Section 2 Site History and Enforcement Activities

The Silver Bow Creek/Butte Area NPL Site is located in the upper Clark Fork River watershed and includes portions of Butte and Walkerville, Montana. EPA designated the original Silver Bow Creek Site as a Superfund site in September 1983, under the authority of the CERCLA. EPA expanded the Silver Bow Creek Site to include the Butte Area in 1987. In addition to the BPSOU, this NPL site also includes the following remedial OUs: Butte Mine Flooding Operable Unit ([BMFOU] - Berkeley Pit and flooded underground mine workings); Rocker Timber Framing and Treatment Plant; Streamside Tailings; Warm Springs Ponds Active Area; Warm Springs Pond Inactive Area; Active Mine Area; and West Side Soils (formerly Non-Priority Soils). Other Superfund sites within the Clark Fork River drainage include the Anaconda Smelter NPL Site, the Montana Pole and Treating Plant NPL Site, and the Milltown Reservoir/Clark Fork River NPL Site.

Site History

In 1864, the first placer gold claims in the Butte area were staked and worked. These low-grade ores proved difficult to recover, and Butte remained a small mining camp compared to others in the region. Early activities focused on placer mining. However, silver and copper ore also attracted the attention of early miners.

By the 1870s, dozens of silver and copper claims had been located and successful treatment processes developed, prompting the construction of mills and smelters capable of refining arsenic-laden copper ores. A world-class copper industry began to develop. In 1881, the purchase of mining claims by future copper baron, Marcus Daly, marked a significant turning point for Butte. Daly and his financial partners organized various companies, which became the Anaconda Copper Mining Company (ACMC) and rapidly accumulated surrounding mining properties on the Butte Hill. At about this time, there were over 300 operating copper mines, at least 10 silver mines, five smelters, and over 4,000 posted claims. Many mining companies operated in the Butte area from the 1860s through the 1920s.

Butte's air quality was poor for many years because of heap roasting – a process in which copper ore was roasted in large, open air fires – and smelting that took place within the city limits. In response to the poor air quality, on December 17, 1890 the city passed Ordinance 186, which made it illegal to roast ore within the city limits.

In 1883, Daly developed his own smelting facility 25 miles away and established the town of Anaconda. In the early 1890s, Daly and the ACMC built their own railroad, the Butte, Anaconda & Pacific, thus monopolizing the mining, transportation, and smelting of the copper ore. Spurs of the mainline tied all of the ACMC mines on the Butte Hill to the smelter works in Anaconda.

By 1910, the Butte district had produced over 284 million pounds of copper, making it the largest producer of copper in North America. All of the mines produced waste piles of various compositions, and the mills and smelters produced large quantities of tailings and related waste that were disposed of in ponds or dumped in Silver Bow Creek. Between 1910 and 1927, ACMC completed consolidation, with few exceptions, of all of the major mines, smelters, and mills in Butte. Milling and smelting continued in Butte until the 1920s but, as the copper smelting capacity at Anaconda grew, Butte became primarily a mining center. 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.

Mining in Butte was entirely underground until 1955, when ACMC began surface mining at the Berkeley Pit. Figure 2-1 shows the mining landscape in Butte at the beginning of the open pit mining era.

For 80 years, immense quantities of low-grade ore were moved from the Berkeley Pit to Anaconda. But in the 1960s and early 1970s, significant changes were made in the mining and processing procedures. The completion of the Weed Concentrator in Butte in 1964 reduced the amount of ore sent to Anaconda from 12 to just one trainload per day. The Weed Concentrator (now known as the Montana Resources Concentrator) was an ore concentrating facility that produced large quantities of waste in the active mine area and discharged large volumes of contaminated water to the Metro Storm Drain.

In 1977, ACMC merged with ARCO. 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. In 1985, certain properties were sold to Dennis Washington, owner of the Montana Resources (MR) Company. MR is the current operator of surface mining operations in the Continental Pit, which is located east of the Berkeley Pit, and the MR Concentrator (formerly known as the Weed Concentrator). ARCO closed the Anaconda Smelter in 1984. ARCO is now known as Atlantic Richfield, and is a wholly owned subsidiary of British Petroleum.

More than 120 years of mining has created numerous waste rock dumps that are scattered throughout the Butte area. Operation of mills, concentrators, and smelters generated tailings and a variety of other materials. The City of Butte and the Town of Walkerville were established with the advent of mining in the area and grew in size and population as the mining and milling industries flourished. The communities were established close to the mining and milling centers as a matter of convenience. Urbanization of Butte Hill and paving of large areas increased storm water runoff relative to pre-urbanization levels. Railroads were used to transport the ore and ore concentrate. Some railroad grades were built using mine waste rock, fill, and other readily available materials.

