U.S. Environmental Protection Agency

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

September 2005

*Report*

# Five-Year Review Report

## Second Five-Year Review Report
## for
## Silver Bow Creek/Butte Area Superfund Site
## Silver Bow and Deer Lodge Counties, Montana

**CERCLIS ID: MTD980502777**

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# Acronyms

| | |
|---|---|
| AMC | Anaconda Mining Company |
| AOC | administrative order on consent |
| ARAR | applicable or relevant and appropriate requirements |
| ARCO | Atlantic Richfield Company |
| BA&P | Butte, Anaconda, and Pacific Railway |
| BMF | Butte Mine Flooding |
| BMI | benthic macroinvertebrate |
| BPS | Butte Priority Soils |
| BSB | Butte-Silver Bow |
| CDM | CDM Federal Programs Corporation |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CERCLIS | Comprehensive Environmental Response, Compensation, and Liability Act Information System |
| CFR | Code of Federal Regulations |
| CFRTac | Clark Fork River Technical Assistance Committee |
| cfs | cubic feet per second |
| CWL | critical water level |
| cy | cubic yard |
| DEQ | Montana Department of Environmental Quality |
| EE/CA | engineering estimate/cost analysis |
| EqP | equilibrium partitioning |
| EPA | U. S. Environmental Protection Agency |
| ERA | expedited response action |
| ESD | explanation of significant differences |
| GPS | Global Positioning System |
| HDS | high density sludge |
| HRA | Historical Research Associates |
| HSB WTP | Horseshoe Bend Water Treatment Plant |
| IWCTU | interstitial water criteria toxic unit |
| MCE | maximum credible earthquake |
| MCL | maximum contaminant level |
| MCLG | maximum contaminant level goal |
| MDFWP | Montana Department of Fish, Wildlife, and Parks |
| MDHES | Montana Department of Health and Environmental Science |
| mgd | million gallons per day |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| MR | Montana Resources |
| MSL | mean sea level |
| NCP | National Contingency Plan |
| N-TCRA | non-time critical removal action |
| O&M | operation and maintenance |

| | |
|---|---|
| OU | operable unit |
| PMF | probable maximum flood |
| ppb | parts per billion |
| ppm | parts per million (equal to mg/L) |
| PRP | potentially responsible party |
| RAO | remedial action objective |
| RCRA | Resource Conservation and Recovery Act |
| RI | remedial investigation |
| RI/FS | remedial investigation/feasibility study |
| Rocker | Rocker Timber Framing and Treatment Plant |
| ROD | record of decision |
| RRU | Reclamation Research Unit |
| SCADA | supervisory control and data acquisition system |
| SEM | simultaneously extracted metals |
| SEM-A VS | simultaneously extracted metals and acid volatile sulfide |
| SST | Streamside Tailings |
| STARS | Streambank Tailings and Revegetation Study |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TCRA | time critical removal action |
| TOC | total organic carbons |
| UAO | Unilateral Administrative Order |
| USGS | U.S. Geological Survey |
| WSP | Warm Springs Ponds |
| WTP | water treatment plant |
| μg/L | micrograms per liter |

# Section 1 Introduction

The U. S. Environmental Protection Agency (EPA) Region 8 has conducted a five-year review of the remedial actions implemented at the Silver Bow Creek / Butte Area Superfund Site, Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS) ID: MTD980502777 in Silver Bow and Deer Lodge Counties, Montana. This review was conducted from April 2005 through June 2005. This report documents the results of the review. CDM Federal Programs Corporation (CDM), an EPA contractor, supported the EPA in preparation of this five-year review.

The purpose of the five-year review is to determine whether the remedies or other response action in place or under construction throughout the Silver Bow Creek / Butte Area site are protective of human health and the environment. The methods, findings, and conclusions of such reviews are documented in five-year review reports. In addition, five-year review reports identify deficiencies found during the review, if any, and identifies recommendations to address them.

The Silver Bow Creek / Butte Area Superfund Site, part of the Clark Fork River Basin, is made up of 8 unique remedial operable units (OU), each in various stages of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process for implementation of remedial actions at Superfund sites. Table 1-1 presents a summary of the Silver Bow Creek / Butte Area remedial OUs and dates of completed record of decision (ROD) documents.

The comprehensive five-year review guidance states that five-year reviews should be conducted either to meet a statutory mandate or as a matter of EPA policy. EPA must implement a statutory five-year review to be consistent with CERCLA 121(c), which states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.*

EPA interprets this requirement further in the National Contingency Plan (NCP) Section 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR), which states:

> *If a remedial action is selected that results in hazardous substances, pollutants or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

Based on both CERCLA and NCP requirements, statutory five-year reviews are required in 2005 for the completed remedial actions at the Warm Springs Ponds (WSP) and Rocker OUs. This will be the second five-year review of the WSP OUs as their remedial action completion date of 1995 triggered the first five -year review of the Silver Bow Creek / Butte Area Superfund Site in March 2000. EPA will also include policy reviews of the Butte Mine Flooding (BMF) and Streamside Tailings (SST) OUs, since both OUs have signed RODs and ongoing remedial actions. This second five-year review will also summarize progress within the CERCLA process for the Active Mining and Milling, West Side Soils, and Butte Priority Soils (BPS) OUs.

# Section 2 Site Chronology

Table 2-1 summarizes the important events and relevant dates in the Silver Bow Creek / Butte Area Superfund Site's chronology.

**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 |
| Open pit mining at Berkeley Pit | 03 | 1955 - 1982 |
| Major smelting period in Butte | 03/08 | 1879 - 1900 |
| Discovery of mining-related contamination along Silver Bow Creek between Butte and Warm Springs, Montana. | 01 | 9/01/1979 |
| Hazard Ranking System Package Completed | 00 | 12/01/1982 |
| Silver Bow Creek Site proposed to the NPL | 00 | 12/30/1982 |
| Silver Bow Creek Site (Original Portion) listed as Final on the NPL | 00 | 09/08/1983 |
| Silver Bow Creek (Original Portion) Phase I Remedial Investigation Final Report | 00 | 01/1987 |
| Butte Area Portion added to Silver Bow Creek Site | 02 | 07/22/1987 |
| Walkerville TCRA completed | 08 | 02/22/1988 |
| Timber Butte TCRA completed | 08 | 1989 |
| Priority Soils TCRA completed | 08 | 1991 |
| ROD for WSP Active Area OU | 04 | 09/28/1990 |
| Explanation of Significant Differences for WSP Active Area OU | 04 | 06/24/1991 |
| Unilateral Administrative Order WSP Active Area OU | 04 | 09/25/1991 |
| Colorado Smelter TCRA completed | 08 | 1992 |
| Anselmo Mine yard and Late Acquisition/Silver Hill TCRA completed | 08 | 1992 |
| Lower Area One Manganese Removal | 08 | 1992 |
| ROD for WSP Inactive Area OU | 12 | 06/30/1992 |
| Unilateral Administrative Order WSP Inactive Area OU | 12 | 06/17/1993 |
| Walkerville II TCRA | 08 | 1994 |
| ROD for Mine Flooding OU | 03 | 09/29/1994 |
| ROD for SST OU | 01 | 11/29/1995 |
| ROD for Rocker OU | 07 | 12/22/1995 |
| Unilateral Administrative Order for Rocker OU ( Remedial Design/Remedial Action) | 07 | 3/29/1996 |
| Unilateral Administrative Order for SST OU ( Remedial Design/Remedial Action) | 01 | 3/29/1996 |
| Explanation of Significant Differences for SST OU | 01 | 08/31/1998 |
| Consent Decree for SST OU | 01 | 11/13/1998 |
| Initial Five Year Review Silver Bow Creek/Butte Area Site With Emphasis on WSP OUs | 04/12 | 03/23/2000 |
| Consent Decree for Rocker OU | 07 | 11/07/2000 |
| Walkerville Residential Removal | 08 | 2000 |
| Consent Decree for BMF OU | 03 | 08/14/2002 |
| Stormwater TCRA | 08 | On-going |
| Railroad Beds TCRA | 08 | On-going |
| Lower Area One N-TCRA | 08 | On-going |
| BPS Residential Soils/Source Areas N-TCRA | 08 | On-going |
| Proposed Plan for Butte Priority Soils OU | 08 | 12/21/2004 |

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# Section 3 Background

## 3.1 Location and Setting

The Silver Bow Creek/Butte Area Superfund Site centers around the town of Butte, Montana. The urban center of "Uptown" Butte, Montana is located on the Butte Hill, which is widely referred to as the "richest hill on earth". The Butte Hill lies just west of the Continental Divide at the head of Silver Bow Creek and the Clark Fork River watershed. Historically, metal mines and ore processing facilities on the Butte Hill produced globally significant quantities of copper, lead, zinc, molybdenum, gold, and silver. Throughout much of the 20th century, the Butte Mining District was the largest producer of copper in North America. Large scale mining in Butte as well as the operation of silver mills and copper and zinc concentrators/smelters has resulted in the generation of tremendous volumes of mining-related waste including waste rock, mill tailings, slag, and aerial smelter emissions. Historically, Silver Bow Creek was used to impound smelter tailings and to convey wastes out of Butte. Mining wastes carried from Butte have impacted water quality throughout the entire length of Silver Bow Creek and the upper Clark Fork River between Butte and Missoula, Montana. The Silver Bow Creek/Butte Area Superfund Site includes the urban uptown part of the city of Butte (the Butte Hill), the underground mines beneath the Butte Hill, the Berkeley Pit, the mining area associated with the historic Berkeley Pit operation and the active Continental Pit operation, the entire reach of Silver Bow Creek between Butte and Warm Springs, Montana, and the Warm Springs treatment ponds. The site encompasses approximately 85 square miles (Figure 3-1).

## 3.2 Physical Characteristics

The boundary of the Silver Bow Creek/Butte Area site begins above Butte, at the Continental Divide, and extends northwestward along Silver Bow Creek to and including the Warm Springs Ponds. Historically, Silver Bow Creek began at the Continental Divide and flowed through the area that is now the Berkeley Pit and the Montana Resources (MR) permitted mine area. Mining activity has completely obliterated this uppermost reach of Silver Bow Creek. The creek now originates at the confluence of Blacktail Creek and the Metro Storm Drain at the base of the Butte Hill. The Metro Storm Drain was an open channel that was constructed in the early 1930s under the Works Progress Administration Program by realigning and filling the original Silver Bow Creek drainage. The purpose of the storm drain was to provide a means of transporting mine water, sewage, and storm water out of Butte. There is now no surface water flow in the Metro Storm Drain except during storm runoff or snowmelt conditions. Downstream of Butte, Silver Bow Creek flows west about 10 miles, into Durant Canyon. Within the Canyon, the creek swings northward and enters the Southern Deer Lodge Valley and continues to flow for another 6.5 miles before entering the Warm Springs Ponds.

The site ranges in elevation from about 6,400 feet above mean sea level (MSL) at the Continental Divide, to about 4,800 feet above MSL at the toe of the Warm Springs

Ponds. The site encompasses the urban uptown portion of Butte as well as the entire length of Silver Bow Creek from its origin in the Summit Valley through Durant Canyon to its end at the confluence with Warm Springs Creek in the Southern Deer Lodge Valley. The site includes approximately 26 miles of stream and stream-side habitat, the urban centers of Butte and Walkerville, the Berkeley Pit and the underground mine workings of the historic Butte Mining District, the active mining area associated with the MR operation at the Continental Pit, and the treatment/settling lagoons at the Warm Springs Ponds.

The site lies within the Northern Rocky Mountain Physiographic Province and is characterized by cool, semi-arid climate. Winters are long, cold, and dry, and summers are short, warm, and dry. Average maximum daily temperatures range from 14 °F in January to 79 °F in July. Annual precipitation in Butte averages 11.72 inches per year and generally varies from 6 to 20 inches (BPSOU PRP Group 2002). The wettest months are May and June when the area typically receives approximately one third of the annual precipitation. The landscape surrounding the site is characterized by high mountain peaks reaching elevations above 10,000 feet. Typically, higher elevations are snow-covered from October until May. Surface water and groundwater resources receive the most recharge in the spring and early summer due to melting mountain snow pack and spring rains.

The geology of the site is diverse and varies significantly from east to west. In the east, rocks in the Butte Area are largely Cretaceous intrusive rocks of the Boulder Batholith. The Boulder Batholith is comprised predominantly of quartz monzonite and is host to the ore deposit that has been extensively mined in the Butte area. Batholithic rocks extend north and west from Butte and comprise the mountains on the southern and eastern margins of the Southern Deer Lodge Valley. The Boulder Batholith is locally overlain by the Eocene Lowland Creek Volcanics, a suite of extrusive igneous rocks of quartz-latite composition (ARCO 1995a). Silver Bow Creek flows onto the Lowland Creek Volcanics as it passes through Durant Canyon between Miles Crossing and Gregson. The Lowland Creek Volcanics are generally more resistant to weathering than the Boulder Batholith. This results in the steep-sided valley walls of Durant Canyon. The Anaconda Pintlar and Flint Creek Mountains west of the Southern Deer Lodge Valley consist of folded and faulted complexes of Precambrian metasedimentary rocks (Belt Series) and Paleozoic and Mesozoic sedimentary rocks that are intruded by granitic plutons. The Silver Bow Creek floodplain is dominated by Tertiary and Quaternary alluvium overlying bedrock. The thickness of alluvium ranges from less than 10 feet west of Butte to several hundred feet in the Summit and Southern Deer Lodge Valleys.

Silver Bow Creek is the primary drainage in the study area. Stream flow is measured continuously at three monitoring stations within the site by the United States Geological Survey (USGS). Monthly mean flow in Silver Bow Creek below Butte (period of record October 1983 to September 2004) ranges from 17.9 cubic feet per second (cfs) to 29.6 cfs, with highest average flows measured in May and lowest average flows measured in January. Similarly, monthly mean flow measured in Silver Bow Creek below the Warm Springs Ponds (period of record March 1972 to

September 2003) ranges from 61.6 cfs (September) to 273 cfs (June). Over the respective periods of record for the Butte and Warm Springs stations, peak stream flow was measured at 447 cfs (June 30, 1998) and 1,320 cfs (June 20, 1975), respectively.

Groundwater occurs in both bedrock and alluvial aquifers within the Silver Bow Creek/Butte Area site. Movement of groundwater within bedrock aquifers is controlled by open fractures and joints in the rock and, beneath the Butte Hill, by interconnected mine workings. Groundwater flow in alluvial aquifers is controlled by the primary porosity of the unconsolidated alluvial sediments and these aquifers generally report to Silver Bow Creek. Alluvial aquifers at the site are typically impacted by mining-related contaminants. Bedrock aquifers show less impact, except within the Mine Flooding OU, where bedrock groundwater is severely degraded from acid rock drainage occurring within the underground mine workings.

## 3.3 Land and Resource Use

The Silver Bow Creek/Butte Area Superfund Site covers an area of approximately 85 square miles. It is a very large site with diverse land uses and resources. The site lies within both Silver Bow and Deer Lodge Counties and encompasses the urban areas of uptown Butte, Walkerville, Rocker, and Ramsay, Montana. These urban areas include both urban residential, commercial, and industrial land use. Significantly, the site also encompasses the entire active mining area east of the Butte Hill. West and north of Butte, the site includes stream and streamside habitat over the length of Silver Bow Creek between Butte and the confluence with Warm Springs Creek. Aquatic life in Silver Bow Creek is severely impaired as a result of water quality and habitat degradation from mining-related contamination. Land within the Silver Bow Creek corridor is predominantly privately owned (NRIS 2005) and consists of sparsely populated open land used primarily for agricultural purposes. The Warm Springs Ponds are located at the downstream end of the site and cover an area of approximately 2,500 acres. These ponds consist of three treatment ponds and two wildlife ponds. Together the treatment ponds and wildlife ponds offer habitat for migrating waterfowl and breeding areas for dozens of songbird and osprey. The area is designated a wildlife refuge that is administered by the Montana Department of Fish Wildlife and Parks.

## 3.4 History of Contamination

The following history of site contamination was taken from the ROD for the SST Decision OU of the Silver Bow Creek/Butte Area National Priories List (NPL) Site (DEQ 1995).

The first recorded disturbance of the Silver Bow Creek channel occurred in 1864 when placer mining techniques were used to extract gold along the stream and its tributaries (Freeman, 1900 and Smith 1952). The gold recovered by placer mining was relatively pure, in the form of dust, flakes, or nuggets. Mercury was sometimes used to "attract" small pieces of gold. This phase of mining activity was short-lived; most placer operations in the area had ceased by 1869, although minor activity continued on a few local streams (Reclamation Research Unit and Schafer and Associates [RRU and Schafer), 1993).

Some evidence of early placer mining along upper portions of Silver Bow Creek is still evident in the form of waterways required to convey water for hydraulic mining and spoils piles (Historical Research Associates [HRA], 1983). The waterways are in disrepair and no longer convey water. As Butte's placer deposits played out during the 1870s, miners turned their attention to the area of hardrock mining. There is no clear record of the amount of mining wastes produced and disposed of by placer miner operations.

Concomitant with placer mining along Silver Bow Creek, hard rock mining started on mineralized vein outcroppings on Butte Hill, north of Silver Bow Creek (Smith, 1952). Some mining claims on the Butte Hill were re-staked in the 1870s because of favorable assays of silver ore found in the area (Smith, 1952). Silver mill construction during the mid-1870s ushered in the era of industrial mining in Butte. This rejuvenated mining activity in Butte and, by 1878, several small mills were operating in the area. A combination of factors contributed to a boom in Butte's silver production during the early 1880s. Completion of railroads to Butte in 1881 along with favorable silver prices led to a drastic increase in mine production. Most existing mills increased their production.

Between 1879 and 1885, at least six major mills were built along Silver Bow Creek from Meaderville to Williamsburg. These mills were operated more or less continuously until 1910 (Freeman, 1900; Smith, 1952; HRA, 1983). The early mills were steam-powered stamp mills (50-10 stamps) designed to crush, concentrate, and amalgamate silver ore. Mills constructed during this time were the: Centennial, Dexter, Davis, Young and Roudebush, Walker Brothers, Clipper, Silver Bow, Grove Gulch, and Thornton (HRA 1983). By 1886, five new mills appeared in the vicinity of Butte's Missoula Gulch and along Silver Bow Creek: the Alice, the Moulton, the Lexington, the Marget Ann, and the Blue Bird (HRA, 1983). The Blue Bird mill was located on Silver Bow Creek east of the town of Rocker and contained 90 stamps which was unusually large at the time. Production capacities from these new mills were many orders of magnitude greater than previous mills. Butte's silver era ended with the repeal of the Sherman Silver Act in 1893. These mills produced tailings and other mining wasters, which were disposed of near the mills. Some of that waste material was disposed directly into or washed into Silver Bow Creek.

By the late 1880s copper mining had become more important, and Butte became one of the nation's prominent copper mining centers. Many of the previously described mills and smelters were used for copper production, and more mills and smelters were added. Five such facilities located along Silver Bow Creek were especially significant. They are the Colorado Smelter, the Butte Reduction Works Facility, the Parrott Smelter, the Montana Ore and Purchasing Company Smelter, and the Butte and Boston Smelter. All of the described facilities along Silver Bow Creek discharged wastes alongside or directly into Silver Bow Creek. These facilities operated large concentrators and smelters and disposed of very volumes of waste directly into or near Silver Bow Creek.

A copper smelter (Old Works) was constructed at the lower end of Warm Springs Creek at the new town of Anaconda, 27 miles west of Butte, in 1884 (Smith, 1952; RRU and Schafer, 1993). The newer Washoe Smelter was constructed and began operations on Smelter Hill, directly east of Anaconda, in 1903. The major smelters erected along Silver Bow Creek in the Butte vicinity continued to operate until approximately 1910 (HRA, 1983). The Amalgamated Copper Company and the Anaconda Copper Mining Company took possession and control of almost all other companies and facilities in the Butte area. These companies ultimately combined into the Anaconda Copper Mining Company. After 1910, most of the ore mined in Butte was then shipped via the Butte, Anaconda and Pacific Railway (BA&P) to the Anaconda Copper Mining Company's (AMC) Washoe Smelter for processing (RRU and Schafer, 1993).

By 1917, approximately 150 mines were located in and near Butte and the population of Butte grew to over 100,000. The mines, which were controlled by AMC or its predecessors, produced a total of approximately 934 million pounds of copper (Techlaw, 1985). This corresponds to a maximum of approximately 4.2 million cubic yards of ore assuming a 5 percent copper content and an ore density of 163 pounds per cubic foot (Techlaw, 1985). Water pumped from these mines contributed to the contamination of Silver Bow Creek.

About 1908, AMC began constructing dikes near the mouth of Silver Bow Creek. These several, often meager construction efforts were intended to trap sediments and prevent further downstream movement of mining, milling, and smelter wastes.

By about 1917, after several washouts of the original series of dikes, a larger dike was constructed above, thus creating Pond 2. During the mid 1950s, AMC constructed still larger dikes to contain the increasing volume of waste that continued to move down Silver Bow Creek. Thus, Pond 3 was created, and altogether, 19 million cubic yards of tailings were contained within three settling ponds.

AMC commenced surface mining of low-grade copper ore with the opening of the Berkeley Pit in 1955 and built the Weed Concentrator in 1963 to process this ore. These operations contributed contamination to Silver Bow Creek.

In 1977, AMC was purchased by the Atlantic Richfield Company (Atlantic Richfield) which expressly assumed liability for AMC. Atlantic Richfield closed all underground mines in 1980 and continued active mining only in the Berkeley Pit. Atlantic Richfield closed the Berkeley Pit in 1982 and the East Berkeley Pit in 1983. There was a hiatus of mining in Butte until 1986, when Montana Resources (MR) initiated open-pit mining operations in the Continental Pit. Aside from a 3-year break in operations between July 2000 and November 2003 (due to economic considerations), MR continues to mine copper and molybdenum in the Continental Pit.

Although floods and storm events contributed to the transport of waste in Silver Bow Creek and as far downstream on the Clark Fork River as Lake Pend Oreille in Idaho, they were not the exclusive cause of contamination downstream. Upstream facilities in Butte, discharged waste directly into or along Silver Bow Creek, and did not exercise due care in anticipating flood events or storm events and taking precautions to avoid waste movement.

Waste was transported from these operations downstream via overland flow and surface water transport.

In June of 1908, the largest flood in recorded history in the Silver Bow Creek basin occurred, contributing to the extent of fluvially-deposited tailings found today. Heavy rains fell in late May and early June, melting the snow pack and causing extensive flooding (CH2M Hill, 1989a). Flood waters transported tailings from smelting facilities in Butte and along Silver Bow Creek and deposited them downstream as flood waters waned. Flood flows and fluvial deposits were physically constrained by railroad grades constructed parallel to Silver Bow Creek, limiting the areal extent of flood deposited tailings.

Other recorded significant storm events occurred in 1892, 1894, 1938, 1948, 1964, 1975 and 1980 (CH2M Hill, 1989a). All of these events occurred during the spring and early summer when precipitation and melting snow combined to produce large runoffs. These events also contributed to the movement of mine wastes from their sources into the Silver Bow Creek floodplain.

## 3.5 Regulatory History Summary

The Silver Bow Creek/Butte Area NPL Site is located in Silver Bow and Deer Lodge counties of Montana at the easternmost extent and headwaters of the upper Clark Fork River drainage. EPA designated the original Silver Bow Creek Site as a Superfund site in September 1983, under the authority of the CERCLA. Work began on a remedial investigation and feasibility study (RI/FS) in 1984. During the course of the RI/FS, the importance of Butte as a source of contamination to Silver Bow Creek was formally recognized. Preliminary results from the Silver Bow Creek RI/FS indicated that upstream sources 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.

Early on, Montana Department of Health and Environmental Sciences (MDHES) (now Montana Department of Environmental Quality - DEQ) was the lead agency for the Butte Metro Storm Drain, Butte Reduction Works and Colorado Tailings, Rocker, all of Silver Bow Creek including the Warm Springs Ponds, and the Clark Fork River to Milltown. EPA was lead agency for the Berkeley Pit and remaining OUs of the Butte Area portion of the site. In 1989, EPA became the lead agency for all OUs except for

Silver Bow Creek proper, which by then had become known as the Streamside Tailings OU. Within 18 months, EPA shifted the Clark Fork River OU from the Silver Bow Creek / Butte Area Superfund Site to the Milltown Reservoir Sediments Superfund Site, a site for which EPA had been the lead agency since its listing in 1983. That situation remains true today.

CERCLIS officially identifies 13 OUs within the Silver Bow Creek / Butte Area Site (Table 3-1) (USEPA 2005). Four of the thirteen OUs are removal OUs and, therefore, are addressed under the ROD for one or more of the remedial OUs and do not require a five year review. For example, the Lower Area One OU was incorporated into the Priority Soils OU and will be addressed accordingly under the ROD for the Priority Soils OU. As described previously in Section 1, this report presents statutory 5-year reviews for the Warm Springs Ponds Active Area OU (OU4), Rocker Timber Framing and Treatment Plant OU (OU7), the Warm Springs Ponds Inactive Area OU (OU12), the Streamside Tailings OU (OU1), and the Mine Flooding OU (OU3). A brief review of site activities is all that is done for the five-year review for the Priority Soils OU, Active Mining and Milling OU, and the West Side Soils OU because RODs for these OUs have not had remedial action selected or undertaken.

A summary of the contamination and regulatory history for the 8 OUs covered in this 5-year review is presented in the following sections.

### 3.5.1 Streamside Tailings OU

The SST OU is the portion of the Silver Bow Creek / Butte Area site located between the city of Butte and the community of Warm Springs, Montana. DEQ is the lead agency for the OU, which includes Silver Bow Creek from Butte, 26 miles downstream to the inlet of the Warm Springs Ponds. The SST OU includes not only Silver Bow Creek, but also the mining wastes along the stream and in the adjacent floodplain and railroad beds.

Wastes from mining, milling and smelting facilities once located in Butte and along Silver Bow Creek have been washed down the creek for more than 100 years. These wastes, primarily tailings, contain high levels of arsenic, and metals such as cadmium, copper, lead, mercury, and zinc. At the time the ROD was signed in 1995, it was estimated that 2,500,000 to 2,800,000 cubic yards of tailings and contaminated soils cover about 1,300 acres. In some areas, the tailings are several feet thick. The largest single tailings deposit, 160 acres, lies near the town of Ramsay and is known as Ramsay Flats. The tailings are largely unvegetated. Silver Bow Creek also contains tailings and is devoid of most aquatic life (DEQ 1995a).

Environmental investigations in the vicinity of the SST OU were initiated by the EPA in 1982 to address mining impacts along Silver Bow Creek. The Silver Bow Creek / Butte Area Site (original portion) was listed on the NPL in 1983 by EPA under the CERCLA and site investigations began in 1984 with the Phase I Remedial Investigation (RI) prepared by MultiTech Services under contract to the DEQ (MutiTech 1987). The Phase II RI described in the draft RI report (ARCO 1995a) was conducted by the potentially responsible party (PRP), Atlantic Richfield, and describes investigation activities, characterizations and interpretations performed since 1991. All pre-1991 studies or data that were determined by Atlantic Richfield and DEQ to be applicable or pertinent to current OU conditions were incorporated in the OU characterization in the draft RI report (Phase II). The draft RI report complied with Superfund law, defined the nature and extent of the contamination to the extent necessary to determine remedial action and provided information to complete the baseline human health and ecological risk assessments (ARCO 1995a). The baseline risk assessment was released by DEQ in December of 1994 (DEQ 1994). The feasibility study, released by Atlantic Richfield in June 1995, included the development, screening and evaluation of potential OU remedies (ARCO 1995b).

The proposed plan was released in June 1995 and delineated the preferred alternative (DEQ, 1995b). In November 1995, EPA and DEQ, as lead agency, issued the ROD. The ROD was modified by a 1998 Explanation of Significant Differences (ESD) (DEQ 1998).

In April 1998, a settlement between Atlantic Richfield, EPA, and DEQ was finalized which provided $80 million for the remediation of the SST OU.

### 3.5.2 Butte Mine Flooding OU

The BMF OU is located within the city of Butte. EPA is the lead agency on the OU and DEQ is the support agency. The BMF OU consists of waters within the Berkeley Pit, the underground mine workings hydraulically connected to the Pit, the associated alluvial and bedrock aquifers, and other contributing sources of inflow to the Berkeley Pit/East Camp System. BMF OU is within the historic Butte Mining District in the upper Silver Bow Creek drainage and covers about 23 square miles (USEPA 1994). The BMF OU is part of the Butte Area portion of the Silver Bow Creek/Butte Area Site.

The Berkeley Pit/East Camp System is located in the northern and eastern portions of the OU. The Berkeley Pit is the major feature of the OU, encompassing an area of 675 acres, a depth of 1,780 feet, and a volume of 35 billion gallons of contaminated water. The water is an acidic sulfate solution containing high levels of copper, zinc, iron, lead, arsenic, aluminum, cadmium, and sulfate. Approximately 3,000 miles of underground mine workings are hydraulically connected to the Pit. The West Camp System, located in the southwest corner of the OU, and includes the Travona, Emma, and Ophir mines and their associated underground workings. The East Camp and West Camp systems are separated by bulkheads installed in the late 1950s and are considered to be separate hydraulic systems. Water levels in the West camp system are notably higher than water levels in the East Camp system (USEPA 1994).

A major seepage area of acidic mine water originates in the Horseshoe Bend Area, located north of the Berkeley Pit. Discharge from the Horseshoe Bend Area varies from 1.7 to 5.9 million gallons per day depending upon current climatic conditions and the MR mining operation. This water was partially used in the active mining operation and the remainder flowed into the Berkeley Pit.

A removal action was implemented in the West Camp Area to control potential impacts of rising mine waters. The purpose of the removal action was to prevent flooding of basements and discharge of contaminated groundwater to Silver Bow Creek. An engineering evaluation/cost analysis (EE/CA) of potential alternatives was conducted by EPA in support of the West Camp Removal action. On March 31, 1989, EPA entered into an administrative order of consent (AOC) with Atlantic Richfield and Dennis Washington (the consenting PRPs) in connection with the West Camp removal action. The West Camp order required the consenting PRPs to convey water pumped from the Travona shaft to the Butte Metro Sewage Treatment Plant for treatment and discharge to Silver Bow Creek. This AOC established a preliminary critical water level for the West Camp and required the consenting PRPs to maintain the water level elevation within the West Camp System below 5,435 feet (USGS datum) (USEPA 1994).

A unilateral order was issued to the non-consenting PRPs to install the pipeline which carried Travona shaft water to the Butte Metro Sewage Treatment Plant. The non-consenting PRPs complied with this order.

EPA completed the RI/FS work plan for the BMF OU in April 1990 (CDM 1990). This document outlined the work to be conducted during the RI/FS, the schedule for the work, and the parties responsible for each portion of the work. EPA and DEQ then entered into an AOC with the consenting PRPs to implement the major portion of the work plan. This AOC established a critical water level of 5,420 feet (USGS datum) for the East Camp/Berkeley Pit System and required the PRPs to maintain the water level in the East Camp/Berkeley Pit System below this level. A unilateral order was also issued to the non-consenting PRPs to implement a small portion of the RI/FS work plan. The RI/FS was conducted from July 1990 through January 1994. Site investigations, results, and remedial alternative development and evaluation are presented in the draft RI report (ARCO 1994a) and the draft FS report (ARCO 1994b).

The ROD was issued in September 1994 (USEPA 1994).

A unilateral administrative order (UAO) was issued to Atlantic Richfield, Montana Resources Inc., ASAR, and Dennis Washington on June 11, 1996 to implement the remedial design/remedial action activities associated with the ROD. The requirements of the ROD were modified in a March 2002 ESD (USEPA 2002).

A consent decree (CD) was signed between Atlantic Richfield, the MR related entities, the United States, and the State of Montana in June 2002 and entered by the Federal district court in August 2002. This CD superseded all previous AOCs and UAOs issued for this OU.

## 3.5.3 Warm Springs Ponds OUs

### 3.5.3.1 Active Area OU

The WSP are located in the Southern Deer Lodge Valley at the downstream end of Silver Bow Creek, approximately 26 river miles downstream of Butte, Montana. The

WSP are a series of three large settling and treatment basins, known as Pond 1, Pond 2, and Pond 3, located near Warm Springs, Montana. The complex covers an area of approximately 2,600 acres, and is bordered by the Mill-Willow Bypass (stream diversion around the WSP) to the west, the Clark Fork River to the north, hills to the east, and marsh lands and incoming streams to the south (USEPA 1992). The stream reach below the confluence of Mill-Willow Bypass and the discharge from the WSP is designated as lower Silver Bow Creek. Just north of the WSP, the confluence of lower Silver Bow Creek and Warm Springs Creek is the defined beginning point of the Clark Fork River. Figure 3-2 shows the current configuration of the Warm springs Ponds complex, including Ponds 1, 2, and 3, the Mill-Willow Bypass, and the wildlife ponds. During initial remedial design / remedial action (RD / RA) activities for the entire the Warm Springs Ponds OU, the site was divided into two separate interim OUs: 1) the Active Area OU; and 2) the Inactive Area OU. The Active Area OU represents the portion of the WSP complex where active water treatment occurs and encompasses Pond 3, the inlet area above Pond 3, Pond 2, and the portion of the Mill-Willow Bypass adjacent to Ponds 2 and 3. The Inactive Area OU includes Pond 1, the area downstream of Pond 1, and the lower portion of the Mill-Willow Bypass.

From the beginning of ore processing (concentrating / smelting) activities in 1880 until about 1911, mine and mill tailings from the Butte and Anaconda areas were carried down Silver Bow Creek to the Clark Fork River, at least as far as the Milltown Reservoir (built in 1907), approximately 145 river miles, and probably farther. AMC made the first attempt to control the amount of sediment carried into the Clark Fork River from Silver Bow Creek in 1911 by building a 20-foot-high tailings dam on Silver Bow Creek near the town of Warm Springs; this created WSP 1 (CH2MHill and Chen Northern 1989).

In 1916, another 18-foot high dam was built at Warm Springs by AMC upstream from the first dam, creating WSP 2. This dam subsequently was raised five feet to a total height of 23 feet during 1967-1969. WSP 1 and 2 trapped and settled out sediment from Silver Bow Creek. The primary sources of this sediment were tailings eroded from deposits, in and along the Silver Bow Creek channel as well as increased natural sedimentation resulting from vegetation disturbance. Additional sediment also may have been contributed by overflow discharge from the adjacent Anaconda and Opportunity Ponds at the Anaconda Smelter. This water was routed into Silver Bow Creek above the WSP (CH2MHill and Chen Northern 1989).

A third, and much larger, 28-foot high dam was built upstream of WSP 2 by AMC between 1954 and 1959, primarily for sediment control. This structure created WSP 3. The height of this dam was increased by five feet during 1967-1969 to a maximum height of 33 feet (CH2MHill and Chen Northern 1989).

As a result of the activities described above, over 19 million cubic yards of contaminated sediments accumulated in the WSP, and a substantial volume of contaminated soils and tailings were present in areas surrounding the WSP, including the Mill-Willow Bypass and the area downstream (north) of Pond 1 (USEPA 1992).

Concerns about the stability of the dams at the WSP, not water quality concerns alone, initiated rapid action under Superfund authority on the WSP in the early 1990s. These actions have proven successful and have eliminated the threat of dam failure due to a flood or earthquake.

Ponds 2 and 3 have been retained as settling ponds. Tailings and other sediments from Silver Bow Creek physically settle to the bottom as the velocity of incoming water decreases. The addition of lime near the inlet of Pond 3 enhances the removal of metals from the influent water. Historically, lime has been added only during fall, winter, and early spring.

Pond 1 was never involved in the active treatment of water from Silver Bow Creek by the addition of lime, and it no longer plays a role in settling sediments. This inactive area, and the area below Pond 1, are essentially isolated from the active portion of the WSP system. The relatively small volume of water contained within the inactive area OU is present due to seepage and minimal flow from the ponds above (USEPA 1993).

Mill and Willow creeks, which historically joined with Silver Bow Creek in the area above the present pond system, were diverted away from Silver Bow Creek and around the pond system in the late 1960s. This diversion became known as the Mill-Willow Bypass.

In 1967, WSP 3 was converted into a treatment facility to treat mill losses, precipitation plant spent solution from Butte Operations, and overflow from the Opportunity Ponds. Treatment consisted of introducing a lime/water suspension from the Anaconda Smelter into Silver Bow Creek above WSP 3. The addition of the lime suspension raised the pH of the creek water to facilitate precipitation of heavy metals in the WSP (CH2MHill and Chen Northern 1989).

Wildlife ponds were constructed about 1967 by the Montana Department of Fish, Wildlife, and Parks in association with AMC. The purpose of the ponds was to enhance waterfowl habitat in the Southern Deer Lodge valley. Two large cells and several smaller sub-cells and islands were constructed for this purpose. Water within the Wildlife Ponds is obtained from siphon structures in Pond 3 (CH2MHill and Chen Northern 1989).

Currently, the WSP treatment system is operated by Atlantic Richfield. Pond 1 is not used in the treatment process at the site because the pond is largely filled with sediment. Lime is added to Silver Bow Creek above Pond 3, primarily during the winter months, to raise the pH of the influent to facilitate metals precipitation.

Prior to 1989, MDHES (now DEQ) was the lead agency for the WSP OU. The DEQ in consultation with EPA, completed site characterization studies, some feasibility studies, and the proposed plan for the WSP OU. Following the release of the proposed plan, EPA became the lead agency.

In July 1990, EPA and Atlantic Richfield entered into an AOC for the Mill-Willow Bypass Removal Action. This work was completed and is an integral part of the two remedial actions (Active Area and Inactive Area) for the WSP. Briefly, the Mill-Willow Bypass Removal Action involved the following work (USEPA 1992):

- Removal of 436,000 cubic yards of tailings and contaminated soils from the bypass and disposal in a dry portion of Pond 3.
- Reinforcing and armoring the Pond 2 and 3 berms (an additional 1 million cubic yards of uncontaminated fill dirt was excavated from the bypass for this purpose).
- Construction of improved inlet and outlet structures and a divider dike between Silver Bow Creek and Willow and Mill creeks.

The initial ROD for the WSP OU was released by EPA on September 28, 1990. In June of 1991, EPA released an ESD that modified certain elements of the initial Warm Springs Ponds ROD. Most significantly, the ESD identified the inactive area of Pond 1 and the area beneath Pond 1 as a separate action that would addressed under a separate ROD. The ESD divided the WSP into two separate OUs: 1) the WSP Active Area OU; and 2) the WSP Inactive Area OU. The Active Area OU would address Ponds 2 and 3, as well as the Mill-Willow Bypass and berms, inlet and outlet structures, treatment improvement features, and monitoring systems. The Inactive Area would address the inactive areas (Pond 1 and the area downstream of Pond 1). In September, 1991, EPA issued a Unilateral Administrative Order directing implementation of the Active Area ROD.

In 1997, Atlantic Richfield issued the initial Five Year Review Report (ARCO 1997) for the WSP OUs. The Atlantic Richfield report presented data collected during construction of the remedial action improvements and an evaluation of the system's performance since completion of the improvements in 1995. An addendum to Atlantic Richfield's report was issued in 1998 (ARCO 1998). The addendum presented additional operational data gathered in the interim and the results of additional investigations completed to understand the system's dynamics. In 2000, after the system had been operating for approximately five years, EPA issued its initial five-year review report for the Silver Bow Creek/Butte Area NPL site, which emphasized the performance of the Warm Springs Ponds (ARCO 2005).

