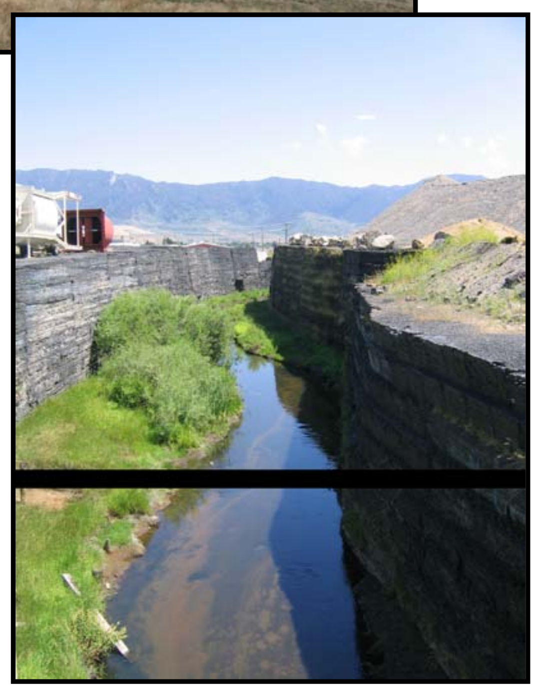
U.S. Environmental Protection Agency

Third Five-Year Review Report for
Silver Bow Creek/Butte Area Superfund Site

Volume 6: Butte Priority Soils Operable Unit

June 2011



Final

REMEDIAL ACTION CONTRACT
FOR REMEDIAL, ENFORCEMENT OVERSIGHT, AND NON-TIME-CRITICAL REMOVAL ACTIVITIES AT SITES OF RELEASE OR THREATENED RELEASE OF HAZARDOUS SUBSTANCES
IN EPA REGION 8

U. S. EPA CONTRACT NO. EP-W-05-049

FINAL

Third Five-Year Review for the
Silver Bow Creek/Butte Area NPL Site
Butte, Montana

Volume 6: Butte Priority Soils Operable Unit

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June 2011

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Acronyms

ACMC	Anaconda Copper Mining Company
ARAR	Applicable or Relevant and Appropriate Requirements
ARCO	Atlantic Richfield Company
BABCGWA	Butte Alluvial and Bedrock Controlled Groundwater Area
BMFOU	Butte Mine Flooding Operable Unit
BMP	Best Management Practices
BPSOU	Butte Priority Soils Operable Unit
BRES	Butte Reclamation Evaluation System
BSB	Butte-Silver Bow County
CD	consent decree
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information System
CFWEP	Clark Fork Watershed Education Program
CGWA	controlled groundwater area
COC	contaminants of concern
CTEC	Citizens Technical Environmental Committee
DEQ	Montana Department of Environmental Quality
DNRC	Department of Natural Resources and Conservation
EBL	elevated blood lead
EPA	U.S. Environmental Protection Agency
ERA	emergency response action
GIS	geographic information system
HEPA	High Efficiency Particulate Air
IC	institutional control
ICIP	institutional control implementation plan
LAO	Lower Area One
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MCA	Montana Code Annotated
MCL	maximum contaminant level
MPTP	Montana Pole Treatment Plant
MSD	Metro Storm Drain
NPL	National Priorities List
N-TCRA	non-time critical removal action
O&M	operations and maintenance
OU	operable unit
PbB	blood lead
PRP	Potentially Responsible Party
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act

RG	Remedial Goals
RI/FS	Remedial Investigation/Feasibility Study
RMAP	Residential Metals Abatement Program
ROD	Record of Decision
RPM	Remedial Project Manager
SD	settling defendants
Site	Silver Bow Creek/Butte Area Superfund Site
SOW	statement of work
TCRA	time critical removal action
TCLP	Toxicity Characteristics Leaching Procedure
TI	technical impracticability
μg/dL	micrograms per deciliter
USGS	United States Geologic Survey
WIC	Women's, Infant's and Children's
WWTP	wastewater treatment plant

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Section 1
Introduction

The U.S. Environmental Protection Agency (EPA) Region 8 has conducted a five-year review of the response actions implemented at the Silver Bow Creek/Butte Area Superfund Site (Site), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Information System (CERCLIS) ID: MTD980502777 in Silver Bow and Deer Lodge Counties, Montana. This review covers activities conducted from January 2005 through December 2009.

This volume of the report focuses on Butte Priority Soils Operable Unit (BPSOU) – separate volumes have been prepared for the other Site operable units (OUs). This is the third five-year review for the Site and the first five-year review for the BPSOU. The BPSOU is one of seven remedial operable units comprising the Site.

The Record of Decision (ROD) for BPSOU was issued in September 2006, and the OU is currently undergoing remedial design and some remedial action implementation. The purpose of this volume of the five-year review is to provide a protectiveness statement for the BPSOU. In addition, the five-year review report identifies issues which keep the remedy from being protective in the long term and makes recommendations to address them.

The BPSOU volume of the five-year review reports on work completed by removal actions, as well as remedial actions in progress. A great deal of work has been completed at the BPSOU through removal actions. These were consistent to the extent practicable with the ROD. Portions of the remedy that have been substantially implemented since the ROD include the residential metals abatement program and source area/land reclamation.

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Section 2
Site Chronology

Table 2-1 presents important site events and relevant dates for the BSPOU. The identified events are selective, not comprehensive.

Table 2-1
Chronology of Site Events

Event	Operable Unit	Date
Placer gold discovered in Silver Bow Creek	00	1864
Large scale underground mining in Butte	03/08	1875 - 1955
Major smelting period in Butte	03/08	1879 - 1900
Open pit mining at Berkeley Pit	03	1955 - 1982
Discovery of mining-related contamination along Silver Bow Creek between Butte and Warm Springs, Montana	01	9/1/1979
Hazard Ranking System Package Completed	00	12/1/1982
Silver Bow Creek Site proposed for the National Priorities List (NPL)	00	12/30/1982
Butte Portion added to the NPL	08	7/22/87
Silver Bow Creek Site (Original Portion) Phase 1 Remedial Investigation Final Report	00	January 1987
Walkerville Time Critical Removal Action (TCRA) Completed	08	February 1988
Timber Butte TCRA Completed	08	1989
Priority Soils TCRA Completed	08	1991
Colorado Smelter TCRA Completed	08	1992
Anselmo Mine Yard and Late Acquisition/Silver Hill TCRA Completed	08	1992
Lower Area One (LAO) Manganese Removal	08	1992
Walkerville Fund Lead TCRA Completed	08	1994
Walkerville Residential Removal	08	2000
Stormwater TCRA	08	Ongoing
Railroad Beds TCRA	08	2004
LAO Non-Time Critical Removal Action (N-TCRA)	08	Ongoing
BPS Residential Soils/Source Areas N-TCRA	08	Ongoing
Final Phase II Remedial Investigation Report Completed	08	April 2002
Final Phase II Feasibility Study Report Completed	08	April 2004
Proposed Plan for BPSOU	08	December 2004
Record of Decision BPSOU and ongoing work under order amendments as design is completed for certain components	08	September 2006
Consent Decree or Unilateral Administrative Order for Full Remedy Implementation at BPSOU	08	Expected 2011

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Section 3 Background

The following section provides a selective site background of the BPSOU. A complete summary of the site background is included in the *Record of Decision Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area NPL Site* (EPA 2006a).

3.1 Location and Setting

The Silver Bow Creek/Butte Area NPL Site, which includes the BPSOU, represents one of four contiguous Superfund Sites in the upper Clark Fork River Basin that extend 140 miles from the headwaters of Silver Bow Creek north of Butte to the Milltown Reservoir near Missoula, Montana as shown in Figure 3-1. The approximate BPSOU boundary and site location are shown in Figure 3-2.

The BPSOU covers an area of approximately five square miles and is located a few miles west of the continental divide at an elevation range of approximately 5,400 to 6,400 feet above mean sea level. The BPSOU is centered on the "Butte Hill", which is the location of the historic Butte Mining District. Contaminants at the site, including arsenic and heavy metals such as copper, lead, mercury, and zinc, are the result of 120 years of hard rock mining, smelting, milling, and other processing activities. Mining and ore-processing wastes in Butte represent the primary source materials. These wastes come in several different forms, including mill tailings, waste rock, slag, smelter fallout, and mixed combinations of each. Arsenic and metals contained in or released from these wastes to soil, surface water, and groundwater, pose significant risks to human and ecological receptors without appropriate remediation as described in the BPSOU ROD.

3.2 Physical Characteristics

The BPSOU encompasses the northwestern portion of the Summit Valley, which is characterized by gently sloping terrain, generally sloping toward the north in the southern portion of the valley and toward the west in the northern portion of the valley. Mountains bound the valley on the east, south, and north with highest elevations reaching over 10,000 feet in the Highland Mountains south of Butte.

Granitic rocks of the Boulder Batholith underlie the Butte area. They are primarily quartz monzonite intersected by porphyritic dikes and plugs. The rocks are fractured and faulted and extensively mineralized. This mineralization was the target of local mining. The communities of Butte and Walkerville were established close to the mining and milling centers as a matter of convenience. Operations of mines, mills, concentrators, and smelters generated tailings, related wastes, and a variety of other materials that were deposited on-location, in the midst of residential areas.

The two primary streams in the valley are Blacktail Creek, which begins in the Highland Mountains to the south, and Silver Bow Creek, which is now considered to begin at the confluence of Blacktail Creek and the Metro Storm Drain (MSD). Prior to mining, Silver Bow Creek originated in the mountains northeast of the BPSOU. As mining production increased, mills and smelters were located along the creek. To accommodate mineral processing activities, Silver Bow Creek was rerouted as needed and was used for waste disposal. Tailings impoundments were constructed in the floodplain and wastes were discharged directly into the creek. With the advent of open pit mining, most of the original Silver Bow Creek channel and floodplain were completely obliterated by the Berkeley Pit and Yankee Doodle Tailings Pond. What remains was converted into a conveyance ditch and is known as the MSD. Many of the waste deposits along the MSD remain in place.

3.3 Land and Resource Use

The BPSOU is situated in a predominantly urban setting, and includes residential neighborhoods, schools, and parks, as well as commercial and industrial areas. Land use within the BPSOU is subject to regulation by the Butte-Silver Bow (BSB) County government through local ordinances. The northern portion of the BPSOU is typified by residential and commercial development and inactive mining operations. Light industrial activity, scattered residences, and the Silver Bow Creek floodplain characterize the central portion of the BPSOU. The southern portion is characterized by residential areas, inactive mining operations, cemeteries, and undeveloped land. The population of Butte peaked in 1920 at 60,313 people. The 2000 U.S. Census reports Butte's population to be 33,829 and a 2006 U.S. Census estimate reports a population of 32,110.

3.4 History of Contamination

The following provides a brief summary of the history of contamination at the BPSOU:

- 1870 – Dozens of silver and copper mining claims had been located and developed, prompting construction of mines, mills, and smelters capable of refining arsenic-laden copper ores.

- 1881 – At this time, there were over 300 operating copper mines, at least 10 silver mines, five smelters, and over 4,000 posted claims

- 1890 – In response to poor air quality for many years, the city of Butte passed ordinance 186, which made it illegal to roast ore with the city limits.

- 1910 – Butte had become the largest producer of copper in North America and large quantities of mine waste and tailings were disposed of in ponds or dumped in Silver Bow Creek. Mining companies were merged into the Anaconda Copper Mining Company (ACMC).

- 1920s – Milling and smelting continued in Butte; however, as the copper smelting capacity at Anaconda grew, Butte became primarily a mining center. Even so, Butte's smelters and mills produced air emissions that contaminated yards and attics throughout the BPSOU, as well as large quantities of waste such as tailings and slag. Butte's mines also produced waste and overburden piles throughout Walkerville and Butte.

- 1955 – Open pit mining began in Butte with the formation of the Berkeley Pit. Previously, all mining in Butte was completed entirely underground.

- 1964 – The completion of the Weed Concentrator (now known as the Montana Resources Concentrator) reduced the amount of ore sent to Anaconda; however, it also produced large quantities of waste in the active mining area and discharged large volumes of contaminated water to the MSD.

- 1977 – ARCO, now known as Atlantic Richfield Company, merged with ACMC. Open pit mining operations were conducted in the Berkeley Pit until 1982 and in the Continental Pit until 1983 when all mining operations were suspended by ARCO, the successor to ACMC.

- 1984 – ARCO closed the Anaconda Smelter.

- 1990s – Atlantic Richfield becomes a wholly owned subsidiary of the BP collection of companies.

3.5 Regulatory History Summary

The following provides a brief summary of the regulatory history at the BPSOU:

- 1983 – EPA designated the original Silver Bow Creek as a Superfund site in September 1983.

- 1987 – Recognizing the importance of Butte as a source of contamination to Silver Bow Creek, EPA concluded that Butte and Silver Bow Creek should be treated as one site under CERCLA. EPA subsequently modified the existing Silver Bow Creek Site to include the Butte area and the formal name changed to the "Silver Bow Creek/Butte Area NPL Site". The BPSOU was one of four remedial OUs formed in the Butte Area.

- 1989 – EPA separated the BPSOU investigation activities into Phase I and Phase II. Phase I activities focused on high-priority human health risks and resulted in the implementation of numerous TCRAs and Emergency Response Actions (ERAs) identified in Section 2 and summarized in the ROD. Phase II activities included conducting the full remedial investigation/feasibility study (RI/FS) for the entire OU.

- 1991 – EPA developed the Statement of Work (SOW) for the Phase II RI/FS. The SOW served as the substantive basis for the Phase II RI/FS Work Plan. A consent order to conduct a RI/FS at the BPSOU was signed by ARCO and other BPSOU Potentially Responsible Parties (PRPs) in June 1992. EPA also continued to sign action memorandums and issued administrative orders for initial actions during this period.

- 2004 – The proposed plan for the BPSOU was completed.
- 2006 – EPA signed the Record of Decision for the BPSOU Silver Bow Creek/Butte Area NPL site.

Additional site background and history details are provided in the *Record of Decision Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area NPL Site, September 2006* (EPA 2006a).

3.6 Basis for Taking Action

Screening studies and risk assessments have been conducted in Butte since the early 1990s to identify contaminants of concern and to quantify actual and potential human health and environmental risks from contaminants of concern (COCs) in tailings, waste, soils, indoor dust, surface water and groundwater. The COCs at the site, and the media for which actions levels were established for each COC, are presented in Table 3-1.

Table 3-1
Summary of Contaminants of Concern for the BPSOU

Chemical	Solid Media	Groundwater	Surface Water
Aluminum			X
Arsenic	X	X	X
Cadmium		X	X
Copper		X	X
Iron			X
Lead	X	X	X
Mercury	X	X	X
Silver			X
Zinc		X	X

For humans, primary exposure pathways at the BPSOU include:

- Ingestion of surface soils (for residents, commercial workers, and railroad workers);
- Ingestion of interior dust (for residents and commercial workers);
- Dermal exposure to surface water (for recreational visitors); and
- Ingestion of surface water (for recreational visitors); and

- Ingestion of alluvial groundwater were calculated, although no current exposures occur.

Assessments of ecological risks focused on aquatic habitat in Silver Bow Creek (terrestrial habitat is limited in the urban environment of the BPSOU and was not evaluated in an ecological risk assessment). Animals in the aquatic environment may be exposed to toxic levels of contamination in the following ways:

- Fish and benthic macroinvertebrates may be exposed by breathing or touching surface water and sediment and by ingestion of prey or sediment.

- Waterfowl may be exposed by direct ingestion of surface water and sediments or by ingestion of contaminated prey.

Previous response actions and the residential lead abatement program have significantly reduced some but not all of the human health risks. Metal-laden mine waste within the BPSOU continues to threaten local groundwater and surface water resources. As a result, the selected remedy (described in the 2006 ROD) adopts the previous response actions to eliminate or mitigate remaining human and ecological risks. The response actions selected in the BPSOU ROD are necessary to protect the public health, welfare, or the environment from actual or threatened releases of hazardous substances into the environment.

The selected remedy includes, but is not limited to, the following major critical elements to address remaining risks:

- A site-wide operations and maintenance program for reclaimed sites to ensure the continued evaluation, maintenance, and permanence of the caps over mine waste.

- Alluvial groundwater collection and treatment along with appropriate institutional controls (ICs), applicable or relevant and appropriate requirements (ARAR) waivers for groundwater, and monitoring.

- Additional source removal, capping of mine waste and land reclamation for contaminated solid media.

- Plans for a Residential Metals Abatement Program (RMAP) that takes a multi-pathway approach to addressing arsenic, lead, and mercury in yards and homes. All residential properties will be sampled within the BPSOU and remediated if elevated metals are detected.

- A phased storm water management program combining initial action, aggressive monitoring, source area stabilization, and engineering controls to minimize impacts from storm water runoff, meet ARARs, and return Silver Bow Creek to its beneficial uses.

- Elevated arsenic and metals occur in stream-bed and bank sediments in Silver Bow Creek at concentrations that present significant risks to aquatic biota. These sediments are most notable within the slag canyon west of Montana Street and within the upper reaches of the Silver Bow Creek channel in Lower Area One (LAO) and the lower reach of Blacktail Creek. The Selected Remedy will remove contaminated sediments from the stream channel bottom and stream banks, and adjacent floodplain from above the confluence through the slag canyon to the reconstructed floodplain in LAO.

Section 4
Remedial Actions

Summaries of the remedial actions selected, their implementation, and operations and maintenance (O&M) activities for the BPSOU are presented below.

4.1 Remedy Selection

4.1.1 Solid Media

The overall remedial action objectives (RAOs) established for the BPSOU solid media are:

- Prevent the ingestion of, direct contact with, and the inhalation of, contaminated soils, indoor dust, waste rock, and/or tailings or other process waste that would results in an unacceptable risk to human health assuming current or reasonably anticipated future land uses.
- Prevent releases of contaminated solid media to the extent that they will not result in an unacceptable risk to aquatic environmental receptors.
- Prevent releases of contaminated water from solid media that would result in exceedances of the Montana State Water Quality Standards for surface water.
- Prevent releases of contaminated water from solid media that would result in exceedances of the Montana State Water Quality Standards for groundwater, except where ARAR waivers are appropriate and other means to protect from associated risks are available.
- Remediate contaminated solid media to the extent that it will not result in an unacceptable risk to human health and/or aquatic environment receptors.
- Prevent release of contaminated water from solid media that would result in degradation of surface water, in accordance with the surface water Remedial Goals (RG).

Major components of the selected remedy for the BPSOU solid media are:

Residential Contamination

- Continuation and expansion of the existing Butte-Silver Bow Lead Intervention and Abatement Program, in a way that requires all residential properties be sampled assessed, and abated if action levels are exceeded for arsenic, lead, and mercury. The expanded program is called the RMAP, and was developed after extensive remedial design efforts. The final RMAP was recently approved by EPA and Montana Department of Environmental Quality (DEQ). That program is being implemented by the potentially responsible parties under order from EPA.

- The RMAP requires a multi-pathway approach to address arsenic, lead, and mercury in yard soil, indoor dust (living space and direct exposure to non-living space dust), interior and/or exterior lead paint and lead solder in household drinking water pipes.

- Homes adjacent to the BPSOU that have lead, arsenic, or mercury in attic dust will also be addressed in the same manner as homes within the OU (the RMAP defines the area for which attics with elevated levels will be addressed in Appendix A to the RMAP. The area is known as the Residential Metals Expanded Area).