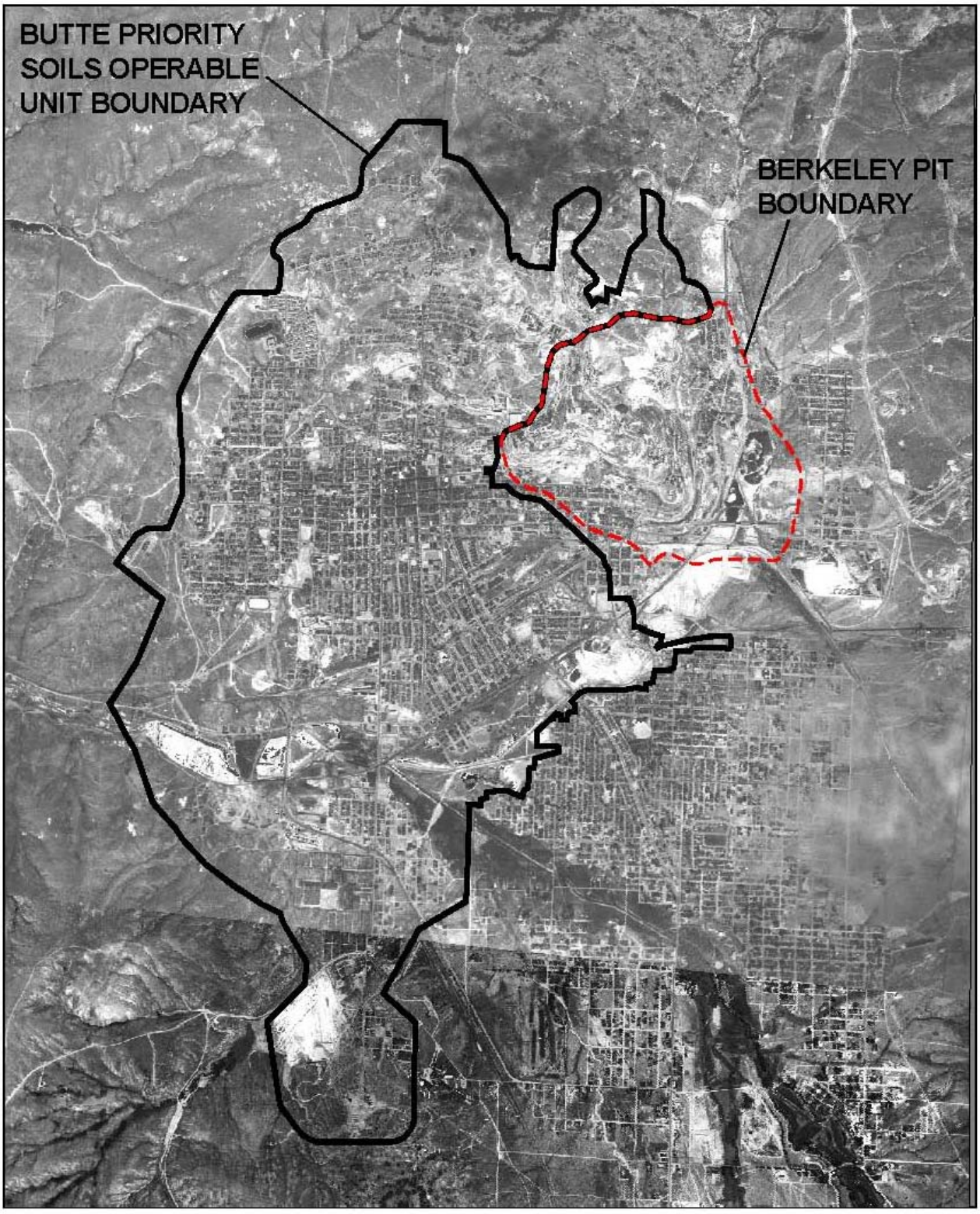

Figure 2-1
Beginning of Butte Open Pit Mining Era
(1954-1956)
Record of Decision
Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

Beginning in 1881, several railroads have served Butte, including the Union Pacific Railroad; Northern Pacific Railway and the Great Northern Railway (now The Burlington Northern and Santa Fe Railway Company); the Butte, Anaconda and Pacific Railroad; the Milwaukee Road (also known as the Chicago, Milwaukee, St. Paul and Pacific Railroad); the Montana Western Railway; and the Rarus Railway (Rarus). Remaining rail lines in the BPSOU area are shown on Figure 2-2.

Enforcement Activities

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.

A list of PRPs is provided in Appendix D. Following issuance of this ROD, EPA will reexamine and update this list. Many of the original PRPs are no longer in existence. The new Anaconda Company has purchased Ferry Lane, one of the PRPs. EPA settled with Montana Power Company in October 2000 for its liability share within the Butte Priority Soils OU. EPA will consider settlement discussions with other small parties, separate from the main Remedial Design/Remedial Action Consent Decree. The main RPs who are likely to participate in the final Consent Decree are ARCO, Butte-Silver Bow County, Burlington Northern Santa Fe Railroad, Union Pacific Railroad Company, and Montana Resources, Inc. and its related entities.

In 1987, the Butte Soils Screening Study (CDM 1988) was conducted to provide EPA with site characterization data for the purpose of prioritizing future Remedial Investigation/Feasibility Studies (RI/FS) and removal activities. In 1989, EPA separated the BPSOU into Phase I and Phase II activities to be implemented concurrently. Phase I activities focused on high-priority human health risks and resulted in the implementation of numerous TCRAs and ERAs (discussed in additional detail previously and below). These activities have included physical removal and/or capping of the majority of potential arsenic and lead source areas within, or close to, residential neighborhoods (e.g., waste rock dumps, railroad beds, residential yards, and play areas) and cleanup of many yards. Phase II activities included conducting the full RI/FS for the entire OU. The emphasis of Phase II was an evaluation of arsenic and metal concentrations and pathways relating to Silver Bow Creek and alluvial groundwater, and both present and future arsenic and metals concentrations and pathways relating to source materials located outside of residential areas.