#### 3.5.3.2 Inactive Area OU

As described previously, the WSP are divided into two separate OUs to address environmental contamination at the WSP: 1) the Active Area OU and 2) the Inactive Area OU. The WSP Inactive Area OU includes Pond 1, the area downstream of Pond 1, and the lower portion of the Mill-Willow Bypass.

Prior to implementing remedial action, the Inactive Area OU contained an estimated 3.4 million cubic yards of contaminated sediments, tailings, and soils. Approximately 475.000 cubic yards of these materials were contained within the area downstream of Pond 1. These source materials consisted of over-bank deposits that settled out along

Silver Bow Creek prior to the construction of Pond 1. Approximately 2.9 million cubic yards of contaminated sediments, tailings, and soils were contained within Pond 1. These materials settled out of Silver Bow Creek over a short period of time after Pond 1 was constructed in 1911. Pond 2 was constructed in 1916.

The original ROD for the WSP OUs (USEPA 1990) described a remedy selected by EPA for controlling the contaminated tailings, sediment, and water contained within the WSP and for preventing these contaminated materials and water from entering the Clark Fork River (USEPA 1991). In June of 1991, EPA released an ESD that modified certain elements of the initial WSP ROD. Most significantly, the ESD identified the inactive area of Pond 1 and the area beneath Pond 1 as a separate action that would addressed under a separate ROD. The ESD divided the WSP into two separate OUs: 1) the WSP Active Area OU; and 2) the WSP Inactive Area OU. The WSP Active Area OU would address Ponds 2 and 3, as well as the Mill-Willow Bypass and berms, inlet and outlet structures, treatment improvement features, and monitoring systems. The Inactive Area would address the inactive areas (Pond 1 and the area downstream of Pond 1).

In March, 1992, EPA released the proposed plan for the Inactive Area OU followed by the ROD in June 1992. In July 1993, EPA issued a UAO to Atlantic Richfield, the respondent, to conduct the remedial action. Remedial action was implemented from 1993 to 1995.

In 1997, Atlantic Richfield issued the initial five-year review report (ARCO 1997) for the WSP OUs. The Atlantic Richfield report presented data collected during construction of the remedial action improvements and an evaluation of the system's performance since completion of the improvements in 1995. An addendum to Atlantic Richfield's report was issued in 1998 (ARCO 1998). The addendum presented additional operational data gathered in the interim and the results of additional investigations completed to understand the system's dynamics. In 2000, after the system had been operating for approximately five years, EPA issued its initial five-year review report for the Silver Bow Creek/Butte Area NPL site, which emphasized the performance of the WSP (ARCO 2005).

### 3.5.4 Rocker OU

The Rocker OU covers approximately 16 surface acres, and is located approximately 3 miles west of the community of Butte and adjacent to the community of Rocker, Montana. EPA is the lead agency on the Rocker OU and DEQ is the support agency.

The Rocker Timber Framing and Treating Plant was constructed in 1909 and operated until the plant was closed in approximately 1957. The Anaconda Company, predecessor in interest to Atlantic Richfield, owned and operated the site. Initially, the facility treated mining timbers with a creosote solution. Subsequently, the facility began using arsenic trioxide solutions for treatment, and this formulation became the primary treatment process up to the final days of plant operation.

During the approximate 48 year history of plant operation, spilled process materials (arsenic trioxide powder), treated wood chip residues, and dripped or leaked process solutions (creosote and caustic heated arsenic brines) have resulted in contaminated soils throughout the plant site and significant groundwater contamination. Rocker wood treating wastes were also mixed with contaminated tailings and other mining waste washed downstream to Rocker from mining/smelting facilities in Butte.

The Rocker OU is part of the original Silver Bow Creek superfund site that was listed on the NPL in 1983. In 1989, the State of Montana directed Atlantic Richfield to remove contaminated soils and debris with concentrations exceeding 10,000 milligrams per kilogram (mg/kg) arsenic. Approximately 1,000 cubic yards (cy) of contaminated material were removed to a licensed disposal facility. Areas involved in the removal action were subsequently covered with approximately one foot of "clean" fill material from a nearby off-site area. Nevertheless, materials exceeding the 10,000 parts per million (ppm) concentration were identified at three locations remaining on the site. Between 1989 and 1995, numerous technical investigations were conducted at the site to characterize the nature and extent of soil and groundwater contamination. These investigations culminated with the final remedial investigation report in March 1995 (ARCO 1995c) and the final feasibility study in July 1995 (ARCO 1995d).

A ROD for the Rocker OU was signed in December 1995 (USEPA 1995). EPA initially ordered the implementation of the ROD. In November 2000, EPA and Atlantic Richfield entered into a consent decree for implementation of the Rocker OU ROD.

### 3.5.5 Butte Priority Soils OU

The BPS OU consists of a five square mile area encompassing the town of Walkerville and a large portion of the city of Butte. The OU is centered on “Butte Hill”, which is the location of the historic Butte Mining District. Silver Bow Creek flows along the base of the Butte Hill. The OU is situated in a predominantly urban setting, and includes residential neighborhoods, schools and parks, as well as commercial and industrial areas.

Mining and ore-processing wastes in Butte represent the primary source of contamination. 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.

EPA is the lead agency and Montana DEQ is the support agency for this OU.

The RI/FS for this OU was conducted by the BPS OU PRP Group. The final remedial investigation report was issued in April 2002 and the final feasibility study was issued in April 2004. EPA released the proposed plan in December 2004 and completion of the ROD is scheduled for 2006.

During the course of the RI/FS, EPA implemented several response actions to address high priority human health risks and reduce the severity of contaminant loading to Silver Bow Creek and to protect downstream remedies at other OUs (e.g., SST OU and the WSP OUs). Response actions have addressed over 8 million cy of waste within the OU using removal, capping, and/or land reclamation. Over 400 acres of mine-impacted land on the Butte Hill has been reclaimed. Also, approximately 1.2 million cy of tailings that were previously in contact with ground and surface water have been removed from the Silver Bow Creek floodplain, and storm water controls, including conveyance channels, diversions, and detention basins, have been constructed to reduce contaminant loading carried from the Butte Hill via storm water runoff.

Despite the past response actions completed at the BPS OU, remedial goals have yet to be achieved and significant risks still threaten human and environmental receptors. The potential exposure to lead and arsenic in residential soil and interior dust continue to pose a significant human health risk. Arsenic and metal contaminants in surface water and alluvial groundwater exceed applicable water quality standards and continue to affect aquatic life in Silver Bow Creek.

*Summary of Butte Priority Soils OU Response Actions*

Prior to the final FS and remedial decision process, extensive areas within the OU have been addressed by response actions (Time Critical Removal Actions [TCRAs] and Non-Time Critical Removal Actions [N-TCRAs]). Most of this work was completed in the late 1980s through late 1990s. Two remaining TCRAs (railroad beds and storm water) will be completed in 2005 and final actions for the two remaining expedited response actions (ERAs) (Lower Area One and one for residential soils/source areas) will be determined in the ROD. These response actions were done as efforts to address the more pressing problems at BPSOU using the faster Superfund removal process. Although an accelerated process was used to conduct these response actions, Superfund law requires that they be implemented in ways that contribute to the efficient performance of a final long-term remedial action, to the extent practicable. Therefore, EPA Region 8 required that the response actions be designed and constructed in a manner intended to be permanent.

If the remedy selection process chooses a remedy which leaves some or all of these actions as-is, the remedy will address long-term monitoring and operation and maintenance for these actions and for the site as whole.

Response actions were selected using removal criteria that give EPA broad discretion in determining what cleanup actions are appropriate. EPA used its authority at the BPSOU in the selection of the type of actions implemented and the oversight of the construction of response actions. Where capping of wastes was selected as part of the early response actions, sound engineering designs were implemented to ensure the stability and performance of the caps. Intensive monitoring and inspections of the caps has been, and will continue to be, performed.

The following is a brief summary of the response actions performed at the BPSOU:

- **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 (Exhibit 2-2). Nearly 300,000 cy 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 Region 8 also removed contaminated soil from six earthen basements and 33 residential yards.

- **Timber Butte TCRA (1989).** Approximately 40,000 cy 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 (Exhibit 2-3). Response actions were taken at 30 waste dumps (100,000 cy) 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 cy 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 either removed or capped in place.

EPA is currently conducting the following response actions:

- **Railroad Beds TCRA.** Addresses 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 includes significant storm water drainage improvements. EPA expects to complete the TCRA in 2005.

- **Storm Water TCRA.** 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 cy 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 cy 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 at an on-site waste repository.

- **Lower Area One ERA.** Focused on the removal of accessible mine tailings impounded in the Silver Bow Creek floodplain from the historic Colorado Smelter and Butte Reduction Works facilities and the interception and treatment of groundwater. In 1997, the PRP excavated and removed approximately 1.2 million cy of tailings from the floodplain. The area was then backfilled with imported material, and the stream channel was reconstructed. Waste removal during the Lower Area One ERA was completed to a predetermined depth-of-excavation contour. Tailings remain beneath the limits of the excavation and beneath the Metro Sewage Treatment Plant facility, historic slag walls, and other immovable structures. As a result, a groundwater collection system was constructed in 1998 and the Lower Area One revegetation plan was completed, including stream bank reclamation. Phase II of the Lower Area One ERA was an interim hydrologic equilibration and monitoring period that included ground and surface water sampling, water level monitoring, and water treatability studies. Phase III, which includes final reclamation and land use planning, will be decided and implemented as a component of the ROD. The groundwater treatment system will be part of the complete site-wide collection and treatment needs.

- **BPS OU ERA (residential soils/source areas).** Addresses residential areas with soil-lead concentrations above the residential lead action level (1,200 mg/kg) via the work plan for residential areas and the Butte-Silver Bow County Lead Prevention and Abatement Program. This action also reclaimed, or repaired to EPA standards, more than 50 sites above the lead action level for non-residential source areas (2,300 mg/kg).

*Other Actions*

- **Lower Area One Manganese Removal (1992).** The objective of this removal action was 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 action was done by the U.S. Bureau of Reclamation in cooperation with the Defense Logistics Agency and EPA. 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 in World War II.

  A total of 261,000 cy were moved to a private repository in Whiskey Gulch, west of the BPS 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 was completed at this site southwest of Butte. The site consisted of a 60-acre impoundment with approximately 1 million cy of mill tailings immediately adjacent to, and partially mixed with, the old Butte Municipal Landfill. The mixed nature of the wastes necessitated a combined remedy be performed under RCRA jurisdiction. At the Clark Mill Tailings, approximately 800,000 cy of the Colorado Tailings removed from Lower Area One were placed were 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.

- **Walkerville (2000).** All unsampled residential properties in Walkerville were tested by EPA and cleanups implemented at those residences with elevated arsenic, lead, and/or mercury above action levels. In all, approximately 40 properties were addressed.

### 3.5.6 Active Mining and Milling Area Operable Unit

This area is located west and northwest of the BPS OU and consists of the permitted mine area currently operated by MR. In 2002, EPA deferred Superfund action at the site to state authority under the operating permit.

### 3.5.7 West Side Soils OU

This OU encompasses areas of Silver Bow County that have experienced mining activity but lie outside of other OU boundaries. This is generally north and west of Butte Hill. EPA is currently conducting preliminary RI/FS forward planning for this OU, but the site has not been funded over the past several years.

# Section 4 Remedial Actions

Summaries of the remedial actions selected, their implementation, and operations and maintenance (O&M) activities for the WSP Active and Inactive OUs, the Rocker OU, the BMF OU, and the SST OU are presented below.

## 4.1 Warm Springs Ponds Active and Inactive OUs

### 4.1.1 Remedy Selection

#### 4.1.1.1 WSP Active Area OU

The overall remedial action objectives established for the WSP Active OU are:

- Prevent releases of pond bottom sediments due to earthquakes or floods. The Montana Department of Natural Resources and Conservation dam safety requirements have been identified as the applicable standard. The standard requires protecting the ponds to fractions of a probable maximum flood and to the maximum credible earthquake.

- Meet Montana Water Quality Act ambient water quality standards for arsenic, cadmium, lead, mercury, copper, iron and zinc at a compliance point just above the defined starting point of the Clark Fork River, and to comply with discharge standards for the Pond 2 discharge after implementation of the Warm Springs Ponds response actions and the upstream cleanup actions.

- Prevent ingestion of water above concentrations deemed safe by the Montana Public Water Supply Act for arsenic, cadmium, lead, mercury, and silver and above established reference doses for copper, iron, lead, zinc, and cadmium. Also, prevent ingestion of water containing arsenic concentrations that would cause risk greater than one chance in 10,000.

- Inhibit the migration of tailings from the Mill-Willow Bypass to the Clark Fork River in order to reduce the potential for future exceedances of ambient water quality standards in the Clark Fork River.

- Inhibit the migration of tailings from the upper reaches of Silver Bow, Mill and Willow creeks to the Clark Fork River in order to reduce the potential for re-contamination of the Mill-Willow Bypass and future exceedances of ambient water quality standards in the Clark Fork River.

- Reduce the potential for direct human contact, inhalation, and ingestion of exposed tailings and contaminated soils and tailings posing excess cancer risks above one chance in 10,000.

- Reduce the levels of arsenic, cadmium, and other contaminant concentrations in the groundwater of the Pond 1 area to achieve compliance with ground water performance standards.

Major components of the selected remedy for the WSP Active OU are:

- Allow the ponds to remain in place; Ponds 3 and 2 will continue to function as treatment ponds until upstream sources of contamination are cleaned up and standards can be met without treatment.

- Raise and strengthen all pond berms according to specified criteria, which will protect against dam failure in the event of major earthquakes or floods, and increase the storage capacity of Pond 3 to receive and treat flows up to the 100- year flood.

- Construct new inlet and hydraulic structures to prevent debris from plugging the Pond 3 inlet and to safely route flows in excess of the 100-year flood around the ponds.

- Comprehensively upgrade the treatment capability of Ponds 2 and 3 to fully treat all flows up to 3,300 cfs (100-year peak discharge) and construct spillways for routing excess flood water into the bypass channel.

- Remove remaining tailings and contaminated soils from the Mill-Willow Bypass, consolidate them over existing dry tailings and contaminated soils within the Pond 1 and Pond 3 berms and provide adequate cover material which will be revegetated.

- Reconstruct the Mill-Willow Bypass channel and armor the north-south berms of all ponds to safely route flows up to 70,000 cfs (one half of the estimated probable maximum flood).

- Flood (wet-close) all dry portions of Pond 2.

- Establish surface and ground water quality monitoring systems and perform all other activities necessary to ensure compliance with all applicable or relevant and appropriate requirements.

- Implement institutional controls to prevent future residential development, to prevent swimming, and to prevent consumption of fish by humans.

- Defer, for not more than one year after the effective date of the ROD, decisions concerning the remediation of contaminated soils, tailings, and groundwater in the area below Pond 1, pending evaluation of various wet- and dry-closure alternatives and public review.

The ESD (USEPA 1991) modified the initial ROD (USEPA 1990) for the Warm Springs Ponds by dividing the original OU into two separate OUs. Components of the remedy associated with Pond 1 and the area downstream of Pond 1 (the inactive area), including the Pond 1 berms, the old Silver Bow Creek channel, and the lowermost portion of the Mill-Willow bypass, were removed from the 1990 ROD for the Warm Springs Ponds. The ESD called for a separate and thorough evaluation of remedial alternatives for the inactive area and a separate proposed plan and ROD for the Warm Springs Ponds Inactive Area OU.

### 4.1.1.2 WSP Inactive Area OU

The overarching remedial action objectives for the Inactive Area OU were to substantially reduce or eliminate risks to human health and the environment and meet federal, state, and local laws. Media specific remedial action objectives were as follows (USEPA 1992b):

- Prevent releases of pond bottom sediments during floods or earthquakes.
- Meet ambient water quality standards established pursuant to the Montana Water Quality Act for arsenic, cadmium, lead, mercury, copper, iron, and zinc at a compliance point just above the starting point of the Clark Fork River.
- Prevent ingestion of water above the Montana Public Water Supply Act's MCLs for arsenic, cadmium, lead, mercury, and silver, and established reference doses for copper, iron, lead, zinc, and cadmium.
- Prevent ingestion of water containing arsenic in concentrations that would cause increased cancer risks greater than 1 in 10,000.
- Substantially reduce the potential for direct contact, inhalation, and ingestion of exposed tailings and contaminated soils. This objective applied to both humans and fish and wildlife.
- Reduce the levels of arsenic, cadmium, and other contaminant concentrations in the groundwater within the Inactive Area to preclude off-site migration of water in excess of Montana groundwater MCLs.

The WSP Inactive Area remedy may be summarized as follows:

- Remove all tailings and contaminated soils from the adjacent portion of the bypass channel and from the area below Pond 1 not planned for wet-closure. Consolidate the wastes over existing dry tailings within the western portion of Pond 1.
- Modify, or enlarge if necessary, the adjacent portion of the bypass channel to safely route flood flows up to 70,000 cfs, which is one-half the estimated probable maximum flood (PMF) for the combined flows of Silver Bow, Willow, and Mill creeks. Soils and gravels that have copper concentrations below 500 mg/kg and meet geotechnical requirements will be used for raising and strengthening the existing berms and constructing new berms.
- Raise, strengthen, and armor with soil cement the north-south aspect of the Pond 1 berm. In accordance with specified state safety standards for high hazard dams and for the protection of human health and the environment, the reconstructed berm must

withstand the estimated maximum credible earthquake (MCE) for this area. In addition, the reinforced berm must be constructed to withstand flood flows up to 70,000 cfs (0.5 PMF) in the enlarged bypass channel.

- Stabilize the east-west aspect of the Pond 1 berm. The reconstructed berm must withstand a maximum credible earthquake for this area, thus protecting against the movement of contained pond bottom sediments or tailings into the uncontaminated or wet-closed areas below Pond 1 in accordance with specified state dam safety standards, and for the protection of human health and the environment.

- Extend and armor the north-south aspect of the Pond 1 berm approximately 2,400 feet in a north-northeasterly direction. This extended berm will be constructed to provide maximum credible earthquake protection and the ability to withstand one-half the estimated probable maximum flood (70,000 cfs) in the adjacent bypass channel.

- Relocate the lowermost portion of the bypass channel and convert the present channel into a groundwater interception trench. The relatively straight reach of the bypass channel, from the apex of the existing Pond 1 berm to the historic Silver Bow Creek channel, will be relocated north of the extended berm. The entire reach of the bypass channel that is adjacent to the inactive area will be reconstructed, reclaimed, and restored to a more natural, meandering condition. Other excavated areas will be reclaimed and restored to their natural condition.

- The converted groundwater interception trench will be deepened and pumps will be installed to allow for a pump-back system. Intercepted water that fails to meet specified standards will be pumped back to the active area for treatment. Monitoring wells and surface water quality monitoring stations will be placed at strategic locations.

- Construct wet-closure berms to enclose the submerged and partially submerged tailings and contaminated soils. Within the eastern portion of Pond 1 and along the historic Silver Bow Creek channel below Pond 1, these smaller berms will create a series of cells, which when flooded will vary in depth from a minimum of one foot to a maximum of six feet.

- Chemically fix (immobilize) the tailings and contaminated soils, now enclosed by smaller berms, by incorporating lime and lime slurry onto or into them.

- Flood the wet-closure cells with water adjusted to a pH greater than 8.5 and maintain proper water surface elevations in the wet-closure cells.

- Cover the dry tailings and contaminated soils within the western portion of Pond 1 with two inches of limestone, 12 inches of fill, and six inches of a suitable soil cap. This dry-closed area will be contoured to control runoff and seeded with native vegetation.

- Construct a runoff interception system along the east side of the inactive area. This system will prevent floods originating in the eastern hills from entering the wet-closure cells. It will be designed to intercept one-half the probable maximum flood, which is estimated to be 8,500 cfs at its peak. A collection system or other engineered solution will be constructed to prevent excessive sediments from entering the Clark Fork River immediately below.

- Install toe drains along the armored berms and construct a collection manifold for both the active and inactive areas. The water collected will be pumped to the active area for treatment if it exceeds final point discharge standards specified in Attachment 5 to the WSP Active Area UAO.

- Implement long-term ecological monitoring. By means of an unbiased set of measurements, this monitoring effort will concentrate on the effects of biological systems living in contact with metals in the water and substrate of ponds and wetlands environments. The results will validate or invalidate the decision to chemically fix, wet-close and contain in place the exposed and submerged tailings and contaminated soils.

- Implement ICs to prevent residential development, swimming, domestic well construction, and disruption of dry-closure caps.

### 4.1.2 Remedy Implementation

Response actions were conducted by Atlantic Richfield under extensive EPA enforcement from July 1990 through September 1995. Beginning with the Mill-Willow Bypass ERA in 1990 and 1991, and continuing through remedial action construction for both the active and inactive areas in 1992 through 1995, EPA has determined that Atlantic Richfield has met all remedial action construction requirements that were set forth in the two RODs (1990 and 1992) and three administrative orders ((Mill-Willow Bypass Removal Action -1990, Active Area Remedial Action – 1991, and Inactive Area Remedial Action - 1993).

### 4.1.3 Remedy O&M

The WSP OU is a series of ponds and wet closures that serve as settling and treatment facilities, removing suspended particles from the influent water prior to discharge back to the natural stream system. Influent flows from Silver Bow Creek enter the WSP OU at the inlet structure where pH is adjusted by lime addition as required to maintain a target pH of 9.2 to 9.5 at monitoring point SS2. Flow passes from the inlet structure through Pond 3 and into Pond 2 with a portion being diverted through the Wildlife Ponds and Pond 2 wet closures, which both discharge back into Pond 2. These discharges are combined with all flows prior to discharge from the outlet structure of the treatment ponds. The Mill-Willow bypass routes the flows of both Mill and Willow Creeks and any seasonal flows in excess of the Silver Bow Creek inlet channel capacity around the WSP system in a reconfigured meandering channel.

The WSP OU has a noxious weed control program to control noxious weed through the site and through the Mill-Willow bypass. Routine clearing of debris on the trash rack prevents overflow events of untreated water into the Mill-Willow bypass. Mixing of the lime with the influent flow is facilitated by the installed baffles at the inlet channel and the meandering stream channel that flows from the inlet into Pond

3. Hydraulic controls are used to control the retention time required for maximum settling and treatment in both Ponds 2 and 3.

# 4.2 Rocker OU

## 4.2.1 Remedy Selection

The primary objective of the groundwater portion of the remedy for the Rocker OU was to prevent further contamination of high quality groundwater resources in contact with the plume of arsenic-contaminated water. Included in this objective was the goal of returning the groundwater resource to the community at the earliest opportunity to allow further development. A second long-term objective is to reduce arsenic concentrations within the area of the arsenic plume to levels suitable for drinking water.

The primary objective of the soil treatment portion of the Rocker OU remedy was to prevent further releases of arsenic into the groundwater or into Silver Bow Creek. The soil remedy is also designed to prevent human health risks for occupational use and to remove contaminated materials from contact with the groundwater or the stream and store them long-term in a repository.

The remedy for the Rocker OU is summarized as follows:

- Excavate and treat contaminated soils above 1,000 ppm arsenic.
- Dispose of treated soils in an on-site repository.
- Cover arsenic-contaminated soils ranging from 380 ppm to 1,000 ppm remaining on site with 18 inches of clean soil and revegetate.
- Treat contaminated groundwater and rely on natural attenuation to achieve cleanup standards.
- Construct an expanded capacity water supply system for the community.
- Monitor and demonstrate that the requirements of the ROD have been met. Return the groundwater resource to the community, and provide operation and maintenance of the repository and soil covers.
- Implement institutional controls to ensure non-residential use of the OU, and prevent domestic groundwater use until cleanup is achieved.

The ROD for the Rocker OU recognized that achieving the arsenic concentrations acceptable for drinking water within the area of the arsenic plume was a goal that could take several years to achieve. Further development of groundwater resources was restricted (via a well ban) to prevent migration of the contaminated groundwater into the deeper, high quality groundwater systems in the area. The ROD stated that when it can be verified that the arsenic plume has been controlled sufficiently to prevent the threat of further migration, the restrictions on groundwater development will be lifted for some of the aquifers.

### 4.2.2 Remedy Implementation

Final remedial design for Rocker began in spring 1996 under EPA order. The project team developed the ferrous iron and lime/pH adjustment groundwater treatment process called for in the ROD through bench-scale tests, and produced greater removal of arsenic from the groundwater than expected. The ROD prescribed a process predicted to reduce arsenic concentrations to approximately 2,000 µg/L. With the developed process, groundwater arsenic concentrations could be reduced to about 30 µg/L.

In fall 1996, pilot-scale groundwater and soil treatments were tested. In the field, 1,230 cy of contaminated soil were excavated from the “hot-zone” of the site and were treated in a pug mill (an industrial mixer) with iron sulfate and lime amendments. Groundwater exposed in the open excavation trench was treated with iron sulfate, lime, and potassium permanganate. The reduction in arsenic concentration following field-scale groundwater treatment was the same as achieved during bench-scale experiments. Soil treatment had similar success, resulting in arsenic concentrations that were at least ten times lower than necessary to meet regulatory requirements for disposal. This work set the stage for completing the design for the full-scale remedy.

After completing the design of the remedy in March 1997, groundwater and soil treatment was initiated and completed in the period from April through October 1997. To facilitate the cleanup at the site, the contaminated materials were divided into two separate treatment actions: 1) soil and debris excavation and treatment in an aboveground treatment plant; and 2) in-place treatment of contaminated groundwater in open trenches. Final disposition of the treated soil materials is in an on-site repository.

Soils contaminated with arsenic above 1,000 ppm were excavated to a depth of five feet below the seasonally low groundwater level and treated in a pug mill with iron sulfate and lime amendments. The iron and lime chemically fix (immobilize) the arsenic to levels below that necessary to allow disposal on-site, as defined by a testing procedure called Toxicity Characteristic Leaching Procedure (TCLP).

Groundwater contaminated with arsenic above 1,000 µg/l was treated in open excavation trenches using iron sulfate, lime, and potassium permanganate amendments. These amendments were added to precipitate arsenic from the water and reduce the amount of arsenic in water to levels approaching the state water quality standard of 18 µg/L.

Based on the final design, the remedy was implemented over a little more than two acres. The total amount of contaminated soils (both above and below the groundwater table) was estimated at 48,000 cy. The excavation of the contaminated soils started at the west end of the site and a series of north-south running trenches were excavated to a depth of five feet below the seasonally low groundwater level.

The soil removed from each strip was stockpiled above ground, sampled for arsenic content, and subsequently treated in the pug mill with iron sulfate and lime amendments in amounts proportional to the arsenic concentration in the soil. Soil samples were collected at 10,000 ton intervals and analyzed using TCLP methods to verify the effectiveness of the treatment process.

The groundwater exposed in the open excavation was treated in a two-step process. The first step involved adding pre-determined amounts of iron sulfate and lime directly to the water surface and mixing the water in the excavated strip (using an excavator bucket) to ensure uniform concentrations of the amendments in the water. The second step involved adding a pre-determined amount of potassium permanganate to the water and mixing. Water samples were collected before and after treatment to verify the success of the operation.

#### 4.2.2.1 Implementation Problems and Subsequent changes to Remedy

During remedy implementation, two areas of contamination were identified that had not been included in the remedy design. Groundwater contamination on the south side of the site within the Rocker rail siding was treated with ferrous iron though a groundwater injection trench. An infiltration gallery was left in place in the event that groundwater needs to be re-dosed in this area. A second area of soil contamination was identified in the floodplain of Silver Bow Creek. These materials were excavated, treated, and stored in the on-site repository.

Based on TCLP analysis, soils exhibiting 5 milligrams per liter (mg/L) or greater leachable arsenic are characterized as hazardous wastes. According to the ROD for the Rocker site, soils exhibiting total arsenic concentrations above 1,000 ppm were to be treated with iron sulfate and lime amendments. The actual total arsenic concentrations were found to vary between several hundred to several thousand ppm at the Rocker OU. After treatment, the average value of TCLP results for the entire project was below 0.30 mg/L leachable arsenic (well below the 5 mg/L requirement for a hazardous waste). Only one TCLP result was greater that 1.0 mg/L leachable arsenic. The next highest TCLP value was 0.27 mg/L leachable arsenic.

From data gathered for the risk assessment, EPA determined that the Rocker site overlies three aquifers that are hydraulically connected to each other. Of the three, only the shallow alluvial aquifer was determined to be contaminated with arsenic. Neither the deep alluvial aquifer nor the underlying Tertiary aquifer were found to be impacted by the arsenic contamination at the site. However, because of the hydraulic connections between the contaminated shallow alluvial aquifer and the underlying aquifers, concerns were raised by EPA and citizens of Rocker about potential migration of the contamination into the deeper aquifer systems.

The Montana DEQ instituted a groundwater control area (well ban) to protect the aquifers from potential contamination. The ban restricted the development of new wells within a ¼ -mile radius of the Rocker site. The ROD called for an alternate water supply for the Rocker community to ensure that further groundwater use did not occur. Concurrent with the cleanup at the Rocker site, approximately 2 ½ miles of new water main was constructed from the existing Butte-Silver Bow County water supply line to the community of Rocker. A 300,000-gallon water supply reservoir was also constructed to provide constant flows during periods of peak water usage.

### 4.2.3 Remedy Operations and Maintenance

Quarterly O&M activities began in 1998. The specific objectives of the Rocker OU quarterly groundwater monitoring program are as follows:

- Confirm treatment results and track groundwater quality trends
- Document the long-term efficacy of the iron/lime/oxidant groundwater treatment process carried out in 1997
- Document potential migration of the arsenic plume
- To document that nearby public and domestic water supplies remain unaffected by the Rocker arsenic plume
- Document changes in water table elevation and flow patterns following excavation and treatment of the shallow alluvial hydrostratigraphic unit
- Monitor compliance with groundwater performance standards

During remedy implementation, a total of seven wells were constructed within the remediation footprint as treated source materials were backfilled into excavated areas; thus, those wells (RH-60 through RH-66) were designated as interior "gravel wells" because their screened intervals were within the treated groundwater that was backfilled with clean gravel. The groundwater monitoring network also includes exterior and contingency (i.e., point-of-compliance) wells screened in each of the three aquifer zones. A summary of the O&M wells sampled for groundwater quality is provided in Table 4-1.

In general, the same tasks are performed during each quarterly sampling event. On the first day of an event, the water level in all site monitoring wells and staff gages in Silver Bow Creek are measured. Subsequently, the three private wells and 31 monitoring wells are sampled. Analytical parameters include 12 dissolved metals, 3 anions, and total dissolved solids. Field parameters measured include temperature, pH, conductivity, redox potential, and dissolved oxygen. Field parameters are also measured in Silver Bow Creek once during each event. Contingency wells located outside the arsenic plume are used to monitor compliance and to determine if and when it may be appropriate, using statistical methodologies, to initiate contingency remedy actions. Provisions within statistical evaluation and implementation plan are designed to objectively identify any expansion of the spatial distribution of the arsenic groundwater plume.

An annual qualitative inspection of general site conditions is also performed, including uniformity of vegetation cover, presence of bare areas, identification of noxious weed infestations, location of erosive areas, condition of ditches, damage due to trespassing, etc. Qualitative recommendations are made based on the overall condition of individual components (e.g., vegetation, erosion, security, channels, etc.) of the reclaimed area.

## 4.3 Butte Mine Flooding OU

### 4.3.1 Remedy Selection

The overall remedial action objectives established for the BMF OU in the September 1994 ROD is:

- To prevent human and aquatic exposure to contaminated groundwater and surface water.

This overall objective will be met by accomplishing the following remedial action objectives:

- Ensuring that the critical water levels (CWLs)in the Berkeley Pit System (5, 410 feet) and the West Camp System (5,435 feet) are not exceeded so that contaminated mine water is contained and does not discharge to the alluvial aquifer or into Silver Bow Creek.

- Ensuring that treated water discharged to the Silver Bow Creek drainage meets State of Montana and other pertinent water quality standards.

- Implementing institutional controls on the public's access to contaminated bedrock aquifer water to ensure the protection of public health.

- Implementing a comprehensive monitoring program to verify the protectiveness of the critical water levels and to ensure that the contaminated water is being contained.

The selected remedy for the Butte Mine Flooding OU is summarized below:

- All surface water from the Horseshoe Bend area is intercepted and treated using a high density lime precipitation treatment system. This treated water is either recycled back into the Montana Resources mining operations or discharged into Silver Bow Creek

- The water level in the Berkeley Pit system is kept below the CWL (5,410 feet) through pumping, treatment, and discharge to Silver Bow Creek (or used for some other beneficial uses).

- The Butte Mine Flooding OU monitoring plan tracks the elevations and quality of water inflows into the Berkeley Pit and West Camp Systems against the CWL for both the Pit and the West Camp. This information is updated annually and used in models of the Berkeley Pit and West Camp to provide EPA and DEQ with a projected date at which the CWLs will be met. The effectiveness of this monitoring plan is reviewed every 3 years by both EPA and MDEQ.

- Produce a focused feasibility study 24 months prior to mine closure or before the Berkeley Pit reaches the CWL. At that time, EPA will evaluate all existing and emerging technologies to provide EPA with information to select a final treatment technology for the Berkeley Pit water prior to discharge of this water into Silver Bow Creek. This treatment technology will treat the Berkeley Pit water to the State of Montana and other pertinent water quality standards.

- Institute a long-term, comprehensive monitoring program.

- Implement an institutional control program to restrict use of contaminated groundwater. Create and implement a public education program to inform the public on the progress of the Mine Flooding project.

An ESD (USEPA 2002) modifies the selected remedy ROD in the following ways:

- It adds more stringent contaminant requirements for the water discharge from the treatment plant. The cadmium (Cd) standard was the most important standard made more stringent by the ESD because of a post-ROD change in water quality standards by the State of Montana.

- It acknowledges DEQ's primary responsibility for the active mine area and the Yankee Doodle Tailings Pond and EPA's responsibility for the sludge repository.

- It acknowledges EPA's prior decision to send West Camp contaminated water into the BPS OU as long as it can be handled effectively there.

- It notes that a full feasibility study level examination of different treatment options for the mine flooding water is no longer required.

- It allows storm water from uptown Butte to be diverted to the Berkeley Pit and sludge from the Horseshoe Bend treatment plant to go to Berkeley Pit.

### 4.3.2 Remedy Implementation

On April 15, 1996, the PRPs instituted the inflow control program by capturing and integrating the Horseshoe Bend discharge into the mining process at the MR Mine. However, a hiatus in MR mining operation from July 2000 to September 2003 triggered construction of a water treatment facility for the Horseshoe Bend discharge. At the time of this 5 year review, the Horseshoe Bend water treatment plant (HSB WTP) is completed, but it is discharging to the resumed MR Mine operations and will not discharge into Silver Bow Creek in the near future.

Treatment of West Camp waters at Butte Metro Sewage Treatment Plant terminated in 2002 in favor of treatment at LAO treatment lagoons. In the 2002 ESD, the requirement to conduct a focused feasibility study to determine the best treatment technology was changed instead to evaluate if the existing HSB WTP can treat the combined HSB and Berkeley Pit flows. This evaluation must be completed four years prior to reaching the CWL. Any necessary upgrades to the WTP must be competed two years prior to the CWL.

### 4.3.3 Remedy O&M Maintenance

The HSB WTP is the only completed component of the remedy for the BMF OU at this time. Therefore, the O&M for the Mine Flooding OU remedy presented in this five year review will only discuss the HSB WTP at this time. In subsequent five year reviews, O&M of other portions of the remedy for the Mine flooding OU will be discussed as they are completed.

The HSB WTP uses lime precipitation for metals removal. It is a fully automated facility with remote alarm indication. The HSB WTP utilizes a high density sludge (HDS) process, recycling a slip stream of sludge to the front end of the treatment process. This HDS recycle helps improve the efficiency of the lime precipitation step while minimizing sludge blowdown.

The HSB WTP has both an influent equalization basin minimizing influent variations and an effluent lagoon controlling effluent discharge and providing a final polishing step. The major treatment components of the WTP such as lime feed, influent pumps, effluent pumps, aeration blowers, polymer feed pumps and clarification stages have completely redundant systems to eliminate downtime due to equipment failure. Major tanks in the WTP process were constructed of concrete to provide longevity. The WTP is also equipped with an automated effluent control loop. If effluent exceeds the acceptable pH range, this system will automatically send water to Berkeley Pit rather than discharge into the Silver Bow Creek.

The HSB WTP uses aeration to enhance sludge stability, as ferric sludge is more stable than ferrous. The WTP was designed with operational flexibility provided by variable frequency drives on influent, effluent, and sludge pumps that can vary influent rates to the plant. This “turn-down” capacity also reduces power consumption at lower flows to the WTP.

The annual system O&M costs are presented in Table 4-2.

#### 4.3.3.1 Implementation Problems and Subsequent changes to Remedy

The HSB WTP experienced problems with the lime slaking system during start-up. While the system has a slaking capacity of 8,000 lbs/ hour, the start up slaking needs were only 8% to 12% of capacity, making slaker operations difficult. Modifications to the spray nozzles, lime addition valves and the PID logic control loop solved this problem. However, no changes in the remedy as defined in the ROD for the BMF OU were required.

Ongoing problems with several WTP systems are described below.

*Blowers*

The blowers providing low pressure air to the reactors were recalled by the factory for a bearing modification. The air flow meters for these blowers were sent back for recalibration to the correct pipe diameter then relocated to a more ideal flow measurement location. The No. 2 blower failed in October 2004. This failure was believed to be a result of operating the blowers at the lower end of the performance curve resulting in a surging problem. This is a result of the air capacity of the reactors being significantly lower than the maxim operating capacity of the blowers. An engineered solution to this problem is being investigated.

*Lime Unloading*

The lime unloading system is not operating at the design specified capacity of 1,000 pounds/minute. Currently the actual unloading rates are 30% to 40% of the design rate. The lime unloading equipment supplier is currently looking at design options and system modifications to reach the desired unloading rate.

*Clarifier Rake*

The number two clarifier stalled out on high torque in December 2003. Numerous factors contributed to this incident, which were resolved by re-labeling the polymer lines, redesigning the feed well inlet, repairing a rubbing problem on the feed well, re-leveling the rake mechanism, and replacing the bearings in the rake lift assembly. However, some rake torque issues in both the No. 1 and No. 2 clarifiers still exist. Solutions for these problems are being investigated at this time.

In December 2004 the sludge pump in the No. 1 clarifier failed electrically. The spare pump was installed and a similar replacement pump ordered. Upon examination of the pump, the root cause of the failure was corrosion of the materials of construction eventually resulting in a motor seal failure. Currently the materials of construction are being reviewed by the plant designer to determine the correct materials of construction.

## 4.4 Streamside Tailings OU

### 4.4.1 Remedy Selection

As stated in the ROD (DEQ 1995a), the final remedial action objectives and final remediation standards for surface water, tailings and impacted soils, railroad materials, groundwater, and air resources in the SST OU are listed below.

- Meet the more restrictive of the aquatic life or human health standards for surface water identified in DEQ Circular WQB-7, through application of I-classification requirements.

- Prevent exposure of humans and aquatic species to in-stream sediments having concentrations of inorganic contamination in excess of risk-based standards. A physical criterion is used to define those sediments posing the greatest risk to receptor species. A contingency is established to develop metal-specific concentrations which would be risk-based, and allow sediment cleanup standards if the physical criterion standard cannot be employed appropriately.