- Properties that refuse property access or properties without current exposure pathways, or vacant properties will be flagged and tracked in the RMAP database for future action.

- The RMAP requires developing and implementing community awareness and educational programs in conjunction with a medical monitoring program.

Non-Residential Contamination

- Non-residential contaminated solid media includes waste rock piles, smelter wastes, milling wastes, and contaminated soils. Contaminated solid media may be present in commercial areas, open areas, non-active mining areas, etc.

- Contaminated solid media shall be addressed through a combination of source removal, capping, and land reclamation. After many years of work under pre-ROD removal actions, and extensive remedial design work post-ROD under order amendments from EPA, virtually all of these areas in BPSOU have now been addressed and have working caps and revegetation.

- Reclaimed areas, including cover soil caps, must achieve the performance standards described by EPA in the Butte Reclamation Evaluation System (BRES). This system is a site-specific tool to evaluate the stability, integrity, and degree of human and environmental protectiveness afforded by EPA-sanctioned response actions, or other past reclamation action initiated on lands impacted by mining within the OU.

- Non-Residential sites with contaminated solid media are grouped into different categories for remedial action.

4.1.2 Groundwater

The RAOs established for the BPSOU groundwater are:

- Prevent ingestion of or direct contact with contaminated groundwater that would result in unacceptable risk to human health.

- Prevent groundwater discharge that would lead to violations of surface water ARARs and RGs for the BPSOU.

- Prevent degradation of groundwater that exceeds current standards.

The BPSOU groundwater remedy is summarized as follows:

- **LAO Removal and Waste Left in Place:** Extensive removal of near stream waste in the LAO and MSD area has occurred, and some additional removal is required. Waste and contaminated soils will be left in place in LAO and MSD. Infiltration barriers or other measures may be placed to reduce metals loading to the groundwater in the area overlying the Parrott Tailings. The sediment basin/former wetland demonstration project shall also be reclaimed according to the intended future land use.

- **Groundwater Capture and Treatment – MSD Area:** Contaminated alluvial groundwater in the MSD shall be captured, pumped, and treated at the treatment facility at LAO using lime precipitation technology. Effluent from the treatment facility will be discharged to Silver Bow Creek in compliance with ARARs. Due to issues regarding long-term performance of the subdrain, this remedy will require upgrade to the MSD system and a five-year shakedown period to determine effectiveness of the system.

- **Groundwater Capture and Treatment – LAO:** Contaminated alluvial groundwater at LAO and base flow from Missoula Gulch shall be intercepted in a hydraulic control channel, and routed to the LAO treatment lagoon facility. Butte Mine Flooding Operable Unit (BMFOU) West Camp System will be routed to the hydraulic control channel at LAO for treatment.

- **Groundwater Treatment Facility:** The LAO treatment lagoon facility shall be used for the treatment and discharge of contaminated ground and surface waters. The existing lagoon treatment system at LAO has demonstrated that treatment discharge data for the system has been meeting state water quality standards for copper, cadmium, and zinc at the point of discharge. Arsenic standards have been met on all but a few occasions. Because issues regarding long-term performance and sludge removal and disposal have not been fully addressed, the Selected Remedy also includes the following:

    1. An engineering review shall be conducted to require LAO treatment lagoon facility upgrades. A five-year shakedown period will be required to demonstrate successful water treatment and full compliance with the standards, when operating under a wide range of conditions, including design conditions. All required modifications must go through the formal EPA design, review, and approval process.

    2. To prevent the discharge of untreated water into Silver Bow Creek, the design will be required to include contingencies for how to manage and store collected groundwater during extended periods of upset (e.g., flooding, equipment malfunction or failure, extended periods of freezing, etc.).

3. Using the Butte Reduction Works area, near the lagoon treatment system, for sludge drying and sludge management is not allowed, since it is a dedicated open space area more suitable for public use.

4. If during the shakedown period, performance standards cannot be met, a conventional lime treatment system shall be designed and built at LAO. The conventional system shall use lime treatment technology to treat the captured contaminated water and meet all discharge standards.

- **Groundwater Monitoring:** Additional groundwater capture and hydraulic control systems may be implemented if the MSD and LAO capture system is found to adversely affect surface water quality. A comprehensive groundwater monitoring plan shall be prepared and implemented for the entire alluvial aquifer to ensure that groundwater capture systems are effective, to determine that contaminated groundwater is not leaving the technical impracticability (TI) Zone or discharging to surface water above standards; and to provide additional information as necessary on the movement, quality, and quantity groundwater. The groundwater monitoring program will include installing additional monitoring wells, regular measurement of water quality and water level in a monitoring network, and shall provide thorough monitoring that includes, but is not limited to, groundwater in upper and lower MSD, groundwater near the southern extent of the TI Zone, between the MSD and LAO groundwater capture systems, and in the area adjacent to, and downgradient of the lagoon system.

- **Controlled Groundwater Area:** The ROD contains provisions describing the decision to waive ARAR compliance in the alluvial aquifer TI Zone. A controlled groundwater area shall be established for the alluvial aquifer to prevent domestic use of this water and to prevent any well development that would exacerbate or spread existing contamination. Other ICs, such as county laws or regulations regarding domestic use of groundwater in the area, may also be required.

Much of the ground water work required by the ROD is undergoing remedial design and major parts of the required work have not yet been implemented.

4.1.3 Surface Water

The RAOs established for BPSOU surface water are:

- Prevent ingestion or direct contact with contaminated surface water that would results in an unacceptable risk to human health.

- Return surface water to a quality that supports its beneficial uses.

- Prevent source areas from releasing contaminants to surface water that would cause the receiving water to violate surface water ARARs and RGs for the OU and prevent degradation of downstream surface water sources, including during storm events.

- Ensure that point source discharge from any water treatment facility (e.g. water treatment plant, wetland, etc.) meet ARARs.
- Prevent further degradation of surface water.
- Meet the more restrictive of chronic aquatic life or human health standards for surface water identified in Circular DEQ-7 through the application of B-1 class standards.

The BPSOU surface water remedy is summarized as follows:

- Implementation of the Surface Water Management Program, which utilizes best management practices (BMPs), developed on an iterative and yearly basis, to address contaminated storm water runoff and improve storm water quality.
- Excavation and removal to a repository of contaminated sediments and other waste from the stream bed, banks, and adjacent floodplain along Blacktail Creek and Silver Bow Creek, from just above the confluence of Blacktail Creek and MSD to the beginning of the reconstructed Silver Bow Creek floodplain at LAO. Following removal of the in-stream sediments, further evaluation of surface water quality in this area will be conducted. If groundwater inflow is found to adversely affect surface water quality, additional hydraulic controls and groundwater capture shall be implemented.
- Capturing and treating storm water runoff up to a specified maximum storm event, if BMPs implemented under the Surface Water Management Program do not achieve the goal of meeting surface water standards in Silver Bow Creek, Grove Gulch, and Blacktail Creek during storm events.
- Hydraulic control, capture, and treatment of contaminated groundwater to prevent its discharge to Silver Bow Creek surface water, as described in the previous section.
- In-stream flow augmentation as appropriate. Flow augmentation will not be considered until the major remedial component described in this ROD are designed and implemented.

Much of the surface water work required by the ROD is undergoing remedial design and major parts of the required work have not yet been implemented.

4.1.4 Institutional Controls

The Selected Remedy includes the following minimum ICs:

- A controlled groundwater area will be established in the Alluvial Aquifer TI Zone to prevent domestic use of contaminated water, exacerbation or spreading of existing contamination, or release of highly contaminated groundwater to surface water resources through irrigation.

- County zoning and permit requirements will be implemented to ensure that capped waste areas, discrete areas of waste left in place, and other control measures such as storm water control are not disturbed, mismanaged, or inappropriately developed and that waste taken from these areas is disposed of at the Butte Waste Repository, or if identified as a hazardous waste disposed of at a Resource Conservation and Recovery Act (RCRA) Subtitle C facility.

- Deed notices and covenants will be required for all areas where wastes were capped and left in place or where engineered controls were constructed or other discrete wastes were left in place.

Where private landowners require fencing or use posting for legitimate reasons relating to the prevention of remedy disruption, the Selected Remedy requires the installation of these fences or signs.

Substantial progress has been made in developing the required ICs and/or plans for ICs.

The above summary of the ROD describes only the major actions required in the selected remedy. A complete description of all the remedy requirements is contained in the *Record of Decision Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area NPL Site* report from September 2006.

4.2 Remedy Implementation

4.2.1 Work Completed under Removal Authority

The following italicized text is from Section 2 of the 2006 BPSOU ROD summarizing response actions from the late 1980s through 2004.

> *EPA designated the original Silver Bow Creek Site as a Superfund site in September 1983. A fund lead RI for Silver Bow Creek was started in 1984. During the course of this initial RI, the importance of Butte as a source of contamination to Silver Bow Creek was formally recognized. Preliminary results from the Silver Bow Creek RI indicated that upstream sources (i.e., ubiquitous mining-related wastes throughout Butte) were partly responsible for the contamination observed in the creek. After a thorough analysis of the relationship between the two sites (Butte and Silver Bow Creek), EPA concluded that they should be treated as one site under CERCLA. EPA subsequently modified the existing Silver Bow Creek Site to include the Butte area and the formal name was changed to the "Silver Bow Creek/Butte Area NPL Site" in 1987. The BPSOU was one of four remedial OUs formed in the Butte Area.*

EPA undertook several removal actions (TCRAs and ERAs) within the BPSOU from the late 1980s through 2004. Virtually all of this work was done by the PRPs under unilateral or administrative consent orders. Prior to the final FS and remedial decision process, 422 acres of land within the BPSOU have undergone extensive response actions. The work was completed from the late 1980s through 2004. The final actions for two ongoing ERAs (LAO and one for residential soils/source areas) were established in the ROD. These response actions were undertaken to address the immediate human health and environmental problems at BPSOU.

Response actions were designed and constructed in a manner intended to be consistent with any final remedy. Response actions conducted at the BPSOU are summarized below.

Walkerville TCRA (1988). *Addressed mine waste dumps (e.g., Lexington Mine Yard) and residential soil areas contaminated with lead above 2,000 milligrams per kilogram (mg/kg) or mercury above 10 mg/kg in Walkerville. Nearly 300,000 cubic yards of material were removed from 10 sites. One mile of rock-lined ditch was also constructed to control surface water runoff from the recontoured waste piles. EPA also removed contaminated soil from six earthen basements and 33 residential yards.*

Timber Butte TCRA (1989). *Approximately 40,000 cubic yards of contaminated soil were removed and consolidated in an on-site repository that was recontoured, covered with fill soil, and revegetated. Drainage was improved with recontouring and the installation of drainage ditches. Contaminated soil was removed from two residential yards and the yards were recontoured, covered with soil, and revegetated.*

Butte Priority Soils TCRA (1990 and 1991). *Mitigated risks from a number of mine waste dumps, a concentrate spill, and seven residential yards located in Butte and Walkerville. Response actions were taken at 30 waste dumps (100,000 cubic yards) that were either capped or removed. In addition, a railroad bed and seven residential yards were reclaimed. These actions included removing waste, adding lime rock, capping with soil, application of fertilizer, and seeding each site.*

Colorado Smelter TCRA (1992). *Addressed wastes associated with the Colorado Smelter. Approximately 40,000 cubic yards of mine waste were removed and consolidated in an on-site repository. The site was reclaimed and drainage channels were installed.*

Anselmo Mine Yard and Late Acquisition/Silver Hill TCRA (1992). *Addressed a mine yard and several mine dumps in Butte. The work involved excavation of mine waste, recontouring, capping, and revegetation. Terracing, rock-lined ditches, and other drainage control measures were used for storm water management purposes.*

Walkerville II TCRA (1994). *EPA conducted further removal activities in Walkerville to address four additional dump areas with elevated soil lead levels. In 1994 and 1995, 12 more waste dumps were removed or capped in place.*

Railroad Beds TCRA (1999 - 2004). *Addressed railroad beds and adjacent residential yards at the OU that contain elevated concentrations of metals and arsenic. The railroad beds were constructed using mining-related waste or contaminated by spillage during transport of ore or ore concentrates. The TCRA included significant storm water drainage improvements.*

Storm Water TCRA (1997 - present). *Begun in 1997 to address storm water problems in Butte. To control storm water flow and minimize soil erosion and transport of contaminated sediment to Silver Bow Creek, storm water conveyance structures were built and large areas of barren land and contaminated soil were reclaimed with cover soil and revegetation.Storm water channels and detention ponds were placed in critical areas to minimize erosion and reduce the release and transport of contaminants from historic mining areas.*

This response action also included reclamation of the Alice Dump and the removal of about 50 cubic yards of soils contaminated with elemental mercury in the Dexter Street area. The Alice Dump is a large waste rock dump located in upper Missoula Gulch that contained about 2 million cubic yards of contaminated soil and waste rock. At Dexter Street, a limited quantity of the mercury-contaminated soils failed Toxicity Characteristic Leaching Procedure (TCLP) and required disposal at an EPA-approved RCRA hazardous waste disposal facility. The remaining soils were disposed of at an on-site waste repository.

Walkerville TCRA (2000). *Residential properties in Walkerville that had not been previously sampled were sampled and cleanups implemented at those residences with elevated arsenic, lead, and/or mercury above action levels. Approximately 40 properties were addressed.*

Lower Area One ERA (1992 - present). *The LAO ERA focused on the removal of accessible mine waste and contaminated soils along Silver Bow Creek and across the floodplains associated with Silver Bow Creek in the area of the historic Colorado Tailings and Butte Reduction Works facilities. In May 1992, ARCO signed a Consent Order with EPA to implement EPA's selected response action alternative for the LAO ERA. Per the work plan, the response action was to be accomplished in three phases. Phase I, which was divided into Segments I and II, included the excavation, transportation, and disposal of tailings and other contaminated materials from LAO, partial backfilling of the site with clean materials, and construction of a new Silver Bow Creek channel. Phase II was an equilibration and monitoring period that involved the collection of ground and surface water data needed to determine the appropriate final response action at LAO. Phase III consists of the design and implementation of the final response actions relating to LAO, as described in this ROD.*

The first step in the removal was Phase I, Segment I activities consisting of the excavation and transport via railroad of the "dry" contaminated material above the water table to the Opportunity Ponds near Anaconda. A total of 270,600 cubic yards of materials were excavated from 1993 to 1994 during Phase I, Segment I. During 1995, EPA and ARCO initiated Phase I, Segment II pilot-scale excavation activities consisting of the removal of wet contaminated materials below the water table. The pilot-scale operation demonstrated that dewatering could be achieved by trenches to intercept groundwater and, in 1996, full-scale dewatering and excavation of saturated materials began. To expedite the cleanup, a proposal was made in the summer of 1996 to haul the contaminated materials by truck to the nearby Clark Tailings site rather than continue to transport to the Opportunity Ponds by rail. Following public comment and subsequent approval of the proposed Clark Tailings repository and future use plan in spring 1997, excavated waste materials were transported *to the Clark Tailings area throughout the summer and fall of 1997. By the end of 1997, Phase I activities had removed a total of 1.2 million cubic yards of mine waste and contaminated soils from Silver Bow Creek and the associated floodplains in the area of the Colorado Tailings and Butte Reduction Works. The area was then backfilled with imported material and grasses, forbs, and trees were planted to establish a diverse and nature vegetative cover. The stream channel was reconstructed in accordance with rigid engineering standards to maintain an elevated stream channel to insure a losing stream. Waste removal during the LAO ERA was completed to a predetermined excavation limit established on the basis of the natural pre-existing land contours. Although the excavation limit ensured that the majority of the waste and contaminated soil was removed, waste was left in some areas that were below the excavation limit. In addition, in-situ waste and contaminated soils remain under the Metro Sewage Treatment Plant facility, and the historic aqueduct and slag walls. A hydraulic control channel was constructed parallel to the floodplain to collect groundwater. The captured groundwater is treated in the Treatment Lagoon Demonstration Project before discharge back to Silver Bow Creek.*

Phase II of the LAO ERA has been completed during which the hydrologic equilibration and monitoring of ground and surface water occurred and water treatability studies were performed. Phase III, which includes final reclamation and land use planning for this area, will be decided and performed as a component of this ROD. For example, the selection of a collection and treatment requirement for groundwater for this area is included in this ROD.

Butte Priority Soils OU ERA Residential Soils/Source Areas (1994-Present). *EPA implemented a program to remediate residential metals and arsenic that focused on certain residential areas with soil-lead concentrations above the residential lead action level (1,200 mg/kg) and the arsenic level of 250 mg/kg. Under this action, EPA, DEQ, Butte-Silver Bow, and ARCO integrated the removal of residential lead contaminated soils associated with mine-related wastes and the removal or mitigation of lead contaminants from non-Superfund sources. This provided BSB with funding and the flexibility to implement a comprehensive public health program while meeting EPA's initial removal action requirement. The BSB Lead Intervention and Abatement Program goal is to reduce the level of lead exposure incurred by children 0–6 years, pregnant women and nursing mothers in a manner that results in long-term health benefits. Butte-Silver Bow's program targets all sources of lead, including interior and exterior lead based paint, interior lead dust, water and residential soils for certain residential areas.*

The source area portion of this action included the remediation of areas that were above the lead action level of 2,300 mg/kg.

Other Actions

Lower Area One Manganese Removal (1992). *This removal action was used to remove manganese ore stockpiles in LAO within the floodplain of Silver Bow Creek. The piles were located east of the Metro Sewage Plant and west of Montana Street in LAO. The Defense Logistics Agency and EPA conducted the manganese removal. The stockpiles included ore and process tailings remaining after efforts by the Department of Defense to process manganese ore at the Butte Reductions Works Plant during World War II.*

A total of 261,000 cubic yards were moved to a private repository in Whiskey Gulch, west of the BPSOU (Bureau of Reclamation 1992). The action was a critical ancillary action to the LAO ERA.

Old Butte Landfill/ Clark Mill Tailings (1998). *A RCRA corrective action and permitting process was completed at this site southwest of Butte, in combination with EPA mandated Superfund action. The site consisted of a 60-acre impoundment with approximately 1 million cubic yards of mill tailings immediately adjacent to, and partially mixed with, the old Butte Municipal Landfill. The mixed nature of the wastes necessitated a combined Superfund and RCRA response action be performed under RCRA jurisdiction.*

At the Clark Mill Tailings, approximately 800,000 cubic yards of the Colorado Tailings removed from LAO were placed in the repository constructed at this site. The final RCRA repository cover was designed in 1997 and constructed in 1997 and 1998. The overall design included the subsequent construction of a recreational complex on top of the repository that included several irrigated ball fields, play areas, and park buildings. The recreational complex was opened in 2001. This area is permitted by DEQ under its solid waste authorities.

4.2.2 Ongoing Remedy Implementation Activities

This section details the status of key components of the selected remedy. Additional details on these components are provided in Section 6.

Solid Media Components:

- ***Residential Contamination.*** The RMAP was approved in 2010 by DEQ and EPA and is currently being implemented. Some form of residential yard cleanup has been ongoing since the 1990s. No significant changes to the current program are anticipated in future remedial design efforts. Therefore, this program is reviewed in Section 6.

- ***Non-Residential Contamination***. Most major source areas in the BPSOU have been reclaimed under prior removal actions or post-ROD implementation under approved work plans. Their integrity must now be evaluated and maintained.