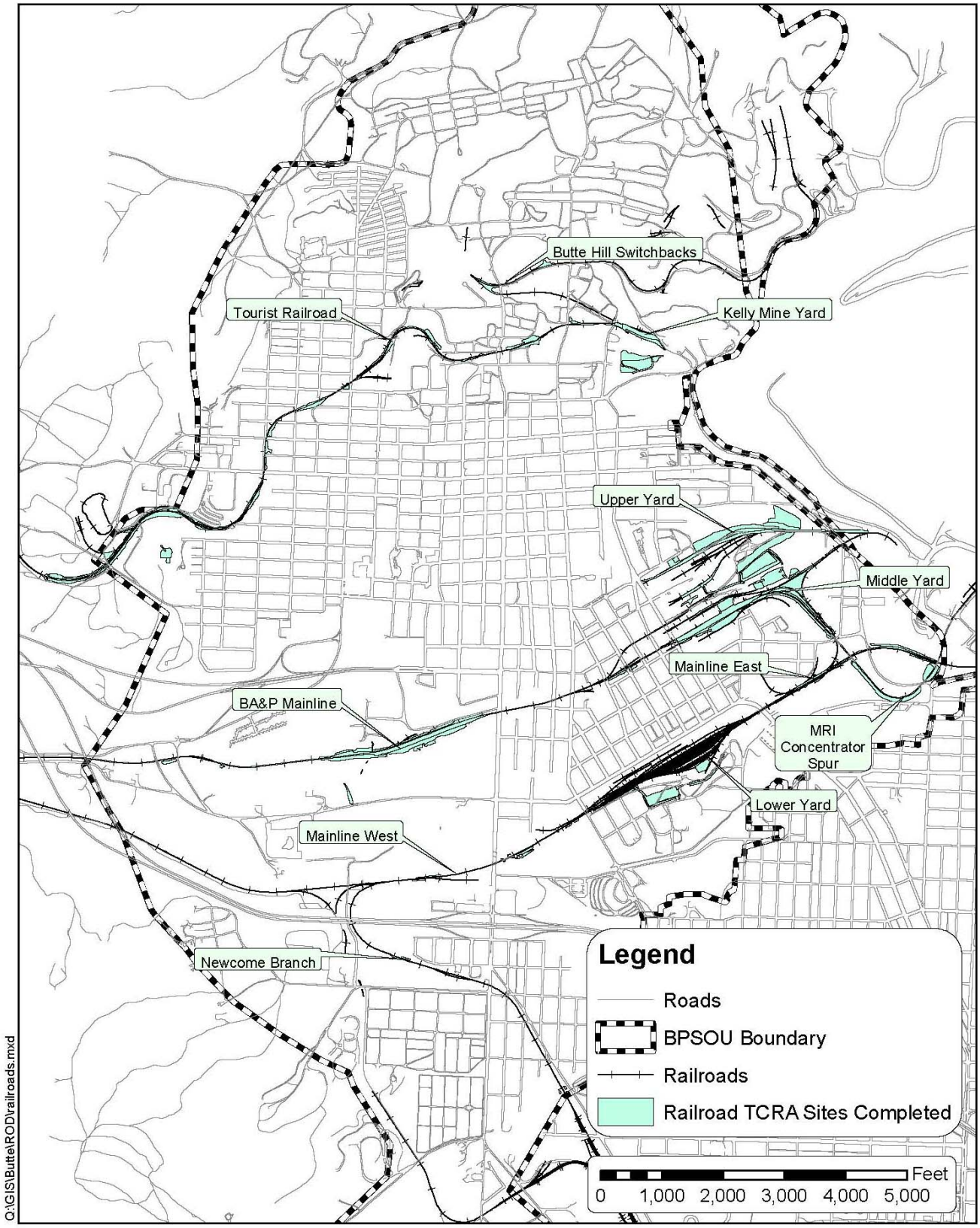

Figure 2-2: Butte Railroads and Sites Addressed in the Railroad TCRA
Record of Decision
Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

In 1991, following initial data collection activities, EPA developed the Statement of Work (SOW) for the Phase II RI/FS (EPA 1991). The SOW served as the substantive basis for the Phase II RI/FS Work Plan (PRP Group 1996). A consent order to conduct a RI/FS at the BPSOU was executed by EPA and signed by ARCO and other BPSOU PRPs in June 1992.

Site Characterization Background

The soil/mine waste, air, surface water, and groundwater media of the BPSOU have been the subjects of studies since the late 1960s. The pace of study picked up considerably after the area became listed on the NPL in 1983. Tables 2-1, 2-2, and 2-3 summarize the soil, surface water, sediment, and groundwater investigations used to prepare the BPSOU RI and FS reports. As shown in Table 2-1, numerous investigations concerning surface soil and surface mine waste were conducted to examine the chemical characteristics of soil within residential and commercial areas, mine waste rock dumps, tailings accumulations, and railroad grades within the BPSOU. The surface water system within and adjacent to the BPSOU has been characterized by the investigations shown in Table 2-2. Both alluvial and bedrock water-bearing units are present within the Silver Bow Creek/Butte Area NPL Site. The BPSOU RI Report and subsequent documents primarily characterized the alluvial aquifer, since the bedrock aquifer was addressed in the Mine Flooding OU. Groundwater investigations are shown in Table 2-3.

Air quality within the BPSOU has been monitored with regard to total suspended particulates and metals concentrations. The majority of the data identified are linked to permitting requirements for the active mining/milling areas. As discussed in Section 3.1 of the RI report, the airborne transport of COC bearing particulates within the BPSOU does not pose a significant threat to human health and, therefore, additional efforts to characterize the air pathway were not undertaken in connection with the RI.

The PRP Group was responsible for developing the Phase II RI/FS work plan, the RI/FS reports and most of the associated sampling and analysis plans, laboratory analytical protocols, site health and safety plans, data reports, and technical memoranda supporting the RI/FS. All reports were reviewed and approved by EPA, in consultation with DEQ. EPA, in consultation with DEQ, prepared human health and ecological risk assessments, the community involvement plan, the Focused Feasibility Study of the Metro Storm Drain, and identified ARARs for the BPSOU site. In consultation with DEQ, EPA prepared the Proposed Plan and this ROD. Following issuance of the ROD, EPA and ARCO, along with other parties, are subject to a court order for mandatory Consent Decree negotiations.

Summary of BPSOU Response Actions

As noted previously, EPA undertook several removal actions (TCRAs and ERAs) within the Butte Priority Soils OU. 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 Butte Priority Soils OU have undergone

Table 2-1
Summary of Previous Soils Investigations
Record of Decision
Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

Reference	Surface Soil/Mine Waste Summary	Types of Soil/Mine Waste Information Collected	Number of Samples within the BPSOU Surface Soils Database	Analytes
Ecology and Environment, 1987. Data Results for Walkerville, Silver Bow County, Montana, letter report to Michael Holmes of EPA from Kenton Alexander of Ecology and Environment, Inc, March 11, 1987.	Surface soil sampling in Walkerville at waste dumps, drainages, residential yards, etc. Data from this investigation was not included in the soil database (Appendix A) due to incomplete sample location information.	Surface soil sampling with 611 samples	NA	542 samples - As, Cd, Cn, Cr, Cu, Hg, Pb, Mn, Zn & pH 69 samples - Ag, Al, As, Ba, Be, Ca, Cd, Cn, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Sn, Tl, V, & Zn
AMC, 1987. Butte/Centerville Soil Sampling Project Report, Prepared by Tetra Tech, Inc, April 1987. BUTS087C	Sampled bare surface soil in public areas where children are likely to play: parks, schools, ball fields, ice rinks, motocross racing areas, day care centers and rodeo grounds. One composite sample from each area was collected and generally consisted of several subsamples.	Surface soil sampling of bare soil in public areas	50 plus 2 duplicates	As, Cd, Cu, Hg, Pb, Zn, pH,& percent moisture
CDM, 1988. Final Report, Butte Soils Screening Study (BSSS) for the Butte Addition to the Silver Bow Creek NPL Site, Butte, Montana, Prepared for EPA. BUTS087 A	A comprehensive soils screening study to provide analytical data for prioritizing future RI/FS activities. Measured soil concentrations at historic mining and processing sites as well as residential and public areas.	Surface soil sampling, soil profile sampling	367 plus 19 duplicates	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Sn, Tl, V, & Zn
Ecology and Environment, 1988. Data Validation Results from the Walkerville Removal Action, letter report to Mike Holmes of EPA from Karen Abbenhaus of Ecology and Environment, Inc, October 25,1988.	Surface soil sampling in Walkerville at residences, ball fields, waste rock piles, etc. Data from this investigation was not included in the soil database (Appendix A) due to incomplete sample location information.	Surface soil sampling with 225 samples	NA	Hg, Pb, pH, & porosity
CH2M Hill and Chen-Northern, 1990a. Draft Final Silver Bow Creek CERCLA Phase II Remedial Investigation Summary, Area 1 Operable Unit. BUTSD89A BUTGW89A	Filled in data gaps of Phase I RI (MultiTech, 1987). Conducted soils mapping, sampling of soils and dispersed tailings and sampling of impounded tailings deposits in the Area One Operable Unit.	Surface soil sampling, lithology, metals by grain size and mapping; subsurface soil sampling	105 plus 9 duplicates 73 additional XRF	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, & Zn
Ecology and Environment Inc., 1990b. Report of Sampling Activities, Butte Priority Soils, Butte, Montana, March 1, 1990. BUTS090B	Determined if elevated metals existed in waste rock piles included in the Butte Priority Soils Removal Action.	Surface soil sampling	35	As, Cd, Cu, Pb, Zn & pH
ARCO, 1991a. Butte Priority Soils Investigation, Prepared by PTI Environmental Services, February 1991. BUTS091D	Helped fill data gaps from CDM (1988) (BSSS). Collected soil samples from 560 residential yards and analyzed for metals.	Surface soil sampling of residential yards	45 CLP data only	As, Cu, Pb & Zn
BSB Department of Health and Univ. of Cincinnati, 1991. The Butte-Silver Bow Environmental Health Lead Study. BUTS091E	650 soil samples were taken in residential yards, gardens, and play areas to help identify and quantify accessible metals in the environment. Performed a blood lead study for children under six years of age.	Surface soil sampling	532	As, Cd, & Pb
CDM, 1991. Priority Soils Railroad Data, Letter to Sara Weinstock of EPA from Robert Rennick of CDM Federal, June 17,1991. BUTS091A	Characterized metals and arsenic concentrations in designated railroad grades within the BPSOU.	Railroad grade sampling	51 plus 3 duplicates	Al, As, Cd, Cu, Cr, Fe, Pb, Mg, Ni, Zn, pH, & EC