- Provided that upstream sources of Silver Bow Creek contaminants are eliminated, meeting the two remediation standards identified above should attain the remedial action objective to improve the quality of Silver Bow Creek's surface water and in-stream sediments to the point that Silver Bow Creek could support the growth and propagation of fishes and associated aquatic life, one of the designated goals for an I-class stream, including a self sustaining population of trout species.

- Prevent human exposure to tailings/impacted soils from residential or occupational activity within the SST OU. This will be accomplished, in part, through ICs that will require the entire OU to be developed into a recreational corridor.

- Prevent erosion or migration of inorganic contaminants of concern in tailings/impacted soils into Silver Bow Creek or into groundwater that would prevent attainment of groundwater, surface water, and sediment remediation levels.

- Protect all solid waste within the SST OU from flood displacement, washout or erosion in accordance with applicable or relevant and appropriate requirements (ARARs).

- Prevent the situation of tailings/impacted soils by groundwater during any period of the hydrologic year or by bank storage of high-flow stream discharge.

- Prevent exposure by recreational users of the railroad beds in excess if acceptable cancer and non-cancer risks from arsenic. Risks will be adequately reduced by removal of ore concentrate spills and other impacted railroad materials exhibiting arsenic concentrations in excess of 2,000 milligrams per kilogram (mg/kg).

- Prevent erosion of contaminated railroad bed materials into Silver Bow Creek to the degree that surface water standards would be exceeded, or in-stream sediments would be contaminated, or vegetation on adjacent relocation or Streambank Tailings and Revegetation Study (STARS) treated areas would be adversely impacted.

- Attain compliance with applicable DEQ Circular WQB-7 standards, federal MCLs and federal non-zero maximum contaminant level goals (MCLGs) for all OU groundwater.

- Prevent discharge of groundwater that would prevent attainment of Silver Bow Creek ambient Circular WQB-7 standards or in-stream sediment remediation goals.

- Compliance with air ARARs within or adjacent to the SST OU during implementation of the remedial action.

The major components of the remedy selected for the SST OU are (USEPA 2000):

- Removal of tailings/impacted soils from the floodplain where (a) they are saturated by groundwater; (b) in-place treatment would not be effective due to thickness of tailings or lack of buffer material between the tailings and groundwater, or (3) treated tailings/impacted soils could be eroded into Silver Bow Creek. Excavated tailings/impacted soils will be placed in mine waste relocation repositories outside of the floodplain, or transported to the Opportunity Ponds disposal area.

- Fine-grained in-stream sediments located in depositional areas are to be removed and placed in repositories with the excavated tailings/impacted soils. After removal of contaminated in-stream sediments, the channel bed and streambank will be reconstructed.

- All contaminated railroad materials that pose a risk to human health or the environment will be excavated, treated, and/or capped. Excavated railroad materials will be placed in the repositories.

- No separate remedial action is planned for groundwater or surface water. Remedial activities for SST OU tailings/impacted soils and for sources of contaminants upstream or offsite under other cleanup actions are expected to reduce contaminant releases to groundwater and surface water with the goal of ultimately attaining State water quality standards.

- The ROD called for an institutional controls program which will be coordinated through a joint effort of the Butte-Silver Bow and Anaconda-Deer Lodge local governments.

The ESD presented the following nine changes from the remedy described in the ROD (DEQ 1998):

- An increase in the volume of tailings/impacted soil in the SST OU.

- Modifications to the alignment of Silver Bow Creek and the channel profile (i.e. elevation profile).

- Use of a temporary stream diversion during and after construction to facilitate dewatering and excavation of near-stream tailings and to enhance floodplain and streambank revegetation efforts.

- Changes in the criteria for in-stream sediment removal as a result of other design changes.

- Modifications to the mine waste relocation repository design.

- The inclusion of sediment basins to contain contaminated overland flow run-on from off-site mine waste sources.

- Elimination of treatment wetlands as the end land use in Subarea 1.

- Changes in the estimated schedule to implement the SST OU remedy.

- An increase in the estimated cost of the SST OU remedy.

### 4.4.2 Remedy O&M

The only O&M activities established under the ROD for the SST OU was a permanent monitoring, management, and maintenance of reclaimed areas and onsite repositories. This monitoring, management and maintenance will address vegetative performance on both STARS treatment areas, onsite repositories, remediated streambanks, streambank stability, and channel meander. It will also address instream sediment sampling for both contaminant concentrations and macroinvertebrate abundance and diversity. Repairs to areas damaged or eroded over time will be completed on an as needed basis. Vadose zone, saturated zone, and overland flow monitoring will ensure that the metals are immobilized in all in situ remediated areas in the SST OU.

### 4.4.3 Remedy Implementation

Construction to implement the remedy was initiated in 1999 involving removal of streamside tailings and stream channel reconstruction. At the time of this five-year review, construction and revegetation has been completed for Subarea 1 (Reaches A-E) and Subarea 4 (Reach R, parcel 152). Construction is completed for Reach F of Subarea 2 and is beginning for Reach G. Of the 1,400 acres of contaminated tailings and soils alongside Silver Bow Creek, approximately 200 acres of tailings impacted area have been remediated. Over 874,000 cubic yards of tailings have been removed from the floodplain. Cleanup is scheduled to be completed sometime between 2011 and 2013.

# Section 5 Progress Since Last Review

This section discusses the performance of the remedies at the Warm Springs Ponds OUs and the Rocker OU since they are complete and functioning.

## 5.1 Evaluation of Warm Springs Ponds OUs

To simplify the discussion of the WSP OUs, the performance of the WSP Active and Inactive OUs will be discussed concurrently. No major new actions have been conducted at the WSP OUs during the 2000 to 2004 time period, hence, the "progress" consists of operation and maintenance of the WSP treatment system. This section will present the performance of the WSP OUs with respect to performance standards during this last review period.

### 5.1.1 Previous Statement on Protectiveness

From the first five-year review in 2000, the following statements were made regarding the protectiveness of the WSP Inactive and Active OUs:

> *The WSP effectively remove or reduce acutely toxic concentrations of metals that enter the treatment system from Silver Bow Creek. Whereas Silver Bow Creek above the ponds supports absolutely no fish population and is severely impaired in respect to invertebrate and periphyton (algal) community structure, the aquatic environment immediately below the WSP supports healthy populations of trout, good biological integrity for periphyton, and biological integrity for invertebrates that has progressed from severely impaired to slightly impaired just within the past few years since cleanup efforts were initiated. The pond system has become a safety net for the Clark Fork River.*
>
> *Fish kills within and below the Mill-Willow bypass, which occurred frequently during the 1970s and 1980s, are today a thing of the past because of implementation of the WSP response actions. Several acute toxicity tests conducted within the past few years, involving sensitive trout fry, yielded "no effects" concentrations or LC 10 concentrations of dissolved copper that are significantly higher than concentrations of copper to which aquatic receptors living below the ponds are subjected. EPA deems the remedy to be protective in terms of substantially reducing--quite possibly eliminating--the threat of acute lethality to fish.*
>
> *With regard to chronic effects, the weight of evidence for fish indicates that an intermittent low-level of stress may be occurring below the Ponds, and the most plausible manifestation of this stress is slightly reduced body mass. It is unlikely that such chronic stress results in mortality. The weight of evidence for invertebrate and possibly periphyton community structure measures indicate to EPA that impacts persist. These impacts, though subtle and apparently steadily being reduced, originate from Silver Bow Creek above the pond system: Despite the effective manner that dissolved and particulate-bound metals are removed within this treatment system, a*

*low level of chronic, less-than-lethal stress persists. The presence of this continued risk emphasizes the need to fully meet performance standards in order to ensure full protectiveness. EPA will continue to monitor the Ponds and progress on upstream cleanups to ensure that this happens. EPA also notes that DEQ rejected ARCO's petition to change these standards, and that ARCO's challenge to these standards has been stayed. EPA fully supports the State's position on these matters.*

*In light of the current and long-standing status of severe contamination in Silver Bow Creek above the ponds, and in light of the rapid degradation of water quality that occurs in the upper Clark Fork River, beginning within a few miles downstream of the WSP and continuing for about 40 miles, any attempt to eliminate chronic threats that persist immediately below the ponds through modification of the WSP system would produce virtually no change in protectiveness for the river in the Deer Lodge valley.*

*The WSP response actions were designed to provide the maximum reasonable degree of compliance and protectiveness. But, they were also designed and constructed with the expectation that a cleanup of Silver Bow Creek would follow close behind. Then, in turn, the upper Clark Fork River cleanup was expected to follow closely on the heels of the Silver Bow Creek cleanup. EPA believes there are limits on the degree of protectiveness which each operable unit cleanup can, by itself, provide for the aquatic life of the upper basin. The level of protectiveness provided by the three response actions for the WSP reviewed here has been shown to be both effective and reasonable. While a high degree of protectiveness has been achieved, an even higher degree of protectiveness is achievable. But, such a higher degree of protectiveness for the river can be attained only after all remaining operable units along this continuum of stream environments have been cleaned up and are functioning as a whole.*

*EPA has determined that the WSP response actions have been constructed and are being operated and maintained in a manner that is as protective as is reasonably possible in the context of a Superfund complex with multiple operable units and critical, unfinished work both upstream and downstream. Continued long-term operations and maintenance, coupled with annual dam safety inspections, required water quality monitoring and biological monitoring, will assure that maximum reasonable protectiveness and effectiveness are maintained until the response actions for Silver Bow Creek and the upper Clark Fork River are completed and have undergone post-construction healing. At that point, full protectiveness and performance standard compliance will be achieved.*

### 5.1.2 Significant Events

The following provides a brief summary of some of the more significant events that have taken place during the report period from January 1, 2000 through December 31, 2004. The events listed involve the Active Area of the WSP system and may have directly or indirectly affected pond water quality. Figure 5-1 presents an overview of the WSP site and indicates Active Area OU sampling locations.

- Entire review period: Montana, including the Upper Clark Fork River drainage basin, is experiencing a significant and prolonged drought, causing decreased influent and effluent flows to and from the WSP system.

- Biomonitoring investigations completed to evaluate ecological performance of the WSP System and the MWB. Investigations were conducted in the WSP in 1998-2000 and in 2003. Spawning surveys conducted in MWB in and 2001, and detailed biomonitoring was conducted in 2000.

- 2002: The Cook Creek sedimentation basin (upgradient of Pond 1) was cleaned and deepened to reduce storm water inputs into Pond 1.

- 2002: A geotextile and soil cap was added to portions of the west Pond 3 dike to create a better habitat for vegetation and improve the appearance of the dike.

- March 14, 2003: The overflow spillway upstream of the inlet structure leading into the WSP was overtopped for a short period of time due to rapid debris accumulation on the trash rack at the WSP inlet (associated with the high-flow runoff event). Subsequent environmental investigations indicated no environmental damage associated with this overflow. However, because EPA and DEQ were not notified within 24 hours of the overflow event, a Notice of Violation (of the reporting requirements) was issued. This event will be discussed in more detail in Section 5.4

### 5.1.3 Facility Operations and Activities

The primary processes involved in the WSP system are two-fold:

- Hydrated lime is added to the influent stream (Silver Bow Creek) to raise the pH to the target level of 9.2 to 9.5 at Station SS-2. This is the first step toward maximizing the chemical and physical changes that cause dissolved metals to become solids and begin settling out (precipitation).

- The WSP are both a treatment and settling facility. The addition of large volumes of lime at the inlet initiates the alkaline precipitation processes. But, adequate retention time (approximately 21 days) and a final "polishing action" (principally in Pond 2 by algae) are also needed to reduce metal concentrations to acceptable levels prior to discharge back into the natural stream system below.

Reducing dissolved copper and zinc is the system's greatest challenge for protection of aquatic life. The dissolved copper and zinc entering the pond system from Silver Bow Creek are almost always acutely toxic. Solubilities of these metals are minimized in the targeted pH range of 9.2 to 9.5. Settling of the metal oxide/hydroxide precipitates is facilitated by the large volume of water in the WSP system.

The opportunities for controlling these processes generally involve two operations or activities. First, the quantity of lime added to the influent stream can be adjusted. When lime is added to Silver Bow Creek, mixing is facilitated by installed baffles at the inlet channel and by the meandering stream channel that flows into Pond 3.

Second, hydraulic controls can be altered so that the water surface elevations (and subsequent volumes) of Ponds 3 and 2 are raised or lowered. Water flows can also be routed differently between or around the ponds and wet closures. The hydraulic controls are applied to create an environment that promotes maximum sedimentation of suspended particles in Pond 3. The wet closures and Pond 2 provide additional sedimentation and treatment polishing. During periods of increased suspended particle loads, the sedimentation process can be prolonged by using the hydraulic controls to increase pond volumes and retention times.

### 5.1.3.1 Lime Addition

As previously discussed, hydrated lime is added to the influent stream (SS-1) to a target level between 9.2 and 9.5 as measured at SS-2. During the report period, the typical lime dosage rate was 35 mg/L during the time when lime was being added.

During high flow/high turbidity influent conditions, the lime dosage rate is increased to ensure sufficient lime addition to maximize treatment of metals, and subsequent settling of metal oxides and hydroxides.

### 5.1.3.2 Hydraulic Controls

Flows from Silver Bow Creek enter the WSP system at the inlet structure where the pH is adjusted by lime addition. Flow passes through Pond 3 and Pond 2 with a portion being diverted through the Wildlife Ponds and Pond 2 wet closures. The Wildlife Ponds and wet closures discharge back into Pond 2 where all flows are combined prior to discharge from the outlet structure. Flows from Mill and Willow Creeks are diverted into the MWB above the inlet structure. Other system flows include the effluent from the Inactive Area Pumpback Station which pumps water from the Ground Water Interception Trench back to Pond 2. In addition, a small flow is maintained from Pond 2 into Pond 1 of the Inactive Area, which is subsequently returned to Pond 2 as part of the pumpback discharge. A general flow schematic for the Active Area is provided in Figure 5-2.

Flows entering the system vary greatly. Figure 5-3 illustrates the daily flow rates measured at SS-1 and SS-5. Monthly average flow measurements are presented in Figure 5-4. Increased flow periods each spring/early summer correspond to seasonal runoff. Increased flows are also observed after isolated precipitation events.

Low discharge rates at SS-5 occur primarily during summer and fall months when influent flows are lower in order to increase the residence time (and sedimentation time) in the ponds.

Although flow patterns can be changed within the pond system, the main control on flow detention is the fluctuation of Pond 3 elevation. Pond 2 elevations have remained relatively constant since being filled in 1993 (Figure 5-5), ranging from about 4,835 to 4,836 feet. Pond 3 elevations vary depending on seasonal flows, and ranged from about 4,868 feet to 4,871 feet (target elevation is 4,870 feet, which minimizes sediment resuspension from previously flooded areas). High or low spikes in data are considered to be instrumentation error.

Pond 3 levels vary based on climatic conditions (Figure 5-6). In years when there is high snowpack, Pond 3 levels are kept low through the winter and spring so as to be able to accommodate high inflow runoff events. During drier years, levels in Pond 3 are maintained at somewhat higher levels in order to maintain flow through the system and maintain habitat for aquatic life.

### 5.1.4 March 2003 Overflow Event

The following information is summarized from information provided by EPA from the Administrative Record project files and from Atlantic Richfield’s summary of the event.

A high flow event occurred in Silver Bow Creek from March 12 through 13, 2003. This high flow event occurred over the course of approximately 72 hours on Silver Bow Creek beginning around 6:00 PM on March 12, 2003 and then subsiding during the afternoon of March 15, 2003. The overall event was characterized by three separate diurnal peak flow events caused by surface runoff of melting snow in the upgradient Silver Bow Creek drainage basin.

These high flows resulted in a large amount of debris being washed down Silver Bow Creek and collecting on the trash rack inlet at SS-1. EPA and USGS also found evidence that debris jams upstream of the ponds (three upstream bridges) broke loose all at once leading to a sudden blocking of the trash rack or a sudden pulse of high water. During the late evening and early morning of March 13-14, 2003, either or both of these events (backed up water due to a clogged trash rack or a sudden pulse of high water when the debris jams broke apart) led to overflow of Silver Bow Creek water over the Approach Channel Overflow Spillway (the Overflow Spillway) upstream of the WSP inlet.

The overflow occurred at a flow rate less than the expected high flow rate due to the way water was blocked and backed up by the debris. Atlantic Richfield noted that the “high level alarm” notified the operator who cleared debris from the trash rack several times on March 12 and 13. However, this same “high level alarm” did not sound during the night of March 13-14 when the overflow occurred. The operator discovered substantial blockage of the trash rack the morning of March 14 and evidence that water had recently passed over the overflow spillway. However, the high water level had since subsided. The trash rack was cleaned several times during the next few days.

Several meetings were held over the next month or so among Agency and Atlantic Richfield representatives to determine the cause and magnitude of the overflow event and to ascertain the potential ecological damage that may have occurred as a result of the overflow. Silver Bow Creek carries high concentrations of metals such as copper and zinc, to which aquatic life are sensitive. Concentrations in the overflow were estimated based on concentrations in Silver Bow Creek water. However, the actual flow rates in Mill and Willow Creeks, along with an unknown amount of water that flowed over the spillway made it difficult to estimate the resulting concentrations in the Mill-Willow Bypass. A rapid bioassessment of macroinvertebrate populations above and below the overflow was conducted by McGuire on April 1, 2003. This assessment concluded that:

- Macroinvertebrates were equally abundant at the upstream reference and downstream (impact) site.
- Taxa richness was not significantly different between sites.
- Macroinvertebrate community composition was similar between sites. Percent community similarity between sites was 72%.

McGuire also noted that "an acutely toxic event would have resulted in significant decreases in the occurrence and abundance of sensitive species and been evident as numerous distinct differences in the communities at each site. Data suggesting acute impacts from the spill were weak".

It does appear, however, that the increased loading from this high flow event did make its way through the pond system, leading to some water quality exceedances (see water quality discussion in subsequent sections).

Regardless of the actual cause, magnitude, or duration of the spill, the ecological significance of this event appears to be minor. While EPA concluded that it was not necessarily reasonable to expect the operators to have anticipated the magnitude of the trash rack clogging and the debris jams forming upstream and suddenly breaking loose, the issue was that the Agencies were not notified of the incident within 24 hours as mandated by the UAO. The event occurred during the overnight hours of March 13-14, 2003, but EPA was not notified until Friday March 21, 2003, and the incident was not formally reported until April 4, 2003. This resulted in Atlantic Richfield receiving a Notice of Violation.

As a result of this Notice of Violation, EPA required that additional work would be necessary to prevent a similar incident from occurring in the future, and to otherwise improve the performance of the Active Ponds treatment (EPA 2003). Additional work that was required by Atlantic Richfield included:

- Replace the existing stage sensor with a continuous measuring device that is capable of monitoring water levels entering the inlet, at all times. The new device must be capable of producing data that are retrievable at all times by telecommunication with the computer. This device should be in place and functioning prior to the early runoff of 2004.
- Develop an awareness and revised safety plan for spring runoff and summer thunderstorms. The plan should account for events such as the event that occurred in early and mid-March of 2003, including upstream inspections whenever a potential for debris build-up at county highway and Interstate highway bridges.

- Conduct sediment sampling and analysis of the uppermost bypass pond, into which the initial flows of the spillover occurred. The analytical results will determine whether or not, and to what extent, additional sampling or other corrective actions may be necessary.

- Eradicate Russian olive shrubs and trees introduced into the Mill-Willow Bypass. As part of Atlantic Richfield Company's ongoing efforts to ensure dam safety and flood passage requirements are met, by periodically trimming willows and other shrubs and trees adjacent to the berms, EPA urgently requests the eradication of Russian olive from the bypass and entire pond system.

(Additional Work items in the Notice of Violation that were not listed here consisted of specific data reporting requirements and requests concerning concentrations, flows, hydrographs, and exceedances that did not require installation of new equipment or changes to O&M procedures.)

To implement these Additional Work items, the following improvements/ modifications were implemented:

1. Improvements to the supervisory control and data acquisition system (SCADA) were implemented. These improvements include a real-time continuous stage recorder upgradient of the trash rack that, in addition to providing an emergency call-out for high stage conditions, can be accessed remotely so that the operator can determine the exact stage.

2. A safety and awareness plan was developed for spring runoff and summer thunderstorm events and incorporated into the Operations and Maintenance Plan. The plan includes inspections of the inlet channel and upstream bridges and channels for debris, and plans for action to address conditions that could lead to a similar overflow event as that which occurred in March 2003.

3. Section 9.0 of the Operations and Maintenance Plan, Routine Inspection and Maintenance Guidelines, was modified to address Russian olive at the site. Since these modifications were adopted, Atlantic Richfield has worked to eradicate Russian olive from the MWB and they anticipate it will be an annual O&M activity.

The additional sediment sampling results in MWB from the uppermost bypass pond were reported in the 2003 WSP Biomonitoring Report (ENSR 2004). The report stated:

> *Metal concentrations measured at the four MWB sites were on the low end of concentrations measured in the ponds, except for copper and lead. For copper, concentrations were at least two times lower than in the ponds and concentrations for lead overlapped those measured in the ponds.*

### 5.1.5 Regulatory Standards and System Performance

Compliance with the performance standards for the WSP Active Area is described in the Active Area UAO. Most of the regulatory standards at the WSP are applied to effluent composite samples taken at SS-5. Additional standards have been established for SS-3B for special instances when circumstances dictate discharge directly from Pond 3, via SS-3B. The SS-3B discharge was not used during this report period. Final standards are in effect for the entire report period of January 1, 1998 through December 31, 2004. The standards contain daily maximum and monthly average limitations for the total recoverable concentrations of nine trace elements (arsenic, cadmium, copper, iron, lead, mercury, selenium, silver, and zinc), TSS, and pH, as stated in the Active Area UAO (EPA 1991).

As required in the UAO, several of the constituents (cadmium, copper, lead, silver, and zinc) have standards that are hardness-based. This means that the maximum allowable concentration varies with each sample depending on the amount of hardness measured in the sample. Therefore, the standards for these metals, as shown on the figures, have been adjusted for each measurement based on the hardness in that sample (or set of samples, for the monthly average standards).

Values for final standards that apply to SS-5 are presented in Table 5-1. Hardness-based standards are presented at 150 mg/L hardness.

During the report period, influent quality at the WSP has been impacted by upstream remedial construction on the SST OU. The SST OU work, conducted by the State of Montana, has been ongoing. According to the SST OU Consent Decree, the WSP are not responsible for the unintentional and temporary exceedances associated with upset influent conditions caused by SST OU construction.

Prior to 1998, both total recoverable and dissolved samples were analyzed to better understand removal mechanisms in the system. After the first quarter of 1998, dissolved metals analyses were discontinued because the Active Area performance standards (outlined in the UAO) for surface water discharge are based on total recoverable concentrations.

The number of exceedances observed during the report period using final daily maximum standards and monthly average standards are presented in Table 5-2 and Table 5-3.

***pH.*** The final daily standard for pH requires SS-5 values to be between 6.5 and 9.5 standard units (s.u.). Figure 5-7 depicts the pH measurement for SS-1 and SS-5 for the report period. The pH standard was exceeded approximately 12 percent of the time (Table 5-2). The exceedances occur consistently in the summer months, and are due to increased biological activity in the system. During this time of year, lime is not being added to the system because natural biological activity raises the pH to the target level (and sometimes above). The high pH is not due to “overliming”. This is a naturally occurring phenomenon and is not attributable to the operation of the WSP. EPA’s previous Five-Year Review report on the WSP (EPA 2000) stated that "exceedances occur invariably during the late summer months as a consequence of warmer temperatures and natural biological activity."

***Total Suspended Solids.*** Concentrations of TSS observed in SS-5 samples have always been less than the final daily standard (Figure 5-8), and the majority of the samples are at or below the detection limit. The figure illustrates that even though TSS concentrations at the effluent vary, high concentrations observed at SS-1 (influent) are decreased significantly through the system.

***Arsenic.*** Comparison of influent and effluent total recoverable arsenic concentrations are presented for the report period in Figure 5-9. The daily maximum discharge standard was exceeded 44 percent of the time, and the monthly average discharge standard was exceeded 46 percent of the time (Table 5-2). The maximum effluent concentration measured was 0.068 mg/L. Exceedances of the arsenic discharge standard of 0.020 mg/L occur seasonally. Figure 5-9 shows that the seasonal period of arsenic exceedances was of longer duration in 2003 than in 2004.

These arsenic exceedances do not necessarily mean that the discharge is not protective of human health and the environment. Arsenic at these concentrations does not exceed aquatic life criteria (the aquatic life standards for arsenic are 340 μg/L acute and 150 μg/L chronic). There are no domestic or municipal water users that withdraw water immediately downstream of the WSP or from the shallow alluvium. There is also a ban on construction of shallow wells in the vicinity of the WSP.

The persistent, seasonal arsenic exceedances at the WSP have received a great deal of attention and concern from regulatory agencies, technical committees, Atlantic Richfield, and citizens. Meetings among technical experts have been conducted to explain the reasons behind the arsenic exceedances. The current theory under evaluation by technical experts is that natural biological activity, which changes the geochemical conditions of the pore water in the pond sediments, is responsible for the seasonal releases of arsenic. The process for arsenic release that has been discussed is summarized below.

As Silver Bow Creek enters the WSP system, arsenic, along with other trace elements of concern, are settled from the water column and sequestered in the pond sediments via precipitation/coprecipitation or adsorption. Arsenic is typically sequestered via adsorption to ferric oxides. During warmer weather and warmer temperatures, biological activity increases, resulting in the production of additional organic material that settles to the bottom. The extra organic material, coupled with warmer temperatures, leads to increased biological decay and the consumption of oxygen in the sediment pore waters. Under these conditions, the iron oxides become soluble as the iron is reduced from ferric to ferrous iron. The solubilization of the iron releases the adsorbed arsenic to the water column.

Since arsenic solubility can be higher at higher pH values, it was suggested that "over-liming" may be causing or exacerbating the arsenic exceedances. However, lime is added to the influent to maintain a pH between 9.2 and 9.5, until biological activity raises the pH to these levels without lime addition. When this occurs, lime addition is discontinued, typically in early summer. The arsenic exceedances in the summer do not correlate to the addition of lime and it cannot be concluded that "over-liming" is the cause of the arsenic exceedances. A more plausible explanation is that arsenic is released due to reducing conditions in sediment pore waters (as explained above).

To put the arsenic exceedances in perspective, arsenic loads were examined in several different ways. First, annual influent and effluent arsenic loads were estimated to quantify the amount of arsenic removed each year. Second, net loads were compared with the timing of arsenic exceedances. Third, arsenic loads were compared with arsenic loads in the Mill-Willow Bypass.

The total influent and effluent arsenic loads were calculated for each year of the report period and are shown in Table 5-4. The annual loads were calculated using the available daily concentrations and flow data to calculate a loading rate. This loading rate was then applied to the number of days between sampling events (typically three or four days) to obtain a mass load for the three or four day time period. These loads were then totaled for each calendar year (the calculations were checked to make sure the number of days in each year was correct). For the years 1998-2003, approximately 40 to 50 percent of the influent arsenic was removed. However, in 2004, removal dropped to only 1.8 percent, essentially indicating no net arsenic removal. In 2003, the largest influent load of arsenic was measured, at about 3-4 times what had been measured in recent years. Most of this was associated with the large influent event of March 2003. During late 2003 through 2004, the arsenic exceedances persisted throughout the winter, rather than ceasing in mid to late fall as in previous years. This partially accounts for the larger release of arsenic from the WSP; however, if the period of arsenic exceedances in early 2004 is removed from the loading analysis (i.e., only March through December loads are summed), percent removal only improves to about 12 percent.

Arsenic loads were also examined using a two-year averaging period; these results are also show in Table 5-4. This analysis shows the percent removal for arsenic is consistently about 45 to 50 percent.

Secondly, the net arsenic loads were compared with the timing of the seasonal periods of arsenic exceedances to determine if arsenic exceedances were a sign that the WSP were acting as a source of arsenic. This comparison is illustrated in Figures 5-10 and 5-11. Figure 5-10 shows a comparison of arsenic mass loads calculated for the influent and the effluent. The thick, horizontal lines indicate periods of time when arsenic exceedances occurred. For much of the year, influent and effluent loads are similar and do not show drastic differences. The exception to this is appears to be during spring runoff periods when influent arsenic loads increase.

The comparison of influent and effluent loads was difficult to clearly illustrate on Figure 5-10. Therefore, Figure 5-11 was generated showing net arsenic loads on an "instantaneous" basis (calculated from the daily monitoring data) and on a quarterly average basis. A net retention of arsenic is indicated by a negative load, a net release of arsenic is shown by a positive load. Similar to Figure 5-10, the thick horizontal lines indicate the time periods when arsenic exceedances occurred. In general, for the first 5 years of the report period (through the end of 2002), the graph shows that the arsenic exceedances were not necessarily indicative of a net release of arsenic from the ponds (all quarterly net arsenic loads were negative). However, during each seasonal time period of arsenic exceedances, the average net load trended upward (less negative or closer to zero), indicating less removal effectiveness and/or release of arsenic from the pond sediments. Interestingly, the quarterly net arsenic loads often showed a seasonal maximum (without crossing zero) in the winter months, when arsenic exceedances were not occurring.

Figure 5-11 shows that the first positive quarterly net load average (net arsenic release) occurred during the fourth quarter of 2002. The large runoff event of March 2003 is shown with a large influent load retained. However, after this event, the WSP were acting as a source of arsenic more frequently than during the previous years. The positive net arsenic loads appeared to occur during the later periods of the seasonal arsenic exceedance timeframes. Positive net loads were not observed immediately once arsenic exceedances began.

Third, the arsenic load contributed by the WSP via SS-5 was compared with the arsenic load present in the Mill-Willow Bypass at MWB-3 (downstream of SS-5). Water quality data are collected at MWB-3 by Atlantic Richfield, however, they do not measure discharge. In order to estimate loads in the MWB, average monthly flow data was obtained from the USGS for the station 12323750 (Silver Bow Creek at Warm Springs), which is located in the same stream reach as MWB-3. The flow data were only available through September 2003; however, this time period is long enough to show the significance of the arsenic discharge from the WSP relative to the MWB. A comparison of the arsenic loads in SS-5 and the MWB are shown on Figure 5-12. Arsenic concentrations are shown in the background for reference. For both the MWB and WSP, high loads occur during spring runoff, as is expected. However, when exceedances of arsenic are occurring in the WSP, arsenic loads at SS-5 are minimal, and loads from the MWB are comparatively higher and more significant than the loads from the WSP.

The intent of these loading analyses was to determine the significance of the arsenic exceedances in the WSP. The arsenic exceedances are consistently a seasonal problem at the WSP. However, the loading analyses show that the ponds have been acting as a significant sink for influent arsenic, until 2004. Yet, another important conclusion can be made from the loading analyses. The arsenic exceedances from the WSP do not necessarily correspond to a release of a large mass of arsenic to the upper Clark Fork River. The net loads show that even if arsenic concentrations are exceeded, for most of this time, the WSP are still acting as a sink for arsenic. Additionally, the arsenic loads from the WSP are often less than the loads contributed by the MWB. In other words, if arsenic concentrations could be brought into compliance at SS-5, the arsenic load to the Upper Clark Fork River would not decrease drastically because loads are already small, and the reduction would be relatively insignificant (and maybe unmeasurable) compared to loads transported by the MWB.

***Cadmium.*** Comparison of influent and effluent total recoverable cadmium concentrations are presented for the report period in Figure 5-13. Concentrations are in compliance with the final standards; there were no exceedances of the daily maximum or monthly average cadmium standards during the reporting period.

***Copper.*** Comparison of influent and effluent total recoverable copper concentrations are presented for the report period in Figure 5-14. Exceedances of the daily maximum standard occur principally during the spring runoff. It is unclear whether this is due to high flow rates/lower residence times, higher influent loads, or some other issue. Figure 5-15 presents influent and effluent copper concentrations but with the scale adjusted to show the magnitude of the influent concentrations. The exceedances during spring 2002 did not appear to be preceded by excessively large influent concentrations or flows, unlike the March 2003 event. Importantly, the final daily maximum discharge standard was met 98 percent of the time (two percent of the samples exceeded the standard). The average monthly standard was exceeded approximately ten percent of the time (eight times out of 84 months). However, six of these eight monthly exceedances were in 1998 and 1999; therefore, compliance with the monthly standard has improved in recent years. The remaining two monthly exceedances occurred during spring runoff conditions, including the March 2003 high flow event.

Monitoring of the dissolved fractions of the constituents was discontinued in 1998. In the past, paired dissolved and total recoverable data indicated that the majority of the copper after treatment is in the solid fraction. Because dissolved copper concentrations after treatment are significantly less than total recoverable concentrations, it can be concluded that dissolved copper concentrations leaving the pond system have been significantly below the 96-hour TRV for over ten years. The 96-hour TRV for trout fry, the most sensitive life stage for trout, is 0.037 mg/L (Erickson, et al. 1999).

***Iron.*** Comparison of influent and effluent total recoverable iron concentrations are presented for the report period in Figure 5-16. There was only one exceedance of the final daily maximum iron discharge standard during the report period, associated with the very high load during the March 2003 runoff event. Other than high loading events such as these, historical data suggest that iron concentrations should remain below final standards. There were no exceedances of the final monthly discharge standard.

***Lead.*** Comparison of influent and effluent total recoverable lead concentrations are presented for the report period in Figure 5-17. There were no lead exceedances of the final daily maximum lead standard during the report period; however, one exceedance of the monthly average standard was measured. This was also due to the high influent load during the March 2003 runoff event.

***Mercury.*** Comparison of influent and effluent total mercury concentrations are presented for the report period in Figure 5-18. The concentration of mercury in SS-5 samples has generally been below the final daily maximum discharge standard of 0.0002 mg/L, although one percent of the sampled did exceed the daily maximum standard during the report period. There has only been one exceedance since 2001, and that was during the March 2003 runoff event.

***Selenium.*** Comparison of influent and effluent total recoverable selenium concentrations are presented for the report period in Figure 5-19. Concentrations are in compliance with the final standards; there were no exceedances of the daily maximum or monthly average cadmium standards during the reporting period. Selenium is rarely detected in either influent or effluent from the WSP.

***Silver.*** Comparison of influent and effluent total recoverable silver concentrations are presented for the report period in Figure 5-20. Concentrations of silver are typically low and are seldom detected in the influent or effluent. There were no exceedances of the daily maximum standard during the report period. The monthly average standard of 0.00012 mg/L is less than the analytical detection limit for silver.

***Zinc.*** Comparison of influent and effluent total recoverable zinc concentrations are presented for the report period in Figure 5-21. There were three exceedances of the daily maximum standard for zinc during the report period. The exceedances occurred during runoff events in spring 2002 and after the March 2003 event. However, concentrations and flows during spring 2002 were not as high as concentrations or flows measured at other times during the report period, where exceedances did not occur. The exceedances were minor, and interestingly were consistently about 20 micrograms per liter above the standard. There were no exceedances of the monthly average zinc standard during the report period. Overall, the WSP system is effective at removing zinc from influent waters.

### 5.1.6 Pond 2 Wet Closures

A fraction of the discharge from Pond 3 is diverted from the Pond 3 discharge channel into the Pond 2 wet closures. Water flows through the wet closures (East Wet Closure and West Wet Closure) and subsequently discharges into Pond 2.

The base flow from the East and West Outlets of Pond 3 is routed into the Pond 2 Wet Closures to maintain inundation of the tailings deposits. A weir structure in the Pond 2 inlet channel allows adjustment of the quantity of flow entering each wet closure with excess flow bypassing the cells directly into Pond 2. The pool level for each wet closure is held at a constant level to ensure that the tailings within the cells remain covered.

The wet closures also provide wetland and wildlife habitat. Construction of islands and nest boxes within certain ponds has increased suitable habitat for waterfowl nesting.

Throughout the report period, the wet closures have remained inundated, thereby achieving the RAOs and this performance standard for the wet closure cells. The wet closure outlets were sampled quarterly during the report period. The performance of each cell was evaluated based on the water quality in the Pond 3 discharge water quality (SS-3E) and the wet closure outlet water quality. Note that SS-3E represents only a fraction of the discharge from Pond 3 to the wet closures because the other portion comes from SS-3W, which is not sampled.

Data showing the quarterly concentrations from SS-3E, the East Wet Closure (EWC) and West Wet Closure (WWC) are shown in Figures 5-22 through 5-26 (5graphs). The wet closures provided additional copper and zinc removal. Iron concentrations were more inconsistent, with some increases in iron concentrations measured at the wet closure outlets. Sulfate concentrations showed a consistent increase through the wet closures. Seasonal increases in arsenic concentrations were measured in the wet closure ponds. During summer and fall, effluent arsenic concentrations from the wet closures were generally greater than influent concentrations, with higher concentrations consistently measured from the West Wet Closure.

In general, it appears that the Wet Closures are functioning as intended, and are providing some additional contaminant removal and polishing, with the exception of arsenic and sulfate. The arsenic data show that the wet closure ponds are subject to the same arsenic mobilization geochemistry as the main ponds.

## 5.1.7 Mill-Willow Bypass and Lower Silver Bow Creek

### 5.1.7.1 Channel stability

The MWB is the primary floodway for the WSP. In addition to flows from Mill and Willow Creeks, it was designed and constructed to divert excessive flows from Silver Bow Creek around the WSP System.

Overall, the vegetative development along the MWB has been excellent. A 1998 investigation (R2 Resource Consultants) concluded that the riparian plan communities were developing well and should be allowed to continue to develop naturally, although additional willow plantings would be helpful (R2 Resource Consultants, February 2000). Limited overbank scour and bank erosion were occurring as part of the natural maturation of the channel; the overbank scour was creating habitat for willow species that were developing communities in these areas. In accordance with R2 Resources recommendations, 5,880 containerized (10 cubic inch) sandbar willows (*Salix exigua*) and 12 mature willow transplants were installed to assist the development of the riparian community and stabilize approximately 200 feet of streambank in the upper reach of the MWB.

### 5.1.7.2 Soil-Cement Toe Drains

Dike side slopes adjacent to the MWB were faced with soil-cement to protect them from erosion. Perforated pipe drains were installed behind the soil-cement to relieve seepage pressures that could build behind the relatively impervious soil-cement. Outfall pipes convey the seepage flow through the soil-cement to the MWB side of the dikes. These outfalls, or toe drains, are illustrated on Figure 5-27. Toe drains along the Pond 2 dike, (165 through 193) discharge into a collection pipeline called the soil-cement toe drain manifold. The toe drain manifold collects the seepage and conveys the water to the interception trench.

Minor seepage from around the toe drain laterals has been observed during routine inspections. This seepage has always been clear and there is no evidence of piping or related dam instability. The seeps are checked periodically to ensure that there is no increase in flow rate or evidence of piping. There have been no observations of a direct discharge to surface water; the seepage rates are so low that water typically collects in low spots at or near the toe of the Pond 2 dike where it presumably infiltrates or evaporates.