- ***Maintenance of Reclaimed Areas***. The BRES, described and included in the ROD, is being implemented to evaluate the condition of the source area caps. Because the BRES is being implemented, and because most of the source areas were reclaimed over 10 years ago, it is EPA's decision that the maintenance of the source areas be included in this five-year review.

Groundwater Components:

- ***Waste Left in Place***. The ROD states that certain contaminated soils and waste will be left in place in LAO and MSD. Infiltration barriers, other upgrades or source control measures, and the reclamation of the former wetland demonstration project are part of the remedial design process which is ongoing. Because these aspects of the remedy have not yet been implemented, this component is not fully evaluated in this five-year review.

- ***Metro Storm Drain Groundwater Capture and Treatment***. The ROD states that the MSD groundwater will be captured and pumped to the treatment facility at LAO for treatment. Currently this groundwater is being captured by a subdrain (French drain) installed under the MSD storm water channel. The performance of the subdrain is being evaluated and will be improved as necessary during remedial design. Because this component is part of the ongoing remedial design efforts and is not yet fully implemented, it is not fully evaluated in this five-year review.

- ***Lower Area One Groundwater Capture and Treatment***: The ROD specifies that the contaminated alluvial groundwater at LAO, along with Missoula Gulch base flow, and the BMFOU West Camp groundwater will be routed to the hydraulic control channel and Butte Treatment Lagoons for treatment. All of these groundwater components have been captured and routed to the groundwater treatment facility. The performance of the capture system is being evaluated and will be improved as necessary during remedial design, and is working within standards at the present time. Because this component is part of the ongoing remedial design efforts and is not yet fully implemented, it is not fully evaluated in this five-year review.

- ***Groundwater Treatment Facility***: The existing lagoon system at LAO (also known as the "Butte Treatment Lagoons"), as currently built, are a full-scale pilot system (required under the LAO removal action) and are not considered the final treatment facility. The existing pilot system will be upgraded to a fully-functional, modern, robust treatment facility. Because this component is part of the ongoing remedial design efforts and is not yet fully implemented, the treatment facility itself it is not fully evaluated in this five-year review. Water quality data from the treatment lagoons facility effluent will be presented to show the general effectiveness of the treatment process.

- *Groundwater Monitoring*: The ROD calls for a comprehensive groundwater monitoring program throughout the alluvial aquifer to ensure the groundwater control and capture system is effective. The details of this monitoring program are being developed as part of the ongoing remedial design efforts and it is not evaluated in this five-year review. An interim groundwater monitoring plan is in place and is being implemented, giving the agencies substantial data to assess groundwater components of the remedy.

- *Controlled Groundwater Area*: The ROD calls for the establishment of a controlled groundwater area for the BPSOU alluvial aquifer. As discussed in the BMFOU portion of this five-year review, a single controlled groundwater area – the Butte Alluvial and Bedrock Controlled Groundwater Area (BABCGWA) – was established in 2009. This component is included in the review of ICs in this five-year review.

Surface Water Components:

- *Implementation of the Surface Water Management Program*. This is a program of BMPs to reduce loading of contamination to surface water (particularly during storm events) and improve water quality in Silver Bow Creek. This is intended to be an ongoing and evolving program to identify sources of water quality degradation in Silver Bow Creek (monitoring, compliance analysis, and loading analysis), and to implement the appropriate storm water BMPs to best address the problem. Due to the varying nature and extent of storm water contamination throughout the BPSOU, this portion of the remedy was intentionally non-prescriptive.

  Surface water monitoring has been ongoing on an interim basis. Early BMPs such as curb and gutter programs, catch basin improvements, and storm water system cleanouts, have been implemented. Additional data on stormwater has also been collected and evaluated as part of the remedial design and implementation process. The Surface Water Management Program has not been finalized. Some surface water data are available to show current water quality and trends in Silver Bow Creek.

- ***Contaminated Sediment Removal.*** This portion of the selected remedy has not been implemented.

- *Capturing and Treating Storm Water Runoff*. It is too early in the implementation of the remedy to identify whether this contingency measure will need to be implemented.

- *Hydraulic Control, Capture, and Treatment of Contaminated Groundwater:* Groundwater capture and treatment is a key component of Silver Bow Creek remediation. This component is evaluated to the extent that surface water quality data are available.

- ***In-Stream Flow Augmentation***: This portion of the ROD is a contingent remedy to be implemented in the future if needed and is not evaluated in the five-year review.

Institutional Controls:

- ***Controlled Groundwater Area.*** A controlled groundwater area – the BABCGWA – was established in 2009 to serve the BMFOU and BPSOU.

- ***County Zoning and Permit Requirements***. An Institutional Controls Implementation Plan (ICIP) has been prepared by BSB and Atlantic Richfield and is near approval by the agencies.

- ***Deed notices on properties where waste was left in place or where engineering controls were constructed.*** An ICIP has been prepared by BSB and Atlantic Richfield and is near approval by the agencies

4.3 System Operations and Maintenance

There are many different O&M-type activities that are ongoing at the BPSOU. Some of these programs are more developed than others. Because the details of these programs have not been officially set in via a final work plan, many of them have been ongoing under interim conditions.

In general, ongoing O&M components at the BPSOU consist of the following:

- Ensuring permanence of the caps over mine waste through maintenance of cap integrity. This includes the BRES and implementation of any corrective actions triggered through these inspections and evaluations.

- Implementing the ongoing RMAP to address arsenic, lead, and mercury in yards and homes.

- Maintaining the stormwater structures (diversions, detention basins) built during the Stormwater and Railroad Beds TCRAs.

- Operating the Butte Treatment Lagoons groundwater treatment system.

- Operating the hydraulic controls and capture systems to collect contaminated alluvial groundwater in LAO and MSD.

- Ongoing groundwater monitoring.

- Ongoing surface water monitoring.

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Section 5
Progress Since Last Review

This is the first five-year review for the BPSOU.

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Section 6
Five-Year Review Evaluation

The BPSOU five-year review team was lead by Roger Hoogerheide, the EPA Remedial Project Manager (RPM) for the five-year review, and included EPA and State of Montana project managers of the OUs covered in the review, and technical staff from EPA's contractor, CDM, with expertise in areas of civil and environmental engineering and community involvement.

The review was initiated in October 2009 and included the following components:

- Community involvement
- Local interviews
- Document review
- Data review
- Institutional controls review
- Site Inspection

The schedule for completing this review extended through December 2010.

6.1 Community Involvement and Notification

Display ads were placed in the local papers (the Montana Standard and the Butte Weekly). The first ad announced the start of the five-year review process and ran in the Butte Weekly and the Montana Standard on September 30, 2009.

The agencies participated in three public meetings hosted by the Citizens Technical Environmental Committee (CTEC) regarding the five-year review process. The meetings were held on November 17, 2009, February 24, 2010, and March 3, 2010.

These advertisements and details of the public meetings are summarized in the community involvement and interviews memorandum included in Appendix A of Volume 1 of this five-year review report.

EPA released a draft of the five-year review report for public review and comment from December 12, 2010 through January 31, 2011. A public meeting was held on January 11, 2011. Comments received on the BPSOU are included in Appendix G.

6.2 Local Interviews

Interviews were conducted from January through March 2010 with several groups of people which included members of the general public, site neighbors, members of special interest groups such as the Citizen Action Group and Technical Action Committees, representatives of local government, and oversight personnel with direct knowledge of the project. The final list of interviewees included 94 individuals. Considering the interview questions were fairly broad in nature and were not specific to any particular OU, the responses have been summarized separately in the community involvement and interviews memorandum (Appendix A of Volume 1).

6.3 Document Review

In preparing this five-year review, the following documents were reviewed:

- Final Multi-Pathway Residential Metals Abatement Program Plan (April 2010)
- Record of Decision Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area NPL Site (September 2006)
- Butte Reclamation Evaluation System (BRES) Field Evaluations of Reclaimed Sites 2007 and 2008 – Final 2007 and 2008 BRES Recommendations Report (April 2009)
- Butte Reclamation Evaluation System (BRES) Field Evaluation of Reclaimed Sites and Final Recommendations Report 2009 (October 2009)
- 2004-2005 Construction Completion Report, Butte-Silver Bow Health Department Memorandum of Understanding-135 (November 3, 2005)
- 2005-2006 Construction Completion Report, Butte-Silver Bow Health Department Memorandum of Understanding-135 (September 12, 2006)
- 2006-2007 Construction Completion Report, Butte-Silver Bow Health Department Residential Metals Program (December 18, 2007)
- 2007-2008 Construction Completion Report, Butte-Silver Bow Health Department Residential Metals Program (January 2009)
- 2008-2009 Construction Completion Report, Butte-Silver Bow Health Department Residential Metals Program (January 2010)
- Final Surface Water Characterization Report, Butte Priority Soils Operable Unit (October 2008)
- Monitoring Report for 2008 Streamside Tailings Operable Unit Silver Bow Creek/Butte Area NPL Site (May 2009)
- Manganese Evaluation for Silver Bow Creek/Butte Area NPL site (July 2010)
- Butte Silver Bow's Municipal Storm Water System Improvement Plan (March 2009)
- Allocation and Settlement Agreement and Mutual Release of Claims By and Between the city and County of Butte-Silver Bow and Atlantic Richfield Company. (2006)

- Group 1 Settling Defendants' (Atlantic Richfield and Butte-Silver Bow) Draft Institutional Controls Implementation Plan (2009)
- Institutional Controls Strategic Plan Framework Document (May 1993)
- Amended Notice of Violation and Administrative Order on Consent. Docket No. WQ-07-07. MPDES Permit requirements under the Montana Water Quality Act, City and County of Butte-Silver Bow, Silver Bow County, Montana (FID #1364). (DEQ. August 28, 2009).
- Montana's Basin Closures and Controlled Groundwater Areas. Prepared by the Montana Water Resources Division, Water Rights Bureau, Department of Natural Resources and Conservation (DNRC) Helena. (December 2003)
- Water-Quality, Bed-Sediment, and Biological Data (October 2007 through September 2008) and Statistical Summaries of Long-Term Data for Streams in the Clark Fork Basin, Montana. U.S. Geological Survey. 2009.

ARARs identified in the 2006 ROD were reviewed to determine whether any changes have occurred since the signing of RODs that could impact the protectiveness of the remedy of the site. The results of this review are discussed in Section 7.0, under Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Selection Still Valid?

6.4 Data Review

6.4.1 Solid Media

6.4.1.1 Residential Metals Abatement Program

During the RI/FS process, EPA and the potentially responsible parties conducted extensive sampling, contaminant screening, and human health and environmental risk assessments. The results of the screening and risk assessments are presented in Section 3.6 of this report. The action levels set for arsenic, lead, and mercury in solid media are presented in Table 6-1.

The BPSOU ROD set action levels for contaminants of concern (arsenic, lead, and mercury for solid media) and requires residential areas within the BPSOU to be cleaned up if action levels are exceeded. The program to accomplish this ROD component is called the RMAP, which was recently approved by EPA in consultation with DEQ. The purpose of the RMAP is to ensure public and environmental heath of the residents of the BPSOU and the Adjacent Area (that is, the area identified in Appendix A to the final RMAP) by effectively identifying and mitigating potentially harmful exposures to sources of lead, arsenic, and mercury (BSB 2010).

Table 6-1
Soil, Dust, and Vapor Action Levels in Residential Areas

Contaminant of Concern	Exposure Scenario	Concentration
Lead	Residential	1,200 mg/kg
	Non-Residential	2,300 mg/kg
Arsenic	Residential	250 mg/kg
	Commercial	500 mg/kg
	Recreational	1,000 mg/kg
Mercury	Residential	147 mg/kg
	Residential (vapor)	0.43 micrograms per cubic meter ($\mu g/m^3$)

From Table 12-1 in the 2006 BPSOU ROD

This program requires an assessment of all residential properties within the BPSOU to occur in 10 years and all contaminated residential properties within the BPSOU to be remediated in 20 years. During the implementation of remedial design and the development of the *Final Multi-Pathway Residential Metals Abatement Program Plan* (BSB 2010), the time frames described above were requested by the implementing PRPs to address both mining and non-mining related lead, arsenic, and mercury contamination at all residential properties that exceed action levels within the BPSOU site, as well as attic dust in the defined Adjacent Area. By including the non-mining related contamination, the time frames for completion of the assessments and remediation were increased from those noted in the ROD by 2 and 5 years, respectfully. EPA, in consultation with DEQ, determined that such changes were reasonable, added to the overall protection of human health through implementation of the Multi-Pathway Program, and met basic requirements for cleanup of mining related contaminants above actions levels in yard soils and indoor dust.

Yard and attic cleanup actions are conducted on an annual basis and summarized in annual Construction Completion Reports. These reports are prepared by the Butte-Silver Bow Health Department RMAP which is implementing the RMAP on the behalf of the PRPs. The following sections describe the prioritized criteria, yard removal procedures, and a summary of both the removal and medical programs as part of RMAP.

Property Prioritization

As described in the BSB RMAP, residential properties are prioritized for remediation based on the following criteria, arranged from highest priority to lowest priority level:

- Homes occupied by one or more children with a blood lead (PbB) equal to or greater than 10 micrograms per deciliter (µg/dL) (which is considered to be an elevated blood lead [EBL]);

- Homes occupied by an individual with elevated urinary arsenic;

CDM

- Home occupied by an individual with elevated blood mercury;
- Secondary residences or subsequent homes occupied by children with elevated blood lead;
- Homes previously occupied by children with an EBL, even if no child is currently living at the address;
- Homes with very young children (e.g., less than one year) and PbB of 5 to 9 µg/dL;
- Homes with no children but with one or more sources (paint, water, soil, house dust) with a lead concentration which exceeds the 95th percentile as determined by the 1990 BSB Environmental Health Lead Study (BSB 1992). Particular attention should be given to homes built prior to 1940;
- Designated playgrounds;
- Informal play areas frequented by children with or without property owner's permission; and
- All other actual or potential residential areas.

Residential Yard Remediation (Exterior Program)
In accordance with the RMAP, an inspection and sampling program is implemented to determine whether soil throughout the property contains elevated levels of arsenic, mercury, and lead. If soil sample results are above the action level, then a yard-specific removal plan must be developed that identifies the location of the contamination, inventories site features that impact removal action, specific dates for the removal to occur, etc.

The selected remedy for the soil sampling initially required sampling at a depth of 0 to 2 inches. However, in order to better define the presence of contamination for the constituents of concern, expanded sampling in three increments (0 to 2 inches, 2 to 6 inches, and 6 to 12 inches) are sampled instead according to the RMAP. These three sampling depths will determine if contamination is present only at the surface or is at depth. If the contamination is only surficial, then ICs would not be necessary for the property after cleanup. If contamination is at depth and is not removed, ICs may be needed depending on the use of the property.

From 1990 through December 2009, a total of 1,464 yards have been sampled within the BPSOU (out of 4,000 total properties estimated as reported in Section 5.2.1 of the 2006 ROD) – first under removal authority and now under remedial authority.

Contaminated soil which exceeds action levels is removed from residential areas to a maximum depth of 12 inches or to the soil bedrock interface (if bedrock is encountered before the 12-inch depth), and to a depth of 24 inches in vegetable garden areas. Previously, a removal depth of 18 inches was prescribed in the ROD;

however, this was recently changed in the RMAP to be consistent with national EPA guidance as defined in the Superfund Lead Contaminated Residential Sites Handbook, August 2003 (EPA 2003).

From 1990 through December 2009, a total of 377 yards were determined to have exceeded action levels and have been abated within the BPSOU – first under removal authority and now under remedial authority.

At each removal location, prior to backfilling, a layer of lightweight geotextile fabric is placed over the exposed surface as a marker of the extent of soil removal/replacement and as a visual indicator that the underlying soil may contain arsenic, lead, or mercury concentrations above action levels. Backfill material may include replacement soil for yard and garden areas, pit-run gravel base for driveways, sod and/or seeding.

Other Media Abatement (Interior Program)
Other media abatement, included as part of the interior residential abatement program, includes sampling/inspection and abatement activities related to indoor dust, earthen basements, attic insulation, lead paint, and lead within pipes. If contamination is present and/or above the action level, then abatement plan must be developed that identifies the location of the contamination, inventories site features that impact removal action, specific dates for the removal to occur, etc.

Indoor dust that exceeds the action level for arsenic, lead, or mercury is thoroughly cleaned with a remediation grade/High Efficiency Particulate Air (HEPA) filter vacuum. Carpets are removed and replaced. Non-living spaces are also cleaned if an action level in those areas is exceeded and there is either a pathway allowing dust into the living space or the property owner is planning a remodel that will disturb the non-living space dust. In total, 396 houses/living spaces have been sampled for contaminated indoor dust from 1990 to December 2009 and 29 required an interior cleaning.

Soils from earthen basements that exceed actions levels are encapsulated with a surfactant, as appropriate for the space.

Attic insulation is removed in conjunction with any contaminated attic dust. In total, 444 attics have been sampled from 1990 to December 2009 and 92 attics have been abated.

Deteriorated and peeling lead paint is abated by painting walls and other surfaces with non-lead based paint. In total, 816 houses/living spaces have been inspected for lead-based paint from 1990 to December 2009 and 149 required abatement of lead-based paint.

If water testing indicates that lead within the plumbing system of a house (e.g., lead solder at pipe joints) exceeds the safe drinking water standards, piping is replaced.

To date, no houses have been identified with elevated lead in the plumbing system, and no pipe replacement has occurred.

Medical Monitoring Program
In addition to the removal actions conducted at properties, a clinical and educational intervention program is completed each year.

Blood lead screening is available to all residents of Butte-Silver Bow. Testing is conducted by the Butte Women's, Infant's, and Children's program (WIC) which is located at the Health Department. Testing is available to walk-in clients, by appointment, or by physician and RMAP referrals. In addition to blood testing, families are educated about potential lead exposures in and around their homes.

Since the inception of the program, a total of 8,568 total blood lead tests were conducted. Table 6-2 provides a summary of the number of blood lead test conducted by year with the corresponding number of blood level test results greater than 9.9 µg/dL. As shown in the table below, the number of blood lead test greater than 9.9 µg/dL has decreased significantly from 1990 to present. In the past two years, none of the tests had results greater than 9.9 µg/dL.

Table 6-2
Blood Lead Test Results by Year

Year	Number of Blood Lead Tests	Number of Blood Lead Tests > 9.9 µg/dL	Percentage of Tests with > 9.9 µg/dL
1990-1994	1044	84	8
1995	186	13	7
1996	156	11	7
1998	270	17	6.3
1999	418	14	3.3
2000-2001	447	15	3.4
2001-2002	304	15	4.9
2002-2003	759	15	2
2003-2004	921	13	1.4
2004-2005	691	4	0.6
2005-2006	762	3	0.4
2006-2007	675	3	0.4
2007-2008	940	2	0.2
2008-2009	995	0	0

Concerns Raised During Community Interviews
Several community members questioned whether or not limiting the analysis of soil samples to lead, mercury, and arsenic was protective. There were concerns that other heavy metals known to be present in Butte such as cadmium, manganese, copper, and zinc may be present at levels of concern, independent of elevated lead, mercury, or arsenic.