Table 2-1
Summary of Previous Soils Investigations
Record of Decision
Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

Reference	Surface Soil/Mine Waste Summary	Types of Soil/Mine Waste Information Collected	Number of Samples within the BPSOU Surface Soils Database	Analytes
ARCO, 1992h. Anaconda Long Term Vegetation Monitoring Project, 1988-1990, Smelter and Butte Hill Sites. Prepared by W. Keammerer, D. Arthur, and A. Kuenstling. CFUS088A	Evaluated revegetation success at reclaimed areas in Butte and Smelter Hill near Anaconda. Characterized existing vegetation and metals concentrations in upper soil layers and plant tissues to help evaluate long term stability of vegetation. Data from this investigation was not included in the soil database because samples of remedial cover soils, not mine waste.	Surface soil sampling, vegetation structure and composition	NA	Al, As, B, Ba, Cd, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Si, Sr, Ti, V, Zn, pH, SAR, TOC, & CEC
CDM, 1992a. Buffalo Gulch Drainage/Residential Yards Sampling Photographs, Letter to Sara Weinstock of EPA from Gregg R. Monger of CDM Federal, July 14, 1992.	Characterized metals and arsenic concentrations in sub-surface soil samples within source areas within the Buffalo Gulch Drainage and surface soil samples from five selected residential properties within BPSOU.	Surface and sub-surface soil sampling	5 Residential yard data only	As, Cd, Cu, Pb, Zn, pH, & EC
Ecology and Environment Inc., 1992. Report of Sampling Activities Anselmo/Late Acquisition Removal Areas, Butte, MT. BUTS092C	Collected surface soil samples at the Anselmo Mine Yard Removal Area and the Late Acquisition Removal Area. Results used to fill data gaps in determining boundaries of materials to be removed by PRPs.	Surface soil sampling	8	As, Pb, & pH
MSE, Inc., 1992. Final Field Sampling Report, ARCO Priority Soils Investigation. BUTS092B	Sampled 37 residential yards for metal analyses. One composite sample from each yard was collected and consisted of 2 to 16 subsamples.	Surface soil sampling of residential yards	46 plus 3 duplicates	As, Cd, Cu, Pb & Zn
ARCO, 1993c. 1991 DS/DV/DU Report, Colorado Tailings and Butte Reduction Works Soils Investigation, Lower Area One Expedited Response Action, Supplemental Investigations, Sliver Bow Creek/Butte Area NPL Site. BUTS091B	Determined areal extent of mine tailings and metals-impacted soils and mapped surface debris within Lower Area One.	Mapped surface debris and performed surface soil sampling with LAO.	5	As, Cu, Pb, Zn, & Organics
CDM, 1993. July 1993 TCRA Sampling Results, Letter to Sara Weinstock of EPA from Darrel Stordahl of CDM, August 12,1993. BUTS093A	Collected soil samples from the Alice Dump, Anselmo Mine Yard area, and fill material stockpiled at Lower Area One.	Soil and fill material sampling	27 plus 1 duplicate	As, Cu, Pb, Zn, and pH
AGI, 1994. Railbed Assessment, BPSOU. BUTS093B	Evaluated metals concentrations in railroads owned or leased by BNRR, UPRR, and MWRC within the BPSOU.	Surface and sub-surface samples of railbed materials. SPLP leach tests.	154 plus 6 duplicates	As, Cu, Pb, & Zn A few samples had: Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, 11, V, & *Zn*
CDM, 1994a. BPSOU January 1994 Soil Sampling Results, Missoula Gulch-Emma Dump, Letter to Sara Weinstock of EPA from Darrel Stordahl of CDM, February 14, 1994. BUTS094B	Collected surface soil samples from the North Emma Dump and the vacant area to the north of this dump.	Surface soil sampling	13 plus 1 duplicate	As, Cd, Cu, Pb, Zn, & pH
CDM, 1994b. BPSOU April 1994 Soil Sampling, Source Areas Sampling Results, Letter to Sara Weinstock of EPA from Darrel Stordahl of CDM, May 26,1994. BUTS094C	Sampled waste rock dumps and other mining-related areas to determine if they would be added to the BPSOU ERA Source Areas SOW for removal.	Surface soil sampling	27 plus 2 duplicates	As, Cd, Cu, Pb, Zn, & pH

Table 2-1
Summary of Previous Soils Investigations
Record of Decision
Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