Some toe drains are not manifolded, as it was determined during RD that such a manifold may not be implementable. Several of the un-manifolded toe drains were selected for water quality sampling on an annual basis. During the evaluation period, samples were collected in October of each year. The toe drains selected as being representative of the overall outfall water quality are numbers 67, 84, 87, 90, 91, 99, 104, 152, 157, 160, and 161. Most of these toe drains are located along Pond 3. Annual and overall average concentrations of selected constituents are presented in Table5-5. In addition, the toe drain where the maximum concentration was measured is noted, along with the sample year. This is then followed by the concentration in this toe drain in 2004 so that current conditions are known. Of the trace elements analyzed, concentrations of cadmium, copper, and zinc are all low or non-detectable. Arsenic concentrations in toe drain samples averaged 0.066 mg/L during the evaluation period. The maximum arsenic concentration was 0.145 mg/L in TD-84 in 1999.

The soil-cement toe drains are successfully draining water from the soil-cement dikes, maintaining the piezometric surface at levels that are safe and ensure dam stability, as designed. The manifolds are collecting and routing water to the Ground Water Interception Trench where intended. Overall the toe drains are functioning as designed and protecting human health and the environment.

### 5.1.7.3 Water Quality Trends

Monthly water quality samples are collected in the MWB at three stations, MWB-1 (farthest upstream station), MWB-2 (just above the SS-5 discharge point), and MWB-3 (immediately below the SS-5 discharge). Flow data are not collected at these stations (although USGS station 12323750 Silver Bow Creek at Warm Springs is located in the vicinity of MWB-3), therefore, it was not possible to do a loading analysis on the MWB.

The water quality data were examined to determine the possible effects that the Warm Springs Ponds system may be having on the MWB, either through direct discharge or through groundwater inflow. Some comparisons are made to performance standards to aid with the data analysis and discussion; however, the UAO does not mandate that the MWB be in compliance with these performance standards. Specifically, arsenic, copper, zinc, and hardness data were examined.

Hardness data for the three stations is presented in Figure 5-28. The hardness data are interesting because the hardness in MWB approximately doubles from upstream to downstream (MWB-1 to MWB-2). Within this stream reach, there are no point source discharges, indicating inflow of groundwater with a high hardness. Surface water at the base of the nearby Opportunity Ponds typically has hardness levels well in excess of 1,000 mg/L; therefore, even a small inflow of this groundwater could impact the hardness in the MWB. The seasonal decrease in hardness is clearly seen during spring runoff. Downstream of the SS-5 discharge from the WSP, hardness levels decrease, indicating that the WSP effluent is diluting the hardness of the water in the MWB.

Arsenic concentrations within the MWB are graphed in Figure 5-29. Arsenic shows the same seasonal oscillation as observed in the WSP monitoring data. The peak concentrations are similar to those observed in the WSP (often near 0.040 to 0.050 mg/L). Arsenic concentrations exceed the 0.020 mg/L performance standard about 45 to 50 percent of the time, similar to the Warm Springs Ponds. This adds weight to the explanation for the arsenic exceedances presented previously, that the exceedances are caused by natural biological processes during warm periods. Additionally, a comparison of MWB-2 and MWB-3 concentrations shows that the effluent from SS-5 typically has a dilution effect on arsenic concentrations in the MWB, except towards the end of the seasonal arsenic exceedances. It appears that the arsenic exceedance oscillation lasts slightly longer in the WSP than in the MWB and that this can lead to a short period of time where arsenic concentrations increase in the MWB as a result of effluent from the WSP.

Copper and zinc concentration data are shown in Figures 5-30 and 5-31. After about 2000, it appears that effluent copper and zinc from the WSP did not typically have a large impact on concentrations in the MWB, and sometimes had a dilution effect in the MWB. Notably, copper concentrations in the MWB showed frequent exceedances of chronic water quality criteria upstream of the WSP effluent. The only zinc exceedances in the MWB were measured upstream at MWB-1 (the large concentration peak of 0.143 mg/L at MWB-3 in August 2001 was not an exceedance).

A comparison of MWB-1 and MWB-2 concentrations was conducted to determine whether or not the unmanifolded toe drains paralleling the MWB were having a measurable impact on water quality in the MWB. Because discharge is not measured at these two stations, a comparison between upstream and downstream loads could not be performed. There does not appear to be a significant change in contaminant water quality from upstream to downstream; however, resolution is limiting in the available data to quantify the extent of any water quality impacts from the unmanifolded toe drains. Because there is little change in contaminant concentrations from upstream to downstream, and because contaminant concentrations in the toe drains are typically low, it is likely any loading contribution from the toe drains is insignificant.

### 5.1.8 Inactive Area Performance Evaluation

The Inactive Area is not directly involved in the treatment of flows entering the Warm Springs Ponds from Silver Bow Creek, as are Ponds 2 and 3. Although some additional treatment of surface water occurs in the wet-closures of the Inactive Area, it is a relatively small volume and the additional treatment benefits only the wet-closure cells. The principal functions of constructed features within the Inactive Area are to prevent migration of contaminated groundwater. Briefly, the constructed features include raised, reinforced and armored berms; toe ditches; manifolded toe drains; the interception trench and pump-back system; and wet- and dry-closure cells (Figure 5-58).

The 1993 unilateral administrative order (UAO) specifies that the performance standards for groundwater are defined as the maximum contaminant levels (MCL) and non-zero MCL goals for contaminants of concern, as promulgated by the Federal Safe Drinking Water Act and the Montana Public Water Supplies Act. The performance standards for the contaminants of concern in groundwater at the Warm Springs Ponds are as follows:

| | |
|---|---|
| Arsenic | 0.050 mg/l |
| Cadmium | 0.010 mg/l |
| Chromium | 0.050 mg/l |
| Lead | 0.050 mg/l |
| Mercury | 0.002 mg/l |
| Nitrate (N) | 10.0 mg/l |

Both the time and point of compliance for these performance standards are influenced by the temporary groundwater interception and pump-back system. During the time that the pump-back system is operational, intercepted water is pumped from the interception trench to the east side of Pond 2 via a 32-inch pipe that is 7,600 feet long. When the pump-back system is operational, the point of compliance for groundwater is the north, or down-gradient side of the interception trench. Piezometers P-02, P-04, P-06 and P-08 are the measurement points of compliance when the pump-back system is operational (Figure 5-58).

When it is demonstrated that all groundwater performance standards have been consistently met at all monitoring wells, both up-gradient and down-gradient of the interception trench, for a period of at least 24 consecutive months, EPA may determine that the pump-back system is no longer needed. If such an action is carried out and it is determined following analysis of the data that migration of groundwater is adversely affecting the lower MWB or the Clark Fork River, then EPA will require that operation of the pump-back system be resumed.

At such time as the pump-back system is deemed by EPA to be no longer needed, the points of compliance for groundwater will shift to the south, or up-gradient side of the interception trench. Piezometers P-01, P-03, P-05, P-07 and P-09 are the measurement points of compliance when the pump-back system is not operational (Figure 5-58).

#### 5.1.8.1 Interception Trench

The interception trench receives groundwater flow from the upper sand and gravel aquifer beneath Pond 1 and surface water flow from Pond 1 and the lower wet closures, the manifolded toe drains, and the Pond 1 and the Pond 2 toe ditches. The eastern-most part of the interception trench is excavated deeper to form a sump for the pump-back system inlet. The interception trench together with the Pond 1 and Pond 2 toe ditches were designed to prevent off-site migration of groundwater that may have constituent concentrations exceeding performance standards.

***Groundwater Quality***

The UAO specifically identifies the groundwater standards that must be met by groundwater that flows off-site toward the MWB, and eventually enters the Clark Fork River. While the interception trench and pump-back system are operating, the standards must be met immediately north (down-gradient) of the interception trench. For a 24-month period prior to shutting down the interception trench and pump-back system, and thereafter, these standards must be met immediately south (up-gradient) of the interception trench. A series of piezometers were installed up-gradient and down-gradient of the Interception trench to evaluate compliance with these standards. These piezometers are shown on Figure 5-58. Groundwater samples were collected semi-annually over the evaluation period (1998 – 2004) to obtain groundwater quality data for measuring compliance at the interception trench.

The UAO also requires that hydraulic gradients be maintained toward the interception trench to ensure all affected groundwater that potentially exceeds performance standards is collected and routed via the pump-back system to Pond 2 for treatment. Groundwater elevation data were not available to CDM at the time this Draft report was prepared and, therefore, hydraulic gradients near the interception trench were not assessed. Piezometer P-14 is located in the south west corner of the Pond 1 dry closure area. Historically, groundwater flow in this area does not report to the interception trench. To insure that groundwater exceeding performance standards was not escaping the Warm Springs Ponds system, groundwater quality in P-14 was also measured semi-annually over the evaluation period and is reported herein.

The pump-back system was operated nearly continuously throughout the evaluation period (the system was shut down for 29 consecutive days in December 2001 - see Section 5.8.4). Therefore, piezometers on the down-gradient (north) side of the interception trench (P-02, P-04, P-06, and P-08) and Piezometer P-14 [since there is not a documented gradient from this piezometer to the interception trench]), represent the points of compliance for the entire evaluation period. All individual measurements from all down-gradient piezometers, and for Piezometer P-14, during this period were below the groundwater performance standards with the exception of one cadmium measurement in Piezometer P-02 in December 2001, with a concentration of 0.0136 mg/L. Not coincidentally, the cadmium exceedance coincided with the shut-down of the pump-back system. Individual sample results from the down-gradient piezometers and for Piezometer P-14 over the evaluation period are shown on Figures 5-32 through 5-43.

All measurements for all constituents in the up-gradient piezometers (P-01, P-03, P-05, P-07, and P-09), located south of interception trench, complied with the performance standards during the period with the exception of arsenic in P-03. The arsenic concentration in Piezometer P-03 exceeded the performance standard for arsenic (0.050 mg/L) in June 2003 and June 2004, with concentrations of 0.062 and 0.065 mg/L, respectively. Individual sample results from the up-gradient piezometers over the evaluation period are shown on Figures 5-44 through 5-49.

#### 5.1.8.2 Manifold Toe Drains and Toe Ditches

For the approximate length of the north-south Pond 2 dike, flows from the toe drains between Stations 165 and 193 are collected in the toe drain manifold (Figure 5-27). The Pond 2 toe ditch is located at the toe of the western portion of the dam separating Pond 2 and Pond 1 (Figure 5-32). The purpose of this ditch is to intercept seepage originating in Pond 2, thereby controlling the groundwater table throughout the western dry-closure area of Pond 1 dry closure. The toe drain manifold collects the drainage from toe drains along Pond 2 and from the Pond 2 toe ditch and the combined system discharges to the upper end of the interception trench (Figure 5-32).

Water quality samples were collected quarterly at the manifold outlet to the interception trench (Station IA-3) over the evaluation period. In general, total recoverable concentrations of cadmium, copper, lead, mercury, and zinc were all low or undetectable throughout the period (Table 5-6). Arsenic concentrations in the manifold samples have averaged 0.029 mg/L, which is generally comparable to seasonal concentrations observed at the Pond 3 (SS-3E) and Pond 2 (SS-5) discharge points and in the MWB (Figure 5-50).

Total recoverable iron concentrations in the manifold samples averaged 4.36 mg/L over the evaluation period and spiked at 21.0 mg/L in June of 2000 (Figure 5-51). Concentrations of iron were notably higher in the toe drain manifold samples than were observed in the MWB and at the Pond 3 (SS-3E) and Pond 2 (SS-5) discharge locations. Also, iron concentrations in the manifolded toe-drains were significantly higher than from the individual, non-manifolded toe drain samples. (It should be noted that total recoverable iron was measured in the manifolded toe drain samples while dissolved iron was measured in the individual, non-manifolded samples.) Dissolved iron concentrations in non-manifolded toe drains average 0.091 mg/L while total recoverable concentrations measured at the manifold discharge average 4.36 mg/L. From this comparison and visual observation of the Pond 2 toe ditch (orange precipitation layer in the bottom of the ditch), it is evident that the toe ditch is collecting iron rich seepage and groundwater flows (Atlantic Richfield 2005).

### 5.1.8.3 Pond 1 Wet Closures

At the time of remediation, Pond 1, the original settling pond in the WSP System, was no longer functional as a settling pond. The relatively small volume of water contained within and flowing through the Inactive Area was due to seepage from the up-gradient ponds, precipitation, and from local runoff. Flows are now managed by means of the pump-back system which intercepts and returns all Pond 1 outflows to Pond 2 for treatment prior to discharge to the MWB.

*System Description*

The Pond 1 Wet Closure inundates approximately 141 acres. A small diversion of flow from Pond 2 into Pond 1 maintains the wet closure. The wet closures below Pond 1 consist of three cells that inundate previously exposed tailings.

A structure between the Pond 2 outlet and the Pond 1 inlet transfers flows, typically less than 4 million gallons per day (mgd), from Pond 2 into the wet-closure area of Pond 1. In addition, inlet and outlet facilities provide flow from the Pond 1 Wet Closure to the lower wet closures. These lower wet closures are referred to as the north, middle, and south cells (Figure 5-32). The lower wet closures were initially filled by flows from Pond 1 from October through November 1995. Flow from the Pond 1 Wet Closure moves consecutively through the south cell, middle cell, and then to the north cell, before discharging to the interception trench and is returned to Pond 2 via the pump-back system.

Pond 1 and the lower wet closures also provide a significant enhancement to wetland/wildlife habitat with minimal risk to the wildlife. Willow stands within and around certain ponds also provide refuge for deer, waterfowl, and songbirds. Nest boxes and islands within certain ponds also continue to provide habitat suitable for waterfowl nesting.

*Cell Performance*

The Pond 1 Wet Closure has remained inundated during the evaluation period, achieving the RAOs for the wet closure areas. Water quality samples are collected quarterly at the north cell outlet (IA-2, Figure 5-58). Concentrations of hardness, sulfate and total recoverable iron in samples from IA-1 suggest a groundwater influence on the wet-closure flows (Table 5-7). Higher concentrations of these constituents are generally observed to be associated with groundwaters as opposed to surface waters.

As reported previously (ARCO, 1997a), several trace metals appeared to have undergone an initial period of elevated concentration immediately following filling of the wet closures. These elevated total recoverable and dissolved concentrations were very short lived. From 1998 through 2004, trace metals measured at IA-2 are relatively low when compared to Active Area concentrations. Figures 5-52, 5-53, and 5-54 show relative concentrations of cadmium, copper, and zinc in the Inactive Area wet closure cells, respectively, compared to concentrations at the Pond 3 (SS-3E) and Pond 2 (SS-5) discharges.

Arsenic and concentrations through Pond 1 and the lower wet closures do not display the same trends as the trace metals. Total recoverable concentrations of arsenic appear to be following the same pattern of seasonal fluctuation that is observed in Pond 3 and Pond 2 of the Active Area (Figure 5-55).

Figures 5-52 to 5-55 illustrate relative concentrations of total recoverable arsenic, cadmium, copper and zinc measured at the north cell discharge (IA-2). The total recoverable concentrations of other trace elements currently measured at IA-2 are generally near or less than corresponding total recoverable concentrations measured at SS-5 and SS-3E.

#### 5.1.8.4 Pump-back System

The pump-back system for the Inactive Area is designed to: 1) maintain the necessary water level elevation in the interception trench to achieve hydraulic capture of groundwater; and 2) to return flows collected from the interception trench, Pond 1 toe ditch, Pond 2 toe ditch, the soil-cement toe drain manifold, and the Inactive Area wet closures (Pond 1, south, middle and north cells to Pond 2 for treatment prior to release to the MWB. The pump-back system consists of two major elements, the pump station facilities and the pump-back pipeline (Figure 5-58).

The pump-back pipeline that discharges to Pond 2 (IA-1) was sampled quarterly over the evaluation period for water quality in accordance with the Operations and Maintenance Plan (ARCO, I995a). The water quality measured at IA-1 typically reflects the combination of flows that enter the interception trench. The quality of these flows entering the interception trench (IA-2 and IA-3) was previously discussed in Sections 5.7.2 and 5.7.3, and in summary, these constituents are generally at levels similar to Pond 2 concentrations. In addition, concentrations of hardness, sulfate, and iron are typically higher than those observed in Active Area surface waters, illustrating continued groundwater influence on the Inactive Area flows.

Pump-back flows have not been measured frequently during the 1998-2004 period. They were measured daily in 1996, when the average flow was 6.4 cfs. Current operations are not significantly different than in 1996 (the system is pumped as needed to maintain the hydraulic gradient to the trench), so current average pumping rates are most likely similar to those in 1996. Typically, pump-back flows are significantly lower than flows through the Active Area system (average flow during the evaluation period was 39 and 36 cfs, respectively, at SS-1 and SS-5). However, during low flow times of the year, the pump-back flows can account for a significant fraction of the discharge from Pond 2 to MWB (flows from SS-5 have averaged less than 6 cfs during August each year since 2001). Note that if the water was not returned to Pond 2 via the pump-back system, the water would discharge as groundwater to MWB or lower Silver Bow Creek, and therefore, in-stream flows should not be affected if the pump-back system is shut down. It does not appear that the pump-back flows have any effect on the water quality in Pond 2 (as observed at the Pond 2 discharge, SS-5). Total recoverable trace metal concentrations do not have an obvious effect on SS-5 concentrations when compared to SS-3E concentrations.

This is illustrated on Figures 5-56 and 5-57 with total recoverable copper and zinc concentrations, respectively.

The only constituents that appear to have an effect on Pond 2 water quality are hardness and sulfate. The effect is not extreme, but slight increases on average (8.4% and 24%, respectively, during the evaluation period) in these two constituents are observed from SS-3E to SS-5 (Table 5-7). These increases may not be due solely to the pump-back system since increased concentrations of hardness and sulfate are also observed in the Pond 2 wet closure discharges, as compared to concentrations at SS-3E.

As previously mentioned, the UAO requires that hydraulic gradients be maintained toward the interception trench to ensure all affected groundwater that potentially exceeds performance standards is collected and routed via the pump-back system to Pond 2 for treatment. Groundwater elevation data were not available to CDM at the time this Draft report was prepared and, therefore, hydraulic gradients near the interception trench were not assessed.

The pump-back system was shut down from December 3 through December 31, 2001 to evaluate the level to which the interception trench would recover. During this period, groundwater elevation and groundwater quality data were collected. These data were reportedly analyzed in the Draft Technical Memorandum: Groundwater Interception Trench Demonstration of Compliance (Atlantic Richfield Company, 2002), which was not available to CDM at the time this report was prepared. Atlantic Richfield (2005) reported that during the period when the pump-back system was shut down, the water quality in the interception trench, which would likely represent water quality that would be discharged to lower Silver Bow Creek, would not have a detrimental impact on surface water quality. Atlantic Richfield further reported that shutting down the pump-back system would not compromise the interception trench dike stability, although further analysis was recommended. This cannot be verified without further review of groundwater elevation and groundwater quality data collected at the time the pump-back system was shut down.

As mentioned previously, cadmium was detected in down-gradient piezometer P-02 during the period when the pump-back system was shut down (December 2001) at a concentration of 0.136 mg/L, an exceedance of the performance standard (0.010 mg/L). Cadmium levels also were elevated to 0.0041 in December 1999 and 0.0068 in June 2003 when the pump-back system was operating, but in these instances, the elevated concentrations did not exceed the standard. The source of cadmium to P-02 groundwater is uncertain, but it is surely notable that the concentration was at its highest level when the pump-back system was shut down.

#### 5.1.8.5 Dry Closures

All of the dry closure cells occur on sites that are essentially flat with little or no topographic diversity. Cell 1 is a small area (7 acres) located in the southern part of the WSP; Cell 2 is somewhat larger (19 acres) and located approximately 0.5 miles north of Cell 1; and Cell 3 is located at the north end of the WSP area and covers approximately 140 acres (Figure 5-58).

In general, the vegetation on the dry closure areas is well established; in spite of dry conditions that have been prevalent since the last detailed vegetation surveys (ARCO, 1997b). Dominance by the major perennial grass species has continued. The dry closure areas are monitored as part of the annual voluntary dam safety inspections, in accordance with Earthwork Inspection and Maintenance Procedure IMP-3 (Operations and Maintenance Plan [ARCO, 1995a]). During the 1998 through 2002 annual inspections, no reportable items (i.e., items in need of repair or items observed to be potential areas of concern) were documented. During the 2003 and 2004 inspections, some weeds were noted. Weed controls (chemical spraying) were implemented in response to these observations, and will be continued until weeds are controlled. Several weedy species were noted in this area but were present at amounts of less than 1 % of the vegetative cover.

Overall, dry closure covers are intact and vegetation success ensures stability of the covers. The dry closures are meeting the RAOs for dry closures of reducing the potential for human exposure to exposed tailings and other surface contamination.

### 5.1.9 Dam Safety

Prior to remedial actions, the dams at the WSP were determined to be unsafe. Dam safety concerns, not water quality concerns alone, initiated rapid response actions on the WSP. Dam safety aspects of the response actions required the most significant amount of construction activity and the greatest cost. These results have proven successful because the threats of failure in a flood or earthquake have been eliminated.

In addition to the routine inspection and maintenance activities identified in the Operations and Maintenance Plan (ARCO, 1995a), voluntary annual Dam Safety Inspections were conducted by the PRP (Atlantic Richfield Company) to evaluate the condition of earthwork and hydraulic facilities. The results of these inspections were documented in an annual inspection report, and any findings were brought to the attention of the site manager and operator to be addressed.

In addition to the annual inspection, once every five-years an inspection by a qualified third-party engineer is completed in accordance with the Operations and Maintenance Plan (Section 9.2.3) (ARCO, 1995a) and Montana Dam Safety Regulations. One five-year third party inspection was conducted during the period covered by this report. This inspection was conducted in 2001 by Todd Lorenzen, P.E., of Pioneer Technical Services, Inc. (AERL, December 2001). This inspection found no critical conditions or maintenance items requiring immediate attention. The inspection did document a number of erosional and other miscellaneous features that required attention; these items were subsequently addressed.

Also, the Emergency Action Plan for the Warm Springs Ponds is updated annually. This plan was updated in accordance with the requirements of the Montana Dam

Safety Regulations to reflect changes in the system and responsible personnel in the event of an emergency. Copies of the updated plan were provided to the EP A, the Montana Department of Natural Resources and Conservation, and Montana DEQ, as well as local emergency response personnel.

The dam safety inspections confirmed that the WSP facilities comply with the State of Montana Dam Safety regulations, and therefore, are protecting human health and the environment. The next third-party dam safety inspection is scheduled for 2006.

### 5.1.10 Biomonitoring Investigations

This section summarizes the results of biomonitoring investigations conducted at the WSP during the 1998 through 2004 period. Two types of biomonitoring investigations of the WSP were completed: one type within the ponds themselves and the other type for the MWB channel. The majority of the following text was taken directly from Atlantic Richfield's Five Year Review report (Atlantic Richfield 2005).

#### 5.1.10.1 Warm Springs Ponds Biomonitoring Investigations

This section summarizes the results from 7 years (1995-2000, and 2003) of biomonitoring at the WSP. The scope and methods used during this extensive sampling and analysis effort over this period of time were based upon the final 1995 Biomonitoring Work Plan for the Warm Springs Ponds (Work Plan) (ARCO, 1995b), 1996 Work Plan Addendum-Biomonitoring Work Plan for the Warm Springs Ponds (1996 Work Plan Addendum) (ARCO, 1996a), the Warm Springs Ponds / Mill-Willow Bypass 1997 Biomonitoring Work Plan Addendum (1997 Work Plan Addendum) (ARCO, 1997c), the Warm Springs Ponds 1998 Biomonitoring Work Plan Addendum (1998 Work Plan Addendum, AERL, 1998a), and the WSP Biomonitoring 1999, 2000a, and 2003 Scopes of Work (1999 SOW; AERL, 1999, AERL, 2000a; Atlantic Richfield Company, 2003) developed in cooperation among the EPA, the U.S. Fish and Wildlife Service (USFWS), and Atlantic Richfield, as a direct result of the RODs for the Active and Inactive OUs of WSP. Since certain aspects of the selected RAs are interim actions, in that metals-contaminated mine wastes will be isolated (in some cases treated) and left on-site, the EP A has determined that long-term monitoring of biological communities was necessary.

The objectives of the long-term biomonitoring program, as provided by the EP A in the Final Draft Biomonitoring Plan, Warm Springs Ponds Operable Unit (EPA, December 1994) included:

- Monitor diversity and abundance in selected biological communities.
- Directly measure the potential toxicity of the submerged sediments using standard toxicity tests.
- Directly measure metals concentrations in water and sediments.
- Directly measure metals concentrations in selected plant and animal tissues to evaluate exposure and metals bioavailability.



CDM

- A multi-year sampling program was originally established because potential effects may manifest themselves over an extended period of time, and to discriminate between normal year-to-year variations in assessing meaningful long-term trends. The WSP biomonitoring results can be used to provide an extensive database to support future decisions regarding the effectiveness of the WSP remedy. The number of sampling sites and types of samples that took place since 1998 decreased slightly, while still providing the necessary data for continued monitoring of metals bioavailability within the WSP system. The specific sampling that took place each sampling year is discussed in brief below or can be found in the respective reports (ARCO, 1996b, 1997b, AERL, 1999; AERL, 2000b, 2000c, 2001; and Atlantic Richfield Company, 2004).

The compilation and comparisons (both within a given year and among all years) of these annual data sets will characterize and evaluate the status of the WSP System biological communities. In certain areas, where expected equilibrium (mature) conditions have been achieved, few, if any, changes among the measured parameters are expected over the long term, other than those associated with natural biological variability.

The original biomonitoring study measurement endpoints selected at the WSP included:

- Metal concentrations in water and sediments
- Toxicity of sediments
- Tissue metal concentrations of key receptors (benthic macroinvertebrates, pelagic macroinvertebrates, aquatic macrophytes, bottom fish, forage fish, and waterfowl)
- Benthic macroinvertebrate and zooplankton abundance and diversity
- Macrophyte abundance and diversity
- Waterfowl abundance and diversity

With the exception of fish tissue, waterfowl liver samples, and vegetation surveys, all field collections required within a given area were collected from common sampling locations as specified in the 1995 Work Plan (ARCO, 1995b). Sampling locations were marked in 1995 with floating buoys or permanent stakes so that these locations could be resampled in subsequent years. In addition, Global Positioning System (GPS) readings were taken at each marker and at the ends of each vegetative survey transect to ensure location consistency with future sampling events. Sites were re-marked as needed depending on the condition of the buoy, which was evaluated during each sampling event.

***Methods.*** Measurements from 1995 - 1998 were made at a total of nine sampling sites representing different types of wetland treatment areas (i.e., active areas versus wet closure cells) and a range of wetland maturity levels. The five original main sampling sites, in which all sample types were collected, consisted of P3WH, P2-WWC, P2-NW, and PI-MWC. The four remaining ancillary sites, P3-N, P2-S, PI-WA, and P 1- WAN, had varying levels of samples collected at each for comparisons. Sampling at all nine sites was consistent through the 1998 sampling event. In 1999 and 2000, the number of sampling sites was reduced to four sites: P3-WH, P2-WWC, P2-NW, and Pl-MWC. In 2003, only three sites (P3-WH, P2-WWC and PI-MWC) were sampled. Sampling locations are summarized in Table 5-8.

Original sample types collected at each site are presented in Table 5-9. The type of samples collected from each site was consistent through 1998 after some slight method changes from 1995 to 1996. The types of samples were altered after 1998 to focus on key receptors. The metals of interest at the WSP include arsenic, cadmium, copper, lead, and zinc. Mercury analysis was included in 1995 but was subsequently excluded in 1996 because of extremely low levels measured in different media the first year of sampling.

In 1999 and 2000, sampling changes consisted of no aqueous metals concentrations, tissue metals concentrations for only benthic macroinvertebrates, and abundance and diversity measures for benthic macroinvertebrates and waterfowl. The 2003 SOW (Atlantic Richfield Company, 2003) was similar to the 2000 Work Plan (AERL, 2000a), except the analysis of in-situ pore water metals concentrations and one site (P2-NW) were excluded.

***Results and Discussion.*** Results of individual sampling events are reported in the respective biomonitoring reports. The information presented below attempts to briefly summarize the overall trends and comparisons of seven years worth of data collected in the Warm Springs Ponds system.

***Surface Water.*** In general, water quality measured as grab samples during each sampling event (e.g., hardness, alkalinity, pH, conductivity and dissolved oxygen levels) indicates characteristics of productive waters. Total recoverable and dissolved metals concentrations were measured at each of the 5 main sites through 1998. For some metals (e.g., copper and zinc) the dissolved surface water metals concentrations were less than the total recoverable concentrations by a factor of approximately 2. However, total recoverable and dissolved arsenic values were similar. Aqueous metals analysis was discontinued after the 1998 sampling event.

***Sediments.*** While there were some differences in sediment metals concentrations among sampling years (1995 - 2000, 2003), bulk sediment metals concentrations showed no strong temporal trends. Concentrations varied for each site and each metal. It is more probable that differences in sediment metal concentrations among sampling years represent spatial variability within the individual ponds, as these were single composited samples. While there were no real trends in sediment metals concentrations over time, there has been a noticeable decrease in sediment toxicity from 1995 to 1998, after which toxicity increased slightly in 1999. Sediment toxicity has generally decreased in 2000 and 2003 from values observed in 1999.

While there were some significant correlations from time to time, bulk sediment metals concentrations did not consistently explain amphipod survival in laboratory sediment tests when data from all years were combined. If bulk metal concentrations were the primary factor for determining toxicity, then a dose:response relationship should be observed with amphipod mortality. Overall, amphipod toxicity was independent of bulk sediment levels. The role of other factors, such as the difference in simultaneously extracted metals (SEM) and acid volatile sulfide (SEM-AVS) values, pore water metals and ammonia (since 1999) concentrations were evaluated to determine if they were more important in explaining amphipod toxicity.

Using the equilibrium partitioning (EqP) theory (Ankley et al., 1996; or see one of the WSP reports), SEM-AVS values were compared with sediment toxicity. While this approach is used to predict the lack of toxicity, mortality (i.e., less than or equal to 24 percent) was still observed at 2 sites sampled in 1995,4 sites sampled in 1996, and 1 sampled in 2003 when toxicity would not be expected due to metals (i.e., SEM-AVS < 0). According to the EqP theory, metals could not have caused the resulting toxicity because they would be bound to excess sulfides. Therefore, factors other than divalent metals (e.g., ammonia) were likely responsible for the observed amphipod mortality.

While excess SEM concentrations do not necessarily predict sediment toxicity (i.e., sulfides are not binding metals but other phases could be complexing metals), the majority of WSP sites with SEM > 0 were toxic.

Amphipod response was then compared to sediment pore water metal concentrations normalized as interstitial water criteria toxic units (IWCTUs). The IWCTUs take into account the hardness-adjusted A WQC for each individual metal. No toxicity should be expected below a value of 1.0 IWCTU (at 1.0 IWCTU all metals would be at their respective chronic A WQC). Alternatively, IWCTU values> 1.0 mayor may not cause toxicity (i.e., IWCTU is a better predictor of non-toxicity than actual toxicity levels), as other factors could mitigate toxicity (e.g., dissolved organic carbon). Compared to bulk metal concentrations and SEM-A VS values, IWCTU was a better model for explaining the observed amphipod response to WSP sediments. Individual IWCTU values were not comprised of a single dominant metal, although copper and arsenic were typically the highest.

As the EqP approach identified toxic sediments that were not explained by metals concentrations, ammonia was evaluated as a potential source of sediment toxicity. Combining data collected since 1999, there is a significant relationship between sediment toxicity and total pore water ammonia concentrations compared with either bulk sediment metals concentrations or pore water metals concentrations. While it cannot be definitively stated that ammonia was the toxicant in these sediments because the toxicity is dependent on temperature and pH and there are no directly comparable studies, it appears to be a strong candidate.

***Benthic Macroinvertebrate Tissue Residues.*** There were no significant temporal relationships in all BMI tissue metals residues at any of the three sites. However, there appeared to be some slight increases from 1999 to 2003 for arsenic, copper, and lead at

P3- WH. The lowest historical tissue residues (arsenic milligrams per kilogram [mg/kg] wet weight) measured since the initiation of biomonitoring was taken in 2003 for three metals at P1-MWC (arsenic, cadmium, and zinc) and P2-WWC (cadmium, copper, and zinc). However, there were two metals at P3-WH (arsenic and copper) that were the maximum concentrations measured historically at this site, although these values are only slightly above the previous highest values observed at this site.

Potential factors that can confound the results in tissue residue concentrations are differences in species composition that can change spatially and temporally.

***Benthic Macroinvertebrate (BMI) Community Analysis.*** In general, benthic macroinvertebrate abundance has been similar among sampling years or has increased since 1995. For example, in 2003 densities at P3-WH and P1-MWC were among the highest values measured historically, 12,657 and 1,509 per square meter, respectively. (Densities were among the highest observed at these sites even though tissue metal residues were also among the highest observed at these locations.) BMI density at P2-WWC has appeared to decrease since 1997 to levels observed in 1996 (2,444 per square meter). Hyalella azteca densities in 2003 at all 3 sites were typically on the low end of numbers observed in past sampling efforts. Species richness measured in 2003 was similar to values measured previously, although there was a significant increase at P1-MWC ($r^2$= 0.659). Density and diversity measurements did not appear to be strongly affected by the chemistry of the sediment samples analyzed or tissue metal residues. In some cases, low invertebrate densities corresponded with areas of high metals bioavailability and the observance of high laboratory toxicity; in others, such relationships were not apparent. Numerous chemical, physical, and ecological factors are controlling the benthic invertebrate community within the WSP System, and may be masking correlations to sediment metals concentrations.

***Avian Population Estimates.*** Bird population densities assessed as part of the biomonitoring program (i.e., all huntable species excluding coots, grebes or shorebirds) suggest that the ponds support a highly abundant and diverse community, especially evident by the sheer number of waterfowl observed. Populations have been fairly consistent over time, with 2003 numbers comparable to those measured in previous years. In addition to the huntable species, the ponds are widely used for nesting by raptors. For example, MDFWP personnel observed in 2003 that four Osprey chicks fledged from the Osprey nests within the WSP System. The Bald Eagle nest at the Great Blue Heron Rookery fledged two eaglets.

Habitat within the WSP appears to be highly suitable for a diverse assemblage of wildlife species. The WSP provide highly abundant invertebrate populations for food, a diverse macrophyte community for food, cover, and nesting, and a number of other man-made amenities that should increase wildlife utilization and success.

***Correlation of Measured Endpoints and Pond Maturity Status.*** In general, older ponds have been associated with lower tissue metals concentrations in benthos, higher sediment AVS concentrations, and lower SEM-A VS values. While there were similar trends among sampling years, most matrices indicated that metals bioavailability was reduced among the more mature sampling locations compared to more recently flooded wetlands. These findings suggest that, as recently flooded locations within the WSP System age and mature, and as sediment AVS and Total Organic Carbon (TOC) concentrations increase, metals should become less bioavailable and metals residues should decrease. A good indication of this is the decreasing trend in sediment toxicity (i.e., amphipod survival overall has increased) since 1995.

Fluctuations among the various parameters are also likely dependent on non-metals related factors. For example, pond depth, sediment particle size distributions, water temperature, and the presence/absence of insectivorous fish are likely contributing to the regulation of invertebrate populations.

***Summary.*** The results of chemical and biological sampling at the WSP demonstrate that complex interactions are operating to control metals concentrations and organism distributions within the OU. Locations bearing maximum sediment metals were not necessarily areas indicating elevated tissue metals concentrations or decreased invertebrate abundance, although analyses indicate metals exposure within the WSP System.

### 5.1.10.2 Mill-Willow Bypass Biomonitoring Investigations

During the report period (1998 through 2004), a number of biomonitoring investigations were conducted of the MWB. These include the 1997-1998 Mill Willow Bypass Biomonitoring Report Addendum (R2 Resource Consultants, February 2000); the Fall Spawning Survey, Upper Clark Fork River, 1999 Data Report (R2 Resource Consultants, December 1999); the Assessment of Trout Population Dynamics and Spawning Use of the Mill-Willow Bypass, Year 2000 Biomonitoring Report (R2 Resource Consultants, June 2001); the Fall Spawning Survey, Upper Clark Fork River, 2001 Data Report (R2 Resource Consultants, January 2002); and the Macroinverebrate-Based Rapid Bioassessment: Mill-Willow Bypass (McGuire, D., April 1, 2003).

The 1998 Addendum (R2 Resource Consultants, February 2000) concluded that riparian vegetation was generally high. In the middle and upper reaches, bank top total vegetation cover was 75% to 100%, with most cover herbaceous vegetation. The lower reaches had somewhat less cover, which may be due to trampling impacts from fisherman, as this reach received a lot of fishing pressure. Shrubs were present in the bank top areas, and almost all shrubs were willows. Shrubs were heavily browsed. Along the bank slopes, plant cover was moderate in 1998. Some subreaches had high (75% to 100%) cover, but most were in the moderate (26% to 75% category). Some invasive weed species were present (primarily Canada thistle) in 1998, but an on-going weed control program was (and still is) in-place to control the spread of weeds at the WSP.

The 1998 Addendum also included invertebrate surveys, which indicated the "presence of a diverse and abundant invertebrate community throughout the Mill-Willow Bypass project site" (R2 Resource Consultants, February 2000, p. 21). The results indicated a continuing improvement in conditions throughout the channel. The results indicated no impairment from metals in the upper three (of four) sites and slight impairment due to metals at the lower site.

Spawning surveys were conducted annually in the MWB through 2001, with the summary of results reported in the 2001 fall spawning survey report (R2 Resource Consultants, January 2002). The surveys showed a continuous improving trend in redd densities in the MWB, from less than 3 redds per 1,000 feet of stream prior to 1999 to 12.9 per 1,000 feet of stream in 2001.

The redd densities from 1998 through 2001 compared very favorably with other tributaries in the basin. It is likely that the fish observed in MWB in 2001 were the second generation of adult fish that spawned in the MWB during 1995, its first year after reconstruction (R2 Resource Consultants, January 2002).

During 2000, in addition to the spawning surveys summarized above, fish population and water quality studies were completed in the MWB (R2 Resource Consultants, June 2001). The 2000 investigation was the first quantitative fish study since the channel reconstruction was completed in 1995. R2 concluded that the 2000 study showed that the MWB was continuing to mature and develop as a functioning ecosystem, and "that healthy and self-sustaining salmonid populations of brown trout and mountain whitefish have developed in the MWB" (R2 Resource Consultants, May 2001, p. 5-1). All age and size classes of trout were captured, indicating that successful reproduction is occurring, an observation that was substantiated by the even-greater redd density documented in the 2001 fall spawning survey.

Basin-wide studies of macroinvertebrates have been conducted basin-wide since 1986 for the DEQ. This study has a station on the MWB, which was sampled 3 times during the report period (1999, 2000, and 2001). Each year, it was concluded that the MWB station was unimpaired based on biointegrity scores greater than 90% (McGuire, 2002 [Clark Fork River Macroinvertebrate Community Biointegrity: 2001 Assessments, Draft]). These studies corroborate R2's findings.