When the initial screening study for BPSOU soils was conducted in 1987, 23 metals and arsenic were analyzed in soil samples. These metals and arsenic were further evaluated in the site risk assessments. Based on the information obtained in the contaminant screening and risk assessments, concerning risk pathways and soil contamination relationships, EPA developed the list of COCs for the site. EPA risk assessors reviewed these actions as part of the five-year review process, and determined that the screening and risk assessments, as well as the current contaminants of concern and action levels remained valid and are protective of human health and the environment.

There was particular concern about manganese and soil contamination raised during the public input process. Because of these concerns, manganese was specifically re-evaluated during this five-year review. EPA's risk assessor found that dermal absorption and exposure had been considered in accordance with EPA Region 8 practices, which are to not quantitatively evaluate dermal exposure from metals, due to studies showing little transmission of inorganics such as metals to human receptors via dermal exposure pathways. EPA's risk assessor believes a screening risk value of 12,609 parts per million in soils is appropriate and valid for manganese. Based on a review of site data, no residential exposure areas (such as yards or playgrounds) exceed this value at the BPSOU. Accordingly, further risk evaluation of actions levels for manganese is not warranted. Manganese is not a COC for solid media at the BPSOU.

Other screening levels considered during the human health risk assessments described generally in Section 3.6 and more specifically in the 2006 ROD were also re-evaluated and EPA concluded other metals were also appropriately screened from the list of solid media contaminants of concern. Accordingly, EPA concluded that the use of the three contaminants of concern for solid media – arsenic, lead, and mercury – and their respective action levels will ensure that human health is protected at the BPSOU.

6.4.1.2 Non-Residential (Source Area) Contamination

Butte Reclamation Evaluation System

When the BPSOU ROD was completed, according to Section 5.2.2.1 of the ROD, over 422 acres of source areas had been reclaimed. Since that time, additional source areas have been reclaimed (e.g., the Granite Mountain Memorial Area). There are over 200 source areas in the BPSOU that have been capped and reclaimed and need to be maintained in perpetuity.

The BRES is identified in the ROD as the program used to evaluate the integrity of all reclaimed land, soil cover caps, or other forms of engineered caps covering mine-waste material left-in-place at the BPSOU. The BRES is also the program by which corrective actions are identified and implemented. All source areas are to be evaluated on a four-year cycle, allowing for evaluation, corrective action implementation, and site healing prior to reevaluation again in four years. This system establishes evaluation procedures for performance standards to direct the long-term monitoring, maintenance, and corrective action of response actions to which it applies. The BRES will ensure that response actions and future remedial actions are maintained at a level that provides for the continuous protection of human health and the environment and compliance with ARARs.

Under BRES procedures, source areas are often divided into smaller units called polygons. Polygons are used when different areas of a site have different land uses (e.g., field vs. drainage ditch or sloping vs. flat, etc.), and should be evaluated as distinct units. For example, the top of a reclaimed waste dump may be a polygon that meets standards, but the side slope, which is a separate polygon, may be a different polygon that requires a corrective action due to an erosion gully. A corrective action would only be required on that polygon, not the entire site. The BRES method requires the evaluation of vegetation condition, site stability (erosion condition), and other parameters important to ensuring that the reclaimed areas are performing as expected and thereby remaining protective of human health and the environment and compliant with ARARs.

The parameters evaluated during the BRES field work are:

- Site edge condition;
- Exposed waste;
- Bulk soil failure;
- Barren areas;
- Gullies;
- Vegetation cover (scored by polygon); and
- Erosion (scored by polygon).

Site evaluation forms for all the BRES monitored sites are included in Appendix D.

Following a site evaluations, the evaluator then uses the decision logic diagrams provided in the BRES document (EPA 2006b) to determine what, if any, additional reclamation work is needed. These recommendations fall into one of three general categories:

- Develop a vegetation and/or reclamation improvement plan and implement that plan.
- Perform an engineering assessment and implement possible engineered (soil stability) controls.
- Monitor again at the next BRES evaluation in four years.

Corrective actions plans are then developed, approved, and implemented the year following the evaluation. All source areas will undergo another full BRES evaluation three years following the corrective action work (allowing sufficient time for reclamation work to heal prior to reevaluation).

The technical recommendations for each of the sites/polygons are used by BSB, DEQ, and EPA to guide further site investigations and maintenance actions. The site team reviews site specific BRES data for each sites/polygons that have trigger items and incorporate any site specific modifying criteria deemed necessary for making decisions that are logical from a management standpoint. The site team may decide on a different recommendation after taking into consideration the modifying criteria (i.e., land ownership, severity of trigger items, land use, etc.). EPA has final approval authority, in consultation with DEQ, for all corrective action plans.

2007 and 2008 BRES Field Evaluations

The 2007 field season was the first time the BRES was used to evaluate previously reclaimed sites within BPSOU. Activities performed during the first season of the BRES implementation included: the development of the BRES tracking database, pre-evaluation office preparation for the field work, field evaluator training, and actual field evaluations of reclaimed sites.

The 2008 field season was similar to the 2007 field season with the exception that there were ten field evaluators from the Clark Fork Watershed Education Program (CFWEP) used to assist with performing the BRES evaluations. The CFWEP were contracted by BSB to assist BSB personnel with the 2008 BRES field evaluations. Additional details regarding the 2007 and 2008 BRES field evaluations are provided in the *Butte Reclamation Evaluation System (BRES) Field Evaluations of Reclaimed Sites 2007 and 2008 – Final 2007 and 2008 BRES Recommendations Report* (CDM 2009).

During the 2007 and 2008 BRES field season, a group of previously reclaimed sites located throughout the entire BPSOU were selected to be evaluated. Table 6-3 provides a summary of the 2007 and 2008 BRES Field Evaluation.

The "number of triggers" summarized in Table 6-3 is a count of the number of times a particular trigger item was discovered. Because one site could have more than one trigger item, the total number of trigger items (234) exceeds the number of sites (100). The next column, "triggers per site or polygon" is the number of triggers divided by the number of sites and indicates the likelihood that a particular trigger item will be encountered (e.g., 61 percent of the sites had a site edge condition). The "trigger type frequency" is the number of triggers in a specific category divided by the total number of triggers, and is an indication of how likely that particular category of trigger occurred (e.g., if a trigger item was found, it was a barren area 25 percent of the time). This can indicate if any particular type of trigger item is more problematic throughout the BPSOU than others.

Table 6-3
2007 and 2008 BRES Field Evaluation Summary

Trigger Item	Number of Sites/ Polygons	Number of Triggers	Triggers per Site or Polygon	Recommended Corrective Action	Trigger Type Frequency
Site Edge Condition	100 Sites	61	61%	M	26%
Exposed Waste		60	60%	EV	26%
Bulk Soil Failure		14	14%	EV	6%
Barren Areas		58	58%	VI	25%
Gullies		41	41%	EV	17%
Total		234	---	---	100%
Polygon-Specific					
Vegetation	140 Polygons	43	31%	VI	74%
Erosion		15	11%	EV	26%
Total		58	---	---	100%

M = Monitoring
EV = Engineering Evaluation
VI = Vegetation Improvement
Number of Triggers = number of times a trigger item was discovered
Triggers per Site/Polygon = number of triggers divided by number of sites or number of polygons
Trigger Type Frequency = number of triggers divided by number of total triggers

It is recommended that these percentages be calculated in subsequent five-year reviews. As this is the first time these sites have undergone a BRES evaluation, any improving, stable, or deteriorating trends over time cannot be discerned. As these sites are monitored over time and corrective actions are taken, these percentages measuring the frequency of trigger items encountered should decrease. This will be a useful metric for measuring the long-term maintenance of these reclaimed caps.

The next scheduled BRES field evaluation for the sites inspected during the 2007 and 2008 field evaluations will be in 2011 and 2012, respectively. The effectiveness of the recommended corrective actions presented above will be evaluated at that time.

2009 BRES Field Evaluations
The 2009 field season was similar to the 2007 and 2008 field season with the exception that five local teachers and six students, trained during the 2009 field season by the CFWEP and CDM, were used to assist with performing the BRES evaluations. Following training, the evaluators formed groups of two, which included one teacher and one student. Four of the groups included members who were BRES field evaluators in 2008. Additional details regarding the 2009 BRES field evaluations are provided in the *Butte Reclamation Evaluation System (BRES) Field Evaluation of Reclaimed Sites and Final Recommendations Report 2009* (CFWEP 2009).

During the 2009 BRES field season, a group of previously reclaimed sites located throughout the entire BPSOU were selected to be evaluated. These sites included standard reclaimed source area sites, recreational use sites reclaimed as walking trails and a number of other sites along the railroad tracks, many of which were reclaimed as stormwater conveyance and catchment areas. Table 6-4 provides a summary of the 2009 BRES Field Evaluation.

The next scheduled BRES field evaluation for the sites inspected during the 2009 field evaluations will be in 2013. The effectiveness of the recommended corrective actions presented above will be evaluated at that time.

According to Tables 6-3 and 6-4, a significant number of the evaluated sites require a corrective action to meet the performance standard in the BRES. BSB has submitted a limited number of BRES corrective action work plans for these sites; however, BSB indicated that O&M-type work had been completed on some of these sites outside of the formal EPA-approval process. These activities include weed spraying, fence mending, planting of native species, shrubs, and trees, and the addition of soil on sites where it was needed. Some of the BRES recommendations for corrective actions at source areas were implemented, but not systematically documented.

Table 6-4
2009 BRES Field Evaluation Summary

Trigger Item	Number of Sites/ Polygons	Number of Triggers	Triggers per Site or Polygon	Recommended Corrective Action	Trigger Type Frequency
Site Edge Condition	206 Sites	119	58%	M	43%
Exposed Waste		75	36%	EV	27%
Bulk Soil Failure		6	3%	EV	2%
Barren Areas		51	25%	VI	18%
Gullies		29	14%	EV	10%
Total		280	---	---	100%
Polygon-Specific					
Vegetation	221 Polygons	41	19%	VI/RI	79%
Erosion		11	5%	EV	21%
Total		52	---	---	100%

M = Monitoring
EV = Engineering Evaluation
VI = Vegetation Improvement
Number of Triggers = number of times a trigger item was discovered
Triggers per Site/Polygon = number of triggers divided by number of sites or number of polygons
Trigger Type Frequency = number of triggers divided by number of total triggers

There were many sites requiring an engineering evaluation prior to a corrective action (see Tables 6-3 and 6-4). BSB is either not taking the necessary corrective actions on these sites or is not sufficiently documenting the work. An example of a corrective action form is included in Appendix E. The information captured on these forms is insufficient for a site needing significant corrective action work.

At present, EPA and BSB are developing a new form that will be used in developing and documenting corrective actions for the source area sites to address this problem. These forms will clearly document what and where all of the corrective actions were taken and will serve as a work plan and construction completion report. These documents will be placed in EPA's formal records and in the EPA Butte office, and EPA will ensure that appropriate follow-up action is taken and documented in each case.

Thus, many BRES-recommended corrective actions have not yet been implemented on these source areas. This is contrary to the schedule set forth in the BRES - that sites with trigger items receive the appropriate corrective action the following calendar year, so that any reclamation work would have three years to heal prior to the next BRES evaluation. For the first set of sites evaluated in 2007, this window of opportunity has passed. These sites are to be evaluated in 2011 but corrective action work has not yet been completed.

During community interviews, concerns about the condition and maintenance of the reclaimed caps were brought up frequently. People were not only worried about eroding caps resulting in exposed mine waste, but also that the high quality soil was eroding and being lost to the storm sewer system and to the stream. It was also discussed that storm water run-on from improper storm water routing upgradient of source areas was an issue that could cause erosion and cap failure.

EPA personnel continually conduct site visits to source areas located throughout Butte and Walkerville. There have been no outright cap failures. Furthermore, there has been no severe erosion problems associated with the Source Areas, despite the problems identified above. EPA has been working with BSB and the other PRPs to ensure corrective actions will be documented and completed on all BRES sites as soon as possible. The EPA is also meeting with BSB storm water personnel to conduct visits of storm water structures to make sure they are working properly.

6.4.2 Groundwater

The initial cleanup work for LAO was completed in 1997 under removal authority when substantial volumes of tailings and contaminated soil were from the area. Removing the tailings from the active stream floodplain mitigated the threat of a catastrophic failure or release of those tailings downstream, and also improved chronic releases to the stream of hazardous substances. Since the removal action at LAO, different treatability studies were performed on contaminated site groundwater. It was known that groundwater capture, control, and treatment would be a required site remedial component, particularly because inaccessible mine waste (e.g., under the municipal wastewater treatment plant) was left in place. Over time, a capture system known as the hydraulic control channel, and a capture system at MSD were implemented. These captured waters are then transported to the Butte Treatment Lagoon system for treatment and discharge into Silver Bow Creek. The pilot-scale Butte Treatment Lagoons were expanded to handle the BPSOU alluvial groundwater, as well as the West Camp groundwater. The BPSOU ROD incorporated these elements into the groundwater treatment and capture component of the selected remedial action.

The effectiveness of current alluvial groundwater capture continues to be evaluated by EPA through the installation of additional groundwater monitoring wells, tracer studies and pumping tests in the MSD, and a dense network of surface water monitoring locations in Blacktail and Silver Bow Creeks. For example, increases in copper concentrations and loading measured at the lower end of the slag canyon in Silver Bow Creek resulted in the need for an extension of the hydraulic control channel farther to the east. This extension now captures groundwater with high copper concentrations that was entering Silver Bow Creek. This important action to improve base flow water quality was implemented in 2010. Evaluating the effectiveness of groundwater capture through a review of water levels and surface water chemistry will be part of future five-year review reports.

The Butte Treatment Lagoons have been operating for some time and have a substantial body of data associated with the performance of the lagoons, so that the performance of the Butte Treatment Lagoons system will be presented to show the anticipated effluent water quality from the final treatment system.

At the Butte Treatment Lagoons, groundwater is treated with lime and then flows through one of three series of three settling ponds. By operating the settling ponds in parallel, one set of ponds can be taken offline for maintenance, while allowing the other two to keep operating. The series of settling ponds facilitate settling of nearly all precipitates in the first pond, and then polishing of remaining suspended precipitates in the final two ponds.

The treatment chemistry is not fundamentally different than that of a conventional lime treatment facility. The primary difference is that settling ponds are used for the settling of sludge, rather than using clarifiers. In addition, the sludge generated is not recycled as it is in a high-density sludge process (like at the Horseshoe Bend Treatment plant for the Berkeley Pit). Recycling of sludge is used in conventional plants to speed metals precipitation and ensure efficient use of lime.

The ROD states that the Butte Treatment Lagoon system would be used for treatment of BPSOU groundwater, as long as issues concerning long-term performance and sludge removal and disposal are adequately addressed. The ROD cites more effective treatment of cadmium as compared to conventional treatment plants as one of the primary reasons for its selection.

Because the upgrades to the Butte Treatment Lagoon system are in the design phase, performance issues related to the internal workings of the system are not discussed in this five-year review. Thus, the data presented are limited to the influent and effluent discharge chemistry of the current treatment system.

Figures 6-1 through 6-5 show influent and effluent chemistry over time for arsenic, cadmium, copper, lead, and zinc. Discharge standards are calculated according to

DEQ-7 water quality criteria at the hardness of the discharge. Because the hardness is frequently greater than 400 milligrams per liter (mg/L) as $CaCO_3$, the standard is calculated at this maximum allowed hardness. Typically the hardness only decreases below 400 mg/L as $CaCO_3$ during spring, when collected groundwater is diluted slightly by infiltrating snowmelt and spring rains.

As the graphs show, the treatment system usually removes the COCs to well below required discharge standards. EPA believes that this indicates the initial success of the selection of this system for treatment of contaminated water. The few times that exceedances have occurred have been directly related to interruptions in the lime addition system (e.g., lime delivery system clogging, etc.). As noted, issues that can affect long-term operation and reliability (chemical addition, sludge removal, contingencies for upsets) are being addressed in remedial design, and a permanent and sustainable treatment system should result. The full system will again be evaluated in the next five-year review.

6.4.3 Surface Water

The selected remedy for surface water at BPSOU, as summarized in Section 4 of this report, is a combination of several elements, some of which have already been implemented. Three general action elements were defined to meet these objectives (detailed requirements are described in the ROD [EPA 2006a]):

- Surface Water Management Program. This program uses BMPs and engineered controls to address runoff of contaminated storm water. This has been partially implemented by construction of some caps at additional source areas, diversion ditches, a curb and gutter program, storage system cleanouts, and stormwater ponds in select areas. More BMPs and engineered controls are required to meet ARARs and ROD objectives.

- Source control along streams. Removal of wastes, contaminated soil, and sediments along the surface water bodies in the OU is required as described in the Butte Site ROD. In addition to the removals previously conducted at LAO, streambank removal actions are required from above the confluence with Blacktail Creek and MSD to the beginning of the reconstructed Silver Bow Creek channel. This action has not yet been implemented, but will be as remedial design continues.

- Capture and treatment of contaminated ground water. Capture systems have been implemented at MSD and LAO with the captured water being treated at the Butte Treatment Lagoons. These capture systems are undergoing evaluation, re-design, and upgrades as part of the remedial action to ensure long-term permanence and ARAR compliance. Of particular importance is ensuring contaminated groundwater is not bypassing the LAO and MSD capture systems and causing exceedances in Silver Bow Creek.

Contingency elements will not be implemented until the remedies above are in place.

Remedial Activities since Issuance of the ROD

The BPSOU ROD described the response activities undertaken at BPSOU up to 2006 (EPA 2006a). The primary pre-2007 activities that impacted surface water quality were:

- Removal of waste and reconstruction of the Silver Bow Creek channel from Butte Reduction Works to the surface water sampling location on Silver Bow Creek below the wastewater treatment plant (SS-07);
- Installation of the hydraulic control channel and construction of the Butte Treatment Lagoons System at LAO;
- Installation of the MSD subdrain and reconstruction of the MSD channel;
- Reclamation of source areas throughout the OU; and
- Installation of storm water controls.

Since that time, the following activities have been undertaken as described in the *Final Surface Water Characterization Report Butte Priority Soils Operable Unit* (CDM 2008):

- Operation of the MSD and hydraulic control channel collection systems;
- Operation of the LAO treatment lagoons;
- Inspections of reclaimed areas; and
- Monitoring of base flow and storm flow surface water.

6.4.3.1 Performance Standards

The ROD defined performance standards for surface water as narrative and numeric water quality standards described in Section 8 and Appendix A of the ROD. The most pertinent numeric standards for the Butte Site surface water COCs are shown in Table 6-5.

Table 6-5
Numeric Water Quality Standards at the BPSOU

Contaminant	Human Health Standard (µg/L)	Chronic Aquatic Standard (µg/L)	Acute Aquatic Standard (µg/L)	Notes
Aluminum	--	87	750	Dissolved fraction
Arsenic	10	150	340	
Cadmium	5	0.097	0.52	Hardness-dependent
Copper	1,300	2.85	3.79	Hardness-dependent
Iron	--	1,000	--	
Lead	15	0.545	13.98	Hardness-dependent
Mercury	0.05	0.91	1.7	
Silver	100	--	0.374	Hardness-dependent
Zinc	2,000	37	37	Hardness-dependent

Note: All standards are based on total recoverable analysis except for aluminum.