Reference	Surface Soil/Mine Waste Summary	Types of Soil/Mine Waste Information Collected	Number of Samples within the BPSOU Surface Soils Database	Analytes
AGI, 1995. October 1994 Supplemental Soil Sampling, Railbed Assessment, BPSOU. BUTS094D	Collected soil samples to confirm metals concentrations in railbed at the westerr extremity of BPSOU and the rail bed on the Newcome Branch. Data from this investigation was not included in the soil database (Appendix A) because samples taken from material which was removed as part of the Montana Pole Site remediation.	Surface and sub-surface sampling	NA	As, Pb
CDM, 1995. BPSOU November 1994 Soil Sampling Results, Letter to Sara Weinstock of EPA from Darrel Stordahl of CDM, January 26, 1995. BUTS094A	Collected surface soil samples from waste rock dumps and other mining-related areas to determine metals and arsenic concentrations as part of BPSOU ERA activities.	Surface soil sampling	30 plus 2 duplicates	As, Cd, Cu, Pb, Zn, & pH
URS Operating Services, Inc., 1997. Trip Report for Removal Support, Alice Dump, Butte/Walkerville, Montana.	Collected surface soil samples from the Alice Dump to determine metals and arsenic concentrations.	Surface soil sampling	96 plus 9 XRF results for samples with CLP results	As, Co, Cu, Pb, Hg, & Zn
CDM, 1998. Data Summary Report for Stream-Sediment and Soil Sampling in Grove Gulch, Blacktail Creek, and Silver Bow Creek Diversion Channel, BPSOU. BUTS097A	Collected surface soil samples adjacent to Grove Gulch. Sampled materials that resembled mine wastes or had little to no vegetation cover.	Surface soil sampling	10 plus 1 duplicate	As, Cd, Cu, Pb, Zn, & pH
ARCO, 2000a. Data Summary Report, Railroad Bed Time Critical Removal Action, Supplemental Railroad Bed Sampling Program. RRTCRA	Performed sampling of railroad bed material and adjacent residential yards to further define the extent of railroad beds and yards to be addressed by the Railroad Bed TCRA.	Surface soil sampling of railroad bed materials and adjacent residential yards.	64 plus 2 duplicates	Railroad Beds: As, Cd, Cu, Pb, Zn, & pH Residential Yards: As, Pb
MBMG 2001. Soil Borings, Tailings and Overburden Thicknesses and Volumes, Lower Area One and Metro Storm Drain.	Conducted soil borings in 19 locations in the Upper Metro Storm Drain Areas to confirm the presence and thickness of buried tailings and mine waste deposits.	Lithologic descriptions, waste volume estimates, Simulated Acid-Rain Leach testing and XRF analyses performed on cores and discrete waste samples.	22 acid-rain leach tests. XRF analyses performed on 4 samples.	Acid-rain leach tests: pH, SC, As, Cd, Cu, Zn XRF: As, Cd, Cu, Pb, Zn
MBMG 2004. Summary of Investigation Upper Silver Bow Creek, Butte, Montana. Montana Bureau of Mines and Geology Open File Report 507.	Lithologic and groundwater quality information from installation of six monitoring wells in the Metro Storm Drain. Also, column leach tests performed on alluvial materials obtained from two separate locations in the Metro Storm Drain.	Lithology, groundwater quality and leachate analyses for column leach tests	NA	Groundwater Quality Data: Dissolved Metals, water quality parameters, major ions, nutrients, tritium and helium isotopes. Column test leachate: Cd, Cu, Fe, Zn
MBMG 2006. Soil Borings at Butte-Silver Bow Metro Sewage Treatment Plant and Butte Reduction Works, Butte, Montana.	Soil core drilling program to expand knowledge of tailings thicknesses at MSTP and BRW, and refine the tailings volume estimates for LAO.	Soil Borings to visually confirm presence or absence of tailings	NA	NA

NA - Not Applicable, because not included in BPSOU surface soils database.
Reasons datasets were omitted listed in Section 3.2 of Final RI Soil/Mine Waste Characterization
SAR - Sodium Absorption Ratio; TOC - Total Organic Carbon; CEC - Cation Exchange Capacity; EC - Electrical Conductivity

Table 2-2
Summary of Previous Surface Water and Sediment Investigations
Record of Decision
Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

Reference	Surface Water/Sediment Summary	Types of Surface Water/Sediment Information Collected	Number of Locations Sampled	Number of Sample Analyses	Analytes
MultiTech, 1987. Silver Bow Creek Remedial Investigation Final Report Phase I RI).	Characterized surface water flow and quality associated with the Silver Bow Creek CERCLA Site.	Surface water flow and quality monitoring, storm water sampling, installation of permanent stream gaging stations	22 [1]	159 [1]	Varied, generally: As, Cd, Cu, Fe, Pb, Zn, N03, S04, TDS, TSS, Hardness, Alkalinity, pH, SC, Temperature, Flow
CH2M Hill, 1987a. Data Summary Report Supplemental Remedial Investigation, Silver Bow Creek Site	Collected surface water and stream sediment data from Silver Bow Creek, upper Clark Fork River, and their tributaries to help characterize the Silver Bow Creek Site.	Surface water flow and quality monitoring, stream bed sediment sampling	31 Surface Water [1] 6 Sediment [1]	95 Surface Water [1] 12 Sediment [1]	Surface Water: AI, As, Cd, Cr, Cu, Fe, Mn, Pb, Zn, S04, TSS, Eh, General Chemistry & Flow Sediment: AI, As, Cd, Cr, Cu, Fe, Mn, Pb,Zn, DO, Eh & General Chemistry
Ingman, G.L., 1987. Completion Report and Final Data Summary, Clark Fork River Basin Water Quality Monitoring Project RIT-86-8503.	Performed water quality monitoring for the entire Clark Fork River at 31 fixed stations with 16 samples each. Two of the stations are located within the BPSOU.	Surface water flow and quality monitoring, macroinvertebrate and periphyton sampling	2	38	As, Cu, N, P, Zn, O-P04, NH3-N, N03+N02, TSS, General Chemistry & Flow
CH2M Hill and Chen-Northern, 1990a. Draft Final Silver Bow Creek CERCLA Phase II Remedial Investigation Summary, Area 1 Operable Unit.	Filled in data gaps of Phase I RI (MultiTech, 1987). Focused on characterizing surface water quality during a snowmelt runoff event and a baseflow sampling event in the Area One Operable Unit.	Surface water flow and quality monitoring, storm water sampling, baseflow sampling	11	14	Varied, generally: Ag, AI, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Se, TI, V, Zn, N03, S04, TSS, CLP RAS Organics, General Chemistry & Flow
Ingman, G.L. and M.A. Kerr, 1990. Water Quality in the Clark Fork River Basin, Montana, State Fiscal Years 1988-1989	Continuation of study documented in (Ingman, 1987). Monitoring stations increased to 32 total with 3 stations located within the BPSOU.	Surface water flow and quality monitoring, macroinvertebrate and periphyton sampling	3	93	As, Cd, Cu, N, P, Pb, Zn ,P04, NH3-N, N03+N02, TSS, General Chemistry & Flow
ARCO, 1992a. Draft Remedial Investigation Report, Montana Pole & Treating Plant Site, Prepared by Keystone, Inc.	Performed surface water and stream sediment sampling to help assess the effect of the Montana Pole and Treating Plant Site on Silver Bow Creek.	Surface water flow and quality monitoring, stream bed sediment sampling	7 Surface Water 4 Sediment	11 Surface Water 4 Sediment	Surface Water: As, Cd, Cr, Cu, Pb, Zn, Organic Compounds (Phenols, PAHs, VOCs, TPHs, TOG) TDS, TSS, pH, SC, Temperature & Flow Sediment: As, Cd, Cr, Cu, Pb, Zn & Organic Compounds (Phenols, PAHs, VOCs, TPHs, PCBs, dioxins)
PRP Group, 1994. DS/DV/DU Report, BPSOU, 1993 Storm Water Investigations	Characterize hydrology of the BPSOU and determine the nature, extent, and potential sources of metals loading to surface waters	Surface/storm water flow and quality monitoring, precipitation monitoring	14	115	Ag, AI, As, Cd, Cu, Fe, Hg, Mo, N, P, Pb, Sb, Zn NH3-NH4, N02, N03, S04, TDS, TSS, DO, COD, General Chemistry & Flow
PRP Group, 1995a. DS/DV/DU Report, BPSOU, 1994 Storm Water Investigations	A continuation of PRP Group (1994) to characterize hydrology of the BPSOU and determine the nature, extent, and potential sources of metals loading to surface waters	Surface/storm water flow and quality monitoring, precipitation monitoring	11	32	Ag, AI, As, Cd, Cu, Fe, Hg, Mn, N, P, Pb, Sb, Zn, NH3-NH4, NO2, N03, S04, TDS, TSS, DO, COD, General Chemistry & Flow
PRP Group, 1996b. DS/DV/DU Report, BPSOU, 1995 Storm Water Investigations	A continuation of PRP Group (1994, 1995a) to characterize hydrology of the BPSOU and determine the nature, extent, and potential sources of metals loading to surface waters	Storm water flow and quality monitoring, precipitation monitoring	11	115	Ag, AI, As, Ba, Be, Cd, Cr, Cu, Fe, Hg, Mn, Mo, Pb, Sb, Se, Zn, N03, S04, TDS, TSS, General Chemistry & Flow
CDM Federal, 1997. Final 1996 Storm Water Monitoring Data Summary Report, BPSOU, Prepared for EPA	Collected data to allow correlation between the amount of precipitation and the volume of storm water runoff in the upper Missoula Gulch watershed.	Storm water flow monitoring in upper Missoula Gulch, precipitation monitoring	0	0	Flow
PRP Group, 1997. DS/DV/DU Report, BPSOU, 1996 Storm Water Investigations	A continuation of PRP Group (1994, 1995a, 1996b) to characterize hydrology of the BPSOU	Storm water flow monitoring, precipitation monitoring	0	0	Flow
CDM Federal, 1998. Data Summary Report for Stream-Sediment and Soil Sampling in Grove Gulch, Blacktail Creek, and the Silver Bow Creek Diversion Channel.	Collected stream sediment samples to assess potential for Grove Gulch to contribute impacted stream sediments to Blacktail Creek and Silver Bow Creek. Appendix A of CDM (1998) includes 2 stream sediment samples from Missoula Gulch collected by MBMG, but unpublished.	Streambed sediment sampling and adjacent soils (Soil samples discussed in Table 1-1 and Section 1.5.1)	12 Sediment 1 Sediment Appendix A unpublished MBMG data	12 Sediment 2 Sediment Appendix A unpublished MBMG data	Sediment: As, Cd, Cu, Pb, Zn MBMG Sediment: AI, As, B, Ba, Cd, Cr, Cu, Fe, Li, Mn, Mo, Ni, P, Pb, Si, Sr, Ti, V, Zn, Zr,