## 5.2 Evaluation of Rocker OU

### 5.2.1 Previous Statement on Protectiveness

From the first five-year review in 2000, the following statement was made regarding the protectiveness of the Rocker remedy:

> *The Rocker OU cleanup is nearly complete. Some operation and maintenance activities, including monitoring, began in November 1997, and EPA is discussing a more complete operation and maintenance plan with the responsible party. Most remedial objectives have been attained, such as reduction in plume concentrations and protection of uncontaminated aquifers. EPA will continue to monitor the site, and may invoke additional work or contingency measures to meet cleanup standards in groundwater and insure that the plume does not migrate. EPA certifies that the remedy for this operable unit remains protective of human health and the environment*

*because of the presence of the alternative water supply and the institutional controls which prevent contaminated groundwater use. However, continued monitoring, further institutional control implementation, and aggressive operation and maintenance activities are required.*

### 5.2.2 Follow-Up Actions Since Last Review

Soils and groundwater at the Rocker OU were remediated in 1997, yet arsenic concentrations in groundwater rebounded to above 10,000 µg/l in certain wells, such as RH 62 and RH 65 below the repository. At the time the Consent Decree was prepared in fall of 2000, it was known that construction activities in the adjacent Streamside Tailings OU could impact groundwater conditions at the Rocker OU and would change the location, elevation, and gradient of Silver Bow Creek in the area of the Rocker OU. These construction activities and the rebound in arsenic concentrations at the Rocker site prompted the development of a supplemental treatment plan to be implemented prior to and contemporaneous with SST OU construction activities adjacent to the Rocker OU. The July 2000 *Streamside Tailings Operable Unit Construction – Treatment Sampling and Analysis Plan* contained in Appendix G of the Consent Decree described a two-phase strategy to determine groundwater hydraulic parameters and develop an in situ zone to reduce arsenic concentrations. The objectives of the supplemental treatment were to

- Implement supplemental treatment in coordination with SST OU construction activities
- Reduce dissolved arsenic concentrations at interior well locations, primarily wells RH-62 and RH-65
- By means of a tracer test, determine groundwater flow velocity, flow direction, reagent mixing, and oxidant consumption
- Analyze the results of monitoring to determine the effects of reagent delivery

Nine delivery ports in two arrays were installed in September 2001 for the introduction of reagents into the gravel zone. Each delivery port was constructed using 2-inch diameter PVC casing with 5-foot perforated well screen. Injection of reagents was made by ½ -inch PVC pipe, with the bottom four feet slotted, inserted into each delivery port to distribute reagent amendments throughout the water column. In late September through early November 2001, alternating deliveries of potassium permanganate and ferrous sulfate, at approximately seven day intervals, until four deliveries of each reagent had been performed. Weekly sampling to assess the results of reagent delivery was conducted until February 2002.

Arsenic levels in well RH-62 temporarily declined from 17,800 µg/l before treatments to as low 3,060 µg/l. The arsenic concentration in RH-65 dropped to 3,090 µg/l (from a pretreatment concentration of 7,490 µg/l). There were broad fluctuations in the arsenic concentrations in wells RH-62 and RH-65, but overall, concentrations appeared to decline during the course of the supplemental treatment. However, drawing firm conclusions regarding the efficacy of the treatments was made more difficult by the temporary alteration of groundwater flow patterns and elevation changes at the Rocker site induced by dewatering actions during SST OU construction activities. Because of this uncertainty, Atlantic Richfield, EPA, and DEQ jointly agreed to re-implement the treatment plan in 2002. The 2002 treatment work was completed in three parts beginning in August and ending in December 2002. Re-treatment data indicated that arsenic concentrations were temporarily reduced by more than 50 percent in both wells RH-62 and RH-65 as a consequence of the delivered reagents.

### 5.2.3 Operations and Maintenance Activities

Quarterly groundwater sampling has been conducted since 1998 to monitor trends in water quality. Four quarterly groundwater sampling events are conducted each year in February, May, August, and November. The specific details of each sampling event are provided in quarterly reports submitted after each event. Each report presents all the data collected during that event, including field notes and field data sheets. In addition, an annual qualitative monitoring inspection and evaluation of general site conditions is conducted at the site. The result of O&M activities are summarized in Annual Operations and Maintenance Reports. A summary of the O&M costs at the Rocker OU for the last five years is provided in Table 5-10.

Since the last five-year review, the water quality in the treatment zone appears to have reached equilibrium with the hydrology and geochemistry of the site, and the effect of the supplemental dosing operations was short-lived. This equilibration has resulted in a rebound in arsenic concentrations above 10,000 µg/l in the gravel zone below the repository. The source of the arsenic appears to be arsenic-containing groundwater immediately underlying the gravel. There is no evidence to suggest that source of arsenic is the gravel zone itself or the stabilized soil mass overlying the gravel zone. Groundwater data from the gravel zone and other surrounding monitor wells indicates minimal expansion of the arsenic plume since completion of the remedial action.

# Section 6 Five-Year Review Process

## 6.1 Administrative Components

The Silver Bow Creek / Butte Area five year review team was lead by Scott Brown, an EPA project manager, and included EPA and state of Montana project managers of the OUs covered in this review, and technical staff from EPA's contractor CDM with expertise in areas of geology, civil and environmental engineering, and community involvement.

The review was initiated in May 2005 and included the following components:

- Community involvement
- Local interviews
- Document review
- Data review
- Site Inspection
- Five year review report development and review

The schedule for the review extended through August 2005.

## 6.2 Community Involvement

Activities to involve the community in the five year review process were initiated with a kick-off meeting on April 12, 2005. The project team discussed the best ways of notifying the affected communities and of obtaining input from members of the public, regulatory agencies, and other entities.

### 6.2.1 Notification

As specified in the guidance, it was agreed that CDM would place display ads in the local papers (the Montana Standard and the Anaconda Leader) (Appendix A). The content of both ads followed the guidance and was approved by EPA prior to placement. The first ad announced the start of the five-year review process and ran in the Montana Standard on May 7, 2005 and in the Anaconda Leader on May 11, 2005. The second ad will announce the completion of the five-year review process and ran in both papers in August 2005.

### 6.2.2 Obtaining Input

A number of brief interviews were planned with persons identified by the project team. As suggested in the guidance, potential interviewees included members of the general public, site neighbors, members of special interest groups, representatives of local government, and oversight personnel. CDM prepared an initial list of interviewees and questions to EPA and DEQ team members, who made revisions to the proposed list. This final list of potential interviewees included 12 individuals (Table 6-1).

The site includes a number of communities spread out over a very large area. The intent of the interviews was to gain additional perspective on the remedies under review. Due to the very small sample size, the input cannot be considered to be representative of one or more of the communities within the site. In some instances, the input identified areas issues that were potential concerns and the reviewers were made aware of the input as part of the review process. However, community input itself was not used to determine the protectiveness of the remedy.

Individuals listed in Table 6-1 were called and asked to participate in the interviews. They were sent a list of six questions via mail or email. Those questions were based on examples provided in the guidance. They were modified slightly to relate to the specific OU or OUs being discussed.

Most interviewees were asked the same basic questions.  The exception was the individual providing Bureau of Land Management construction oversight for SST OU and the individual providing regulatory input from the Fish Wildlife and Parks Department (Table 6-2).

Most people elected to provide their answers to the interviewer over the telephone. The answers were then written up by the interviewer and sent to them via email for review. Several people provided their answers in writing, either via email or direct mail. Responses were obtained from 11 individuals (Table 6-2). In addition to the input received from these individuals, a letter was received from Mr. Jim Kuipers of CFRTac.

### 6.2.3 Responses

The complete, unabridged written responses from the 12 individuals that were interviewed and from Mr. Kuipers, are provided in Appendix B. Annotated responses to the most frequently answered questions are presented below:

What is your overall impression of the project?

- The project was not a success. There are still rebound effects, and EPA did not clean up the aquifer as planned. They are still doing work, so maybe it will be cleaned up eventually – by EPA or Mother Nature (Molignoni).

- The SST OU seems to be going along as planned. The WSP OU has a few issues that concern the county. The primary concern is with long-term preservation and maintenance of Rainbow Bridge. ARCO was supposed to ensure that this historic bridge would be preserved. However, that is not occurring. It has been flooded and pieces of the concrete base are broken (Bouck).

- My overall impression is that work that has been completed has vastly improved the condition of Silver Bow Creek. Definitely the looks of the area have changed dramatically in a positive direction (Dziak).

- Reasonable progress is being made (Peoples).

- The SST OU is coming along fabulously. The new contractor is very fast, and it looks nice when they move on. EPA is also doing a good job in Rocker, and we are hoping that the ROD for the Butte Hill will also be successful (Kerns).

- The work done to date is wonderful. Total removal of the mine wastes from the streamside was more than what was needed, but is very positive. The streamside looks better than the natural environment nearby. The WSP are doing their job, and the Mill Willow Bypass is great – especially the meanders. I am generally very happy with the cleanup (Ueland).

- The Greenway Service District has been closely involved with remedial activities along Silver Bow Creek as efforts to coordinate remediation with habitat restoration along the Silver Bow Creek Corridor. We believe remediation goals and objectives are being met. DEQ has demonstrated the ability to respond to our restoration objectives to improve the character and the quality of the corridor. Their remediation strategies have adapted to varying conditions within the corridor to achieve remediation and restoration goals, including the removal of additional tailings in areas where tailings were slated to have remained for "in situ" treatment (Skrukrud).

- Superfund projects take way too long to complete, and EPA does not put enough emphasis on public involvement. At SSTOU, remediation seems to be proceeding as planned although there are unresolved issues with long-term O&M and stewardship of the reclamation. DEQ appears to think it is premature to commit to a level of O&M&M, especially in relation to the Greenway, but that is a vital part of remediation success. At the MFOU, the public felt their concerns and input were not attended to during the ROD process. It was a disappointment that innovative treatment technologies were not fast tracked as part of the process selected (Sesso).

- The project is going well and has been a success. The design is done in stages from upstream to downstream and is evolving as new information is obtained during construction. The vegetation along the streambank is excellent. The vegetation on the floodplain is very good with the exception of several small areas where I believe the soil has conductivity levels that prevent vegetation from growing (Brockman).

- The parts of the project I have seen (SST OU and WSP OU) seem to be well-planned and, given all the glitches that are inevitable on big undertakings, seem to be progressing pretty well. Visually, portions of the SST OU and the bypass at WSP OU give the impression that things are on the mend (Benson).

What effect have site activities had on the surrounding community or local government?

- There were not too many effects. EPA was in and out pretty quickly. The most visible and lasting effect is the grassy mound where the contaminated soils are stored. It doesn't look natural and sticks out. It just looks like a Superfund site (Molignoni).

- There are occasional problems with chain of command. For instance, DEQ located a haul road that splits a county road (Stewart Street crossing) without going through channels. (A letter from DEQ responding to this concern is included in Appendix B.) Also, with the recent concerns about the spread of West Nile Virus across the state, the county is worried about having breeding areas for mosquitoes and the borrow pits have large areas of standing, stagnant water in them (Bouck).

- There have been many aesthetic improvements. Recreational opportunities have been increased by the addition of numerous walking trails. With the cooperation of the agencies and Atlantic Richfield, MERDI has been instrumental in the redevelopment of over 30 acres of Brownfield area (BPSOU). This includes a sports complex and has had many aesthetic and economic benefits for the community (Peoples).

- The effects have been positive. Many mine waste areas have been turned into green spaces, and it has greatly improved the aesthetics in the area. Additionally, the health risks have been greatly decreased to EPA's work (Kerns).

- The major impact has been a temporary influx of money into the community from jobs and expenses associated with the construction work. Not aware of any negative impacts (Ueland).

- I believe site operations have had a positive effect. The ongoing activities are tangible and the outcome, the new stream corridor and healthy vegetative cover, represent a new beginning for the stream corridor that is apparent to anyone who visits or sees the corridor. I am unaware of any adverse effects on the community – every effort is made to work with property owners and adjoining landowners to cause as little disruption in day-to-day activity for the community (Skrukrud).

- Involvement in Superfund has been a burden for BSB. Existing resources were not sufficient to take on the tasks of reviewing documents and active participation in Superfund activities. We were fortunate to maintain staff continuity, and the burden has been made manageable by grants from the State and ARCO to hire additional personnel. BSB is doing a good job keeping up with the process. The activities at SST OU have not had an immediate impact on citizens of BSB. When remediation is complete and the Greenway is finished, the community will benefit from the added recreational benefits, but most people are not affected at this time. For the MFOU, site operations have not had a significant impact on the community. However, unresolved concerns associated with the OU have had a negative impact (Sesso).

- At WSP OU, I had heard there was some concern over traffic and dust when the ponds were being reconstructed. This is only hearsay however, as our TAG was limited to Milltown at the time (Benson).

Are you aware of any community concerns?

- The biggest concern is that people in Rocker cannot drill wells anymore because of the Institutional Controls. Because the cost of water is rising, people have to cut back on watering to stay within their household budgets. This has a negative impact on the aesthetics of the community (Molignoni).

- The primary community concerns are those with citizens of Opportunity. A number of people had used pasture owned by ARCO but leased long-term to the community. When the SST OU remediation began, they were no longer allowed to graze livestock on the land. This has been a hardship for them. A citizens group has recently been formed to deal with Superfund issues (Bouck).

- The recent controversy over attic dust (BPSOU) has somewhat polarized the community. People are also concerned that the cleanup is both protective and supportive of future redevelopment (Peoples).

- Attic dust at the Butte Hill (BPSOU) is a new concern that resulted from Imagine Butte's survey of the low-income community in that area. Interest in the MF OU seems to have died down. There is also some debate as to whether EPA should make ARCO remove the Parrott Tailings or leave them in place. I am not aware of any concerns for Rocker or SST OU (Kerns).

- Most people were not terribly concerned with contamination prior to cleanup. The area had been contaminated for over 100 years, and we just lived with it. There were no obvious health effects that people were aware of, and environmental effects seemed to be limited. Most people are aware that a cleanup has taken place, although many do not know the details. They can tell that the area looks better. Not aware of any specific community concerns – other than a desire for the economic boost to continue (Ueland).

- One concern is the uncertainty of funding and plans for long-term operations, maintenance and management of the remedy (SST OU). Sufficient funds and plans must be in place to protect and preserve the remedy in perpetuity. Community members have discussed these concerns with the agencies. The reality is that operations, maintenance and management are a reality for this site and must be readily acknowledged and planned for to ensure the health of the corridor (Skrukrud).

- For SST, there have not been a lot of community concerns. There is a feeling that public health-related concerns at other OUs have not received as much attention as did the impacts to fish in the SST OU. There is also a concern that long-term stewardship of remediation and restoration activities will not get the attention needed. For MFOU, there has been some concern about future catastrophic events, such as a large earthquake, or that the critical water level was not the most appropriate decision point.

What would happen if PRPs and EPA are gone? There are concerns about health impacts from the fog off the pit in winter and whether contaminated water in the bedrock aquifer will affect wells in the alluvial aquifer. There is disappointment that the water treatment selected did not include a resource recovery stage. There is residual anger at ARCO for shutting off the pumps in the first place. There are issues related to confusion over the reclamation obligations of the current mine operations by MR and remedial obligations by MR and Arco under Superfund (Sesso).

- Citizen's groups have asked EPA to consider possible effects of the Warm Springs Ponds operation due to likely changes in the influent water quality from improvements (nitrate reductions) in the Butte Silver Bow municipal wastewater treatment facility and due to future discharges of high hardness water from the HSB WTP.

Do you feel the remedy is protective?

- Yes, as long as they keep the Institutional Controls in place (Molignoni).
- We can't say at this time whether the remediation is protective. It needs time to age, to see how things will work out. We had no significant concerns with the proposed remedy. However, there have been some issues that lead us to question if work is being done as planned. For instance, if the Rainbow Bridge preservation is not being handled successfully, there may be other less visible issues that are also going wrong. This concern was reinforced by recent problems with cleanup at the Anaconda Smelter Site where an area that had been remediated ended up having beryllium contamination at depth that needed to be cleaned up (Bouck).
- I believe the remedy is somewhat protective, as it has removed some degree of tailings from the immediate stream banks. My concern is that much of the railroad grades that parallel the stream still contain high concentrations of heavy metals and the possible leaching of these metals back into the system. My other concern is for water quality as it comes into the system from the Butte area. This relies greatly on Butte mine flooding and the Treatment plant system when it comes on line (Dziak).
- Yes, providing they continue to monitor the wastes left in place. The underlying groundwater is contaminated – that is a given. We need to be sure that the contamination does not migrate to any other aquifers (Peoples).
- Yes. Anyone who has been to the SST OU can see that it is working. For the BPSOU, I would prefer to see the water treatment plant become part of the final remedy, rather than the lagoons that are now in place. BSB have been working hard to make sure that the community will benefit in the long run (Kerns).
- Yes. It is certainly better than it was before. Although we won't know for sure for many years, it seems to be working well. I trust that Atlantic Richfield and the regulators will keep up the monitoring and will do what is right to ensure protectiveness (Ueland).
- Remedial actions (including tailings removal, stream reconstruction and riparian, floodplain and uplands revegetation strategies) coupled with restoration enhancements

and the long-term land use strategy for the corridor to remain as open space for public benefit will be protective of the remedy. It is imperative that costs of operations, maintenance and management be acknowledged and funded (Skrukrud).

- For SST, the remedy appears to be protective. It is based primarily on threats to fish and other organisms in the water – not on a threat to human health. DEQ is making good decisions on over excavating where needed, such as at Ramsey Flats. The area is definitely in much better shape than it was before. They are also making good decisions on scheduling, by accelerating cleanup of some areas, such as the rest stop on the way to Anaconda, without compromising the quality of the cleanup. Long term O&M of the remediation and restoration will be the key to overall protectiveness of the remedy. For MFOU, BSB hopes that the remedy is protective and that the scientists who defined the hydrogeologic system are correct. There is less confidence that anyone really knows for sure if the critical water level of 5410 feet is accurate. If it is, then the remedy appears to be protective (Sesso).

- I think the jury is still out on this. For SST OU, we won't know until the work is complete, stabilization measures are in place, and vegetation has been established and grown. The real proof will be a 50-year flood event! At WSP OU, the last meeting I was at in Opportunity indicated there was still a concern over arsenic. Our technical advisor, Jim Kuipers, wrote a white paper on arsenic. If the fish biologists are correct, the liming operations at the pond are probably a contributor to the algae blooms we see all along the river in summer. But this is of course compounded by ag operations, sewers and septics, and other runoff sources of nutrients (Benson).

Do you feel informed about site progress and activities?

- Not really. It would be nice if EPA and DEQ could send out more fact sheets or get stories in the newspaper to keep people up to date. It is a complicated site and people get confused just trying to keep all the pieces separate. The fact sheet inserts in the Anaconda Leader that EPA does for the Anaconda site are helpful (Ueland).

- Yes, but BSB is directly involved in the activities, and is therefore better informed than most people in Butte. The public sees BSB staff members as an advocate for them. There is a reasonable level of trust that the people in local government are looking out for all citizens of Butte. In general, EPA does not spend the effort needed in Butte to inform and engage the citizens (Sesso).

- The DEQ has been responsive to requests for updates on the status of the project and available to the public in many forums (Skrukrud).

- Yes. EPA does a good job of keeping people aware of what is going on. It is hard to keep people's interest alive about a complicated subject over so many years. It was easier in Missoula, where they only had one issue to deal with and it was over a relatively short time frame (Kearns).

- Most of the information I receive comes from local newspaper articles or sections of the newspaper that devote a section for the work that has been done. I have attended a few meetings both public and state sanctioned. I also receive an update once in a while on the work being performed as a signed attendee of a local meeting (Dziak).

- Yes, but there needs to be more effort informing County Commissioners. DEQ should hold annual pre- and post-construction meetings with the commissioners that will bring them up to speed so that they can answer questions from the community. DEQ should also consider speaking to the community group from Opportunity (Bouck).

- I used to, but EPA has cut back on the communication over the last year or so. Even though the site is pretty quiet, people still need to be updated fairly regularly. A public meeting where we can ask questions would be a good thing at least once a year, if not more often (Molignoni).

- Yes. Because our company works in redevelopment of this area, I am better informed than the average person in Butte about the cleanup (Peoples).

- Fairly well informed.  I could do more on my own to get more info. However, I have noticed that the media have not given much coverage unless there is some unusual event like the dead birds at the pit. That is where most people get their info (Benson).

Do you have an additional comments or suggestions?

- EPA should put some additional vegetation, like trees or bushes, out on the grassy mound at Rocker to make it look more natural (Molignoni).

- We need to ensure that the long-term O&M is adequately planned, implemented, and funded. There appears to be a belief among regulators that once the remediation is complete, all land uses can be allowed. However, the area has been damaged and wastes are left in place in many areas. Community standards for how we maintain things may be higher than what would otherwise be done. We need to get on the same page in this regard. For example, we believe restoration projects are a part of the overall O&M strategy and a good way to help achieve that end. Since most remedies selected involve wastes-left-in-place, these sites will require more money at the back end of the project than typical Superfund sites. The track record for stewardship, ICs, and O&M at Superfund sites is not so good. Leaving wastes in place is likely the most practical option and can / will be protective, but we must face concerns related to maintaining these sites for future generations. Vigilance has to be maintained to weather losses that will occur when the people working on the projects turn over. EPA’s review and other monitoring processes must be substantial and have the teeth needed to ensure that remediation is being maintained as promised (Sesso).

- I have concerns with the Greenway project and the expected increase use of the area by the public. Items that need to be addressed will be trail maintenance, ORV travel, trespass and injured wildlife (Dziak).

- MERDI is concerned with two issues: there needs to be a redevelopment fund that is of sufficient size to make an impact of the community, and the O&M funding must be sufficient so that the county is not stuck with the costs for O&M in the future. Finally, the remedy must obviously be protective of human health, but it should also allow for (and support) future redevelopment of the area (Peoples).

- We need to discuss the need for a solid operations, maintenance and management plans for the corridor and receive assurances that funds will be available to implement these strategies (Skrukrud).

- The Greenway trails that were constructed as part of the floodplain were never finished by the Greenway organization. These trails are deteriorating due to vegetation encroaching on the trail. Also, the bridges planned for the trail to cross the creek were never installed. Future work on the trail and bridges could damage the good vegetation on the floodplain and creek banks. Work on the Greenway Trail should be coordinated better with work on the remedy. This would also allow for the area to be re-opened for public use (Brockman).

- Maybe getting more media coverage on how things are going at these sites, such as a field trip in connection with the 5-year review. I think also that what would be of interest to landowners along the river in the Deerlodge valley would be some information on the type, duration, and other experience of landowners along Silver Bow Creek (Benson).

What is the current state of construction?

- Reach A was essentially completed in 2000. However, the creek flow control dike and bypass channel that protected the new channel and floodplain during the grow-in period were removed in late 2004/early 2005. The regraded areas were seeded in Spring of 2005 (Brockman).

Have you encountered any problems that changed or will change the remedy?

- There were no major problems encountered. There were several minor problems that resulted in minor adjustments to the design as it progressed downstream, but these were mostly reactions to what was learned during construction (Brockman).

Have any problems impacted construction or implementability?

- No problems that impacted construction or implementability come to mind (Brockman).

Have you done any site visits, inspections, reporting, etc at the site?

- I have on a very limited basis toured sub-area 2 as construction was taking place (WSP OU). I do make a point of looking at the area as I drive by/or near while working or otherwise (Dziak).

Have there been any complaints, violations, or other incidents?

- I have received a couple of calls on “problem” beaver that inhabit some of the completed areas on Silver Bow creek. These calls have been from state personnel concerned about possible destruction of re-vegetated areas. I have also received calls regarding bridges and structures built over the stream without permits (Dziak).

## 6.3 Document Review

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

- Atlantic Richfield Company, WSP, Five-Year Review Report, 2005
- Atlantic Richfield Company, WSP, Quarterly Operations and Maintenance Report, Fourth Quarter 2004
- Bighorn Environmental, Monitoring Report 2004, SST OU, 2005
- EPA ROD for BMF OU, 1994
- EPA ROD for SST OU, 1995
- EPA Comprehensive Five-Year Review Guidance, 2001

Full reference citations are included in Attachment 2 for each document reviewed.

Applicable or relevant and appropriate requirements (ARARs) were reviewed to determine whether any changes to the ARARs has occurred since the sign of RODS or ESDs at any of the eight OUs included in this review 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 objective (RAOs) Used at the Time of the Remedy Selection Still Valid?

# Section 7 Technical Assessment

A technical assessment of the remedies for the five Silver Bow Creek/Butte Area OUs undergoing a full statutory review is performed as part of the five-year review process. This technical assessment, focusing on answers to three unique questions, is presented in this section of the five-year review.

## 7.1 Question A: Is The Remedy Functioning As Intended By The Decision Documents?

### 7.1.1 Warm Springs Ponds Active and Inactive OUs

*Remedial Action Performance*

In general, the remedial action at the WSP OUs is protective of human health and the environment. The WSP OUs are functioning as designed and effectively remove influent contaminants from Silver Bow Creek, protecting the Clark Fork River downstream. Wet and dry closures over tailings are protective of human health and the environment by preventing human exposure to surface wastes and by minimizing further oxidation and mobilization of heavy metals in the waste materials. The dams are routinely inspected for stability and have met all dam safety requirements.

The remedy is supporting a healthy, diverse, and abundant aquatic, terrestrial, and avian wildlife population, as documented by the WSP and MWB biomonitoring studies. These studies are corroborated by the benthic macroinvertebrate surveys conducted by McGuire on Lower Silver Bow Creek and the Upper Clark Fork River, which indicate continued improvement of benthic macroinvertebrates and no indications of metals impacts on the diversity or abundance of benthic macroinvertebrates.

Groundwater is being prevented from migrating offsite through use of the groundwater interception trench and the pumpback system. Exceedances in downgradient piezometers resulted from a shutdown of the pumpback system; therefore, the pumpback system will need to continue operation into the foreseeable future.

Performance standards were largely met for cadmium, iron, lead, mercury, silver, and selenium, and total suspended solids in the WSP effluent. The only exceedances of these constituents were generally attributed to the large runoff event of March 2003.

Copper and, to a lesser extent, zinc exceedances have occurred primarily during spring runoff. The final daily maximum discharge standard for copper has been met 98 percent of the time during this performance evaluation period. It is also noteworthy that the 96-hour TRV for dissolved copper has not been approached during the past ten years. The number of monthly exceedances for copper has decreased in recent years. This is likely due to better operation, performance, optimization, and maturation of the WSP system. Or, it could be because the WSP have been treating lower than normal flows and contaminant loads due to the prolonged drought. For example, exceedances occurred in spring of 2002 but the influent loads and concentrations were not exceptionally high. Special consideration should be given to operational procedures at the WSP during the spring runoff period so that treatment needs can be better anticipated during high flows. Or, other reasons for the spring exceedances need to be determined. For instance, seasonal turnover of the ponds or ice scour may be impacting the WSP performance. However, it is possible that the WSP are operating at their maximum potential given the inherent limitations of alkaline precipitation and settling technology and the physical limitation on the size of the ponds. The best method to achieve compliance will be to complete the upstream SST OU cleanup, and further control releases from the BPS OU into Silver Bow Creek.

The seasonal exceedances/concentration oscillation for arsenic is a problematic performance issue. Other waters at the site such as the Mill-Willow Bypass show similar concentration oscillations and are likely affected by similar geochemical processes for arsenic. Therefore, despite the fact that the ponds are exceeding the performance standard based on protecting human health, human health risks from arsenic should be minimal because there is no human consumption of surface water or ground water from the WSP, and there is no indication that this water is impacting downstream domestic wells. Arsenic concentrations do not exceed aquatic life criteria, and based on these levels, the discharge should be protective of aquatic receptors.

The loading analysis presented in Section 5 shows that the loads from the WSP during the period of exceedances is generally low compared to the loads from the MWB. Thus, from a basin-wide perspective, bringing arsenic concentrations into compliance will not result in a large decrease in arsenic loading to the upper Clark Fork River.

The loading analysis presented in Section 5 was a cursory analysis performed on a less than ideal dataset. The water quality at MWB-3 had to be coupled with flow data from the USGS to approximate loads. Additionally, there was not enough resolution in the data to determine whether or not seepage from the toe drains was having an impact on the MWB. In order to resolve these questions, first, it is recommended that concurrent flow measurements be made at the time of water quality sampling in the MWB. Secondly, these issues could be resolved with a supplemental loading analysis performed to determine loads along the MWB, in Silver Bow Creek below the WSP, and at the headwaters of the Clark Fork River. Understanding the relative significance of the arsenic loading from the WSP would aid decision-makers in determining whether or not additional arsenic treatment in the WSP would result in a significant benefit when other arsenic sources in the upper CFR basin are considered.

If EPA ultimately decides that arsenic issues in the WSP effluent must be addressed, this will require a separate treatment step in addition to the current treatment of lime addition and settling. The feasibility of adding an arsenic polishing treatment step to facilitate arsenic removal would need to be studied.

*System Operations/O&M*

In general, system operations and O&M activities appear to be protective of the remedy. System operations and O&M activities appear to be protective. The exception to this was the March 2003 overflow event, where upstream debris jams broke loose, resulting in clogging of the inflow trash rack and large pulse of water that overwhelmed the treatment system. In order to prevent system upsets resulting from similar situations in the future, a safety and awareness plan was developed for spring runoff and summer thunderstorm events and incorporated into the Operations and Maintenance Plan. The plan includes inspections of the inlet channel and upstream bridges and channels for debris, and plans for action to address conditions that could lead to a similar overflow event as that which occurred in March 2003. Improvements to the supervisory control and data acquisition system (SCADA) were implemented that include a real-time continuous stage recorder upgradient of the trash rack that, in addition to providing an emergency call-out for high stage conditions, can be accessed remotely so that the operator can determine the exact stage.

*Opportunities for Optimization*

As was shown in the performance evaluation in Section 5, concentrations of silver and selenium were constantly well below performance standards. It appears these parameters could be dropped from the analytical list.

*Early Indicators of Potential Issues*

There are no early indicators of additional potential issues (the major performance issues have been discussed in this report).

*Implementation of Institutional Controls and Other Measures*

There are no domestic or municipal water users that withdraw water immediately downstream of the WSP or from the shallow alluvium. There is also a ban on construction of shallow wells in the vicinity of the WSP. Therefore, these institutional controls are protective of human receptors.

### 7.1.2 Rocker OU

*Remedial Action Performance*

The remedy is functioning within the scope outlined in the ROD, as modified in the documentation of significant changes. Because EPA projected moderate difficulty in meeting the ARARs in a limited part of the groundwater system (i.e., the shallow alluvium), the RAOs were prioritized according to the actual or potential use of these groundwater zones. The prime objective is to prevent pollution from reaching the high quality lower aquifers which are currently used (Tertiary groundwater system) and that have the potential to be used (deep alluvium). Monitoring to date has documented the effectiveness of the remedy in meeting this prime objective. The soils component of the remedy continues to perform as designed.

*Remedy O&M*

Systems operation and O&M activities for the Rocker OU are consistent with site requirements and objectives. Monitoring of the plume continues on a quarterly basis, and repository cap and other site maintenance actions are implemented, as necessary, on an annual basis. Costs for system operation and O&M have been within an acceptable range.

*Early Indicators of Potential Issues*

As stated in Section 4.2.2.1 of this five-year review, two areas of arsenic contaminated soils were identified during implementation of the remedy. These materials were evacuated, treated, and stored in the on-site repository. EPA will continue to examine whether additional work is needed to address non-compliance with performance standards in the shallow, deep, or tertiary aquifers. EPA may also look at the appropriateness of a waiver of standards for the affected aquifers. Finally, EPA will examine the existing institutional controls relevant to these aquifers.

*Implementation of Institutional Controls*

The MDEQ instituted institutional controls on groundwater wells, eliminating a potential pathway for arsenic contaminated water in the shallow alluvial aquifer to enter both the deep alluvial and tertiary aquifers through well installation. This ban also controls the exposure pathway for humans from the contaminated groundwater in the shallow alluvial aquifer.

## 7.1.3 Butte Mine Flooding OU

*Remedial Action Performance*

The overall remedy as defined by the decision documents on the BMF OU is ongoing. The HSB WTP, the only portion of the remedy that is complete, is sending effluent to the MR mining operations and not discharging into Silver Bow Creek at this time.

Long term monitoring of the Berkeley Pit and all ancillary mine shafts and monitoring wells is ongoing. As stated in Section 4.3.2, modeling predicts the CWL in the Berkeley Pit will not be reached until 2020. The water levels in several monitoring wells measured in 2004 increased only 60% of the increases seen in 2003. This is a direct result of the diversion of Horseshoe Bend drainage water from the Berkeley Pit and into the HSB WTP. Berkeley Pit water quality samples were collected twice in 2004 during depth profiling of the pit. The analytical results for these samples and other water quality samples collected from monitoring wells and selected mine shafts were for the most part unchanged.

*Remedy O&M*

A performance test run on the HSB WTP in December 2003 demonstrated the ability to meet all the established interim effluent metals criteria. The final standard for cadmium was not met during the 2003 performance testing. The results of this performance test are presented below and summarized in Table 7-1. Additional performance testing is scheduled for Fall 2005 to evaluate whether the HSB WTP can meet the final cadmium standard without further modifications.

*Opportunities for Optimization*

The HSB WTP has three systems, the lime unloading, blowers and the clarifier rake systems that are presently operating at lower than specified design rates. Each of these systems is undergoing an engineering evaluation to determine the cause of this operational bottle neck. Recommended upgrades to these systems are schedule to be performed after completion of this evaluation.

*Early Indicators of Potential Issues*

There are no indications of potential equipment problems or operational problems that would put the protectiveness of the HSB WTP at risk.

*Implementation of Institutional Controls*

Institutional controls are in place restricting the use of contaminated groundwater from the BMF OU. Publications such as the PIT Watch, inform the public as to progress on the Mine Flooding OU.

### 7.1.4 Streamside Tailings OU

*Remedial Action Performance*

The removal of contaminated materials from Silver Bow Creek has resulted in major improvements in physical and ecological systems as measured in a variety of media. Vegetation has been successfully reestablished in most remediated areas where vegetation was originally sparse to non-existent. The decreases in instream sediment metals concentrations and surface water metals concentrations have created an environment in which healthier populations of macroinvertebrates and fish have established. Further improvements in aquatic biota in remediated reaches appear to be limited primarily by nutrient loading originating at the Butte POTW.

*Opportunities for Optimization*

Because the remediation and restoration implemented thus far for Silver Bow Creek has been successful as measured by most parameters, only limited recommendations are made for changes. DEQ and their consultants have made the following recommendations.

- The most important recommendation for revegetation is to plant willows in the spring to minimize mortality.
- Data collection for solid and water media should continue to follow the Comprehensive Long-Term Monitoring Plan.
- Aquatic biotic resources should continue to be monitored according to the plan. In addition to the existing battery of periphyton metrics, additional metrics may prove useful for evaluating recovery in Silver Bow Creek and will be developed in the future.

- Finally, multiple pass fish population estimates should be conducted to improve the understanding of fishery trends in Silver Bow Creek after populations have increased or multiple age groups appear.

*Early Indicators of Potential Issues*

There are no indications of potential equipment problems or operational problems that would put the protectiveness of the SST OU remedy at risk.

*Implementation of Institutional Controls*

Institutional controls developed by Deer Lodge and Anaconda governments are in place protecting the reclaimed corridor along the Silver Bow Creek Reaches (A through R), comprising the SST OU.

# 7.2 Question B: Are The Exposure Assumptions, Toxicity Data, Cleanup Levels, And RAOs Used At The Time Of The Remedy Selection Still Valid?

## 7.2.1 Warm Springs Ponds Active and Inactive OUs

***Changes in standards, newly promulgated standards, standards to be considered (TBC).***

Since EPA issued the RODs for the Warm Springs Ponds Active Area and Inactive Area OUs, both the State and Federal aquatic and human health standards have changed for several constituents of concern (Table 7-2). 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 FR 8757 [March 8, 1990]). A discussion is provided below with respect to surface water and groundwater performance standards, and each of the State and Federal standards that have been modified since the time of the ROD.

*Surface Water*

*Arsenic*

The current daily maximum and monthly average performance standard for arsenic in surface water discharge from the Warm Springs Ponds is 0.020 mg/L. This performance standard is lower than the State and Federal acute and chronic aquatic life standards, but exceeds the State human health standard for surface water (0.018 mg/L) and the federal MCL of 10 µg/L. Water quality in the discharge from the Warm Springs Ponds does not exceed current Federal and State aquatic life standards and, therefore, must be considered protective of aquatic life to downstream ecological receptors. Arsenic in discharged surface water from the ponds does exceed the current federal and state human health standards. However, the water in the upper Clark Fork River is not used directly as a drinking water source. Additionally, existing institutional controls prohibit swimming in the Warm Springs Ponds the upper Clark Fork River. Thus, there is not a pathway for human exposure to arsenic at levels that would reasonably present a health risk and the current performance standard for arsenic in surface water continues to be protective of human health.

Biological monitoring conducted between 1995 and 2003 shows no clear trends with respect to arsenic bioaccumulation in vertebrate and invertebrate species that inhabit the Warm Springs Ponds. There appears to be an upward trend in tissue arsenic residue in benthic macroinvertebrates at one of three monitoring stations within the Ponds, but other biological data indicate that complex interactions are operating to control metals concentrations and organism distributions within the Warm Springs Ponds. Locations bearing maximum sediment metals were not necessarily areas indicating elevated tissue arsenic concentrations or decreased invertebrate abundance, although analyses indicate metals exposure within the WSP System. Collection and analysis of biological data should continue at the Warm Springs Ponds to clarify the presence and significance of increasing tissue arsenic trends to benthic macroinvertebrates within the Pond system. However, the current performance standard for arsenic in surface water does not affect the performance of the remedy.

***Cadmium***

The Federal and State aquatic life acute and chronic standards for cadmium have been lowered (Table 7-2). The new acute standard is lower than the current daily maximum performance standard by a factor of approximately 2 and the chronic standard is approximately 4 times lower than the monthly average concentration. From 1998 through 2004, there were no exceedances of the existing daily maximum or monthly average performance standards for cadmium. However, the Pond 2 discharge (SS-5) exceeded the Federal chronic criterion continuous concentration (CCC – analogous to State chronic standard) in approximately 8 percent of the samples analyzed (assuming a hardness of 150 mg/L) over the evaluation period. It is believed that operation of the WSP cannot be improved to consistently meet the lower cadmium standard because the WSP are performing at their maximum ability given the inherent limitations of size (i.e., they cannot be made larger) and alkaline precipitation technology.

***Copper***

The Federal and State aquatic life acute and chronic standards for copper have been lowered (Table 7-2). From 1998 through 2004, the existing daily maximum (0.026 mg/L) and monthly average (0.017 mg/L) performance standards for copper, were exceeded in 2 percent and 10 percent of the samples analyzed for Pond 2 discharge (SS-5), respectively. Lowering of the standard would increase the number of exceedances, but would provide a higher level of protection to downstream aquatic receptors. Similar to cadmium above, it is believed that operation of the WSP cannot be measurably improved because the WSP are performing at their maximum ability.

***Lead***

The federal criteria maximum concentration (CMC) and criterion continuous concentration (CCC) for lead have been lowered (Table 7-2). State of Montana Aquatic life standards for lead have not changed. From 1998 through 2004, the existing daily maximum performance standard for lead (0.137 mg/L) was not exceeded in any samples analyzed for Pond 2 discharge (SS-5). The monthly average performance standard (0.017 mg/L) was exceeded in 3.5 percent of the samples analyzed. Lowering of the standard would increase the number of exceedances, but would provide a higher level of protection to downstream aquatic receptors.