µg/L = micrograms per liter

Hardness-dependent chronic and acute aquatic life standards are variable based on formulae contained in Circular DEQ-7, February 2006 edition. Values in this table are calculated at a hardness of 25 mg/L. Any result greater than the acute standard is an exceedance. A four-day average of results greater than the chronic standard is an exceedance. Results indicated as base flow are assumed to be equivalent to a four-day average. Base flow results are compared to chronic standards since base flow should be representative of a longer than four-day average of COC concentrations. Storm water results are compared to acute standards since this represents a discrete value that is rapidly changing.

A map showing the surface water sampling stations in the BPSOU is shown on Figure 6-6 and listed as follows:

In-Stream Stations:

- SS-01 (Blacktail Creek at Harrison Avenue, United States Geological Survey [USGS] station 123231230)
- SS-04 (Blacktail Creek above Metro Storm Drain, USGS station 12323240)
- SS-05 (Silver Bow Creek below MSD and Buffalo Gulch)
- SS-05A (Silver Bow Creek below “slag canyon”)
- SS-06A (Silver Bow Creek below new channel below Catch Basin 9)
- SS-06G (Silver Bow Creek below treatment lagoon effluent)

- SS-07 (Silver Bow Creek below wastewater treatment plant)
- GG-01 (Grove Gulch)

Surface water standards do not apply to MSD, Buffalo Gulch, and Missoula Gulch.

The data show that these actions have significantly improved surface water quality, when comparing water quality data from the 1980s to today's water quality data. Concentrations have improved an order of magnitude in this time period, and this progress is more specifically described in section 6.4.3.4 below. Fish are now found in Silver Bow Creek in the Butte and BPSOU area.

A comprehensive characterization study of current surface water in the BPSOU was conducted in October 2008. That study presents a summary and interpretation of surface water quality data collected at the BPSOU of the Silver Bow Creek/Butte Area NPL Site since 2005, as required by the BPSOU ROD. The report is titled *Final Surface Water Characterization Report Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area National Priorities List Site* (CDM 2008). The following sections provide a brief summary of the compliance analysis conducted at the site.

Copper exhibits the highest rate of exceedances during base and high flow, and has been the most challenging of the COCs to bring into compliance. Therefore, the discussion and analysis will focus primarily on copper. As copper exceedances are mitigated, it is expected that concentrations of the other mining-related COCs will also decrease. Zinc is also briefly discussed as it has higher concentrations, particularly during storm events. Other surface water COCs are presented in the 2008 report; however, because their exceedances are less frequent or non-existent as compared to copper and zinc, their results have not been elaborated upon.

6.4.3.2 Base Flow Conditions

Copper

Base flow copper concentrations at SS-07 have been sampled periodically as shown on Figure 6-7 since September 2005 and are compared with the DEQ-7 chronic surface water standard. Dissolved copper during base flow has generally stabilized since August 2006 varying from around 0.01 mg/L. Total recoverable copper during base flow has stabilized between 0.011 and 0.028 mg/L since August 2006. The gap between dissolved and total recoverable has remained indicating colloids or suspended fine sediments containing copper are still present in Silver Bow Creek. In most instances, total recoverable copper concentrations remained above the chronic standard for the period shown.

Base flow copper concentrations since 2005 at SS-06G are shown in Figure 6-8. Dissolved copper concentrations are relatively stable ranging from 0.0017 to 0.017 mg/L after August 2006. Total recoverable copper is greater than dissolved and shows a seasonal fluctuation with higher concentrations generally during winter months.

Base flow copper concentrations since 2005 at SS-06A are shown in Figure 6-9. Similar to SS-06G, total recoverable copper is greater than dissolved and shows a seasonal fluctuation with higher concentrations during winter months. At this station, the total recoverable copper predominantly exceeded the chronic standard. Dissolved copper was predominantly below the chronic standard.

Base flow copper concentrations since 2005 at SS-05A are shown in Figure 6-10. Dissolved copper concentrations are relatively stable ranging from 0.0018 to 0.0137 mg/L after August 2006. Total recoverable copper is greater than dissolved by up to two times the dissolved concentration. Seasonality is not readily apparent at this location. In 2009, dissolved copper was well below the chronic standard and total recoverable copper was approximately equal to the chronic standard.

Base flow copper concentrations at station SS-05 since 2005 are shown on Figure 6-11. Dissolved copper concentrations are low with the exceptions of March 2, 2006 and May 9, 2007. The March 2, 2006 elevated copper values are consistent throughout all stations for that day, possibly indicting a runoff event that was categorized as base flow. The May 9, 2007 dissolved concentration is approximately double the total recoverable concentration indicating an error in the data. The total recoverable copper concentrations are near the chronic standard with the exception of March 2006. Since the remedial action goal is to meet water quality standards at all times, further work is needed upstream of SS-05 to meet the remedial action goals. The primary sources upstream of SS-05 are Buffalo Gulch and MSD and possibly uncaptured groundwater influx. On November 18, 2009, the data shows an elevated spike of total recoverable copper. During this sampling event, a beaver dam was breached by BSB personnel above the SS-04 station. The results of this dam breach are evident at this sampling location, as well as SS-04. Total copper measured above the dam site, as SS-01, reflected a more typical copper value. Thus this data point does not indicate a seasonal winter-time impact, but is more reflective of the turbidity caused by the release of this beaver dam.

Station SS-04 is upstream of the BPSOU. Base flow copper concentrations since 2005 are shown on Figure 6-12. Dissolved copper concentrations have been very stable since August 2006 remaining below 0.007 mg/L. Total recoverable copper concentrations are lower than at SS-05 with most values falling below 0.010 mg/L, with a couple exceptions. Seasonal peaks occurred in December 2006, December 2007, and November 2008. The large spike in total recoverable copper was the result of the beaver dam breach described above.

Station SS-01 is upstream of Grove Gulch and represents water quality entering the OU (Figure 6-13). Other than one sampling event in 2006, all copper concentrations are moderately low and were below the chronic standard during the majority of sampling events. There is less separation between total recoverable and dissolved values.

Copper concentrations at Grove Gulch station GG-01 since 2005 are shown in Figure 6-14. At times, there is no flow at GG-01, so the sample set is smaller than stations on the mainstem. The three samples collected from September 2005 to May 2006 exceeded the chronic standard for total recoverable copper while more recent samples did not exceed. Additionally, there is little difference between total recoverable and dissolved copper results in the 2007-2008 data.

A bar and whisker graphical summary of statistics of the compliance ratio for total recoverable copper since 2005 is shown in Figure 6-15. The compliance ratio is calculated by dividing the analyte concentration by the compliance standard. A ratio calculated greater than one indicates an exceedance of the standard. This simplification is needed to allow presentation of statistics when the standard varies based on water hardness. The upstream end of the system at SS-01 contains total recoverable copper at approximately half of the chronic aquatic standard. Results from downstream stations SS-04, SS-05 and SS-05A indicate that a significant total recoverable copper load enters the stream through this reach. Total recoverable copper concentrations at SS-05A are normally about 1.5 times the standard. From SS-05A to SS-07 there is little change in the compliance ratio. This indicates the primary sources affecting compliance with the copper standard lie between SS-04 and SS-05A. Median dissolved copper compliance ratios were less than 1 for all in-stream monitoring stations; however, maximum concentrations all exceed the ratio of 1 as shown Figure 6-16.

The difference between dissolved and total recoverable copper increases in a downstream direction indicating that copper entering the surface water during base flow contains or generates a suspended solid fraction containing copper. Seasonality of total recoverable copper concentrations is seen at most stations, with peak concentrations occurring during late fall or early winter. The cause is currently under investigation.

Zinc

Base flow zinc concentrations at station SS-07 since 2005 are shown on Figure 6-17. Prior to February 2007, some of the samples show a distinct difference between total recoverable and dissolved fractions including two results where dissolved was greater than total recoverable (this could be a data entry error where total and dissolved results were switched). After February 2007, the difference was insignificant. A decline in zinc is shown from 2005 to December 2009 with the only exceedances occurring prior to 2007. Samples collected since 2007 are well below the chronic standard for zinc.

Zinc concentrations in surface water at SS-06G since 2005 are shown on Figure 6-18. A seasonal pattern is present with highest total recoverable zinc concentrations occurring during the winter, with the exception of a total recoverable zinc result from October 2008. No exceedances occurred during the period as shown on the figure.

Zinc concentrations in surface water at SS-06A since 2005 are shown on Figure 6-19. The seasonal pattern seen in SS-06G is also apparent in SS-06A. Only one exceedance for total recoverable zinc was observed on September 12, 2006.

Figure 6-20 shows zinc concentrations at SS-05A since 2005. The seasonality of total recoverable zinc values is only obvious during the winter of 2006-2007 when one exceedance occurred.

Zinc concentrations in surface water at SS-05 since 2005 are shown on Figure 6-21. The pattern is similar to SS-06A with no exceedances during the period shown.

Figure 6-22 shows zinc concentrations at SS-04 since 2005. The seasonal pattern for total recoverable zinc is clear at this station during the winters of 2005-2006 and 2006-2007. Most recently, this seasonal pattern is less apparent where most of the results were either nondetected or qualified as estimated. No exceedances occurred during the period shown, with the exception of one sampling event on November 18, 2009 when a beaver dam was breached by BSB personnel.

At station SS-01 shown in Figure 6-23, the results are similar to SS-04 with the more recent results being nondetected or qualified as estimated. The effects from the beaver dam breach are not apparent at this sampling station.

Zinc concentrations at GG-01 are shown on Figure 6-24. Only one result has equaled the chronic standard for zinc for the period. Since June 2006, all results have been far below the standard.

A graphical summary of the total recoverable zinc compliance ratio since 2005 is shown in Figure 6-25. Many of the results at the upstream stations are nondetected and the detection limit was substituted for the result during calculations, so the statistics for these stations are probably skewed slightly high. Exceedances of the chronic standards are rare for zinc at base flow conditions. The compliance ratios for total recoverable zinc are well below unity for all statistics except for the maximum. Median and maximum dissolved zinc concentrations are in compliance as shown in Figure 6-26.

6.4.3.3 Storm Water Conditions

For the compliance analysis of storm water, only data since 2005 were evaluated because they represent the data collected since implementation of the most recent major BMPs (i.e., MSD reconstruction). There were 42 storm events that were monitored from 2005 to 2009. No data were collected during the winter months due to freezing conditions.

The following analysis evaluates in-stream COC concentrations against the acute aquatic life standards. Because storm water data are inherently variable, the data are presented to highlight the median concentrations and to show the ranges in the data.

The explanation of how the dataset was utilized and how the statistics were calculated (i.e., which samples were included and not included and why) can be found in the text of the 2008 surface water interpretation report. These details are not repeated here.

Copper

Storm flow copper concentrations at station SS-07 since 2005 are shown on Figure 6-27. Total recoverable copper concentrations significantly exceed the acute aquatic standard during all sampling events during the report period. Large fluctuations in concentration are evident between sampling events. Dissolved copper concentrations also exceed the standard; however, these exceedances are not as significant.

Copper concentrations in surface storm water at SS-06G since 2005 are shown on Figure 6-28. Concentrations for total recoverable and dissolved copper are similar to SS-07 and exceed the acute standard on most dates.

Copper concentrations in surface storm water at SS-06A since 2007 are shown on Figure 6-29. The yearly results fluctuated significantly through each sampling period but ultimately exceeded the acute standard on most occasions.

Copper concentrations in surface storm water at SS-05A since 2005 are shown on Figure 6-30. Total recoverable and dissolved concentrations exceeded the acute standard on all but a few sampling events.

Copper concentrations in surface storm water at SS-05 since 2005 are shown on Figure 6-31. Total recoverable and dissolved copper generally exceeded the acute standard. Total recoverable copper exceeded on all but two occasions, whereas dissolved copper exceeded on all but four occasions.

Copper concentrations in surface storm water at SS-04 since 2005 are shown on Figure 6-32. During the 2005 sampling events, only one total recoverable copper sample was below the acute standard; in 2006 all samples exceeded; in 2007 two samples were below the standard; and in 2008 and 2009, all samples exceeded the standard. In general, dissolved copper was below the standard with the exception of several sampling events through the period shown.

Copper concentrations in surface storm water at SS-01 since 2007 are shown on Figure 6-33. A storm water monitoring station was not established until 2007. All total recoverable copper concentrations were above the acute aquatic standard. All dissolved copper concentrations, except for a few samples, were above the standard.

Copper concentrations in surface storm water at GG-01 since 2005 are shown on Figure 6-34. All total recoverable copper concentrations were above the acute aquatic standard, except one in 2005. All dissolved copper concentrations were below the standard, except one in 2008.

Figure 6-35 shows the box and whisker plot of in-stream copper storm water data since 2005. Median total recoverable copper compliance ratios exceed 1 for all in-stream monitoring stations, and frequently are between 5 to 20 times the standard. Maximum compliance ratios are several hundred times the standard. Minimum compliance ratios are also generally greater than one, indicating that downstream of SS−05, Silver Bow Creek is almost never in compliance with the acute aquatic life standard. Median dissolved copper compliance ratios exceed 1 for all in-stream monitoring stations except for SS-04, as shown in Figure 6-36.

For completeness, summary statistics of all the BPSOU COCs (aluminum, arsenic, cadmium, copper, lead, mercury, silver, and zinc) for the different stations are also presented in the *Final Surface Water Characterization Report Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area National Priorities List Site* (CDM 2008). Examination of the statistics for COCs other than copper, cadmium, and zinc indicates that mercury, silver, and lead also show occasional exceedances. Arsenic rarely shows exceedances of the 340 micrograms per liter (µg/L) acute aquatic life standard.

Zinc

Storm flow zinc concentrations at station SS-07 since 2005 are shown on Figure 6-37. Total recoverable zinc exceeded the acute standard on all but one occasion in 2007 whereas dissolved zinc concentrations did not exceed the standard.

Zinc concentrations in surface storm water at SS-06G since 2005 are shown on Figure 6-38. Total recoverable zinc concentrations exceed the acute standard on most occasions. Dissolved concentrations of zinc were below the standard during all sampling events.

Zinc concentrations in surface storm water at SS-06A are shown on Figure 6-39. Samples were only collected in 2007 at this location. Total recoverable zinc was below the acute standard on several occasions in 2007 and 2008, but exceeded the standard on all occasions in 2009. Dissolved zinc concentrations were below the standard during all sampling events, with the exception of three samples in 2009.

Zinc concentrations in surface storm water at SS-05A since 2005 are shown on Figure 6-40. Total recoverable zinc was above the acute standard on all occasions in 2005 and during the majority of sampling events from 2006 through 2009. Dissolved zinc concentrations were below the standard most of the time, with a few exceedances in 2008 and 2009.

Zinc concentrations in surface storm water at SS-05 since 2005 are shown on Figure 6-41. Total recoverable zinc generally exceeded the acute standard with a few exceptions. Dissolved zinc concentrations were below the standard with the exception of several exceedances in 2007, 2008, and 2009.

Zinc concentrations in surface storm water at SS-04 since 2005 are shown on Figure 6-42. SS-04 is the first upstream sampling location where the majority of the total recoverable zinc concentrations are below the acute standard; however, several sampling events did exceed the standard. All dissolved zinc concentrations were below the acute standard.

Zinc concentrations in surface storm water at SS-01 since 2007 are shown on Figure 6-43. Total recoverable zinc concentrations fluctuated above and below the standard from 2007 through 2009. All dissolved zinc concentrations were below the acute standard, with the exception of one event in 2009.

Zinc concentrations in storm water at GG-01 since 2005 are shown on Figure 6-44. All total recoverable zinc concentrations were below the acute aquatic standard, except two. These two samples were just slightly above the standard. All dissolved zinc concentrations were below the standard.

Figure 6-45 shows the box and whisker plot of in-stream total recoverable zinc storm water data since 2005. For zinc, median total recoverable compliance ratios exceed 1 for stations SS-05 and downstream through SS-07. Median dissolved zinc concentrations are in compliance as shown on Figure 6-46.

6.4.3.4 Silver Bow Creek Historic Concentrations

Surface water station SS-07 (USGS station 12323250) is the farthest downstream point of compliance before Silver Bow Creek exits the OU and also historically has had the worst water quality of any station on the perennial streams in the OU. Historic concentrations for arsenic, cadmium, copper, iron, lead, manganese, and zinc from 1993 through 2009 are presented in Figures 6-47 through 6-53. These data were obtained through a query of the online USGS database. The approximate dates of significant removal action milestones that improved water quality are also shown on these figures for reference.

It is important to note that station SS-07 was chosen for this data presentation due to its long period of record. However, station SS-07 is located just below the outfall of the municipal wastewater treatment plant. The discharge from the wastewater treatment plant contains metals, and, depending on the flow, it can affect water quality at this station. Thus, not all water quality exceedances at this station in recent years are attributable to residual wastes or groundwater inflow along the Silver Bow Creek floodplain. Some of the exceedances may be in part due to the wastewater treatment plant discharge.

COC concentrations in Silver Bow Creek have decreased dramatically since 1993 due to removal actions, storm water controls, and the control, capture, and treatment of alluvial groundwater in the MSD and at LAO. The milestones shown on the graphs correspond not only to when major construction activities occurred, but also when additional groundwater was routed to the treatment system. Chronic aquatic life standards, while not met all of the time for all COCs, are starting to be met. This is a significant accomplishment.

Arsenic

Figure 6-47 presents the historical concentrations of total recoverable and dissolved arsenic, as well as significant milestones. Starting in 1993, total recoverable arsenic concentrations have significantly exceeded the human health standard of 10 µg/L. Following completion of the LAO ERA, total recoverable concentrations began to decrease. A decreasing trend continued following treatment of all groundwater at LAO. Following completion of the MSD and treatment of all groundwater from the MSD, the concentrations of arsenic have generally been below the human health standard. Seasonal fluctuations have become apparent starting in 2006, with higher concentrations observed in the summer months and lower concentrations in the winter months. The summer concentrations have slightly exceeded the human health standard since 2006 with the exception of the summer of 2007. Dissolved concentrations showed a similar trend; however, dissolved concentrations were typically below the human health standard for much of the historical period, with the exception of a few isolated exceedances.

Cadmium

Figure 6-48 presents the historical concentrations of total recoverable and dissolved cadmium, as well as significant milestones. Starting in 1993, total recoverable and dissolved concentrations of cadmium fluctuated above and below the acute aquatic and human health standard; however, they consistently exceeded the chronic aquatic standard. Following completion of the LAO ERA, cadmium concentrations were typically below the acute aquatic standard but still generally above the chronic standard. Following the treatment of all MSD groundwater, all cadmium concentrations were below both human health and acute and chronic aquatic standards.

Copper

Figure 6-49 presents the historical concentrations of total recoverable and dissolved copper, as well as significant milestones. Starting in 1993, total recoverble and dissolved copper concentrations were significant higher than the chronic and acute aquatic standard. The completion of the LAO ERA reduced total copper concentrations significantly; however, the concentrations still exceeded the standards. Following the treatment of all MSD groundwater, total recoverable copper concentrationss have stabilized; however, continue to exceed the acute and chronic standard on most occassions. The dissolved copper concentrations have generally remained below the acute and chronic standard with the exception of a few instances.

Iron

Figure 6-50 presents the historical concentrations of total recoverable and dissolved iron, as well as significant milestones. Until the completion of the LAO ERA in 1998, total recoverable iron was greater than the human health standard. Seasonal fluctuations are evident, particularly post-1998 with a more prenounced pattern post-2005, following treatment of all MSD groundwater. During this report period, total iron concentrations have been below the chronic aquatic standard and above the human health standard mainly during winter and spring months. Dissolved iron concentrations have been below both the chronic aquatic and human health standard since 1993.