Table 2-2
Summary of Previous Surface Water and Sediment Investigations
Record of Decision
Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

Reference	Surface Water/Sediment Summary	Types of Surface Water/Sediment Information Collected	Number of Locations Sampled	Number of Sample Analyses	Analytes
PRP Group, 1998. Final DS/DV/DU Report BPSOU Surface Water Investigation	Presents the results of field and laboratory analysis of surface water samples collected during the Final Phase II RI/FS for the BPSOU.				
CDM Federal, 1999. Task Specific Sampling Memorandum for Stream-Sediment Sampling in Upper Silver Bow Creek, the Metro Storm Drain, and the Lower Portions of Blacktail Creek, Buffalo Gulch, and Missoula Gulch.	Collected stream sediment samples to assess metals associated with stream sediments in Silver Bow Creek and its tributaries within the BPSOU.	Streambed sediment sampling	19 Sediment	19 Sediment	Sediment: As, Cd, Cu, Pb, Hg, Zn, TOC
United States Geological Survey, Long-Term Clark Fork River Monitoring Program	Collect surface water flow and quality data at two locations within the BPSOU on Blacktail Creek and Silver Bow Creek. Water quality sampling began in March 1993 and has continued through the present, except for 1996. Sample frequency is eight times per year.	Surface water flow and quality monitoring	2	Approximately 90 through 1999, ongoing (16/year)	As, Cd, Cu, Fe, Mn, Pb, Zn, TSS, General Chemistry & Flow
BMFOU Remedial Design / Remedial Action Monitoring Program	Monitoring water quality monthly to determine I-Class standard for future treated water discharge requirements.	Surface water flow and quality monitoring	3	Approximately 300 through 1999 (ongoing) 50/year	Ag, Al, As, Cd, Cu, F, Fe, Mn, Pb, Se, Tl, Zn, N03, S04, & General Chemistry
ARCO 2000. Draft LAO Expedited Response Action Final Phase II Monitoring Report for May 1998 through June 30, 2000 and Quarterly Report for April 1, 2000 through June 30, 2000	Summarizes the monitoring activities conducted from April 1998 through June 2000.	Presents surface water and groundwater elevations, water chemistry, and surface water flow data for the period of April 1998 to June 2000.	Varies, over 150 GW and SW monitoring locations	Quarterly from May 1998 through June 2000	Varies, some stations were water levels only, others included general chemistry and total and dissolved metals.
CDM Federal, 2000. Draft Technical Memorandum Regulatory Considerations for Storm Water Management at the Silver Bow Creek/Butte Area NPL Site	Considers site-specific storm water runoff characteristics in conjunction with federal, state and local storm water regulations in recommending a basis for storm water management and compliance the BPSOU.	NA	NA	NA	NA
ARCO 2005. Draft Data Summary and Interpretation Report, Base Flow and Wet Weather Data, October 2002 – September 2003	Summarizes and evaluates the surface water data collected during base flow and runoff events monitored from Oct. 2002 through Sept. 2003.	Base and wet weather flow and quality monitoring	64	Quarterly base flow measurements and 7 wet weather events from Oct. 2002 to Sept. 2003	Ag, Al, As, Cd, Cr, Cu, Fe, Hg, Mn, Pb, Zn, S04, TDS, TSS, DO, Alk, pH, General Chemistry & Flow
ARCO 2005. Draft Data Summary and Interpretation Report, Base Flow and Wet Weather Data, October 2003 – September 2004	Summarizes and evaluates the surface water data collected during base flow and runoff events monitored from Oct. 2003 through Sept. 2004.	Base and wet weather flow and quality monitoring	63	Quarterly base flow measurements and 11 wet weather events from Oct. 2003 to Sept. 2004	Ag, Al, As, Cd, Cr, Cu, Fe, Hg, Mn, Pb, Zn, S04, TDS, TSS, DO, Alk, pH, General Chemistry & Flow
ARCO 2003. Draft Data Summary and Interpretation Report, Base Flow and Wet Weather Data, October 2001 – September 2001	Summarizes and evaluates the surface water data collected during base flow and runoff events monitored from Oct. 2001 through Sept. 2002.	Base and wet weather flow and quality monitoring	59	Quarterly base flow measurements and 13 wet weather events from Oct. 2001 to Sept. 2002	Ag, Al, As, Cd, Cr, Cu, Fe, Hg, Mn, Pb, Zn, S04, TDS, TSS, DO, Alk, pH, General Chemistry & Flow
ARCO, 2005. Butte Treatment Lagoons Draft Quarterly Data Summary Report, 3rd Quarter 2005 (Quarterly Report No.14)	Summarizes and evaluates water quality and flow data collected from July 2005 to Sept. 2005 at the Lower Area One treatment lagoons.	Water quality and flows monitored	25	Flows monitored daily; water quality sampled 9 times per month.	Ag, Al, As, Cd, Cr, Cu, Fe, Hg, Mn, Pb, Si, U, Zn, Hard