### *Groundwater*

Since implementation of the remedy at the Warm Springs Ponds OUs, the federal Safe Drinking Water Act MCLs and the State of Montana human health standards for groundwater for arsenic, cadmium, chromium, and lead have been lowered, relative to the groundwater performance standards established for the Warm Springs Ponds (Table 7-2). (Currently, groundwater in the area of the Warm Springs Ponds is not used as a drinking water source and, therefore, lowering of the groundwater performance standards to be consistent with State and/or Federal drinking water standards would not affect the protectiveness of the remedy with regard to human health). EPA will consider revising or keeping existing standards after further examination of institutional controls and groundwater usage at the two WSP OUs.

### *Expected progress towards meeting RAOs*

In large part, RAOs at the WSP OUs have been met and conditions have improved dramatically over pre-remedial conditions. In large part, performance standards are being met, and the WSP are supporting a healthy, diverse, and abundant aquatic, terrestrial, and avian wildlife population. There is uncertainty as to whether the arsenic performance standard can be met and whether or not meeting this performance standard is a requisite for protectiveness in the upper Clark Fork River basin.

### *Changes in Exposure Pathways*

No changes in site conditions that affect exposure pathways were identified as part of this five-year review.

### *Changes in Land Use*

No changes in land use at the WSP OUs have been made since completion of the remedy.

### *New Contaminants and/or Contaminant Sources*

No new contaminants or contaminant sources have been identified at the site since completion of the remedy.

### *Changes in Toxicity and Other Contaminant Characteristics*

Toxicity and other contaminant characteristics have not significantly changed.

## 7.2.2 Rocker OU

*Changes in Standards and To Be Considereds*

Since implementation of the remedy at the Rocker OU, a revised drinking water standard for arsenic has been promulgated. The Arsenic Rule was published in the Federal Register on January 22, 2001 (66 FR 6976). This Rule updates the current MCL for arsenic to 10 µg/L (from the previous arsenic MCL of 50 µg/L). The effective date of the Arsenic Rule was February 22, 2002. The revised Arsenic MCL is being applied prospectively at all Superfund sites. Currently, the shallow groundwater system in the area of the Rocker OU is not used as a drinking water source, but may be in the future. The lower arsenic MCL may be applied as the cleanup standard for the Rocker OU (replacing the prior standard of 18 µg/L) through an appropriate ROD modification or Explanation of Significant Differences. The application of the new standard does not change the findings of this five-year review for the Rocker OU because institutional controls are in place at the OU.

Although the arsenic concentrations in the shallow aquifer and gravel zone beneath the repository have rebounded to a greater extent than originally anticipated, the concentrations are, on the whole, significantly reduced compared to pre-remediation results. The highest levels of arsenic in groundwater generally coincide with the location of past operations at the site and the arsenic plume has not expanded beyond the site's contingency wells. Any expansion of the arsenic plume will be detected under the current monitoring program. However, the remedy is still considered to have a moderate uncertainty when considering the potential time-frame to achieve the cleanup standard of 10 µg/L.

*Changes in Exposure Pathways*

No changes in site conditions that affect exposure pathways were identified as part of this five-year review. Also, no changes in land use at the Rocker OU have been made since completion of the remedy.

## 7.2.3 Butte Mine Flooding OU

There have been no changes in the physical condition of the Butte Mine Flooding OU that would affect the protectiveness of the remedy.

*Changes in Standards and To Be Considereds*

The ARARs cited in the ROD for groundwater and surface water contamination have been met by the HSB WTP. Since the signing of the ROD in September 1994, the Safe Drinking Water Act (SDWA) (40 CFR 141/11-141.16) from which the discharge limits of the WTP were based has modified the maximum contaminant level (MCL) for arsenic. However, the effluent level for arsenic was set at the anticipated new standard as illustrated in Table 7-2. The State of Montana also modified the cadmium standard. This change was reflected in the 2002 ESD and incorporated into a final discharge standard.

*Changes in Exposure Pathways*

The exposure assessments used to determine clean up levels included both current and future exposures. There have been no changes in the toxicity factors for the COC or the assumptions used to establish clean up levels for the Mine Flooding OU. The remedy is progressing as expected and will be completed in 2020.

### 7.2.4 Streamside Tailings OU

There have been no changes in the physical condition of the Streamside Tailings OU that would affect the protectiveness of the remedy.

*Changes in Standards and To Be Considereds*

Revised standards similar to those presented for the Warm Springs Ponds OUs, for groundwater and surface water, have been promulgated and may be relevant to the SST OU. EPA will work with the State (the State is the lead agency) regarding whether these new standards are necessary or appropriate for the OU.

*Changes in Exposure Pathways*

The exposure assessments for used to determine clean up levels included both current and future exposures. There have been no changes in the toxicity factors for the COC or the assumptions used to establish clean up levels for the SST OU. The remedy is progressing as expected and will be completed by 2011.

## 7.3 Question C: Has Any Other Information Come to Light that Could Call Into Question the Protectiveness of the Remedy?

### 7.3.1 Warm Springs Ponds Active and Inactive OUs

There is no other information that has come to light that would call into question the protectiveness of the remedy. The remedy is functioning as intended and is effectively removing contaminants from Silver Bow Creek that would have otherwise discharged directly into the Upper Clark Fork River. Issues with respect to arsenic and copper exceedances have been discussed. The site will continue to be monitored for any changes in this regard.

### 7.3.2 Rocker OU

No additional information has been identified that would call into question the protectiveness of the remedy. The site will continue to be monitored for any changes in this regard. However, data and information obtained from the supplemental treatment plan prepared in conjunction with the SST OU and implemented in 2001 and 2002 may be useful if any further action at the site is proved necessary.

### 7.3.3 Butte Mine Flooding OU

There has been no information gathered during this five year review that calls into question the protectiveness of the remedy for the Mine Flooding OU.

### 7.3.4 Streamside Tailings OU

There has been no information gathered during this five year review that calls into question the protectiveness of the remedy for the Streamside Tailings OU.

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# Section 8 Issues

Based on information collected during preparation of this five year review report, the following issues were identified (Table 8 -1).

**Table 8-1**
**Issues Identified during this Five Year Review**

| Applicable OU | Issue No. | Issue | Affects Current Protectiveness? (Y/N) | Affects Future Protectiveness? (Y/N) |
|---|---|---|---|---|
| WSP Active and Inactive OUs | 1 | Continual seasonal exceedances of arsenic concentrations in effluent. | No – Arsenic concentrations are well below aquatic life standards and the water in the upper Clark Fork River is not used directly as a drinking water source. Additionally, existing ICs prohibit swimming in the ponds and the Clark Fork River. | Uncertain – If current ICs are continued, human exposure to arsenic in water will be prevented. Nevertheless, new standards for groundwater may be necessary in the future. |
| WSP Active and Inactive OUs | 2 | Meeting arsenic standards for surface water will require an additional treatment step (beyond lime addition and settling) because the ponds are operating at their maximum efficiency and capacity. The cost-benefit of additional treatment to meet lower arsenic standards could be examined, keeping in mind that the upstream SST and BPS OU remedial actions will decrease influent loading, improving treatment performance, and that significant additional arsenic loads are discharged by the Mill-Willow Bypass | No – arsenic performance standards are not consistently met throughout the year. However, arsenic in WSP discharge does not exceed aquatic life standards and pathways for human exposure are prevented by ICs. | Uncertain – Additional arsenic removal could enable consistent achievement of the arsenic performance standard. However, this may not be necessary depending on the effectiveness of upstream remedial actions, and may not be warranted if arsenic loads from the WSP are low compared to loads contributed by the Mill-Willow Bypass.. |
| WSP Active and Inactive OUs | 3 | Increasing trend in benthic macroinvertebrate tissue metal concentrations | Uncertain - Increasing tissue-metal trends observed at only 1 of 3 monitoring stations. Data do not correlate to metal sediment data and significance is confounded by increasing benthic invertebrate abundance and diversity. | Uncertain – Continued monitoring of trends in tissue metal concentrations should be performed to determine if risks are significant to fish or wildlife inhabiting the WSP. |
| Rocker OU | 4 | Rebound of arsenic concentrations below repository is greater than expected | No – the well ban (1/4 mile radius) is in place protecting human health. Any significant changes in site conditions will be detected with the current monitoring program. | Possibly – the existing well ban assures protectiveness. However, the well ban in the area may be changed. Implementation of additional work or contingent remedies may be required in the future. |
| Butte Mine Flooding OU | 5 | The HSB WTP did not meet the final cadmium performance criterion. | No – Effluent from the WTP is currently recycled to MR mining operations | Yes - should MR suspend their mining operations, cadmium must meet the final discharge standard or it must be shown that an alternate standard is protective before discharge to Silver Bow Creek. Additional performance testing is planned for Fall 2005 to evaluate whether the HSB WTP can meet the final cadmium standard without further modifications. |

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# Section 9 Recommendations and Follow-Up Actions

The recommendations and follow-up actions for the issues identified within the Silver Bow Creek / Butte Area site are summarized in Table 9-1.

**Table 9-1**
**Recommendations and Follow-up Actions for Issues Identified**

| Applicable OU | Issue | Recommendations and Follow-up Actions | Party Responsible | Oversight Agency | Milestone Date | Affects Protectiveness (Y/N) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Current | Future |
| WSP Active and Inactive OU | 1, 2 | EPA may conduct arsenic mass loading studies (seasonal) to determine the significance of the arsenic load from the WSP as compared to other sources of arsenic loading in the basin. This may provide a better understanding of arsenic loading from numerous sources in the upper reaches of the system.<br>EPA may initiate additional wildlife studies to determine whether bioaccumulation of arsenic in birds requires mitigation. | EPA | EPA/DEQ | January 2007 | No | Uncertain |
| WSP Active and Inactive OU | 3 | Continued periodic monitoring of trends in tissue metal concentrations should be performed to determine if risks are significant to fish or wildlife inhabiting the WSP. | Atlantic Richfield | EPA/DEQ | Ongoing | Uncertain | Uncertain |
| Rocker OU | 4 | Atlantic Richfield will continue quarterly groundwater sampling and O&M activities so that any changes in site conditions will be detected. | Atlantic Richfield | EPA/DEQ | Ongoing | No | No – unless site changes such as changes to ICs occurs |
| Rocker OU | 4 | EPA to evaluate the protectiveness and continuation of the 1/4-mile radius well ban | EPA | EPA | Ongoing | No | No |
| Butte Mine Flooding OU | 5 | Atlantic Richfield and MR to conduct additional performance testing. If the testing shows that the final Cd standard cannot be met at the HSB WTP without further modification, Atlantic Richfield and MR will explore potential additional treatment solutions or perform a protectiveness analysis to determine if the discharge is protective of Silver Bow Creek. | Atlantic Richfield | EPA/DEQ | Ongoing | No | Yes – this issue must be addressed once discharge to Silver Bow Creek begins |

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# Section 10 Protectiveness Statements

With only the WSP and Rocker OUs having completed Remedies, it is difficult to quantify the protectiveness of the entire Silver Bow Creek/Butte Area Superfund site at this time. Statements are made below with respect to the remedies specific to the Rocker and WSP OUs, respectively, and it can be stated that with the future completion of remedies at other OUs, protection of human health and the environment at the Silver Bow Creek/Butte Area site as a whole will improve.

**Rocker OU.** The original remedy is presently protective of human health and the environment. Most remedial objectives have been attained, such as reduction in plume concentrations and protection of uncontaminated aquifers. EPA will continue to monitor the site and, if warranted, may invoke additional work or contingency measures to meet cleanup standards in groundwater and insure that the arsenic plume does not migrate. EPA certifies that the remedy for this operable unit remains protective of human health and the environment because of the presence of the alternative water supply and the institutional controls which prevent contaminated groundwater use. However, ongoing monitoring, continued implementation of institutional controls, and O&M activities are required to maintain protectiveness.

**Warm Springs Ponds OUs.** The remedy for the WSP Active Area and Inactive Area OUs is currently functioning as designed. The Ponds serve to capture, treat, and retain contaminants from upstream sources in other OUs, and greatly reduce contaminant loading to the Clark Fork River. Discharge from the Active Area treatment system is generally in compliance for most constituents. Arsenic exceedances occur seasonally as a result of changing geochemical conditions in the pond bottom sediments within the treatment ponds (Ponds 2 and 3) and copper and zinc exceedances occur infrequently as a result of seasonal high flows into the Pond system. Surface water discharge from the WSP treatment system typically exceeds human health standards for arsenic during the late summer and fall of the year. However, aquatic life standards for arsenic are never exceeded and institutional controls are in place to protect against human exposure. During this evaluation period, the frequency of exceedances of copper and zinc were reduced from the initial five-year review period. Continued long-term operations and maintenance, coupled with annual dam safety inspections, required water quality and biological monitoring, will ensure that maximum protectiveness and effectiveness are maintained within the recognized limitations of alkaline precipitation technology and the physical size of the WSP system.

The WSP effectively remove or reduce acutely toxic concentrations of metals that enter the treatment system from Silver Bow Creek. Whereas Silver Bow Creek above the ponds supports absolutely no fish population and is severely impaired in respect to invertebrate and periphyton (algal) community structure, the aquatic environment immediately below the WSP supports healthy populations of trout, good biological integrity for periphyton, and biological integrity for invertebrates. The pond system has become a safety net for the Clark Fork River. EPA deems the remedy to be protective in terms of substantially reducing – quite possibly eliminating – the threat of acute lethality to fish.

In light of the current and long-standing status of severe contamination in Silver Bow Creek above the ponds, and in light of the gradual degradation of water quality that occurs in the upper Clark Fork River, beginning within a few miles downstream of the WSP and continuing for about 40 miles, any attempt to eliminate occasional chronic threats that persist immediately below the ponds through modification of the WSP system would produce virtually no change in protectiveness for the river in the Deer Lodge valley. However, as the Clark Fork River water quality is improved, this issue will need to be re-examined, as will standards.

While a high degree of protectiveness has been achieved, an even higher degree of protectiveness is achievable. But, such a higher degree of protectiveness for the river can be attained only after all remaining operable units along this continuum of stream environments have been cleaned up and are functioning as a whole.

# Section 11 References

AERL 2001. Warm Springs Ponds 2000 Biomonitoring and Analysis Results, Draft Report. Silver Bow Creek / Butte Area NPL Site, Warm Springs Ponds Operable Units. Report prepared by ENSR Environmental Toxicology Services. May 2001.

Ankley, G.T., D.M. Di Toro, D.J. Hansen, W.J. Berry. 1996. Technical Basis and Proposal for Deriving Sediment Quality Criteria for Metals. Environmental Toxicology and Chemistry. 15:2056-2066.

ARCO 1995a. Draft Remedial Investigation. Streamside Tailings Operable Unit Silver Bow Creek / Butte Area National Priorities List site. Prepared by the Atlantic Richfield Company. 1995

ARCO 1995b. Feasibility Study. Streamside Tailings Operable Unit Silver Bow Creek / Butte Area National Priorities List Site. Prepared by the Atlantic Richfield Company. 1995.

ARCO 1995c. Final Remedial Investigation Report. Rocker Timber Framing and Treatment Plant Operable Unit Silver Bow Creek / Butte Area National Priorities List Site. Prepared by the Atlantic Richfield Company. March 1995.

ARCO 1995d. Final Feasibility Study Report. Rocker Timber Framing and Treatment Plant Operable Unit Silver Bow Creek / Butte Area National Priorities List Site. Prepared by the Atlantic Richfield Company. July 1995.

ARCO 1997. Initial 5-Year Review. Warm Springs Ponds Operable Unit Silver Bow Creek / Butte Area National Priorities List Site.

ARCO 1998. Initial 5-Year Review Addendum. Warm Springs Ponds Operable Unit Silver bow Creek / Butte Area National Priorities List Site.

Atlantic Richfield. 2004. Warm Springs Ponds Operable Units of the Silver Bow Creek Area NPL Site, Docket No. CERCLA-VIII-91-25; Response to EPA's Letter of December 5, 2003: Notice of Violation and Request for Additional Work – Warm Springs Ponds spill incident; and submittal of Work Plan for Additional Work. January 6, 2004.

Atlantic Richfield 2004. Warm Springs Ponds 2003 Biomonitoring and Analysis Results Draft Report. Silver Bow Creek / Butte Area NPL Site, Warm Springs Ponds Operable Units, Upper Clark Fork River Basin, Montana. Prepared for Atlantic Richfield Company by ENSR International. June 2004.

Atlantic Richfield 2005. Warm Springs Ponds Five-Year Review Report. Silver Bow Creek / Butte Area NPL Site, Warm Springs Ponds Operable Units, Upper Clark Fork River Basin, Montana. April 27, 2005.

BPSOU PRP Group 2002. Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area Superfund Site. Phase II Remedial Investigation Report. Prepared by MFG Inc. for the PRP Group. April 2002.

CDM 1990. Final Work Plan for Remedial Investigation Feasibility Study, Butte Mine Flooding Operable Unit, Butte Addition to the Silver Bow Creek/Butte Area NPL Site, Butte, Montana. Prepared for the U.S. Environmental Protection Agency by CDM Federal Programs Corporation. April 27, 1990.CH2MHill & Chen Northern 1989.

CH2MHill and Chen Northern 1989. Final Silver Bow Creek CERCLA Phase II Remedial Investigation Data Summary, Warm Springs Ponds Operable Unit, volumes I, II, and III. Prepared by CH2MHill, Inc. and Chen-Northern, Inc. May 5, 1989.

CH2MHill & Chen Northern 1990. Draft Final Silver Bow Creek CERCLA Phase II Remedial Investigation Summary, Area 1 Operable Unit, Volumes I and II. Prepared by CH2MHill, Inc. and Chen-Northern, Inc. August 1990.

DEQ 1994. Draft Baseline Risk Assessment, Streamside Tailings Operable Unit Silver Bow Creek/ Butte Area Site. Prepared by Camp, Dresser, and McKee, Inc. December.

DEQ 1995b. Streamside Tailings Operable Unit - Proposed Plan. June.

DEQ 1995a. Record of Decision. Streamside Tailings Operable Unit Silver Bow Creek Butte Area (Original Portion) National Priorities List Site. Prepared by the Montana Department of Environmental Quality. November 29, 1995.

DEQ 1998. Explanation of Significant Differences. Streamside Tailings Operable Unit Silver Bow Creek/Butte Area (Original Portion) National Priorities List Site. Prepared by the Montana Department of Environmental Quality. August 31, 1998.

Erickson, R., D. Mount, and C. Stephan. 1999. Derivation of Recommended Chronic Copper TRVs for Salmonids. Report prepared by USEPA, Duluth, MN, November, 1999.

McGuire, Daniel. 2003. Macroinvertebrate-Based Rapid Bioassessment: Mill-Willow Bypass. Deerlodge County, MT. April 1, 2003.

NRIS 2005. Montana Natural Resource Information System Web Page http://maps2.nris.state.mt.us/mapper/ThemeList.asp?Profile=1546514&qLayer1=FWPSTREAMROUTE&qField1=LLID&qValue1=1127708461870&Oper1=&Buffer1=805.5&TabName=Land%20Information

Online Highways 2005. Web Page http://www.ohwy.com/mt/b/butte.htm

U.S. Census Bureau 2005. 2000 Census Data for Montana (Web Page). http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=04000US30&-_box_head_nbr=GCT-PH1&-ds_name=DEC_2000_SF1_U&-format=ST-2

USEPA 1990. Record of Decision, Warm Springs Ponds Operable Unit, Silver Bow Creek Butte Area NPL Site, Butte, Montana. U.S. Environmental Protection Agency, Montana Office. September 28, 1990.

USEPA 1991. Explanation of Significant Differences for the Warm springs Ponds Operable Unit, Silver Bow Creek/Butte Area NPL Site, Butte, Montana. U.S. Environmental Protection Agency, Montana Office. June 24, 1991.

EPA 1991. Unilateral Administrative Order for Remedial Design/Remedial Action EPA Docket Number CERCLA-VIII-91-25. Silver Bow Creek/Butte Area (Original Portion) Warm Springs Ponds Operable Unit. September 25, 1991.

USEPA 1992b. Silver bow Creek/Butte Area Superfund site, Warm Springs Ponds Inactive Area Proposed Plan. Prepared by the U.S. Environmental Protection Agency, Montana Office and the Montana Department of Health and Environmental Sciences. March 1992.

EPA 1993. Unilateral Administrative Order for Remedial Design/Remedial Action EPA Docket Number CERCLA-VIII-93-23. Silver Bow Creek/Butte Area (Original Portion) Warm Springs Ponds Operable Unit (Inactive Area). June 19, 1993.

USEPA 1994. Record of Decision, Butte Mine Flooding Operable Unit, Silver Bow Creek Butte Area NPL Site, Butte, Montana. U.S. Environmental Protection Agency, Montana Office. September 29, 1994.

USEPA 1995. Record of Decision, Rocker Timber Framing and Treatment Plant Operable Unit, Silver Bow Creek Butte Area NPL Site, Butte, Montana. U.S. Environmental Protection Agency, Montana Office. December 22, 1995.

USEPA 2000. Statutory Five Year Review Report. Silver Bow Creek/Butte Area Superfund Site. Clark Fork Basin, Montana with Emphasis on the Warm Springs Ponds Operable Units. U.S. Environmental Protection Agency, Montana Office. March 23, 2000.

USEPA 2002. Explanation of Significant Differences for the Butte Mine flooding Operable Unit, Silver Bow Creek/Butte Area NPL Site, Butte, Montana. U.S. Environmental Protection Agency, Montana Office. March 2002

USEPA 2002. Superfund Cleanup Proposal (Proposed Plan) for the Clark Fork River Operable Unit of the Milltown Reservoir/Clark fork River Superfund Site. Prepared by the US Environmental Protection Agency, Montana Operations Office. Helena, Montana. August 2002.

EPA. 2003. Notice of Violation and Request for Additional Work – Warm Springs Ponds spill incident. Letter from D. Scott Brown (EPA) to David McCarthy (Atlantic Richfield Company). December 5, 2003.

USEPA 2005. USEPA Comprehensive Environmental Response Compensation and Liability Act Information System (CERCLIS) Web Page. http://cfpub.epa.gov/supercpad/cursites/copinfo.cfm?id=0800416

# Tables

## Table 1-1
## Remedial Operable Units at the Silver Bow Creek/Butte Area Superfund Site

| Operable Unit | ROD Date | Remedial Action Status | Date of Previous Five-Year Review | 2005 Five-Year Review Requirement |
|---|---|---|---|---|
| Active Mining and Milling OU | None | None | 3/23/2000 | Statutory |
| Butte Priority Soils(BPS) OU | None | None | 3/23/2000 | Statutory |
| Butte Mine Flooding (BMF) OU | 9/29/1994 | On-going | 3/23/2000 | Statutory |
| Rocker Timber Framing and Treatment Plant (Rocker) OU | 12/22/1995 | Complete | 3/23/2000 | Statutory |
| Streamside Tailings (SST) OU | 11/29/1995 | On-going | 3/23/2000 | Statutory |
| Warm Springs Ponds (WSP) – Active Area OU | 9/28/1990 | Complete | 3/23/2000 | Statutory |
| WSP OU – Inactive Area OU | 6/30/1992 | Complete | 3/23/2000 | Statutory |
| West Side Soils OU | None | None | 3/23/2000 | Statutory |

## 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 |
| Open pit mining at Berkeley Pit | 03 | 1955 - 1982 |
| Major smelting period in Butte | 03/08 | 1879 - 1900 |
| Discovery of mining-related contamination along Silver Bow Creek between Butte and Warm Springs, Montana. | 01 | 9/01/1979 |
| Hazard Ranking System Package Completed | 00 | 12/01/1982 |
| Silver Bow Creek Site proposed to the NPL | 00 | 12/30/1982 |
| Silver Bow Creek Site (Original Portion) listed as Final on the NPL | 00 | 09/08/1983 |
| Silver Bow Creek (Original Portion) Remedial Investigation Final Report | 00 | 01/1987 |
| Butte Area Portion added to Silver Bow Creek Site | 02 | 07/22/1987 |
| Walkerville TCRA completed | 08 | 02/22/1988 |
| Timber Butte TCRA completed | 08 | 1989 |
| Priority Soils TCRA completed | 08 | 1991 |
| ROD for WSPs Active Area OU | 04 | 09/28/1990 |
| Explanation of Significant Differences for WSPs Active Area OU | 04 | 06/24/1991 |
| Unilateral Administrative Order WSPs Active Area OU | 04 | 09/25/1991 |
| Colorado Smelter TCRA completed | 08 | 1992 |
| Anselmo Mine yard and Late Acquisition/Silver Hill TCRA completed | 08 | 1992 |
| Lower Area One Manganese Removal | 08 | 1992 |
| ROD for WSPs Inactive Area OU | 12 | 06/30/1992 |
| Unilateral Administrative Order WSPs Inactive Area OU | 12 | 06/17/1993 |
| Walkerville II TCRA | 08 | 1994 |
| ROD for Mine Flooding OU | 03 | 09/29/1994 |
| ROD for SST OU | 01 | 11/29/1995 |
| ROD for Rocker OU | 07 | 12/22/1995 |
| Explanation of Significant Differences for SST OU | 01 | 08/31/1998 |
| Consent Decree for SST OU | 01 | 04/19/1999 |
| Explanation of Significant Differences for SST OU | 08 | 08/31/1998 |
| Initial Five Year Review Silver Bow Creek/Butte Area Site With Emphasis on WSPs OUs | 04/12 | 03/23/2000 |
| Consent Decree for Rocker OU | 07 | 11/07/2000 |
| Walkerville Residential Removal | 08 | 2000 |
| Consent Decree for BMF OU | 03 | 08/14/2002 |
| Stormwater TCRA | 08 | On-going |
| Railroad Beds TCRA | 08 | On-going |
| Lower Area One N-TCRA | 08 | On-going |
| BPS Residential Soils/Source Areas N-TCRA | 08 | On-going |
| Proposed Plan for Butte Priority Soils OU | 08 | 12/21/2004 |

Notes:* Operable Units (OUs) are numbered as follows: (00) Sitewide; (01) SST; (02) Area 1; (03) Mine Flooding; (04) WSPs Active Area; (05) Reduction Works Tailings; (06) Travona Mine; (07) Rocker Timber Framing and Treatment Plant; (08) Priority Soils; (10) Butte Residential Soils; (11) Lower Area One; (12); WSPs Inactive Area (13); West Side Soils.

**Table 3-1**
**Complete List of Remedial and Removal Operable Units at the Silver Bow Creek/Butte Area Superfund Site as Listed in the CERCLIS Database**

| Operable Unit ID | Operable Unit Name | Function | Site Portion |
|---|---|---|---|
| 01 | SST | Remedial | Original |
| 02 | Area One | | Butte Area |
| 03 | BMF | Remedial | Butte Area |
| 04 | WSP (Active Area) | Remedial | Original |
| 05 | Reduction Works Tailings | Removal | Original |
| 06 | Travona Mine | Removal | Butte Area |
| 07 | Rocker | Remedial | Original |
| 08 | BPS | Remedial | Butte Area |
| 09* | Active Mining and Milling | Remedial | Butte Area |
| 10 | Residential Soils | Removal | Butte Area |
| 11 | Lower Area One | Removal | Original |
| 12 | WSP Inactive Area | Remedial | Original |
| 13 | West Side Soils | Remedial | Butte Area |

*The Active Mining and Milling OU is not included in the list of OUs in the on-line CERLIS Database listing.

## Table 4-1
## Rocker OU O&M Wells Sampled for Groundwater Quality

| | | |
|---|---|---|
| **SHALLOW ALLUVIAL WELLS (17 total)** | INTERIOR | RH-60, RH-61, RH-62, RH-63, RH-64, RH-65, RH-66 |
| | EXTERIOR | RH-5, RH-7, RH-15, RH-17, RH-19, RH-41, RH-44, RH-47 |
| | CONTINGENCY | RH-52R, RH-75 |
| **DEEP ALLUVIAL WELLS (7 total)** | EXTERIOR | RH-14R, RH-16, RH-18, RH-20 |
| | CONTINGENCY | RH-12R, RH-51, RH-55 |
| **TERTIARY SEDIMENT WELLS (10 total)** | EXTERIOR | RH-6, RH-43, RH-48 |
| | CONTINGENCY | RH-36R, RH-46, RH-53, RH-76, Town Pump 1, Ayers, Palmer |

## Table 4-2
## Rocker OU Operations and Maintenance Costs

| **Dates** | | **Total Cost Rounded to Nearest $1,000** |
|---|---|---|
| **From** | **To** | |
| January 2004 | December 2004 | $1,068,000 |

**Table 5-1**
**Surface Water Quality Final Discharge Standards for the Warm Springs Ponds Active Area OU (Station SS-5)**

| Constituent | Daily Maximum (mg/L) | Monthly Average (mg/L) |
|---|---|---|
| Arsenic | 0.02 | 0.02 |
| Cadmium | 0.0062** | 0.0016** |
| Copper | 0.026** | 0.017** |
| Iron | 1.5 | 1.0 |
| Lead | 0.137** | 0.0053** |
| Mercury | 0.0002 | 0.0002 |
| Selenium | 0.26 | 0.035 |
| Silver | 0.0082** | 0.00012 |
| Zinc | 0.16** | 0.15** |
| TSS | 45.0 | 30.0 |
| pH | 6.5-9.5 units | --- |

**Notes:**
Metals are total recoverable analyses
**These standards are hardness-dependent and are shown at a hardness of 150 mg/L as $CaCO_3$

## Table 5-2
## Daily Performance Standards Exceedance Summary for the Warm Springs Ponds
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

| Constituent | Final Daily Maximum Standards January 1, 1998 - December 31, 2004 | | |
|---|---|---|---|
| | **No. of Measurements** | **No. of Exceedences** | **% of Exceedences** |
| TSS | 730 | 0 | 0 |
| pH (1) | 731 | 86 | 12 |
| Arsenic | 730 | 321 | 44 |
| Cadmium | 730 | 0 | 0 |
| Copper | 730 | 14 | 1.9 |
| Iron | 730 | 1 | <1 |
| Lead | 730 | 0 | 0 |
| Mercury (2) | 730 | 10 | 1.4 |
| Selenium | 168 | 0 | 0 |
| Silver | 168 | 0 | 0 |
| Zinc | 730 | 3 | <1 |

**Notes:**

(1) pH measurements at SS-5 greater than 9.0 result from natural biological activity.

(2) Mercury as total analysis, all other metals as total recoverable analysis.

**Table 5-3**

**Monthly Performance Standards Exceedance Summary for the Warm Springs Ponds**

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

| Constituent | Monthly Average Standards January 1, 1998 - December 31, 2004 | | |
|---|---|---|---|
| | No. of Measurements | No. of Exceedences | % of Exceedences |
| TSS | 84 | 0 | 0 |
| Arsenic | 84 | 39 | 46 |
| Cadmium | 84 | 0 | 0 |
| Copper | 84 | 8 | 10 |
| Iron | 84 | 0 | 0 |
| Lead | 84 | 1 | 1 |
| Mercury | 84 | 1 | 1 |
| Selenium | 84 | 0 | 0 |
| Silver | 84 | See Note 2. | |
| Zinc | 84 | 0 | 0 |

**Notes:**

(1) Mercury as total analysis, all other metals as total recoverable analysis.

(2) The detection limit for silver is greater than the monthly average standard of 0.00012 mg/l.

## Table 5-4

## Summary of Approximate Net Arsenic Loads in the Warm Springs Ponds

***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

| Annual Averages | | | | | Two-Year Averages | | |
|---|---|---|---|---|---|---|---|
| Year | SS-1 (kg) | SS-5 (kg) | Net Load Removed (kg) | Percent Removed | Two-Year Period | Net Load Removed (kg) | Percent Removed |
| **1998** | 1,530 | 929 | 602 | 39.3 | **--** | -- | -- |
| **1999** | 1,301 | 637 | 664 | 51.0 | **1998-1999** | 1,266 | 44.7 |
| **2000** | 587 | 329 | 258 | 43.9 | **1999-2000** | 921 | 48.8 |
| **2001** | 553 | 301 | 252 | 45.5 | **2000-2001** | 509 | 44.7 |
| **2002** | 597 | 301 | 296 | 49.5 | **2001-2002** | 547 | 47.6 |
| **2003** | 2,161 | 1,042 | 1,119 | 51.8 | **2002-2003** | 1,414 | 51.3 |
| **2004** | 625 | 614 | 11 | 1.8 | **2003-2004** | 1,130 | 40.6 |

**Notes:**

The arsenic loads were calculated using daily concentration and flow data to obtain a daily loading rate (kg/day).
The number of days between daily samples was calculated (ususally 3 or 4 days) and multiplied by the daily loading rate
This gave an approximate load for the period between samples. These loads were then totaled for each year.
The total number of days in the calculation was checked to make sure it was 365 days (or 366 for leap year).
If concentration data were absent, the concentration from the previous sample date was used.
If flow data were absent, the average of the two measurements immediately before and after the missing date was used.

**Table 5-5**

## Average Concentrations and Statistics for the Unmanifolded Toe Drains at the Warm Springs Ponds

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

| | Toe Drain Average Concentration | | | | | | | Statistics for Entire Report Period | | | Toe Drain and Date of Maximum | Concentration in 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | Average | Minimum | Maximum | | |
| **Arsenic** | 0.071 | 0.076 | 0.068 | 0.058 | 0.051 | 0.070 | 0.067 | 0.066 | 0.016 | 0.145 | TD-84 in 1999 | 0.110 |
| **Cadmium** | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.00015 | 0.0002 | 0.0001 | 0.00012 | 0.00005 | 0.0005 | TD-161 in 2002 | 0.0001 |
| **Copper** | 0.0027 | 0.0013 | 0.0020 | 0.0028 | 0.0031 | 0.0024 | 0.0021 | 0.0023 | 0.0010 | 0.0100 | TD-67 in 2001 | 0.0080 |
| **Iron** | 0.059 | 0.017 | 0.074 | 0.092 | 0.113 | 0.132 | 0.152 | 0.091 | 0.008 | 0.51 | TD-152 in 2004 | 0.51 |
| **Zinc** | 0.007 | 0.010 | 0.011 | 0.004 | 0.038 | 0.008 | 0.010 | 0.013 | 0.004 | 0.190 | TD-104 in 2002 | 0.010 |
| **Hardness** | 281 | 232 | 273 | 257 | 225 | 229 | 261 | 251 | 192 | 687 | TD-67 in 1998 | 484 |

**Notes:**

Toe drains 67, 84, 87, 90, 91, 99, 104, 152, 157, 160, and 161 were sampled annually; these concentrations were averaged.

The statistics for the entire report period include all of the data from 1998 through 2004.

"Toe Drain and Date of Maximum" indicates the specific toe drain and year where the maximum concentration was measured.

"Concentration in 2004" shows the 2004 concentration of the toe drain where the maximum concentration was measured.

**Table 5-6**
**Maximum, Minimum, and Average Concentrations for Select Constituents at Inactive Area Sampling Locations Relative to Performance Standards, March 1998 – December 2004**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

| Constituent | Station IA-1 | | | Station IA-2 | | | Station IA-3 | | | Monthly Average Surface Water Performance Std |
|---|---|---|---|---|---|---|---|---|---|---|
| | Maximum | Minimum | Average | Maximum | Minimum | Average | Maximum | Minimum | Average | |
| **Arsenic** | 0.130 | 0.008 | 0.030 | 0.092 | 0.040 | 0.031 | 0.100 | 0.002 | 0.029 | 0.020 |
| **Cadmium** | 0.0007 | 0.00001 | 0.00032 | 0.0006 | 0.0001 | 0.0001 | 0.0010 | 0.0001 | 0.0003 | **0.0016** |
| **Copper** | 0.022 | 0.004 | 0.012 | 0.018 | 0.001 | 0.008 | 0.011 | 0.001 | 0.004 | **0.017** |
| **Iron** | 16.4 | 0.28 | 2.25 | 6.2 | 0.034 | 0.870 | 21.00 | 0.85 | 4.36 | 1.0 |
| **Lead** | 0.0020 | 0.0007 | 0.0011 | 0.003 | 0.0005 | 0.0009 | 0.0040 | 0.0005 | 0.0008 | **0.0053** |
| **Mercury** | 0.0002 | 0.0001 | 0.0001 | 0.00040 | 0.00005 | 0.00008 | 0.00040 | 0.00005 | 0.00008 | 0.0002 |
| **Selenium** | 0.004 | 0.001 | 0.001 | 0.0030 | 0.0005 | 0.0010 | 0.0030 | 0.0005 | 0.0007 | 0.035 |
| **Silver** | 0.0006 | 0.0005 | 0.0005 | 0.00070 | 0.00050 | 0.00051 | UNDETECTED (<0.001) | | | 0.00012 |
| **Zinc** | 0.310 | 0.052 | 0.111 | 0.502 | 0.005 | 0.056 | 0.850 | 0.047 | 0.137 | **0.015** |
| **TSS** | 41 | 2 | 8 | 15 | 2 | 5 | 51 | 2 | 11 | 30 |
| **Hardness** | 516 | 241 | 397 | 560 | 212 | 363 | 792 | 193 | 301 | --- |

**Notes:**

1. Station IA-1: Discharge of Inactive Area pump-back system pipeline to Pond 2.
2. Station IA-2: Pond 1 Wet closure North Cell Discharge.
3. Station IA-3 Soil-cement toe drain manifold discharge into interception trench.
4. For undetected values, one half the detection limit was used to calculate statistics.
5. Performance standards shown for reference only. IA monitoring stations are not points of compliance.
6. Performance standards presented in bold type are hardness-dependent. Values shown are for a hardness of 150 mg/L and are calculated in accordance with the standards in the 1991 UAO.