Lead

Figure 6-51 presents the historical concentrations of total recoverable and dissolved lead, as well as significant milestones. Starting in 1993, total recoverable lead concentrations exceeded the human health and chronic aquatic standards much of the time, with several exceedances of the acute aquatic standard. Following completion of the LAO ERA, total recoverable lead concentrations declined until the reconstruction of the MSD. In 2003, total recoverable lead was below the human health and acute aquatic standard; however, continued to exceed the chronic standard occasionally. In 2005, there was a sudden spike in total recoverable lead; however, the lead concentration has since stabilized through 2009. This spike was likely related to construction activities in the Metro Storm Drain.Total recoverable lead concentrations continue to remain below human and acute aquatic standards, but have exceeded the chronic aquatic standard on only a couple occassions. Dissolved lead concentrations have been below all standards from 1993 through 2009.

Manganese

Figure 6-52 presents the historical concentrations of total recoverable and dissolved manganese, as well as significant milestones. Since 1993, concentrations of total recoverable and dissolved manganese were similar, with little gap between the concentrations. Manganese concentrations have steadily declined since 1993 until 2003 following the reconstruction of the MSD. Concentrations rose slightly until treatment of all MSD groundwater began in 2005. Since then, concentrations of manganese have stabilized. Dissolved manganese concentrations were below the secondary standard only on several occassions post-2005.

Zinc

Figure 6-53 presents the historical concentrations of total recoverable and dissolved zinc, as well as significant milestones. Since 1993, concentrations of total recoverable and dissolved zinc were similar, with little gap between the values. Zinc concentrations held steady through construction of the LAO, until completion in 1998. Following completion of the LAO ERA, zinc concentrations declined until 2003 during reconstruction of the MSD at which point concentrations rose slightly. Following treatment of the all MSD groundwater, zinc concentrations dropped significantly and have remained below the human health and acute and chronic aquatic standards.

6.4.3.5 Municipal Storm Water System Improvement Plan

Although the municipal storm water system in Butte as a whole (which addresses many sources of contamination and pollutants – not just mining waste) is not comprehensively addressed in the ROD, it has long been identified as a key part of the recovery of Silver Bow Creek. In 2009, BSB County published a comprehensive inventory and improvement plan of Butte's underground storm sewer system (BSB 2009). Until this point, reliable, specific documentation of the location, sizes, extent, and conditions of the storm sewer system were not readily available. A geographic information system (GIS) database of the system was developed, which will be invaluable. Understanding the storm sewer system is a critical component for BSB in its effort at prioritizing and designing future underground storm water improvements.

BSB, with funding from ARCO, is replacing the upper portion of the Butte Anaconda Brewery underground storm water system. The project has a cost of approximately 1 million dollars. In addition, BSB is preparing an ordinance that will levy a fee on each property owner that will be used to implement and maintain the stormwater system for the Butte area. BSB will continue to prioritize storm water structure replacement and/or maintenance based on the Municipal Storm Water System Improvement Plan.

EPA continues to gather data on the BSB storm water conveyance system to determine its impact on the water quality of Silver Bow Creek, and to assist BSB in its improvement efforts. If mining waste contamination or site-specific improvements in the storm water conveyance system are identified in the Superfund BMP process, those efforts may come under the ROD’s BMP program. Otherwise, the county’s improvement program will be conducted independent of the Superfund process in a cooperative manner. EPA and BSB County are both expecting that continued storm water conveyance system improvements will lead to improved water quality in Silver Bow Creek.

6.4.3.6 Fish Population Monitoring

In the fall of 2008, a live caged fish study was conducted to better understand if fish are capable of surviving in Silver Bow Creek as described in detail in the *Monitoring Report for 2008, Streamside Tailings Operable Unit Silver Bow Creek/Butte Area NPL Site* (Bighorn Environmental et al. 2009). As a result of metals concentrations generally decreasing over the past decade to levels at or below chronic toxicity levels, a 30-day chronic caged fish study was chosen to evaluate the affecting fish survival rate. Young-of-the-year fish (westslope cutthroat trout from Washoe State Fish Hatchery in Anaconda) were used for the study because they are typically more vulnerable to poor water quality conditions. They are also more readily available from the hatchery and can be replicated at higher densities in the cages. This study was conducted at various stations along Silver Bow Creek, not just along the reach flowing through the BPSOU. For the purposes of this report, mainstem sites located above SS-06G and below SS-07 will be discussed as these are within the BPSOU. Metal contaminants of concern included: arsenic, lead, cadmium, copper, and zinc.

During the first week of the study, no mortalities were reported, indicating that stress and acclimation procedures were not factors affecting fish survival. Water temperatures remained approximately 20 degrees Celsius, which is considered to be a physiological threshold temperature that can cause stress in trout.

A relatively small rain event occurred in the watershed on August 7th that resulted in increased flow of approximately 8 cubic feet per second in Silver Bow Creek that crested by August 11th. Even though this rain event was not significant, it enabled the mobilization of metals which increased copper and zinc concentrations in Silver Bow Creek above acute levels, particularly at SS-07. On August 8th, significant mortalities were observed in the caged fish at SS-07 and by August 11th, a 100 percent mortality rate was reported. Concentrations of both copper and zinc had increased to levels well above acute standards during this period. Total ammonia nitrogen concentrations were frequently above chronic standards and exceeded acute standards on August 9th and 11th. However, during the study, no mortalities were observed at SS-06G, the site immediately above the Butte sewage treatment outfall.

Notably, there was a difference in metals concentrations between SS-06G and SS-07 suggesting that additional metals loading occurs between these two locations; most likely the wastewater treatment plant (WWTP) outfall. Ammonia concentrations measured at SS-07 are a concern for water quality and survival of fish; however, the results reported during this study were not much different than results from previous studies conducted on Silver Bow Creek. The researchers concluded it was not possible to determine the ultimate cause of the fish mortalities.

Butte-Silver Bow is currently under order pursuant to the Clean Water Act (Administrative Order on Consent, Docket No. WQ-07-07) to upgrade the WWTP (DEQ 2009 – see Appendix F) for treatment of nutrients. New effluent limits for total nitrogen, total phosphorous, and chlorine became effective January 1, 2009 and applied to discharges between June 1 through September 30 of each year. The upgrades to the treatment plant were not completed by January 1, 2009. The Order establishes a compliance schedule for BSB to implement the upgrades to the WWTP. Again, EPA and BSB County are expecting further improvements to the overall water quality in Silver Bow Creek, based on these important efforts.

6.5 Review of Institutional Controls

EPA completed the ROD for BPSOU in September 2006. The EPA is currently in consent decree (CD) negotiations with the settling defendants (SDs). The Group 1 SDs (ARCO, BSB, and other parties) have prepared a draft ICIP as part of remedial design and this report was tentatively approved by the agencies and submitted to the public for comment (BSB/ARCO 2009). The current draft version of the draft ICIP can be found at information repositories and the Butte office of the EPA. EPA is currently evaluating public comments and may request changes to the document before it is finally approved.

Discussed below are the ICs identified in the BPSOU ROD and the draft ICIP, and those in use today to protect remediated areas from disturbance and to protect public health.

The Group 2 SDs (the railroad group) are also preparing an ICs implementation plan for their active railroad properties; however, this plan is not complete and was not available for review. Abandoned railbeds that have been reclaimed will be treated the same way as other reclaimed source areas in the BPSOU.

This section of the five-year review is intended to present the ICs implemented to date at the BPSOU (the groundwater control area and the "hook-up" ordinance) as well as the draft ICIP plan that was tentatively approved by the agencies, and to discuss the ICs that will be codified upon finalization of the CD. Because the CD negotiations are ongoing, the ICs presented for BPSOU may change.

6.5.1 Institutional Controls and Instruments

EPA and BSB recognized early that ICs for the BPSOU would eventually be needed to protect the integrity of the remedy and thereby protect human health and the environment. The EPA has been working with ARCO and the county to refine the components of an IC program for several years and that program has been defined in the ROD and is partially reflected in the draft ICIP.

The goal of the BPSOU ICs program is to prevent unacceptable human and environmental exposure to ore-processing contaminants remaining within the OU following remedial activities and other work, some of which may occur in the future. ICs are being used at the BPSOU to: 1) protect the remedial (and removal) components that have been implemented to address contaminated soil, groundwater, and surface water; 2) ensure the protection of public health and the environment during the development of property where contaminated source material was not addressed as part of remedial actions; and 3) continue community health testing and awareness programs.

EPA identified the following minimum required ICs in the ROD for the BPSOU (EPA 2006a):

1. A controlled groundwater area has been established in the BABCGWA ruling by the DNRC. The purpose of this ruling and regulation is to prevent domestic use of contaminated water, exacerbation or spreading of existing contamination, or release of highly contaminated groundwater to surface water resources through irrigation. The BABCGWA prevents new well development, except for CERCLA monitoring wells, well systems that treat contaminated water prior to use, and the use of existing domestic and commercial wells. To the extent a controlled groundwater area will not prevent the use of existing wells, an education and well abandonment program will be implemented to persuade owners not to use contaminated water and to voluntarily take existing wells out of service in exchange, for example, for being hooked up to public water. An administrative entity will be identified under remedial design/remedial action to monitor and enforce these restrictions. This IC is in place and functioning.

2. County zoning and permit requirements will be implemented to ensure that capped waste areas, discrete areas of waste left in place, and other control measures such as stormwater controls are not disturbed, mismanaged, or inappropriately developed and that waste taken from these areas is disposed of at the Butte Mine Waste Repository, or if identified as a hazardous waste

disposed of at an RCRA Subtitle C facility. These controls and permits are best implemented with adequate funding for appropriate redevelopment and re-use of affected sites. This IC is not yet in place. An initial county action to require the hookup of domestic water users to the county's public water supply system is in place and is functioning. Other county efforts are in development.

3. Deed notices will be required for all areas where wastes were capped and left in place or where engineered controls were constructed or other discrete wastes were left in place. The deed notices will notify current and subsequent landowners of the presence of these wastes or engineered controls and ensure that these wastes are not disturbed. In addition, fencing and signs may be required to ensure the integrity of caps and engineered controls. This IC is reflected in the draft ICIP plan, and much of this work has been implemented by ARCO and the county.

4. Where private landowners require fencing or use posting for legitimate reasons relating to the prevention of remedy disruption, the selected remedy requires the installation of these fences or signs. This IC will be monitored and enforced by EPA in the future.

In 2009, the Group 1 SDs prepared the draft ICIP, which identifies the public and private ICs that are being used, or will be implemented, to meet EPA's requirements for a comprehensive ICs program (BSB/ARCO 2009). The draft ICIP specifically addresses the following IC instruments.

A. Public ICs

- Controlled groundwater area designation;
- Hook-up ordinance/education and well abandonment program;
- Excavation and dirt-moving protocols ordinance;
- Stormwater management ordinance;
- Database and GIS; and
- Zoning ordinance.

B. Private ICs

- Access rights and restrictive covenants for ARCO/BSB property and third party private property.

6.5.2 Implementation

In addition to the information obtained from the controlling documents, interviews were conducted with the following individuals to determine which ICs or other protocols have been implemented and are being effective in protecting the remedy:

- Ted Duaime. Montana Bureau of Mines and Geology (MBMG). December 22, 2009.
- Tom Malloy. BSB Planning Department. December 22, 2009.
- Rob Jordan. ARCO land manager. December 29, 2009.
- Sara Sparks. EPA Remedial Program Manager for BPSOU. January 2010.
- Dan Powers. BSB Health Department. January 2010.

The implementation of ICs for the BPSOU is discussed below and a summary is provided in Table 6-6.

6.5.2.1 Site Access

Because the boundary of the BPSOU includes a large portion of the City of Butte, property ownership includes the full gamut of entities expected in a large mining community: private ownerships, commercial and industrial properties representing all types of businesses including former and active mining companies and railroads, state property, and property owned by BSB. Access rights are fully described in Section II – Private ICs of the draft ICIP, as well as granted in the Superfund statute, and are summarized below.

The draft ICIP states that the Group 1 SDs and others have created, or facilitated the creation of, private ICs that provide access easements or agreements (collectively, "access rights") for the benefit of the EPA, the DEQ, and any party performing response actions. Access rights are presently in place for much of the BPSOU where response actions have or will occur, including source area property and other real property where stormwater conveyance and management structures are present. According to the draft ICIP, most of the ARCO/BSB properties are currently subject to reserved access rights that provide access for addressing environmental conditions including response actions required under the CD. In addition, pursuant to the ARCO/BSB allocation agreement, it has been agreed that ARCO will convey to BSB substantial property located within the BPSOU, including certain source area properties and properties on which CERCLA stormwater structures are located.

With respect to third-party properties, the draft ICIP states that reserved access rights have been included in various conveyances of source area property to third parties and will be included in future land conveyances. It further states that if access to implement the CD is needed to any source area property owned by a third party, the SDs will use their best efforts to secure from the third parties an agreement to provide access for the purpose of conducting all activities related to the implementation of the

CD, including access for future operation and maintenance. This will be the approach used for some properties that were conveyed to third parties prior to realizing that perpetual access would be needed. As part of the CD, these properties are being systematically identified so that access agreements can be filed. According to the draft ICIP, access easements are intended to be filed in BSB property records and will run with the title of the land. As part of the RMAP, BSB has obtained, and will continue to seek, access rights and/or agreements to properties for any required additional response actions that may be necessary to protect human health.

6.5.2.2 Land and Water Use Restrictions

Groundwater Use Restrictions

Controlled Groundwater Areas – A CGWA was designated by the DNRC for the Old Butte Landfill/Clark Tailings site in December 1999. This area is located in the southern portion of the BPSOU (Figure 6-54).

On October 30, 2009, the DNRC designated the Butte Alluvial and Bedrock Controlled Groundwater Area (BABCGWA) No. 76G-30043832 (BSB 2009). The basis for the BABCGWA is that water quality in portions of the alluvial and bedrock aquifers, based on available information, are not suitable for a specific beneficial use as defined by Montana Code Annotated (MCA) 85-2-102(2)(a): a use of water for the benefit of the appropriator, other persons, or the public, including but not limited to agricultural (including stock water), domestic, fish and wildlife, industrial, irrigation, mining, municipal, power, and recreation uses. The final order for the BABCGWA contains specific findings of fact and conclusions of law that support DNRC's order. Key elements of the order include:

- New groundwater wells, except Superfund or other environmental monitoring/treatment wells necessary for environmental cleanup purposes, are generally prohibited.
- Existing wells for irrigation or industrial use may be replaced at the owner's expense, but only if the conditions stated in the order are satisfied.
- Wells used for drinking water supply must meet the applicable human health standards or cease being used for such purposes.
- The boundaries of the CGWA may be amended with the express written approval of the DNRC, the EPA, and DEQ.

The establishment of this CGWA meets the requirements of the RODs and enforcement instrument for both the BPSOU and BMFOU. Additionally, the Montana Pole Treating Plant (MPTP) CERCLA site is located within the BABCGWA and this designation also satisfies the MPTP CD requirement for groundwater well restrictions and the creation of a CGWA for that site.

Hook-Up Ordinance/Education/Well Abandonment - BSB has adopted a "hook-up" ordinance that requires all prospective potable water users to hook into the BSB water system where municipal service is available—i.e., within 300 feet of an existing water main. This ordinance enhances the BABCGWA and private covenants by requiring the majority of local water users to obtain their domestic water supply from the BSB municipal water system instead of from local wells. To the extent a CGWA will not prevent the use of existing wells, the BSB Water Quality District is to implement, in conjunction with the BSB Public Works Water Division, the EPA, the DEQ, and the DNRC, an education, testing, and well abandonment program designed to a) discourage inappropriate uses of groundwater from existing wells and b) encourage owners to take existing wells out of service voluntarily (BSB/ARCO 2009).

Earth Moving Ordinance

The county intends to file a resolution and draft, and enact an ordinance to enforce procedures used during earth moving activities (BSB/ARCO 2009). The ordinance is intended to help protect human health and the environment in Butte, and the long-term effectiveness of remediated areas during property development or re-use. As stated in the allocation agreement between BSB and ARCO, this ordinance would reiterate that other current zoning ordinances and designations apply, along with building codes, stormwater management ordinances and/or requirements, groundwater control area requirements, provisions for municipal infrastructure (public water, sewer, and utilities), weed control regulations, and the laws of the State of Montana applicable to building and construction (BSB/ARCO 2006). The ordinance would enforce the provisions of BSB's Excavation and Dirt-Moving Protocols for All Dirt-Work to be Performed In and Near the Butte-area Superfund Sites (discussed below). Also, the ordinance would indicate that BSB personnel would be available to answer questions and provide guidance to applicants proposing to develop or re-develop reclaimed property.

BSB has developed and is using a set of procedures to ensure that property development is protective of human health, the environment, and the implemented remedy. Key components of this process are discussed below.

Excavation and Dirt-Moving Protocol - In March 2009, BSB revised the former Reclaimed Areas Guidebook and republished the protocols for earth-moving in the *Excavation and Dirt-Moving Protocols for All Dirt-work to be Performed In and Near the Butte-area Superfund Sites* (BSBC/ARCO 2009). EPA approved the republished protocol document in June 2009.

During the building permit application process, the county planning department provides these protocols to the property owner and/or developer to help them identify and properly handle mine wastes when and if they are encountered (Malloy 2009). In addition to protecting human health and the environment, goals of this program are to ensure that soils contaminated with mine-wastes are not imported to a clean site or exported to any other site (other than the repository), and that contaminated soils are properly capped with clean soil and revegetated during property development. The earth moving protocols document provides a step-by-step set of instructions to meet these goals. The document also provides protocol for transporting material and placing that material in the mine waste repository and provides BSB contact information, if mine waste is suspected of being encountered during the construction.

County Assistance and Inspections - BSB personnel are responsible for providing oversight during earth moving activities to ensure that waste and contaminated soil material are managed and handled according to established protocol. Mr. Malloy indicated that BSB personnel are available to provide this oversight and to assist with sampling material suspected of being contaminated; he also indicated that the county has a laboratory contract established for sample analyses.

Upon completion of construction, the BSB inspector must attest to whether the clean coversoil cap placed overtop waste or contaminated soil material remaining on the property meets the minimum required depth and physicochemical criteria and that the area has been seeded as required under the Butte Hill Reclamation Specifications. The inspector also determines whether stormwater BMPs have been implemented properly and are thereby likely to remain effective in preventing unacceptable erosion of the coversoil. All final site work must meet the established protocol and specifications before BSB approves the notice of occupancy.