TDS - Total Dissolved Solids; TSS - Total Suspended Solids; SC - Specific Conductance; DO - Dissolved Oxygen; COD - Chemical Oxygen Demand;
CLP RAS Organics - Contract Laboratory Program Routine Analytical Services organic analyses;
DS/DV/DU - Data Summary Data Validation/Data Usability
1 Includes sample locations outside of the BPSOU boundary.
2 General Chemistry Parameters usually include Ca, Mg, K, Na, CI, Alkalinity, pH, temperature, specific conductance.

Table 2-3
Summary of Previous Groundwater Investigations
Record of Decision
Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

Reference	Groundwater Summary	Types of Groundwater Data Collected	Number of Groundwater Locations Sampled	Number of Groundwater Sample Analyses	Analytes [2]
Botz, 1969. Hydrogeology of the Upper Silver Bow Creek Drainage Area, Montana.	Described occurrence, quality, and movement of groundwater in Upper Silver Bow Creek drainage area.	Aquifer testing, groundwater quality and water level monitoring	56	56	S04, General Chemistry
CH2M Hill, 1987a. Data Summary Report Supplemental Remedial Investigation, Silver Bow Creek Site	Vadose Zone Characterization Study to assess flux of metals from unsaturated stream side tailings into underlying groundwater.	Vadose zone hydraulic characterization	9	80	Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Sb, Se, Sn, Tl, V, Zn, & General Chemistry
CH2M Hill, 1987b. Final Data Summary Report Addendum, Supplemental Remedial Investigation, Silver Bow Creek Site	Data report containing pore water samples from the Vadose Zone Characterization study. Data were not available at the time of CH2M Hill 1987.	Vadose zone water quality monitoring	5	10	Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Sb, Se, Sn, Tl, V, Zn, & General Chemistry
MultiTech, 1987. Silver Bow Creek Remedial Investigation Final Report (Phase I RI).	Evaluated extent of groundwater impacted by COCs and significance of tailings as COC sources in Silver Bow Creek CERCLA Site.	Well installations, groundwater quality and water level monitoring, aquifer testing, soil water measurements	98	209	As, Cd, Cu, Fe, Pb, Zn, S04, General Chemistry, & Eh.
EPA, 1989. Supplemental Data Package, Enclosure 1 - Attachment 3 of Notice Letter, Mine Flooding Operable Unit of the Silver Bow Creek/Butte Area NPL Site.	Supplemental data package associated with the Special Notice Letter and Draft Administrative Order for the Mine Flooding Operable Unit of the Silver Bow Creek Butte Area NPL Site. Package is Enclosure 1 - Attachment 3 in the Notice Letter.	Groundwater quality and water level monitoring	22	195	Varies, generally: Ag, Al, As, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Pb, Se, Si, Zn, S04, & General Chemistry.
ARCO, 1990a. Colorado Tailings and Butte Reduction Works Project, Prepared by Hydrometrics, Inc.	Gathered groundwater data to support remediation actions within the LAO.	Well installations, groundwater quality and water level monitoring, aquifer testing	26	30	As,Cd,Cu,Fe,Pb,Zn,S04 & General Chemistry
ARCO, 1990b. Data Report, Lower Area One Groundwater, Bedrock, and Geotechnical Site Investigations, Silver Bow Creek CERCLA Site, Expedited Response Action, Prepared by Dames & Moore, Inc.	Further assessed groundwater conditions in LAO for COCs.	Well installations, groundwater quality and water level monitoring	5	5	Ag, Al, As, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Si, Sr, Zn, S04 & General Chemistry
CH2M Hill and Chen-Northern, 1990a. Draft Final Silver Bow Creek CERCLA Phase II Remedial Investigation Summary, Area 1 Operable Unit.	Filled in data gaps of Phase I RI (MultiTech, 1987). Further defined nature, extent, and transport of groundwater impacted by COCs in the Area One Operable Unit.	Well installations, groundwater quality and water level monitoring, aquifer testing, surface geophysical investigation	71	126	Ag, Al, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Se, Tl, V, Zn, N03, S04, General Chemistry & Eh.
CH2M Hill and Chen-Northern, 1990b. Draft Final Silver Bow Creek CERCLA Phase II RI Data Addendum, Area 1 Operable Unit	Addendum of groundwater analytical data to the Phase II RI (CH2M Hill and Chen-Northern, 1990a).	Groundwater quality data	72	72	Ag, As, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Se, Tl, V, Zn, N03, S04, & General Chemistry.
ARCO, 1992a. Draft Remedial Investigation Report, Montana Pole & Treating Plant Site, Prepared by Keystone, Inc.	Identified nature and extent of COCs in groundwater associated with the wood treating facility. COCs different than BPSOU.	Well installations, groundwater quality and water level monitoring, aquifer testing	53	76	As, Cd, Cr, Cu, Pb, Zn, Organic Compounds (PCP, PAHs, TPH, BTEX, dioxinlfurans, etc.) & General Chemistry
ARCO, 1992. Lower Area One/West Camp Ground Water Treatability Study Quarterly Data Summary Report 1st Quarter 2002 (Quarterly Report No. 1)	Field scale treatability study of combined LAO and West Camp ground water. Evaluates treating both LAO and West Camp flows in the LAO Colorado Tailings Treatment Lagoons.	Ground water quality, mixing of ground water flows, and treatment evaluation. Water level monitoring	13	61	Ag, Al, As, Cd, Cr, Cu, Fi, Hg, Mn, Pb, Si, Zn & General Chemistry
Groundwater Technology, 1992. Final Screening Site Inspection Report for the Montana Power Company's Montana Street Operation Center, Butte, MT.	Collected data to determine nature and extent of COCs at the Montana Power Company's Montana Street Operating Center.	Well installations, groundwater quality and water level monitoring	9	19	Al, As, Ba, Be, B, Cd, Cr, Cu, Hg, Li, Mo, Ni, Pb, Sb, Se, Sr, Tl, Ti, V, Zn, Zr & General Chemistry