**Table 5-7**
**Average Concentrations for Select Water Quality Constituents Measured at the Pump-back Pipeline Discharge (IA-1) and the Pond 3 (SS-3E) and Pond 2 (SS-5) Discharge Locations**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

| Constituent | Units | Pump-back Discharge, IA-1 | Pond 3 Discharge, SS-3E | Pond 2 Discharge, SS-5 | % Increase in Concentration from Pond 3 to Pond 2 |
|---|---|---|---|---|---|
| Hardness | mg/L | 397 | 194 | 211 | 8.8 |
| Sulfate | mg/L | 323 | 116 | 144 | 24.1 |
| Total Recoverable Arsenic | mg/L | 0.030 | 0.0255 | 0.0233 | -8.6 |
| Total Recoverable Iron | mg/L | 2.25 | 0.2493 | 0.226 | -9.3 |
| Total Recoverable Cadmium | mg/L | 0.00032 | 0.00072 | 0.00018 | -75.0 |
| Total Recoverable Copper | mg/L | 0.012 | 0.0366 | 0.0126 | -65.6 |
| Total Recoverable Zinc | mg/L | 0.111 | 0.1066 | 0.0354 | -66.8 |

**Table 5-8**
**Warm Springs Ponds Biomonitoring Sampling Locations**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

| Site Designation | Location | Site Description | Events Sampled |
|---|---|---|---|
| P3-WH | Wetlands at head of Pond 3 | Upstream portion of active treatment area; receives direct input from Silver bow Creek (post liming); this area was flooded in 1993. | 1995 – 1998, 1999, 2000, 2003 |
| P3-N | North end of Pond 3 | Near outlet in northwest corner of Pond 3; water discharges from here into Pond 2; Pond 3 was initially flooded during the late 1950s (circa 1956-1959) | 1995 - 1998 |
| P2-WWC | West wet closure area, Pond 2 | Wet closure cell to the south of and separated from the active area of Pond 2; this are was flooded in 1995. | 1995 – 1998, 1999, 2000, 2003 |
| P2EWC | East wet closure area, Pond 2 | Wet closure cell to the south(east) of and separated from the active area of pond 2; this area was flooded in 1995. | 1995 - 1998 |
| P2-S | Southern end of Pond 2 | Inlet portion of active treatment areas (receives water from Pond 3); this area was flooded in 1993. | 1995 - 1998 |
| P2-NW | Northwestern part of Pond 2 | Near outlet of Pond 2 (and, therefore, of the active WSP treatment area as a whole); Pond 2 was initially flooded in 1916. | 1995 – 1998, 1999, 2000 |
| P1-WA | Wetlands adjacent to Pond 1 | Flooded areas adjacent to the Pond 1 – Center; this area has been flooded for many years. No longer part of the active treatment system. | 1995 - 1998 |
| P1-C | Central part of Pond 1 | Pond 1 has been flooded since approximately 1911 and is no longer part of the active treatment system. | 1995 - 1998 |
| P1-MWC | Middle wet closure area, north of Pond 1 | Wet closure cell north of Pond 1 – wet closure area; flooded with water in late 1995. not part of the active treatment system. | 1995 – 1998, 1999, 2000, 2003 |
| P1-WAN | Wetlands adjacent to middle Pond 1 wet closure area | Wetland area adjacent to the wet closure cell north of Pond 1; flooded with water in late 1995. Not part of the active treatment system. | 1995 - 1998 |

**Table 5-9**
**Warm Springs Ponds Biomonitoring Sample Types**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

| Site Designation | Benthic Invertebrate | Pelagic Invertebrate | Fish/Waterfowl Tissue* | Vegetation | Chemistry |
|---|---|---|---|---|---|
| P3-WH | C, T, Tox | C, T | (Collected in ’95) | MT | W, S, PW |
| P3-N | C | | | | |
| P3-General Area | | | BFT | C | |
| P2-WWC | C, T, Tox | C, T | BFT, L | C, MT | W, S, PW |
| P2EWC | T, Tox | | | | S, PW |
| P2-S | C | C, T | | MT | |
| P2-NW | C, T, Tox | C, T | | MT | W, S, PW |
| P2 General Area | | | BFT, L | | |
| P1-WA | C | | | | |
| P1-C | C, T, Tox | C, T | | MT | W, S, PW |
| P1 General Area | | | BFT, L | C | |
| P1-MWC | C, T, Tox | C, T | BFT, L | C, MT | W, S, PW |
| P1-WAN | C | | | | |

**Where**:

- C — Community Data
- T — Whole body tissue metal concentrations (all collected organisms for benthic macroinvertebrates, and specifically Corixidae for pelagic invertebrates)
- Tox — Laboratory sediment toxicity tests using *H. azteca* (10-d)
- L — Coot liver tissue metal concentration (Sampled from the vicinity of fixed locations listed, P1-MWC was included in 1996)
- MT — Aquatic macrophyte tissue metal concentration (initiated in 1996 biomonitoring)
- BFT — Bottom fish tissue metal concentration (fish were collected in P1-GA and P1-MWC in 1997)
- W — Water Chemistry
- S — Sediment Chemistry
- PW — Sediment pore water chemistry (in addition to laboratory pore water measurements, *in situ* pore water samplers were included in 1997, 1998, and 1999)
- * — Forage fish (Redside shiners) were originally included in the 1995 biomonitoring effort, but were subsequently excluded as tissue residues were similar to those in bottom fish

Note: Changes made after the 1995 sampling seasons included modifications in the collection methods for sediments/benthic macroinvertebrates and pelagic invertebrates.

Table modified from *Warm Springs Ponds 2003 Biomonitoring and Analysis Results*, ENSR International, June 2004.

**Table 5-10**
**Five-Year Operation and Maintenance Costs for the Rocker OU**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 5-Year Total | Average Annual O&M Cost |
|---|---|---|---|---|---|---|---|
| **O&M Cost** | $59,776 | $87,527 | $137,248 | $63,325 | $61,829 | $409,705 | $81,941 |

## Table 6-1
## List of Potential Interviewees

| Name | Affiliation | Response Received? |
|---|---|---|
| Background Information | | |
| Don Ueland | Landowner (SST OU) | Yes |
| Albert Molignoni | Neighbor (Rocker OU) | Yes |
| Scott Payne | CTEC (BPSOU) | Yes |
| Bob Benson | CFRTac (WSP OUs and SST OU) | Yes |
| Don Peoples | MERDI (Redevelopment Group) (BPS OU) | Yes |
| State and Local Considerations | | |
| Linda Bouck | Anaconda-Deer Lodge Co. Planning Department | Yes |
| Jon Sesso | Butte-Silver Bow (BSB) Planning Department | Yes |
| Dori Skrukrud | BSB (Greenway Issues – SST OU) | Yes |
| Mike Kerns | BSB Commissioner (SST OU, Rocker OU) | Yes |
| Dave Dziak* | MT Dept. of Fish, Wildlife, and Parks (WSP OU) | Yes |
| Construction Considerations | | |
| Ken Brockman | Bureau of Land Management (oversight – SST OU) | Yes |

** Regulatory perspective*

## Table 6-2
## List of Questions for Interviewees

| Question | Area of Concern | | |
|---|---|---|---|
| | Back-ground | State or Local | Construc-tion |
| What is your overall impression of the project? | X | X | X |
| What effects have site activities or operations had on the surrounding community? | X | X | |
| Are you aware of any community concerns regarding the site or its operation? | X | X | |
| Do you feel the remedy (or proposed remedy) is protective? | X | X | |
| Do you feel well informed about site progress and activities? | X | X | |
| Do you have any comments or suggestions? | X | X | X |
| Have you done any site visits, inspections, reporting, etc at the site?* | | X | |
| Have there been any complaints, violations, or other incidents?* | | X | |
| What is the current state of construction? | | | X |
| Have you encountered any problems that changed, or will change, the remedy? | | | X |
| Have any problems impacted construction or implementability? | | | X |

** Asked of FWP only*

**Table 7-1**
**Results of Horseshoe Bend WTP Performance Testing**
**Butte Mine Flooding OU**

| Metals | Performance Test Results (ug/L) | Interim Limits Monthly Average (ug/L) | Final Limits Daily Maximum (ug/L) | Final Limits Monthly Average (ug/L) |
|---|---|---|---|---|
| Arsenic | <0.8 | 10 | 10 | 10 |
| Cadmium | 1.5 | 11 | 5 | 0.8 |
| Copper | 8.9 | 30.5 | 51.6 | 30.5 |
| Iron | 57 | 1000 | 1500 | 1000 |
| Lead | Non detect | 15 | 15 | 15 |
| Mercury | Non detect | 0.91 | 1.7 | 0.91 |
| Uranium | Non detect | 30 | 30 | 30 |
| Zinc | 123 | 388 | 388 | 388 |

## Table 7-2
## Existing Performance Standards at the Warm Springs Ponds OUs and Current State and Federal Aquatic Life and Human Health Standards

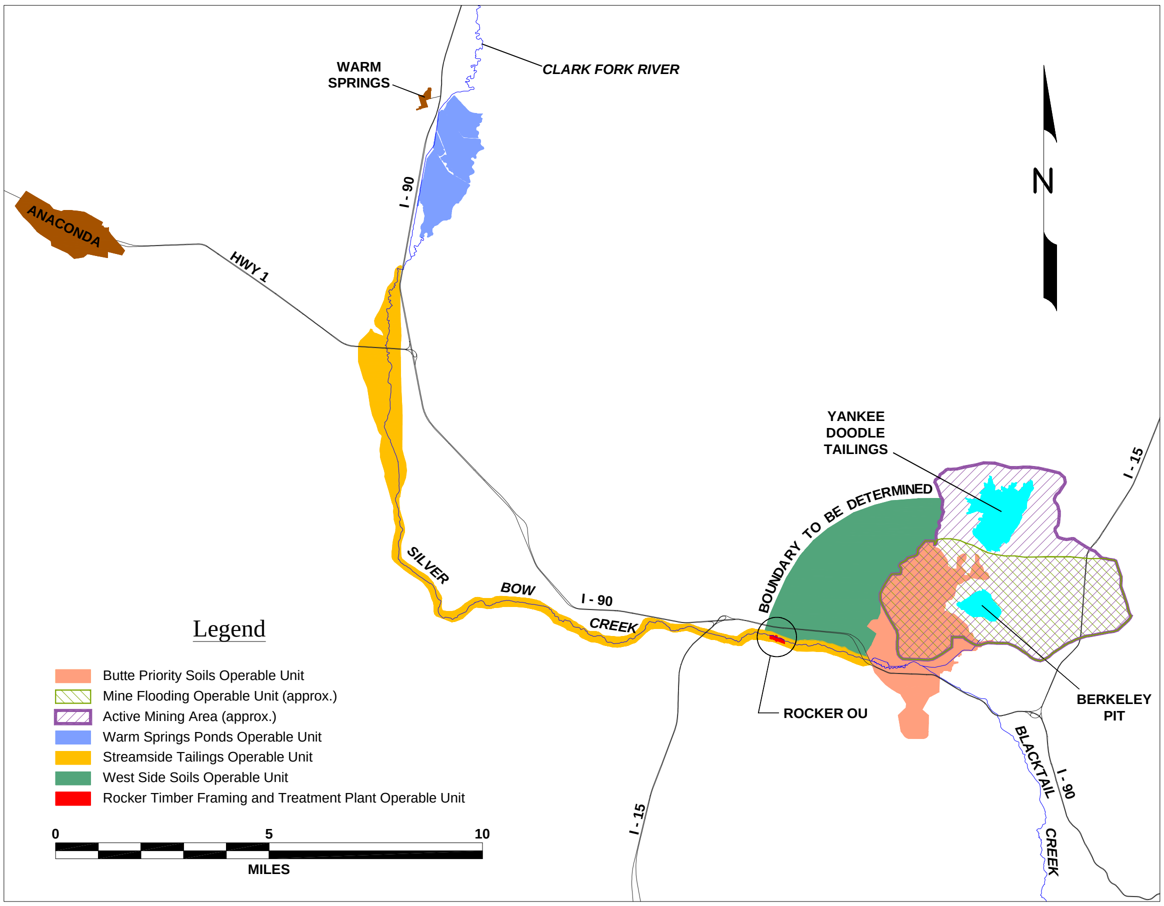
| Constituent | Surface Water | | | | | | | Groundwater | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Existing Performance Std. | | State [1] | | | Federal [2] | | Existing Performance Std. (mg/L) | State [1] | Federal [3] |
| | | | Current Aquatic Life Standards | | Current Human Health Std. (mg/L) | Ambient Water Quality Criteria | | | Current Human Health Std. (mg/L) | Current MCL (mg/L) |
| | Daily Maximum (mg/L) | Monthly Average (mg/L) | Acute (mg/L) | Chronic (mg/L) | | CMC [4] (mg/L) | CCC [5] (mg/L) | | | |
| Arsenic | 0.020 | 0.020 | 0.340 | 0.150 | 0.018 | 0.340 | 0.150 | 0.050 | 0.020 | 0.010 |
| Cadmium | 0.0062 [6] | 0.0016 [6] | 0.0032 [6] | 0.00037 [6] | 0.005 | 0.0030 [6] | 0.00033 [6] | 0.010 | 0.005 | 0.005 |
| Chromium | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 0.050 | 0.1 | 0.1 |
| Copper | 0.026 [6] | 0.017 [6] | 0.0205 [6] | 0.0132 [6] | 1.3 | 0.0197 [6] | 0.0127 [6] | N/A | 1.3 | 1.3 |
| Lead | 0.137 [6] | 0.0053 [6] | 0.137 [6] | 0.0053 [6] | 0.015 | 0.1001 [6] | 0.0039 [6] | 0.050 | 0.015 | 0.015 |

**Notes:**

1. Montana Numeric water Quality Standards – Circular WQB-7. January 2004
2. Current National Recommended Water Quality Criteria; U.S. Environmental Protection Agency Web Page: http://www.epa.gov/waterscience/criteria/wqcriteria.html#notes
3. Safe Drinking Water Contaminants and Federal Maximum Contaminant Levels(MCLs); U.S. Environmental Protection Agency Web Page: http://www.epa.gov/safewater/mcl.html#mcls
4. CMC – Criteria Maximum Concentration is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.
5. CCC - Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.
6. Hardness-dependent aquatic life standards(Cd, Cu, Pb) are presented based on a hardness of 150 mg/L as $CaCO_3$.

# Figures

# Figure 3-1
# Site Location

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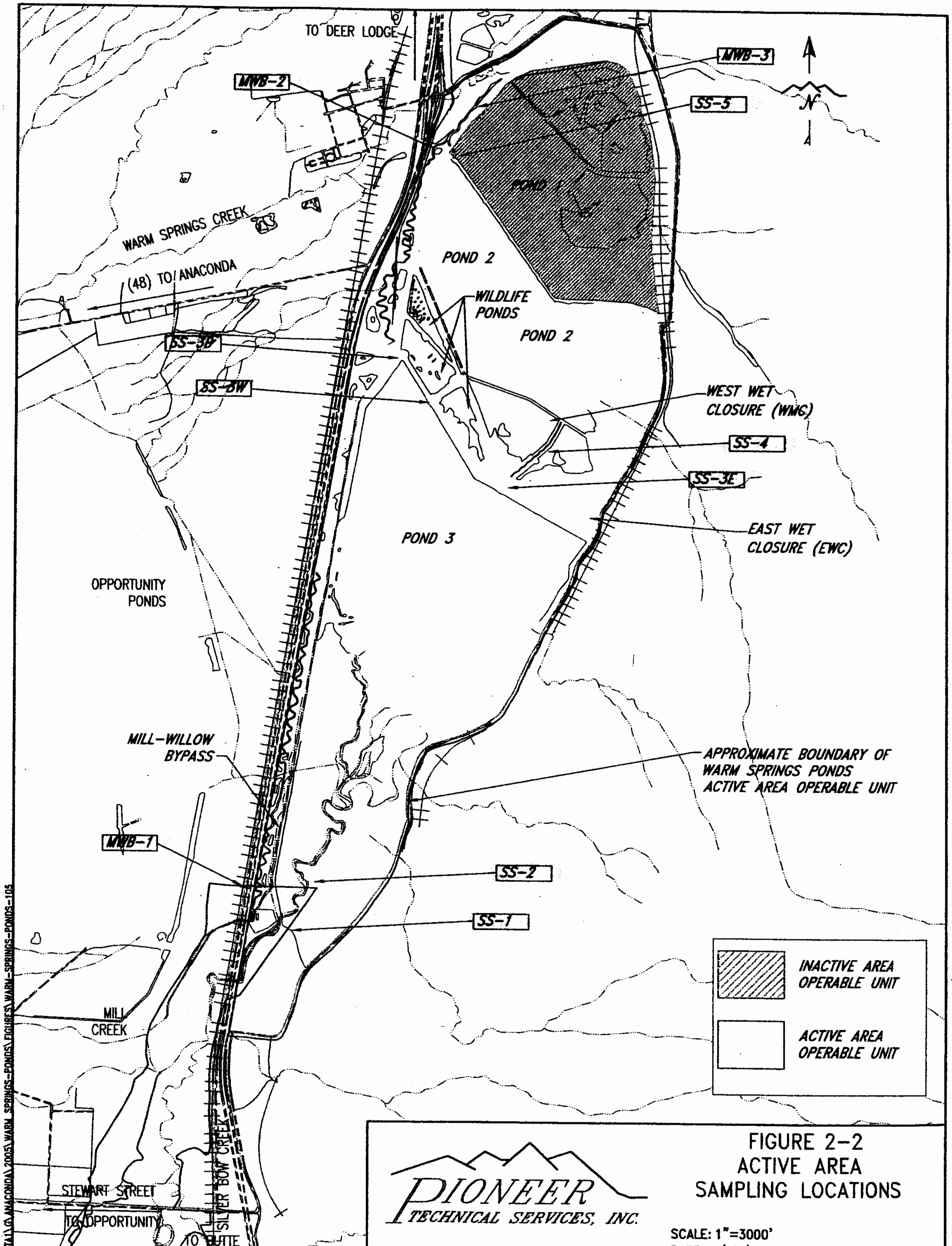


FIGURE 2-2
ACTIVE AREA
SAMPLING LOCATIONS

SCALE: 1"=3000'
DATE: 4/25/05

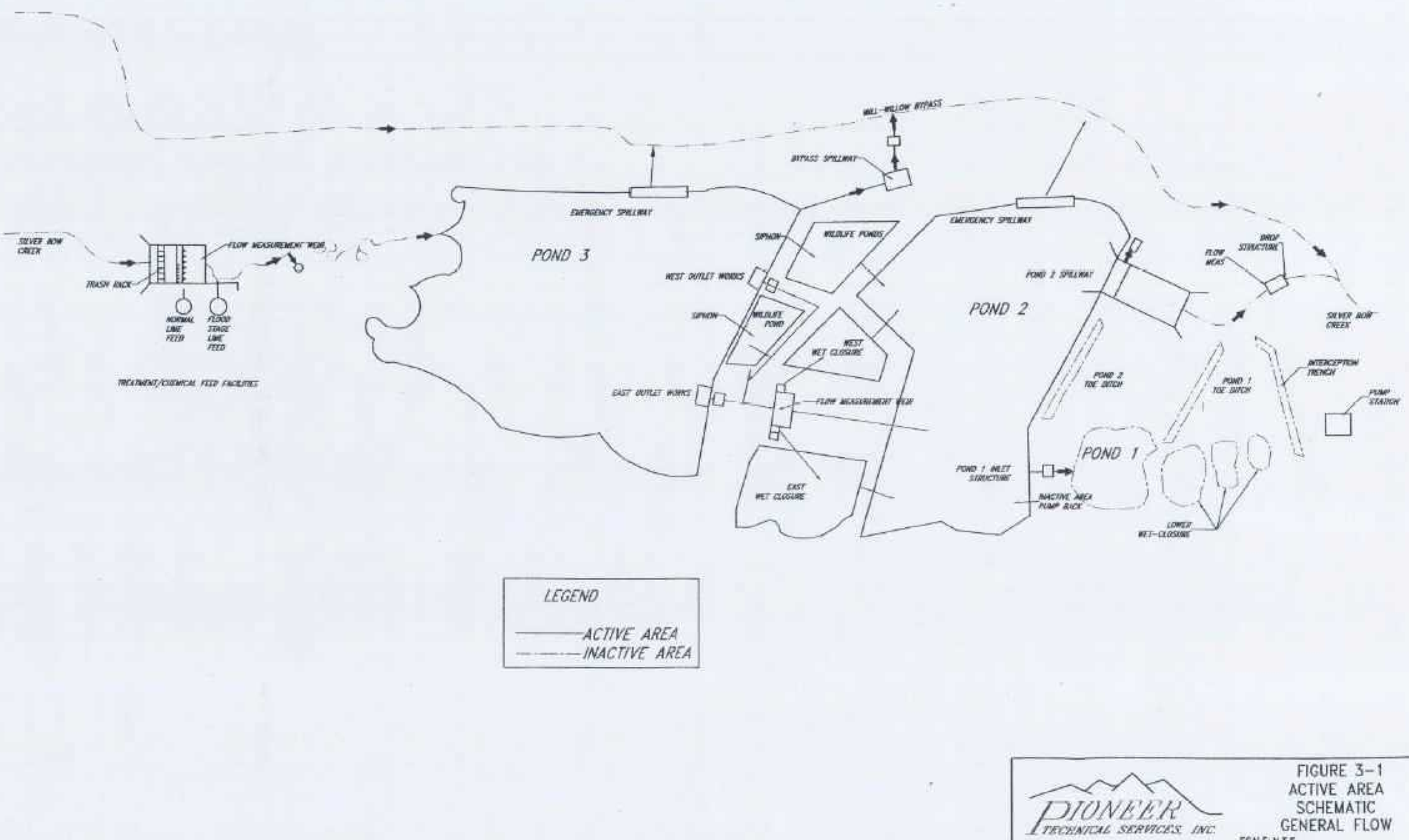


FIGURE 3-1
ACTIVE AREA
SCHEMATIC
GENERAL FLOW

SCALE: N.T.S.
DATE: 4/25/05

**Figure 5-3**
**Influent (SS-1) and Effluent (SS-5) Daily Flow Rates for the Warm Springs Ponds**
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

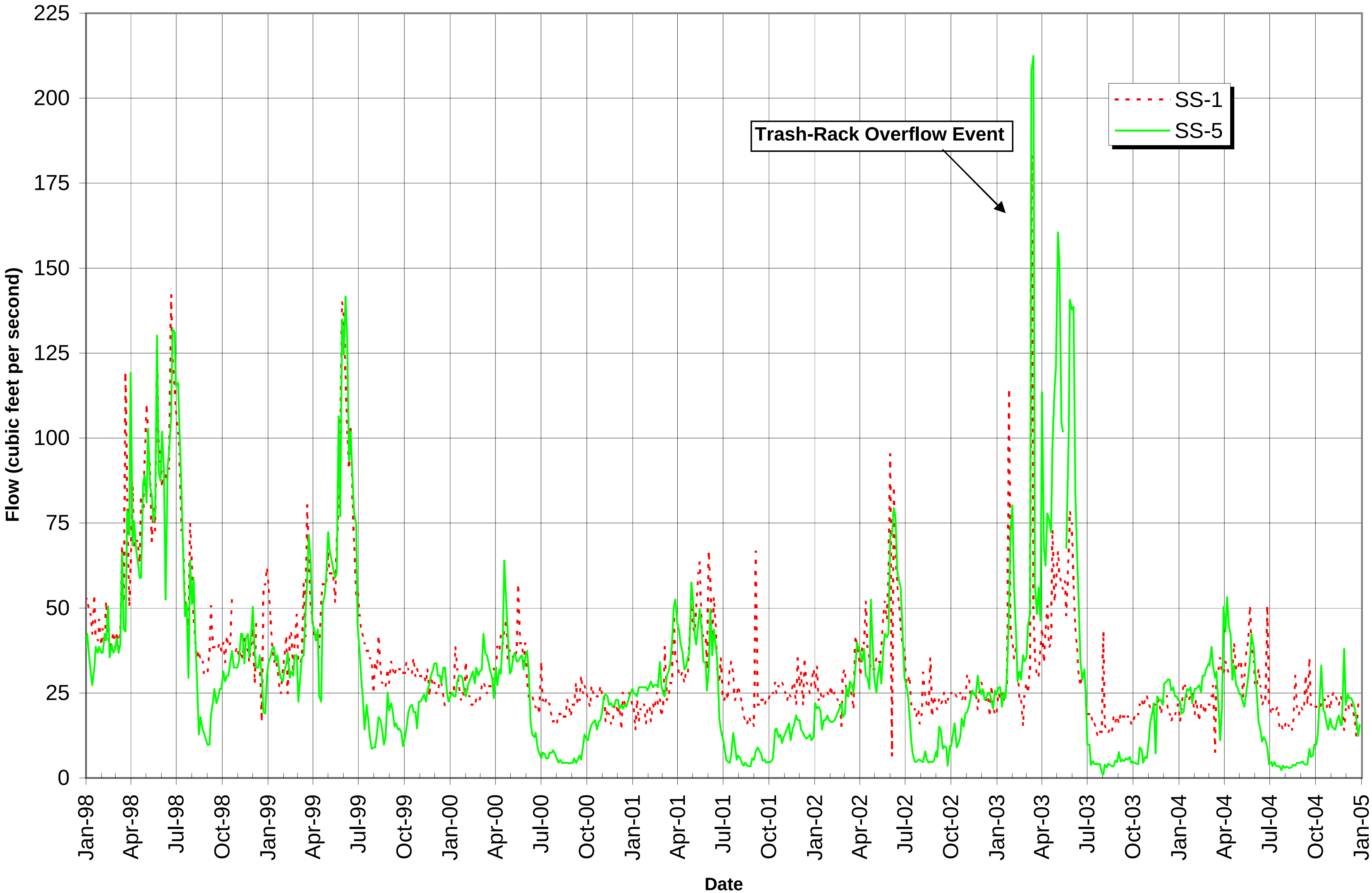


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**Figure 5-4**

**Influent (SS-1) and Effluent (SS-5) Monthly Flow Rates for the Warm Springs Ponds**

***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

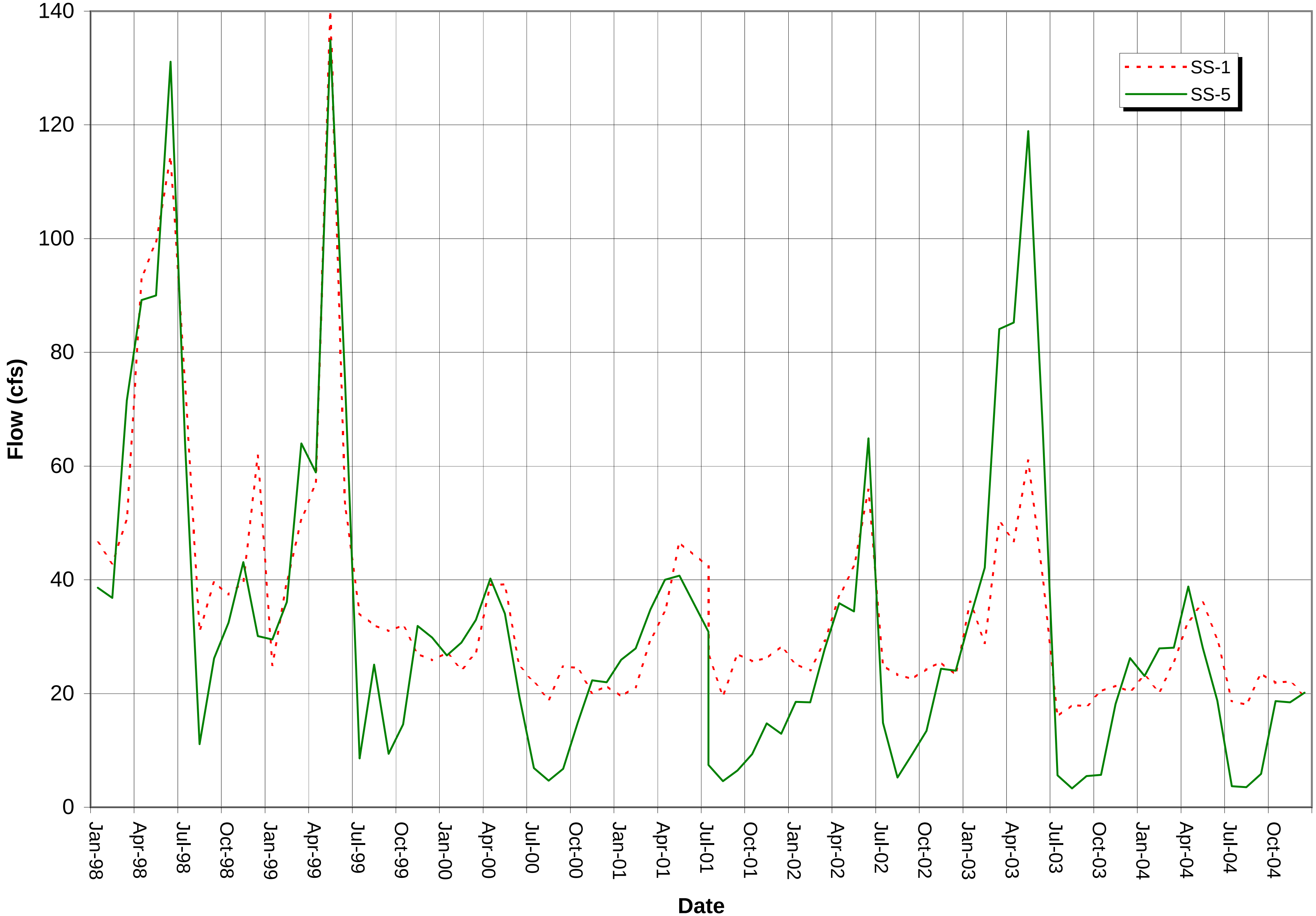


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**Figure 5-5**
**Pond 2 Elevations at the Warm Springs Ponds**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

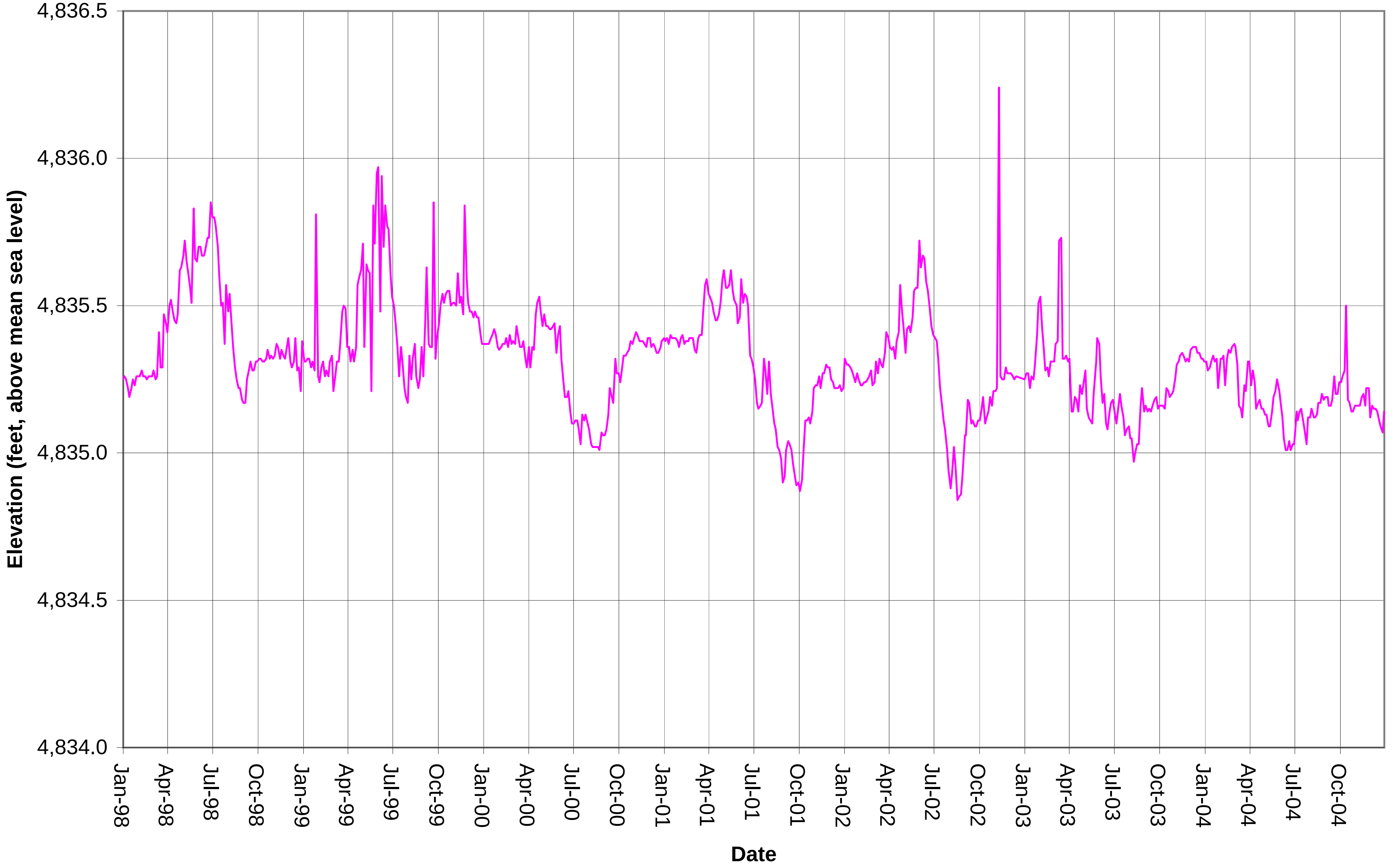


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**Figure 5-6**
**Pond 3 Elevations at the Warm Springs Ponds**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

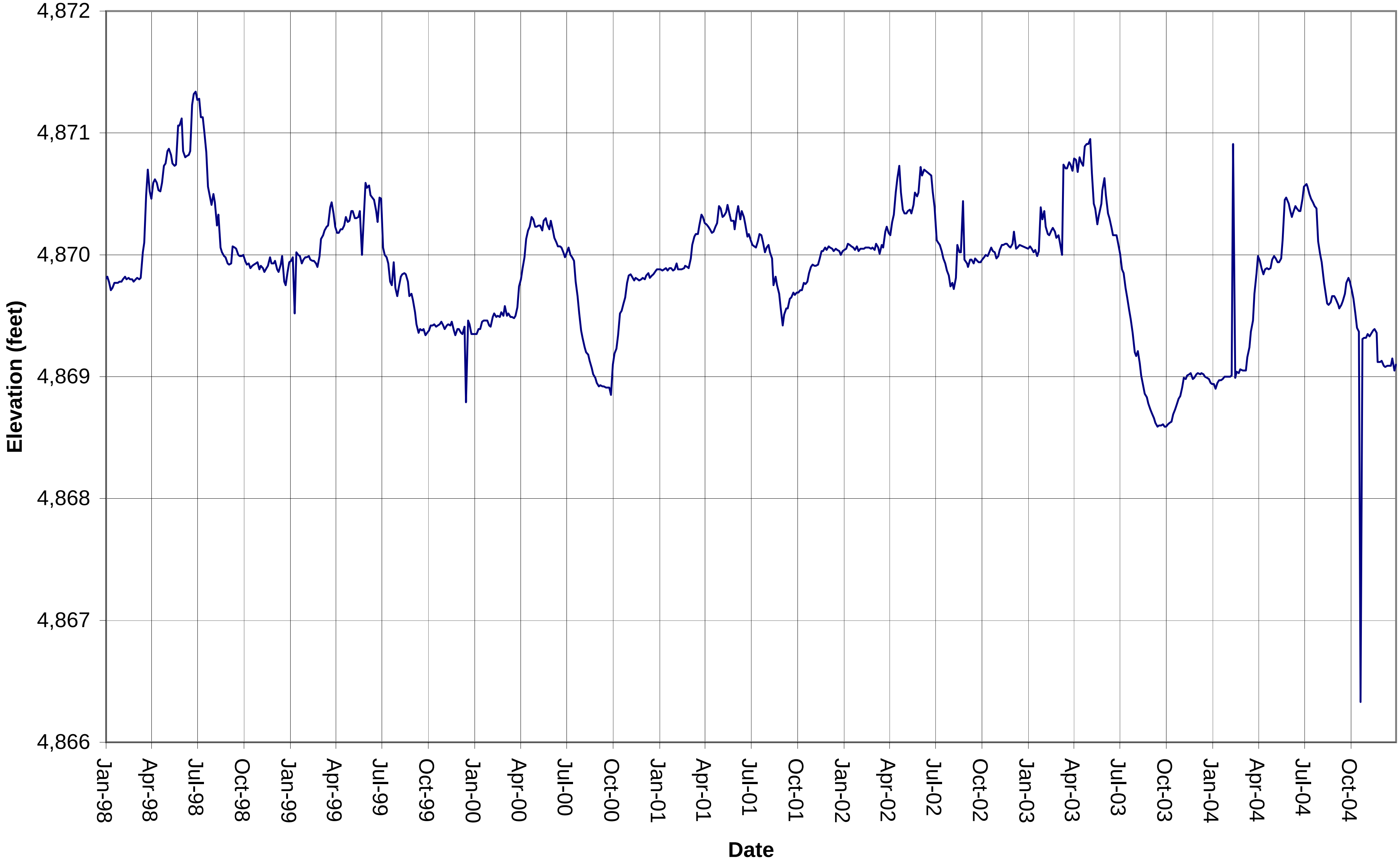


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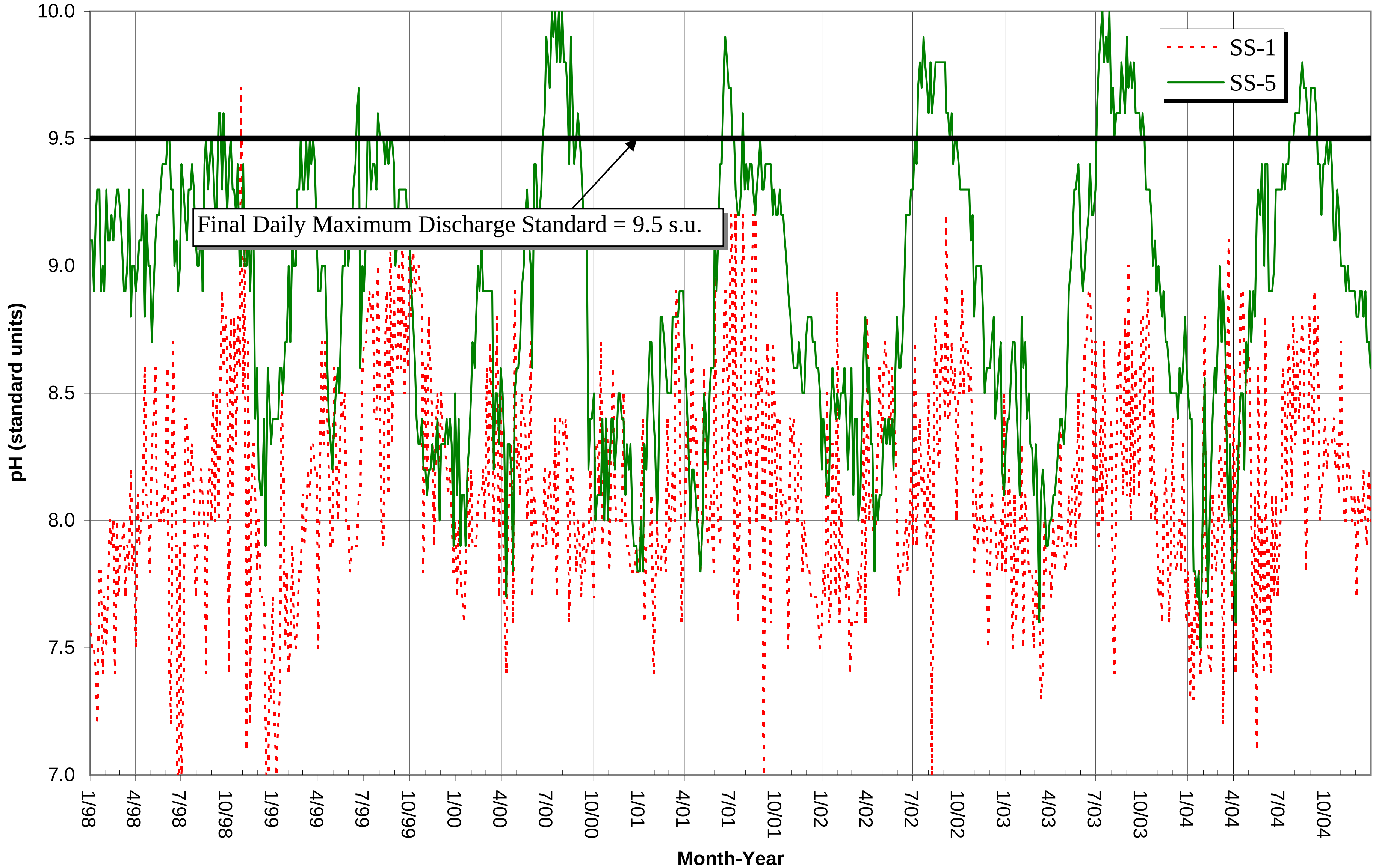
**Figure 5-7**