Table 6-6
Implementation and Effectiveness of Institutional Controls at BPSOU

	Institutional Control and Instrument (as identified in the controlling documents)	Instrument Implementation and Use	Effectiveness of the Institutional Control in Supporting the Remedy
Controlling Document	ROD and Group 1 IC Plan		
Responsible Entity	BSB County and other Group 1 SDs		
Access	Access easements for lands owned by the Group 1 SDs to allow the access to perform Superfund-related monitoring and maintenance activities.	This is currently implemented for the Group 1 SD owned property through the existing administrative orders and will in the future through the CD or Unilateral Administrative Order (UAO).	This IC is currently effective.
	Access easements for property not owned by the SDs (i.e., third party private lands).	Most, but not all, third party private lands currently have access agreements. BSB and ARCO (the principal Group 1 SDs) are working to identify these properties and the draft ICIP indicates that they will seek agreements with the owners for access rights that would run with the property deed.	This IC is currently effective for most third-party private properties.
Land and Water Use Restrictions	Controlled Groundwater Area (CGWA)	Two DNRC-designated CGWAs are currently in place that restricts well drilling and groundwater use in areas overlying contaminated aquifers.	This IC is implemented and effective.
	Hook-up ordinance	An ordinance is in place that requires all prospective water users to hook into the BSB municipal water system, where it's available.	This IC enhances the effectiveness of the CGWA and private covenants already in place.
	Earth moving ordinance	Although not yet filed/enacted, this ordinance will compel land owners and developers to comply with the *Excavation and Dirt-Moving Protocols for All Dirt-Work to be Performed In and Near the Butte-area Superfund Sites.*	The *Protocols* document is currently being used and is effective. The enactment of the ordinance will provide enforcement capabilities to ensure human health is protected.
	Stormwater management ordinance	Although not yet filed/enacted, this ordinance will outline the procedures, protocols and/or requirements to implement and enforce effective storm water management. The ordinance will allow BSB perpetual access to inspect and maintain water conveyance structures and enact penalties for anyone damaging these structures.	This IC is anticipated to be effective.
	Restrictive covenants	Restrictive covenants prohibiting the unauthorized disruption of source area caps or other controls or engineered structures are presently in place for much of the BPSOU where response actions have or will occur. According to the draft ICIP, the restrictive covenants have or will be filed in BSB property records and run with the title of the land. An examination of property records for the Ophir Mine site did not reveal restrictive covenants. BSB and ARCO (the principal Group 1 SDs) are working to identify the remaining properties where these are needed and to get the covenants into the property records.	This IC is currently effective for all BSB/ARCO property and is anticipated to be effective for third-party property.
	Zoning ordinance	According to the draft ICIP, BSB plans to adopt amendments to the existing zoning ordinance that complement the other ICs, such as the controlled groundwater areas, the excavation/dirt-moving protocols, and the stormwater management regulations, to ensure land use development is consistent with remedial actions and their associated maintenance.	These amendments to the existing zoning ordinance are expected to enhance the effectiveness of BPSOU ICs.
Informational Devices	Community awareness and education.	This is fully implemented as part of the county Health Department's RMAP.	This IC is implemented and effective.
	Medical monitoring.	This is fully implemented as part of the county Health Department's RMAP.	This IC is currently in place and effective.
	Land information management and availability.	The BSB Database/GIS contains data and other information for all remedial areas. This information is available to land owners, developers, and prospective buyers upon request.	This IC is currently in place and effective.
	Fencing and land-use posting.	As part of BSB's on-going operations and maintenance program for reclaimed areas, fencing and land-use signage are installed as necessary to prevent impacts to reclaimed caps. This is an ongoing activity for both public and private lands.	This IC is currently in place and effective.

Preventing Improper Use of Contaminated Fill - The use of mining and ore-processing wastes as backfill material has been a common practice at historic mining communities such as Butte. BSB now requires developers to disclose the location of fill intended to be brought to the site being developed. The established protocol requires that this material be certified as not contaminated and, if used for coversoil, that it meets the Butte Hill Reclamation Specifications.

Home Renovation Protocol and Assistance - When a building permit is requested for a home renovation, the homeowner is provided with the earth moving protocols plus guidelines specific for renovations. The latter are part of the Health Department's RMAP. Upon issuing a building permit that involves an attic renovation, health department personnel will inspect the attic and sample and analyze material (e.g., attic dust) suspected of being contaminated. If contaminated material is present, BSB will arrange for the attic to be cleaned of contaminated dust prior to the renovations taking place. The county will also arrange for and manage the disposal of contaminated dust at the mine waste repository.

Stormwater Management Ordinance

Stream channels have been repeatedly reconfigured throughout the history of mining in Butte to keep water out of mining areas and, in some cases, to transport process waste away from milling areas. As part of the on-going effort to reduce contaminant transport to Silver Bow Creek, certain drainages on the Butte Hill, the MSD channel, and the Silver Bow Creek stream channel in LAO have been constructed to carry the design stormwater flow and their banks have been re-engineered and reinforced to ensure their long-term stability.

The allocation and settlement agreement between BSB and ARCO states that BSB will propose and support the adoption of a stormwater management ordinance to protect stormwater BMPs. As such, the draft ICIP states that BSB will file a resolution and draft and enact an ordinance which outlines the procedures, protocols and/or requirements to implement and enforce effective stormwater management within the Butte site. Key components of the stormwater ordinance are to include:

- Nationally-accepted design standards;
- Requirements that site-specific stormwater design plans be prepared and certified by registered engineers;
- Requirements that will allow maintenance and inspections by BSB personnel, including perpetual easements granted to BSB to conduct the inspections; and
- Provisions for enforcement against violators and appropriate penalties.

The draft Stormwater Management Ordinance was submitted to EPA and DEQ for review and comment prior to proposing a final ordinance for formal adoption by BSB. This ordinance is about to be enacted, or recently was enacted.

According to Rob Jordan, ARCO land manager, ARCO is currently in the process of transferring the remaining source area property owned by ARCO to BSB, so BSB will have control of nearly all properties in the BSPOU with stormwater structures (Jordan 2009). ARCO is also working toward getting access agreements and covenants established for the few remaining private pieces of property that have stormwater structures. Access was discussed above and restrictive land-use covenants are discussed below.

Restrictive Covenants

The draft ICIP separates the discussion of restrictive covenants based on land ownership: property owned by ARCO or BSB and property owned by a third party. According to the draft ICIP, restrictive covenants are presently in place for much of the BPSOU where response actions have or will occur, including source area property and other real property where stormwater conveyance and management structures are present. These covenants prohibit the unauthorized disruption of caps or other controls or engineered structures. Restrictive covenants have or will be filed in BSB property records and run with the title of the land.

According to the draft ICIP, restrictive covenants include the following typical provisions:

- a general covenant prohibiting the property owner from hindering, interfering with, or otherwise modifying any remedial actions that have been undertaken on the property;
- a covenant requiring the property owner to perform any property maintenance that may be required on the property; and
- a provision that permits the EPA and DEQ to enforce the obligations against the property owner.

The first restrictive covenant listed above addresses the need to protect the implemented remedy, which includes remediated source area caps, water conveyance structures, and monitoring wells. This protection is especially important for third-party private property. For example, during the preparation of the groundwater monitoring plan, EPA noted more than 450 wells within or in close proximity to the BPSOU. The plan identified approximately 144 wells that are potentially useful for monitoring; these are currently being sampled as part of the program and are shown on Figure 6-62. Most of these wells are located on ARCO or BSB property. However, as was the case for the BMFOU, some of these wells are located on third-party property and therefore require closer scrutiny to ensure their functionality for future groundwater monitoring. Restrictive covenants associated with the deeds to these properties would provide BSB another tool to enforce the protection of these well heads.

All source area property and other real property presently owned by ARCO on which any CERCLA stormwater structure is located is, or upon conveyance to BSB pursuant to the ARCO/BSB allocation agreement, subject to covenants that restrict the use and development of the property to the appropriate land use. These are commonly referred to as either developable property covenants or dedicated use property covenants depending on the current and anticipated use of a particular piece of property. The draft ICIP provides representative examples of these. According to Rob Jordan, ARCO land manager, restrictive covenants have been or are in the process of being recorded at the county clerk and recorder's office for property being transferred from ARCO to BSB. As such, these covenants will be permanently associated with the property deed (Jordan 2009).

Over time, ARCO has conveyed certain source area property to third parties. In those conveyances, according to the draft ICIP, ARCO has included appropriate developable or dedicated use property covenants, as well as appropriate enforcement rights and remedies for EPA and DEQ, in the conveyance deeds. In future conveyances, quitclaim deeds will be used as the mechanism to apply restrictive covenants when property is conveyed.

<u>Zoning Ordinance</u>

BSB has adopted an updated Growth Policy, the city-county's future land use classification plan. The county plans to continue development of draft amendments to the existing zoning ordinance to implement land use changes specified in the updated Growth Policy. This includes re-zoning certain properties to open space to be consistent with future land use classifications and remedial action plans. According to the draft ICIP, amendments will also be drafted and adopted to complement the other ICs, such as the CGWAs, the excavation/dirt-moving protocols, and the stormwater management regulations to ensure land use development is consistent with remedial actions and their associated maintenance.

6.5.2.3 Informational Devices

<u>Community Awareness and Education</u>

An extensive community awareness and education program to manage lead, arsenic, and/or mercury exposure within Butte is an integral part of the county's RMAP (BSB 2010). This part of the program includes a range of education components to enhance and maintain community awareness of potential sources of and exposure risks to lead, arsenic, and mercury in and around homes (in soil and dust). The plan also describes approaches residents can take to avoid or limit their exposure. The community awareness and education program includes advertising and outreach, periodic mailings to property owners and residents, and distributing free educational materials to various target groups.

An important aspect of the education and outreach components addresses portions of homes that are seldom, if ever, visited. Addressing dust in non-living portions of a residence only when remodeling or other activities create an exposure pathway is based on the findings of the human health risk assessment completed in Walkerville (UOS 2003). The objective of this aspect of the program is to ensure that contaminated dust is appropriately handled and disposed of by a responsible entity; in most cases this will be by an approved contractor. Educational materials are designed to ensure that home owners, remodeling contractors, and weatherization workers: (1) are aware of the potential presence of lead, arsenic, and/or mercury in the seldom-accessed portions of homes, (2) understand the importance of restricting access to those areas, (3) take measures to avoid tracking dust from those areas into the interior living space when access does occur, and (4) are provided with the proper contact information prior to implementing any remodeling effort.

Educational materials are provided to residents by BSB at the time any work is implemented (whether interior or exterior) as well as when building permits are sought for remodeling projects. The recommendations made to residents are based on the results of environmental sampling at their homes and specific information collected by BSB staff about their daily habits and activities. In addition to the education and outreach to the residents, BSB is specifically targeting remodeling contractors and weatherization workers as they may be exposed during their work. Education and awareness materials are also posted and available at local hardware and home improvement stores throughout Butte, in order to inform home owners performing their own "do-it-yourself" projects of potential risks (Powers 2010). Also, abatement protocols are designed to ensure that contaminated attic dust is not tracked into living spaces or inappropriately covered by insulation during remodeling.

Based upon discussions with BSB staff and the RPM, the community awareness and education program is fully implemented as a part of the RMAP (Malloy 2009, Sparks 2010).

Medical Monitoring

The County's RMAP includes medical monitoring and participation is encouraged through community outreach and education. Medical monitoring uses blood-lead and urinary-arsenic data to identify individuals who have concentrations of those elements above risk-based thresholds. The home of an affected person (or persons) undergoes immediate sampling and evaluation. Residential remediation is then performed if sampling determines that yard soil, interior living-space dust, or mercury vapor action levels are exceeded.

In cases of high arsenic concentrations in dust or soil, individuals may be tested for urinary arsenic levels. Exposure mitigation in the home will occur when residents have urinary arsenic levels exceeding risk-based criteria. Follow-up testing is conducted to confirm that the remedy has been successful and to determine what additional measures are required to reduce an unacceptable exposure.

As with the community awareness and education program, the medical monitoring program is fully implemented as a part of the RMAP (Malloy 2009, Sparks 2010).

Land Information Management and Availability

The BSB computer database/network allows the storage and retrieval of CERCLA-related data and information among BSB departments for all properties within the BPSOU. This network system allows the health, planning, and building permit departments to coordinate on the inter-related components of the ICs program (Malloy 2009). As demonstrated successfully throughout the country, state, county, and city governments have implemented computerized systems to track the status of properties that have undergone environmental sampling and restoration. Among other things, the county-administered database is used to keep track of properties sampled and properties cleaned up/not cleaned up as part of the selected remedy for the BPSOU. With the information contained in the system, a property owner or prospective buyer/developer who contacts the county can be advised of the status of the property and whether or not the property may need to be sampled during development. CERCLA-related information the county can provide includes analytical results and maps showing sampled locations, areas of remaining (in-situ) wastes, and the boundaries of remediated areas (Malloy 2009). According to the draft ICIP, the database/GIS provides:

- All data and other information obtained in connection with response actions performed within the Butte site by ARCO or BSB or any other person or governmental entity.
- All data and other information obtained in connection with operation and maintenance activities within the Butte site, performed by ARCO or BSB, Data will be recorded, stored, and managed in a separate database.
- All data and pertinent information compiled as part of the implementation of the BRES.
- All data and other information obtained regarding health in connection with the implementation of the Multi-Pathway Program by ARCO or BSB, subject to privacy access policies related to health information.
- All data and information relating to applicable requirements under the Growth Policy and/or Zoning Ordinance.
- All data and information relating to CGWAs.
- All data and information relating to applicable real property use restrictions, covenants and obligations.

For this operable unit, BSB provides GIS services and maps to EPA, DEQ, and ARCO and their employees, agents, representatives, and contractors upon request and at no additional charge or expense (BSB/ARCO 2009). According to the BSB reclamation specialist, the database/GIS is operational and providing the necessary information (Malloy 2009). In addition, AR is working on upgrades to this system.

Fencing and Land-Use Posting

The Selected Remedy for the BPSOU requires the installation of fencing or use-posting to prevent adverse impacts to the remedy. Where private landowners require fences or signage for legitimate reasons relating to the prevention of these impacts, the SDs are required to provide them (EPA 2006a).

According to the draft ICIP, the Group 1 SDs will construct and install appropriate signage or fencing upon request by EPA, to support the work required under the CD. This does not apply to property owned or controlled by the Group 2 SDs (railroad group) (BSB/ARCO 2009). Examples of where signage or fencing may be required include the need to address safety issues associated with construction or where community interest supports the need for explanatory signs. Additionally, fencing may be appropriate to prevent unauthorized use and to control access to source areas or stormwater conveyance/retention structures.

During the interviews, BSB personnel and the RPM indicated that the installation of appropriate signage and fencing has occurred as needed throughout the course of removal and remedial work at the BPSOU (Malloy 2009, Sparks 2010).

6.6 Site Inspection

EPA and stakeholder representatives attended a site inspection of key features at the BPSOU on October 6, 2009. The site tour consisted of an overview of the groundwater collection and treatment system at LAO, and a tour of representative reclaimed source areas on the Butte Hill. Site photos can be found in Appendix A. Three sites were visited: The Minnie Irvine which was stable with minor issues, the Little Mina which was stable but requiring vegetation improvement due to weeds and some barren areas, and the Otisco which is a State of Montana Abandoned Mines Program site which had a reclaimed cap which now is in poor condition. All source area sites are being inspected in turn through the BRES program. Appendix D includes the BRES inspection field forms for all of the source areas evaluated to date.

At LAO, the site inspection consisted of a tour of the lime addition building and the open ponds used for settling and polishing the treated water. Sludge is currently removed using a floating dredge and then allowed to settle and dry in a nearby location. Because the system is a full-scale pilot and is undergoing design improvements, the scope of the inspection was limited to the field tour, and items on the five-year review inspection checklist were not yet relevant. This should be reevaluated in the next five-year review.

Section 7
Technical Assessment
7.1 Question A: Is The Remedy Functioning As Intended By The Decision Documents?

Yes, with the qualifications as noted below.

Remedial Action Performance

Solid Media

Residential Yard/RMAP Assessment. The implementation of the RMAP continues to remove contaminated soil, dust, and other material from residential properties throughout Butte. Several non-fundamental modifications to the selected remedy for residential cleanup have been incorporated into the RMAP. These changes include modification of the sampling depth from a single depth interval of 0 to 2 inches to a multi-depth interval of 0 to 2 inches, 2 to 6 inches, and 6 to 12 inches; the removal depth from residential yards areas has been modified from 18 inches to 12 inches to be consistent with national EPA guidance (EPA 2003); and including an additional 2 years and 5 years to the assessment and remediation of residential properties, respectively. Due to these changes, it is recommended that an ESD be prepared to capture these changes to the ROD.

The RMAP is being implemented as written. Continued progress on a yearly basis, in accordance with the schedule contained in the RMAP, is being accomplished.

The yard/attic removal and cleanup program has shown signs of success based on blood lead test results. Blood lead concentrations indicate a steady decline from 1990 through December 2009. In 2008 and 2009, 995 blood tests were performed and none of the tests had results greater than 9.9 µg/dL. Furthermore, the Butte-Silver Bow Health Department is in the process of systematically sampling every residential property within the BPSOU.

Source Area Maintenance/BRES Assessment. The BRES monitoring and maintenance program has been assessing the performance of previously reclaimed non-residential areas throughout Butte since the start of the program in 2007. The BRES evaluations are ongoing. They have identified trigger items needing corrective measures up to 61 percent of the time (see Tables 6-4 and 6-5). Follow-up measures and their progress have not been traced. Minor repairs and corrections are taking place (such as reseeding, gully repairs, and fence mending), however the regulators are not receiving plans for work which requires engineering. Some actions are not taking place within the specified timeframe.

Limited documentation is available that identifies progress towards implementing the recommendations provided by the BRES program. It is recommended that adequate tracking be established to maintain records showing that corrective actions have been taken to maintain the caps and meet the program schedule. Engineered BMP solutions for stormwater should also be tracked. At a minimum, these records should use the existing aerial photographs of each site to clearly document specific locations where corrective actions were implemented. If significant construction work is done, as-built drawings should be included in the records. This information will then become a record for the following BRES evaluation cycle.

Concerns raised during community interviews and review of the BRES field forms (see Appendix D) highlighted the link between the BRES and the Surface Water Management Program. On many source areas, cap erosion was occurring due to storm water runon/runoff issues that were originating outside of the immediate site boundaries. If a source area is determined to have erosion problems due to storm water routing, an engineering evaluation is required. Appendix A of the BRES document indicates that the BRES and the Surface Water Management Program are interactive. Therefore, the engineering evaluation will need to coordinate with any municipal storm water construction to address such issues.

Surface Water

Major portions of the selected remedy for surface water have not yet been fully implemented. Mine waste and tailings were removed from the active floodplain of Silver Bow Creek in 1997 (through the LAO removal action), along with capture and treatment of contaminated groundwater and other remedial actions (such as further removal of sediments and streamside waste as indicated in the ROD). These have largely mitigated the threat of a catastrophic failure or release of those tailings downstream, and also improved chronic releases to the stream of hazardous substances. Water quality improvements have been achieved, as the figures in Section 6 show. During base flow, Silver Bow Creek is now meeting the chronic aquatic water quality standards for metals such as cadmium and zinc most of the time, and is moving toward compliance for copper.

Storm water still severely impacts Silver Bow Creek with mining-related COCs, particularly copper, from the Butte Hill. This causes exceedances of acute aquatic life standards. The highest concentrations of dissolved copper appear to be during spring snowmelt events. It is suspected that soluble copper-laden salts accumulate during the fall and winter months and are flushed from the system during these first snowmelt events.

The frequency and magnitude of the copper exceedances during runoff events are as much as ten to hundreds of times above the acute aquatic life standards. The largest increase in COC concentrations occurs between mainstem stations SS-04 and SS-05, which includes storm sewer tributary inputs from MSD and Buffalo Gulch (the east side of the Butte Hill). Additionally, there are significant COC inputs from the reach extending from SS-05 to SS-05A that passes through the slag canyon area. From the data presented in Section 6, it appears that these high COC concentrations are maintained as Silver Bow Creek flows downstream through the operable unit. However, downstream of the slag canyon area (station SS-06A through SS-07), there does not appear to be any significant regular additions of COCs during storm events. This is likely because storm water detention basins in Missoula Gulch are able to control storm water for most storms, and only release water during larger events.