Table 2-3
Summary of Previous Groundwater Investigations
Record of Decision
Butte Priority Soils Operable Unit
Silver Bow Creek/Butte Area NPL Site

Reference	Groundwater Summary	Types of Groundwater Data Collected	Number of Groundwater Locations Sampled	Number of Groundwater Sample Analyses	Analytes [2]
ARCO, 1994a. Draft Remedial Investigation Report for the Butte Mine Flooding Operable Unit RI/FS, Prepared by Canonie Environmental Services, Inc.	Identified nature and extent of COCs in groundwater within the BMFOU. Some BMFOU monitoring wells are located within the BPSOU. Established a critical maximum level for water in the Berkeley Pit and performed a Private Well inventory.	Well installations, groundwater quality and water level monitoring, aquifer testing, private well inventory, groundwater modeling	77	144	Ag, Al, As, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Si, Zn, N03, S04, General Chemistry & Eh.
ARCO, 1994b. Data package submittal for the Supplemental Hydrologic Investigations (no report).	Implemented to provide a groundwater supplement to the Storm Water Investigations. Objectives included developing preliminary estimates of the quality, quantity, and distribution of surface water/groundwater exchanges as related to potential COC loading to Silver Bow Creek.	Well installations, groundwater quality and water level monitoring, aquifer testing	43	43	Ag, Al, As, Cd, Cu, Fe, Hg, Mn, Pb, Sb, Zn, S04 & General Chemistry
PRP Group, 1998. Final DS/DV/DU Report BPSOU Groundwater Investigation February 1997 – January 1998.	Presents the groundwater data collected and analyses completed during the Final Phase II RI/FS for the BPSOU.	Groundwater quality tested and water level measured	Water level measured in 49 wells; samples taken from 38 wells	217	Ag, Al, As, Cd, Cu, Fe, Hg, Mg, Mn, K, Na, Alk, Cl, Fl, Pb, Ti, Zn, TDS, S04, Sb & General Chemistry
ARCO, 2002. LAO/West Camp Groundwater Treatability Study, Quarterly Data Summary Reports, Numbers 1 through 14, ongoing	Presents sampling and analyses results for the Field-Treatability Study of combined LAO and West Camp groundwater at the LAO Colorado Tailings Treatment Lagoons at BPSOU.	Groundwater flow rate, pH and the rate lime was added were measured, as was water quality	6 stations	68	Ag, Al, As, CD, Cr, Cu, Fe, Hg, Mn, Pb, Si, Zn, and general chemistry
ARCO 2000. Draft LAO Expedited Response Action Final Phase II Monitoring Report for May 1998 through June 30, 2000 and Quarterly report for April 1, 2000 through June 30, 2000	Monitoring of surface water and groundwater re-equilibration after the LAO ERA to determine effectiveness of surface water and groundwater separation and effectiveness of groundwater capture and management	Groundwater Elevations and Groundwater chemistry, precipitation	Varies, over 150 GW and SW monitoring locations	Quarterly from May 1998 through June 2000	Varies, some stations were water levels only, others included general chemistry and total and dissolved metals.
CDM 2003. Data Summary Report, May 2003 Metro Storm Drain Supplemental Base Flow Sampling	Mass loading study along the MSD channel from Harrison Avenue to station SS-03	Measured discharge and water chemistry at intervals along the MSD channel. Sampling was of groundwater discharging to surface water in the MSD channel	18 sample points (16 mainstem, 2 tributaries)	18 (for parameters shown)	Discharge, Total and Dissolved Al, Sb, As, Cd, Cu, Cr, Ca, Co, Fe, Pb, Mn, Mg, Hg, Ni, K. Ag, Na, Zn, sulfate, chloride, bicarbonate, carbonate, acidity, hardness, TDS, temperature, turbidity, oxidation-reduction potential (ORP), pH, specific conductance (SC), and dissolved oxygen (DO).
CDM 2004. Focused Feasibility Study of the Metro Storm Drain	Evaluated 7 alternatives for remedial action in the Metro Storm Drain	Used necessary data from previous studies (water levels, chemistry, seepage run, well logs, leaching tests, etc.)	NA	NA	NA
MBMG 2004. Summary of Investigation Upper Silver Bow Creek, Butte, Montana. Montana bureau of Mines and Geology Open File Report 507.	Lithologic and groundwater quality information from installation of six monitoring wells in the Metro Storm Drain. Also, column leach tests performed on alluvial materials obtained from two separate locations in the Metro Storm Drain.	Lithology, groundwater quality and leachate analyses for column leach tests	6	6	Groundwater Quality Data: Dissolved Metals, water quality parameters, major ions, nutrients, tritium and helium isotopes. Column test leachate: Cadmium, copper, iron, and zinc.
ARCO 2004. MSD Post Construction Groundwater Monitoring	Monitoring plan to evaluate the change in the potentiometric surface after installation of the MSD subdrain	Water levels from wells and surface water bodies, flow and chemistry at subdrain cleanouts	Approximately 110 water levels measured	10 cleanouts, vault, and mouth of MSD	Water levels, metals As, Cd, Cu, Fe, PB, Si, Zn, Mn, K , Ca, Na, and general chemistry
BMFOU Remedial Design / Remedial Action Monitoring Program	Monitoring changes in water levels and water quality. Water levels of the system will trigger components of remedial action program.	Well installations, groundwater quality and water level monitoring	49	Approximately 600 through 1999 (ongoing) 98/year	Varies, generally: Al, As, Cd, Cu, F, Fe, Li, Mo, Mn, Ni, Pb, Se, Zn, N03, S04, Eh, & General Chemistry

1 Includes sample locations outside of the BPSOU boundary.
2 General Chemistry Parameters usually include Ca, Mg, K, Na, Cl, Alkalinity, pH, temperature, specific conductance

extensive response actions. The work was completed from the late 1980s through 2004. The final actions for two ongoing ERAs (Lower Area One and one for residential soils/source areas) are determined in this ROD. These response actions were undertaken to address the immediate human health and environmental problems at Butte Priority Soils OU.

Although an expedited process was used to conduct these response actions, Superfund law requires that removal actions be implemented in ways that contribute to the efficient performance of a final long-term remedial action, to the extent practicable. Therefore, EPA required that the response actions be 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 (see Figure 2-2). 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 Resource Conservation and Recovery Act (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 (LAO) 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 Lower Area One 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 Lower Area One 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, MDEQ, 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 Lower Area One within the floodplain of Silver Bow Creek. The piles were located east of the Metro Sewage Plant and west of Montana Street in Lower Area One. 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 Butte Priority Soils OU (Bureau of Reclamation 1992). The action was a critical ancillary action to the Lower Area One 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 Lower Area One 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.

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