	N1	10/09/08	12		---		0.24		---		643		---		2.3		3.8		994		125		292
BH-SF-E-PZ-22	N1	10/09/08	17		---		0.066		---		706		---		3.0		3.2		722		188		251
	FD1	10/09/08	15		---		0.065		---		721		---		2.9		3.3		727				
BH-SF-E-PZ-23	N1	10/09/08	24		---		0.050	U	---		3,460		---		6.5		8.1		365		---		---
BH-SF-E-PZ-24	N1	10/09/08	23		---		0.050	U	---		963		---		6.3		3.1		675		---		---
BH-SF-E-PZ-25	N1	10/09/08	33		---		0.050	U	---		2,790		---		6.9		3.2		522		---		---
BH-SF-E-PZ-26	N1	10/09/08	29		---		0.050	U	---		187		---		3.6		5.8		607		---		---

Notes:
J = The analyte was positively identified, the quantitation is an estimation.
U = The analyte was not detected at the specified detection limit.