The graphs presented in Section 6 clearly show that copper is most problematic. Median total recoverable copper concentrations in storm water in Silver Bow Creek, from SS-05 downstream to SS-07, are typically greater than 10 times the acute standard. In the same reach, the mean values for dissolved copper generally exceed the acute standard by at least 1.5 times. Median total recoverable zinc concentrations are less than 3.8 times the standard. It is anticipated that as copper exceedances are mitigated, concentrations of the other mining related COCs will also decrease.

Discharge of the municipal wastewater treatment plant (SS-STP) just upstream of SS-07 has a significant impact on water quality in Silver Bow Creek and is not subject to the Superfund remedy. BSB is currently upgrading the wastewater treatment plant under an Administrative Order on Consent (DEQ 2009), and improvements are expected to be complete by 2017.

The BSB storm water conveyance system is also a clear source of contamination to Silver Bow Creek. Improvements to both of these water sources are needed to improve overall water quality in Silver Bow Creek. New storm water BMPs targeting the Butte Hill are currently in the preliminary evaluation phase.

To reduce sediment problems associated with Superfund and non-Superfund source areas, BSB and Atlantic Richfield are implementing Curb and Gutter Programs that will be installed throughout the Butte Hill. Miles of curb and gutter have been or will be installed in 2010 and 2011 to reduce storm water runon/runoff problems.

Groundwater

Portions of the selected remedy, such as performance of the Butte Treatment Lagoons system, do provide a positive outlook about groundwater control and capture, considering the system usually treats and removes COCs to well below the required discharge standards. In the short-term, the system has been functioning well with few interruptions. Long-term operation and issues that may impact performance, such as chemical addition, sludge removal, contingencies for upsets, etc., are being addressed in remedial design. Designing a fully functional and effective capture system is important for the success of the BPSOU remedy. The optimization of the groundwater capture system is in progress.

Implementation of Institutional Controls and Other Measures

An area of controlled groundwater access and educational ICs are in place and provide interim protectiveness while a more comprehensive IC plan is pending approval. It is anticipated that once the ICs are fully implemented that they will be effective in maintaining the protectiveness of the remedy.

7.2 Question B: Are The Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used At The Time of Remedy Selection Still Valid?

Yes. The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid.

Changes in Standards and TBCs
An ARAR review was conducted for the BPSOU as a part of this five-year review. In accordance with the preamble to the National Contingency Plan, ARARs are frozen at the time of the ROD unless "a new or modified requirement calls into question the protectiveness of the selected remedy" (55 federal register [FR] 8757 [March 8, 1990]). The findings of the ARARs review are found in the ARARs Review Technical Memorandum (CDM 2010a), which is attached to Volume I of the overall five year review report.

Since signing of the ROD in September 2006 for the BPSOU, both the State and Federal aquatic and human health standards have not changed. The current State of Montana water quality standards (Circular DEQ-7, published in 2008) are reflective of the surface water quality standards identified in Section 8, Table 8-2 of the BPSOU ROD.

Changes in Exposure Pathway and Exposure Assumptions
Based on the evaluation included in the review of the human health and ecological risk assessments, no additional exposure pathways were identified during this review that should be addressed in order to evaluate remedy protectiveness.

A review of exposure assumptions used in the BPSOU site risk assessments compared to current guidance indicates that previous exposure assumptions remain conservative and reasonable in evaluating risk and developing risk-based cleanup levels (see Tables 7-1 and 7-2).

Table 7-1
Comparison of Toxicity Values Used for the BPSOU

COC	Noncancer Oral RfD (mg/kg-day)				Oral Cancer Slope Factor (mg/kg/day)-1			
	Baseline Risk Assessments		2010		Baseline Risk Assessments		2010	
	Value	Ref	Value	Ref	Value	Ref	Value	Ref
Arsenic	3.00E-04	1,4	3.00E-04	6	1.5	1,4	1.5	6
Lead	NA	--	NA	--	NA	--	NA	--
Manganese	Not evaluated	--	1.4E-01	6	Not evaluated	--	NA	--
Mercuric Chloride	3.00E-04	3,5	3.00E-04	6	NA	--	NA	--
Elemental Mercury	NA	--	1.6E-04	7	NA	--	NA	--
	Non-cancer Inhalation Criteria				**Cancer Inhalation Criteria**			
	(mg/kg-day)		**mg/m^3**		**(mg/kg/day)-1**		**µg/m^3**	
Arsenic	NA	--	1.5E-05	6	15	1,4	4.3E-03	6
Lead	NA	--	NA	--	NA	--	NA	--
Manganese	Not evaluated		5.0E-05	6	Not evaluated		NA	--
Mercuric Chloride	NA	--	3.0E-05	7	NA	--	NA	--
Elemental Mercury	8.6E-05	3,5	3.0E-04	6	NA	--	NA	--

References (Ref)
NA = Not Available
1 EPA 1997. Butte Priority Soils Operable Unit. Baseline Risk Assessment for Arsenic.
2 IEUBK Model was used to evaluate exposure to lead
3 EPA 2003. Final Human Health Risk Assessment, Walkerville Residential Site
4 IRIS 1991. EPA Integrated Risk Information System Database (IRIS).
5 IRIS 2003. EPA Integrated Risk Information System Database (IRIS).
6 IRIS 2010 EPA Integrated Risk Information System Database (IRIS). Online database at: http://www.epa.gov/IRIS/search.htm
7 EPA Regional Screening Level Table December 2009
Note: Although manganese was not a COC at the time of the risk assessment it is presented on this table due to the lower inhalation reference dose currently available.

Table 7-2
IEUBK Assumptions

	1994 HHRA		2010 IEUBK	
Air Data				
Vary Air Conc. By Year	No, not varied		No, not varied	
Outdoor Air Lead Concentration	0.2 µg/m^3		0.1 µg/m^3	
Indoor Air Lead Concentration (Percentage of Outdoor Air	30%		30%	
Lung Absorption	32%		32%	
Age Specific Data for Air Pathway:				
Age Range	**Ventilation Rate**	**Time Spent Outdoors**	**Ventilation Rate**	**Time Spent Outdoors**
0-1	2.0 m^3/day	1 hr/day	2.0 m^3/day	1 hr/day
1-2	3.0 m^3/day	2 hr/day	3.0 m^3/day	2 hr/day
2-3	5.0 m^3/day	3 hr/day	5.0 m^3/day	3 hr/day
3-4	5.0 m^3/day	4 hr/day	5.0 m^3/day	4 hr/day
4-5	5.0 m^3/day	4 hr/day	5.0 m^3/day	4 hr/day
5-6	7.0 m^3/day	4 hr/day	7.0 m^3/day	4 hr/day
6-7	7.0 m^3/day	4 hr/day	7.0 m^3/day	4 hr/day
	Walkerville RA	Alternate		
Drinking Water Rate				
Lead Concentration in Drinking Water Constant	4 µg Pb /L	Water Data not Varied	4 µg Pb /L	
Age Specific Data for Water Pathway:				
Age Range:	**Water Consumption**		**Water Consumption**	
0-1	0.20 l/day		0.20 l/day	
1-2	0.50 l/day		0.50 l/day	
2-3	0.52 l/day		0.52 l/day	
3-4	0.53 l/day		0.53 l/day	
4-5	0.55 l/day		0.55 l/day	
5-6	0.58 l/day		0.58 l/day	
6-7	0.59 l/day		0.59 l/day	
Use Alternate Water Values?	No		No	
Soil Data				
Percentage of soil/dust intake	**45% soil ingestion**	**55%dust Ingestion**	**45% soil ingestion**	**55%dust Ingestion**
Age Range	**Total Soil + Dust Intake**		**Total Soil + Dust Intake**	
0-1	0.043		0.085	
1-2	0.108		0.135	
2-3	0.108		0.135	
3-4	0.108		0.135	
4-5	0.085		0.1	
5-6	0.075		0.09	
6-7	0.070		0.085	
Soil to dust transfer Factor	0.24 (Site Specific)		0.24 (Site Specific)	
GI Values/Bioavailability Information				
Absorption Fraction for Soil	See below		30% default (12% site specific)	
Absorption Fraction for Dust	See below		30%	
Absorption Fraction for Water			50%	
Absorption Fraction for Diet			50%	

Table 7-2
IEUBK Assumptions

	1994 HHRA		2010 IEUBK	
GI Method Bioavailability	Non-linear Passive Method: Soil			
Passive Absorption Coefficient	0.02			
Active Absorption Coefficient	0.1			
Absorption Half-Saturation Coefficient (µg/L)	1000			
Residence Time in GI tract (days)	1			
GI Method Bioavailability	Non-linear Passive Method: Dust			
Passive Absorption Coefficient	0.05			
Active Absorption Coefficient	0.25			
Absorption Half-Saturation Coefficient (µg/L)	1000			
Residence Time in GI tract (days)	1			
Dietary Lead Intake				
Age Range:	**Dietary Lead Intake (µg/day)**[1]	**Dietary Lead Intake (µg/day)**[2]	**Model default Dietary Lead Intake (µg/day)**	
0-1	5.88	1.82	2.26	
1-2	5.92	1.90	1.96	
2-3	6.79	1.87	2.13	
3-4	6.57	1.80	2.04	
4-5	6.36	1.73	1.95	
5-6	6.75	1.83	2.05	
6-7	7.48	2.20	2.22	
Distribution values:				
GSD	1.68		1.6 Default (1.68 Site Specific)	
Cutoff	10 µg Pb/dl		10 µg Pb/dl	

Notes:
1. Model Defaults used in the 1994 Lead Risk Assessment
2. Region 8 Dietary Lead Intake rates based on Total Diet Studies by Gunderson (1995) and Bolger et. al. (1996). These values were used in the Walkerville HHRA.

hr/day = hours per day
L/day =liters per day
$\mu g/m^3$ = micrograms per cubic meter
µg Pb /L = micrograms lead per liter
µg Pb/dL = micrograms lead per deciliter
µg/day = micrograms per day

Changes in Toxicity and Other Contaminant Characteristics

Non-cancer toxicity criteria (references doses and reference concentrations) and cancer slope factors and inhalation unit risks were examined for any changes that may affect protectiveness of the remedy. The review found:

- Criteria for oral exposure pathways have not changed.
- Criteria for inhalation exposure to **arsenic** have changed, but do not significantly change calculated arsenic action levels.

- Criteria for inhalation exposure to **mercury** have changed; a recalculation of the action level using current recommendations results in a slight increase in the mercury action level in air from 0.43 μg/m^3 to 0.63 μg/m^3.

- The criteria for inhalation exposure to **manganese** changed. EPA's risk assessor reviewed the screening level evaluation of manganese exposure and concluded that the screening level of 12,609 parts per million for manganese remains protective and appropriate.

The exposure assumptions for exposure to **lead** were evaluated separately from the other COCs through evaluation and use of the most recent version of the IEUBK model. The PRG for lead was recalculated using the most updated version of the IEUBK model (Version 1.1 Build 11) with site-specific parameters included – 12 percent bioavailability of lead in soil, a soil-to-dust transfer coefficient of 0.24 and a geometric standard deviation of 1.68. The recalculated estimated PRG was 1,174 mg/kg, a value essentially the same as the current remediation goals of 1,200 mg/kg. According to the *Superfund Lead-Contaminated Residential Sites Handbook* (EPA 2003), a model-derived soil lead remedial goal calculated to be between 400 mg/kg to 1,200 mg/kg does not require further review by the Lead Sites Consultation Group.

The results of blood lead tests collected as part of the voluntary medical monitoring program have shown a downward trend for several years, with no blood lead levels reported above 10 ug/dL in the last two years. These data suggest that exposures to lead are decreasing in response to the Superfund actions at the BPSOU.

Thus, this review concludes that the actions levels for lead, arsenic, and mercury established in past risk assessments are still appropriate and protective of human health.

Expected Progress Towards Meeting RAOs

At the BPSOU, most exposure pathways that could result in unacceptable risks are being controlled to the extent possible considering the interim state of remedy implementation. Despite several past response actions completed at the BPSOU, covering more than 400 acres, not all remediation components or goals have been achieved. The RMAP has not addressed all residential yards yet, potential exposure to lead and arsenic in residential soil and interior dust may continue to pose a risk to human health in areas that have not yet been sampled or cleaned up. The program anticipates completing these goals within ten years of the Effective Date of the Consent Decree or about 2020. In the interim, parcels have been prioritized to remediate places with sensitive populations first. For non-residential areas, engineering controls effectively isolate identified waste materials, thus preventing human and environmental exposures.

The Butte CGWA protects human health and the environment by preventing the consumption and spread of contamination from groundwater. In addition BSB has adopted an ordinance requiring the majority of local water users to obtain their domestic water supply from the BSB municipal water system instead of from local wells. To the extent a CGWA will not prevent the use of existing wells, the BSB Water Quality District is to implement an education, testing, and well abandonment program.

Arsenic and metal contaminants in alluvial groundwater are now largely prevented from reaching Silver Bow Creek through a comprehensive groundwater control, capture, and treatment system, with the result that chronic water quality standards are being met most of the time during base flow conditions. Isolated, lesser sources of contaminant loading to Silver Bow Creek from groundwater are being identified and addressed. The capture system requires further evaluation and optimization to address current ground water conditions. Storm water continues to be a significant source of contaminant loading to Silver Bow Creek during runoff events.

Finally, ecological monitoring may need to be updated to track the success of the remedy in attaining the goal of a self-sustaining fishery. Inputs of mine-related waste from the BPSOU may be of concern for ecological receptors. Methods for conducting ecological risks assessments have advanced considerably since the last assessments within the BPSOU.

7.3 Question C: Has Any Other Information Come To Light That Could Call Into Question The Protectiveness Of The Remedy?

No, there is no other information at this time that calls into question the protectiveness of the remedy.

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Section 8
Issues

Based on information collected during preparation of this BPSOU five-year review report, the following issues were identified and summarized in Table 8-1.

Table 8-1
BPSOU Issues Summary

Issue No.	Issue	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1	Changes have been made to the Selected Remedy for Solid Media (sampling depths and removal depth)	No	No. These changes make the program more effective and/or bring the program into consistency with other residential yard cleanup programs.
2	Some corrective actions identified during BRES monitoring are not taking place in a timely manner. Corrective action work plans are not being developed and sent to EPA for approval before implementation. Corrective actions need to be implemented on an annual basis to maintain cap integrity.	No. Caps generally remain in-place as a barrier between mine waste and humans.	Yes – If previously reclaimed areas deteriorate, a potential exposure pathway may be generated that could increase human health and environmental risks.
3	There are gross exceedances of acute aquatic life standards in Silver Bow Creek during storm events. Copper exceedances of acute aquatic life standards are tens and hundreds of times greater than the standard.	Yes	Yes. If runoff from the BPSOU cannot be improved, this could prevent establishment of a self-sustaining fishery and impact downstream OUs.
4	The BSB storm sewer system is aging and contributing to contamination in Silver Bow Creek. Monitoring of storm system point sources from Superfund and non-Superfund sources will be required as BMP's are implemented, to determine where the need exists for additional work on the storm water system.	Yes. The storm water system may be a source of contaminants and a conveyor of these contaminants to Silver Bow Creek.	Yes. It is recognized that the storm water conveyance system is not completely a Superfund issue, but monitoring, coordination with BSB on its implementation of its improvement plan, and continued BMP evaluation for specific mine waste-related issues is important for achievement of remedial goals.

Table 8-1
BPSOU Issues Summary

Issue No.	Issue	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
5	Interim institutional controls are in place. Specific, key ICs include: (1) earth moving protocols (not in place); (2) storm water ordinance (in place); (3) zoning ordinances (in place); (4) restrictive covenants on caps and other engineered structures (in place); and, (5) controlled groundwater area (in place).	No. Initial IC implementation efforts are encouraging and should be pursued.	Yes. The ICs will be critical to ensure waste-left-in place is not disturbed, that excavated mine waste is properly disposed of, and that storm water structures function as designed. Finalization of the ICIP plans is important.
6	Ecological monitoring does not track the success of the remedy in attaining the goal of a self-sustaining fishery in Silver Bow Creek.	No	Yes. Ecological monitoring may show issues not detected by current monitoring programs.

Section 9
Recommendations and Follow-Up Actions

Table 9-1 presents recommendations and follow-up actions for the BPSOU.

Table 9-1
Recommendations and Follow-Up Actions

Issue	Recommendation and Follow-Up Action	Party Responsible	Oversight Agency	Milestone Date
1	Issue a decision document to acknowledge changes in sampling and removal depths for residential properties.	EPA/DEQ	EPA/DEQ	December 31, 2011
2	Develop a program to follow up on BRES-related recommended corrective actions and other O&M for reclaimed areas. Include corrective action tracking, annual work plans, updates to the source area database and an annual audit of the schedule and accomplishments.	BSB	EPA/DEQ	December 31, 2011
3	Construct new BMPs on the Butte Hill to control runoff. Continue water quality monitoring during storm events to measure progress and long- term trends in storm water quality. Include careful monitoring and coordination with BSB with the storm water conveyance system in this process.	Atlantic Richfield/BSB	EPA/DEQ	December 31, 2014
4	Evaluate and optimize municipal storm water collection system in concert with upgrades to the Superfund collection and treatment system.	Atlantic Richfield/BSB	EPA/DEQ	December 31, 2014
5	Implement an enforceable Institutional Control Plan.	Atlantic Richfield/BSB	EPA/DEQ	December 31, 2014
6	Update the monitoring plan to include ecological monitoring.	Atlantic Richfield	EPA/DEQ	December 31, 2014

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Section 10
Protectiveness Statement

The remedy at OU8 is not protective because aquatic life standards are not met in the stream. Environmental exposures continue. Short-term protectiveness is provided for all other potential exposures by the recently enacted CGWA, information/educational ICs, and engineering and access controls of source areas. To ensure protectiveness, remedy implementation must be completed, and municipal storm water contributions to Silver Bow Creek must be abated.

Releases of arsenic and heavy metal contaminants in alluvial groundwater to Silver Bow Creek have been reduced through a comprehensive groundwater control, capture, and treatment system, such that water quality standards are being met much of the time during base flow conditions. The design of a more effective capture system is very important for completion of the surface water component of the remedy. Storm water continues to be a significant source of contaminant loading to Silver Bow Creek during runoff events, and additional remedial actions are necessary.

The RMAP program will continue to obtain access to residential properties within the BPSOU that have not previously been sampled to complete indoor and outdoor assessments (i.e., residential yard soil, indoor and outdoor dust, attic dust, lead-based paint, drinking water, and mercury vapor) and perform clean up actions where necessary. The program anticipates completing these goals by about 2020.

For non-residential areas, engineering and institutional controls effectively isolate identified waste materials, thus preventing human and environmental exposures. Protection of human health is expected to be strengthened as the BRES evaluation and cover maintenance programs are improved and mature, and as the IC Plan is fully implemented, tested, and enforced. It is important that follow-up on BRES findings be tracked and implemented.

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Section 11
Next Review

The next five-year review for the BPSOU is required by September 30, 2015, five years from the date of this review.

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Section 12
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