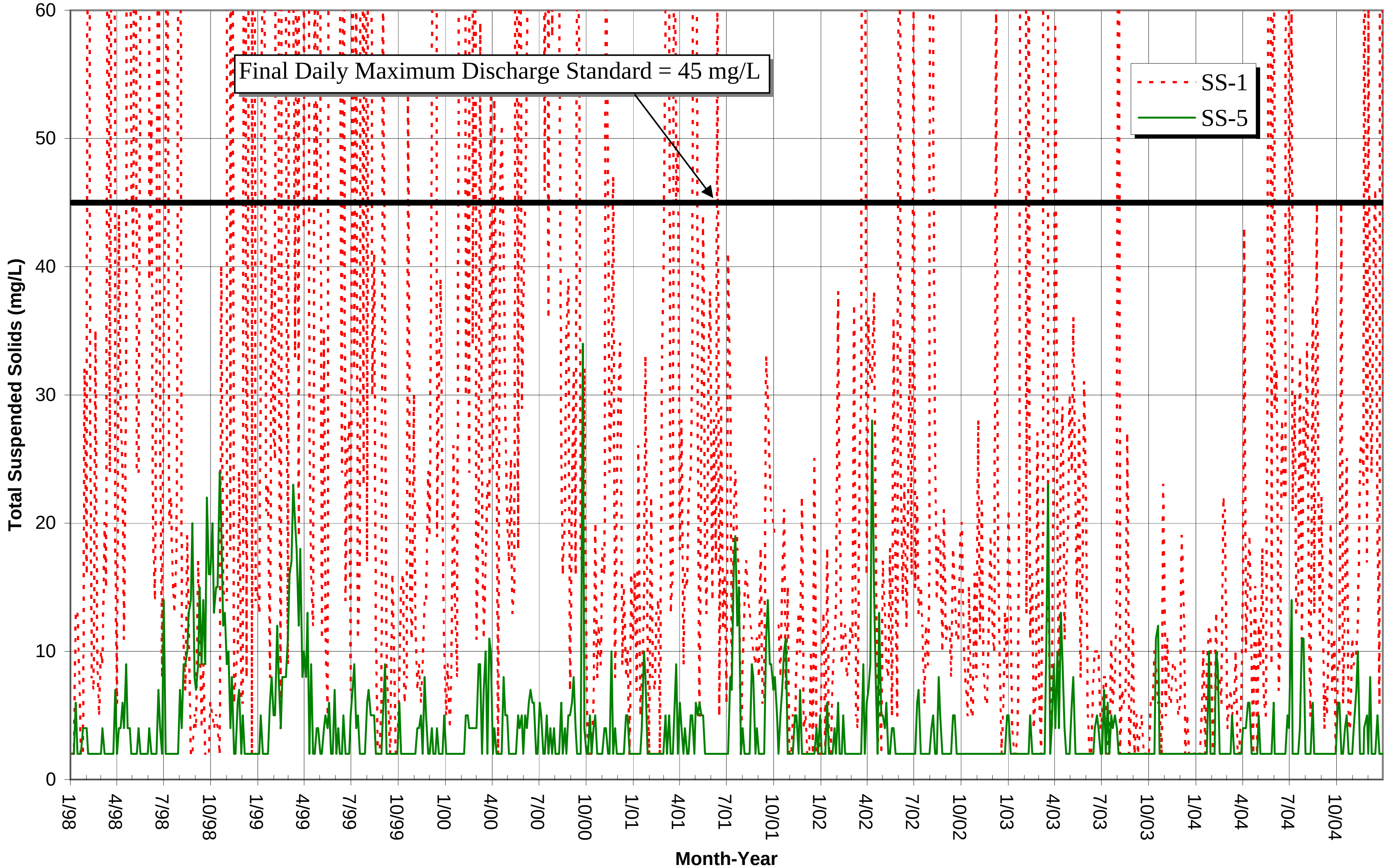
**Comparison of Influent (SS-1) and Effluent (SS-5) pH values with Final Daily Performance Standard**

***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***



## Figure 5-8
## Comparison of Influent (SS-1) and Effluent (SS-5) Total Suspended Solids Concentration with Final Daily Performance Standard

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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## Figure 5-9
## Comparison of Influent (SS-1) and Effluent (SS-5) Total Recoverable Arsenic Concentrations with Final Daily Performance Standard

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

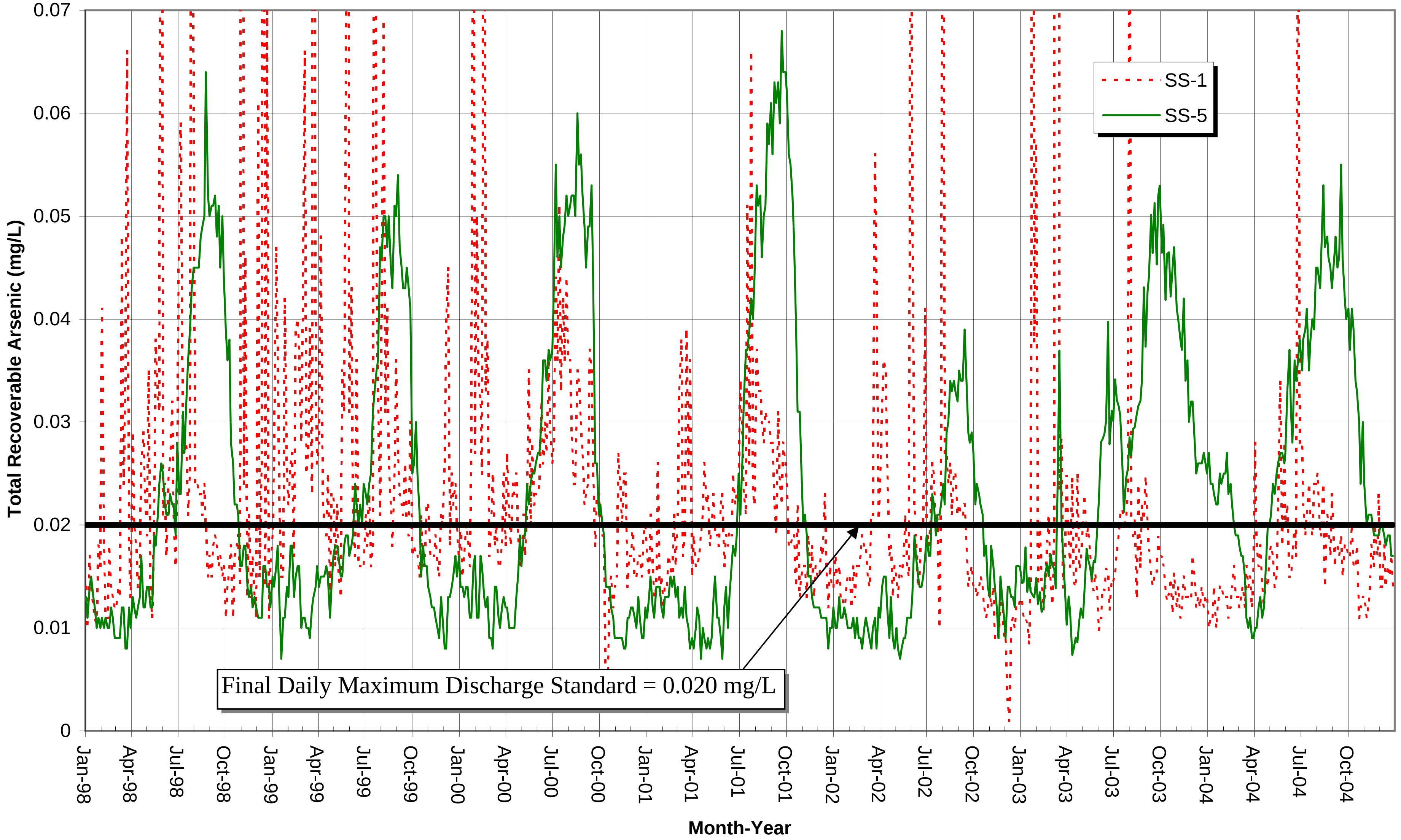


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**Figure 5-10**
**Comparison of Influent and Effluent Arsenic Loading at the Warm Springs Ponds**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

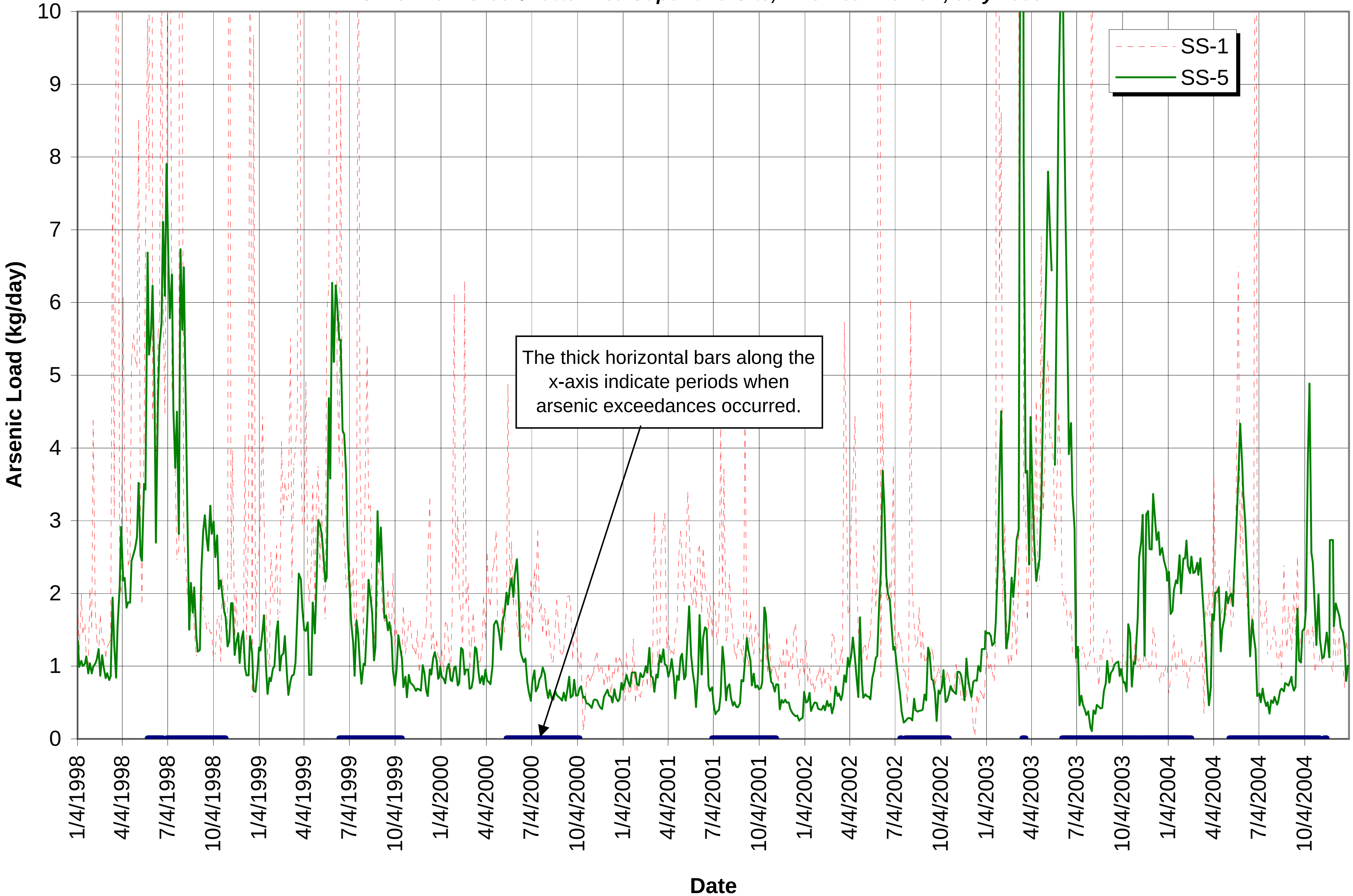


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**Figure 5-11**
**Comparison of Net Arsenic Loading with Periods of Exceedances**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

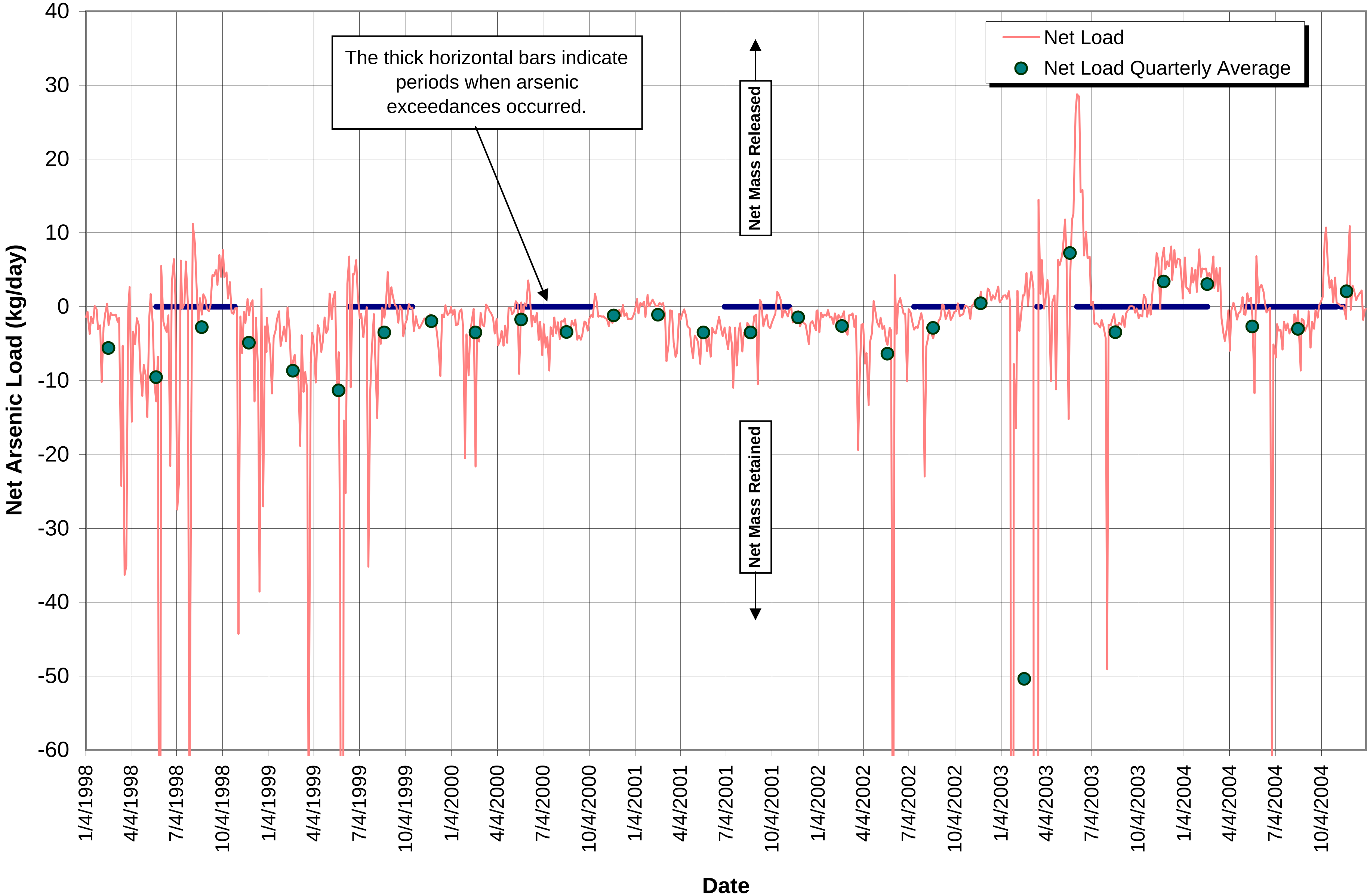


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**Figure 5-12**
**Comparison of Arsenic Loads from the Warm Springs Ponds (SS-5) and Downstream Station MWB-3 against SS-5 Discharge Concentrations**
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

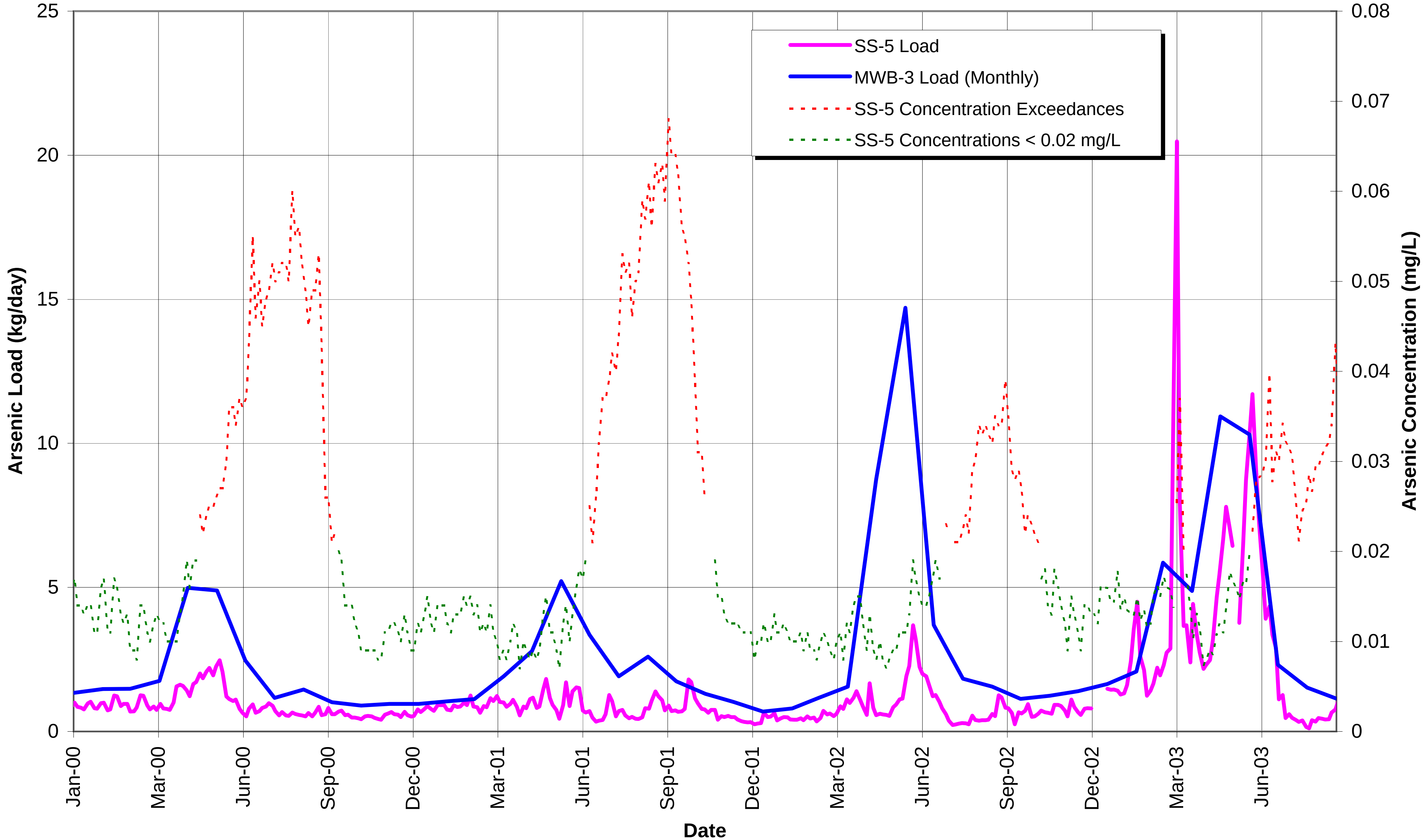


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**Figure 5-13**
**Comparison of Influent (SS-1) and Effluent (SS-5) Total Recoverable Cadmium Concentrations with Final Daily Performance Standard**
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

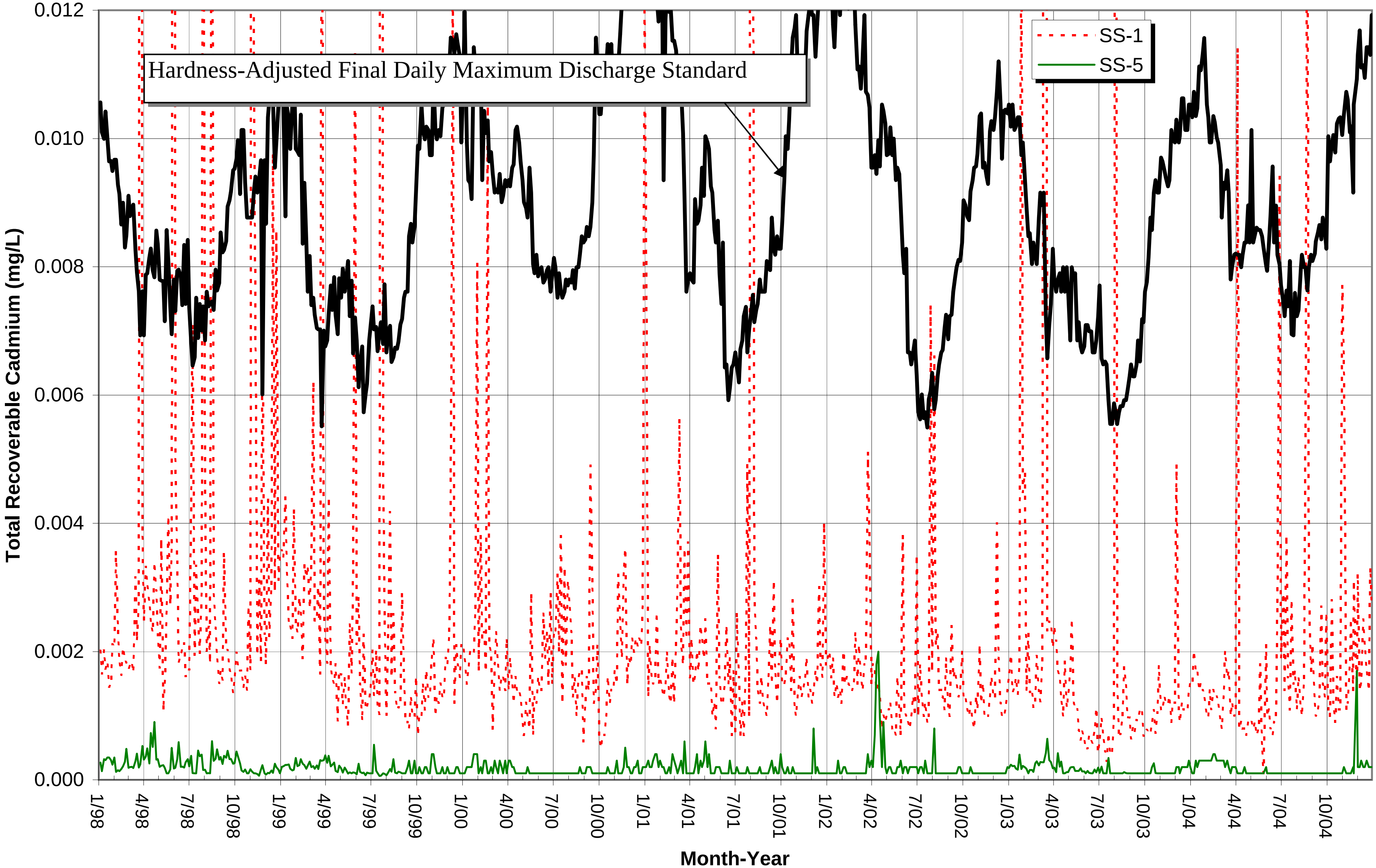


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**Figure 5-14**
**Comparison of Influent (SS-1) and Effluent (SS-5) Total Recoverable Copper Concentrations with Final Daily Performance Standard**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

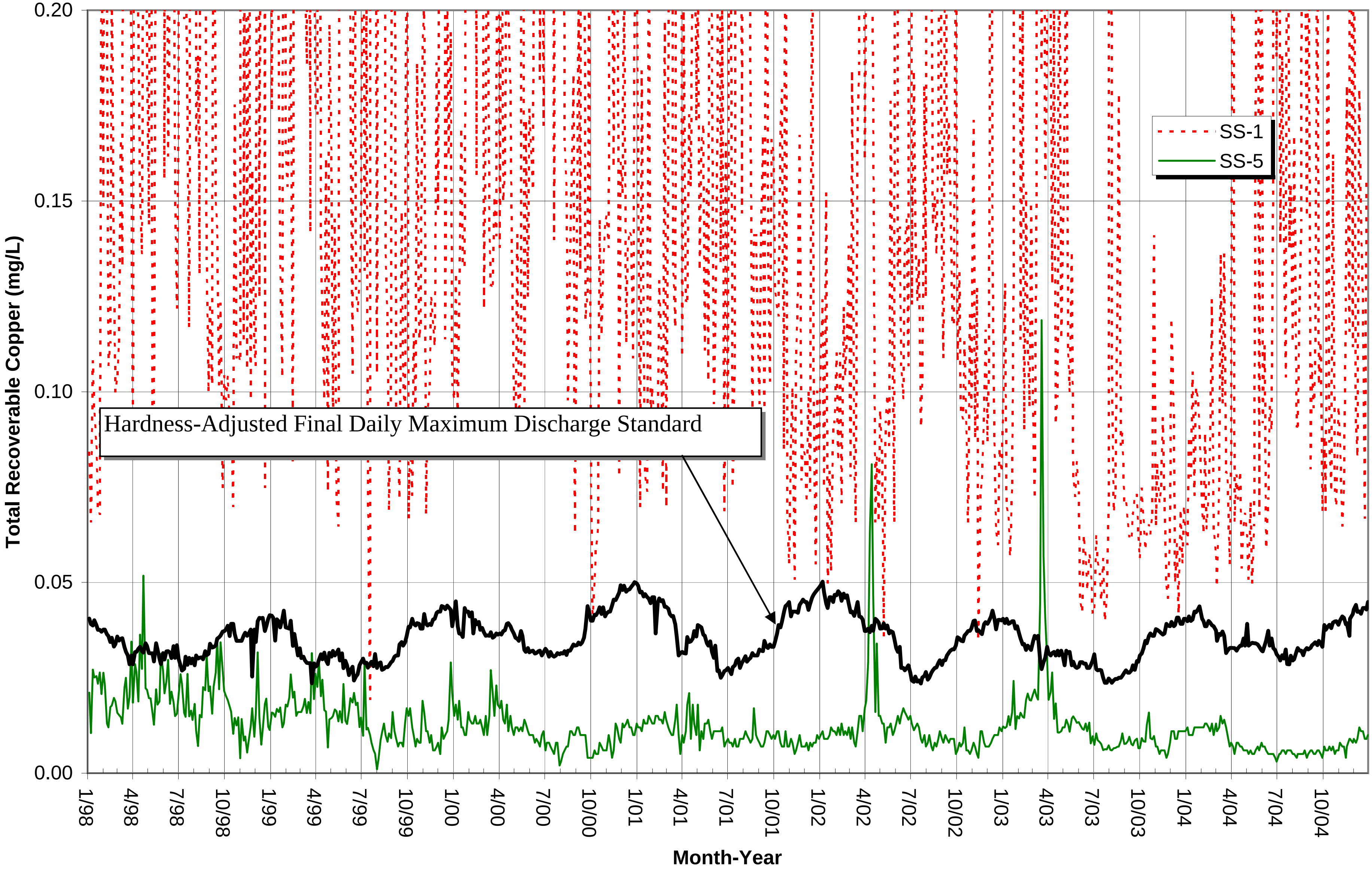


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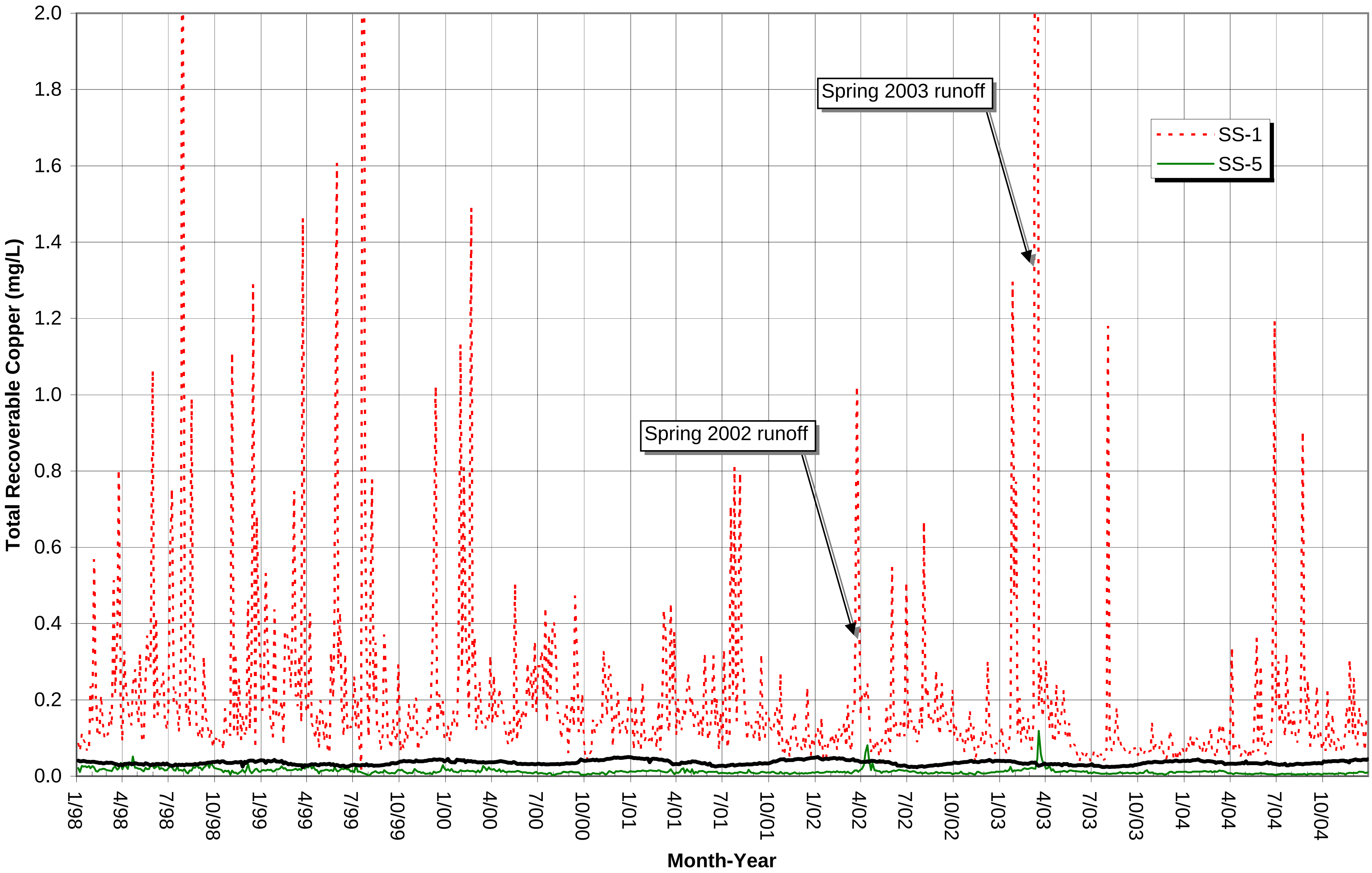
**Figure 5-15**
**Comparison of Influent (SS-1) and Effluent (SS-5) Total Recoverable Copper Concentrations with Final Daily Performance Standard, Scale Adjusted**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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## Figure 5-16

## Comparison of Influent (SS-1) and Effluent (SS-5) Total Recoverable Iron Concentrations with Final Daily Performance Standard

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

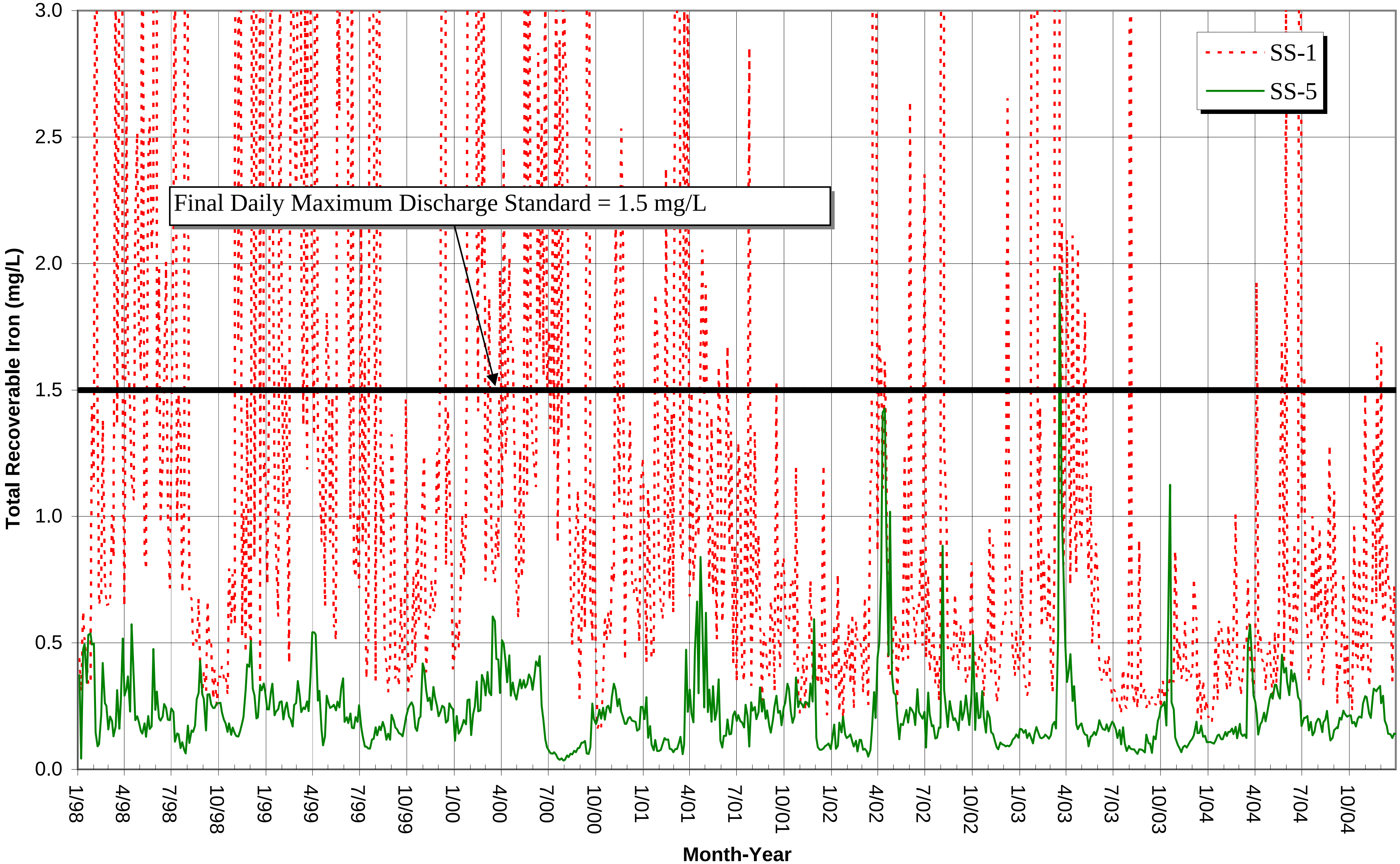


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**Figure 5-17**
**Comparison of Influent (SS-1) and Effluent (SS-5) Total Recoverable Lead Concentrations with Final Daily Performance Standard**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

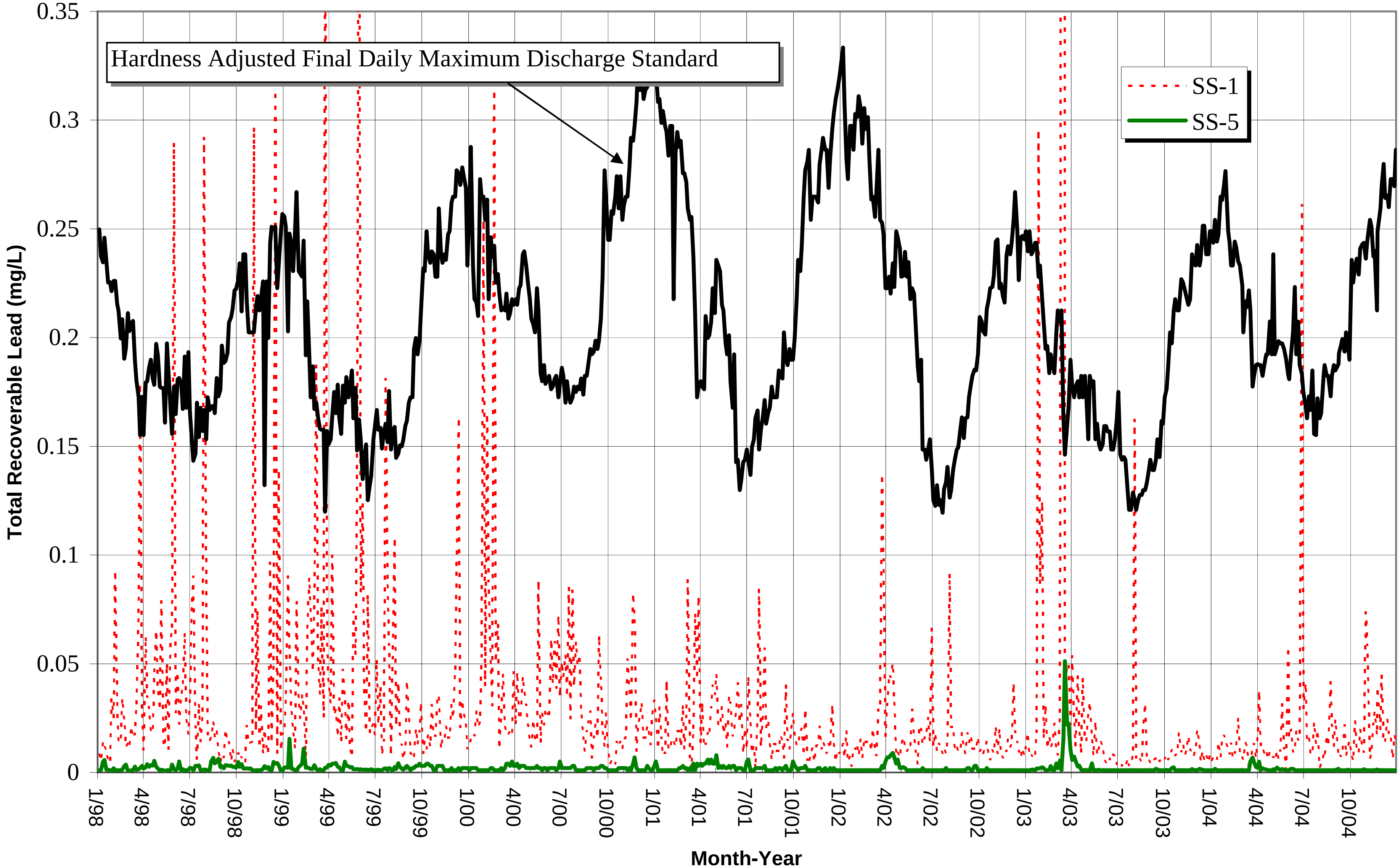


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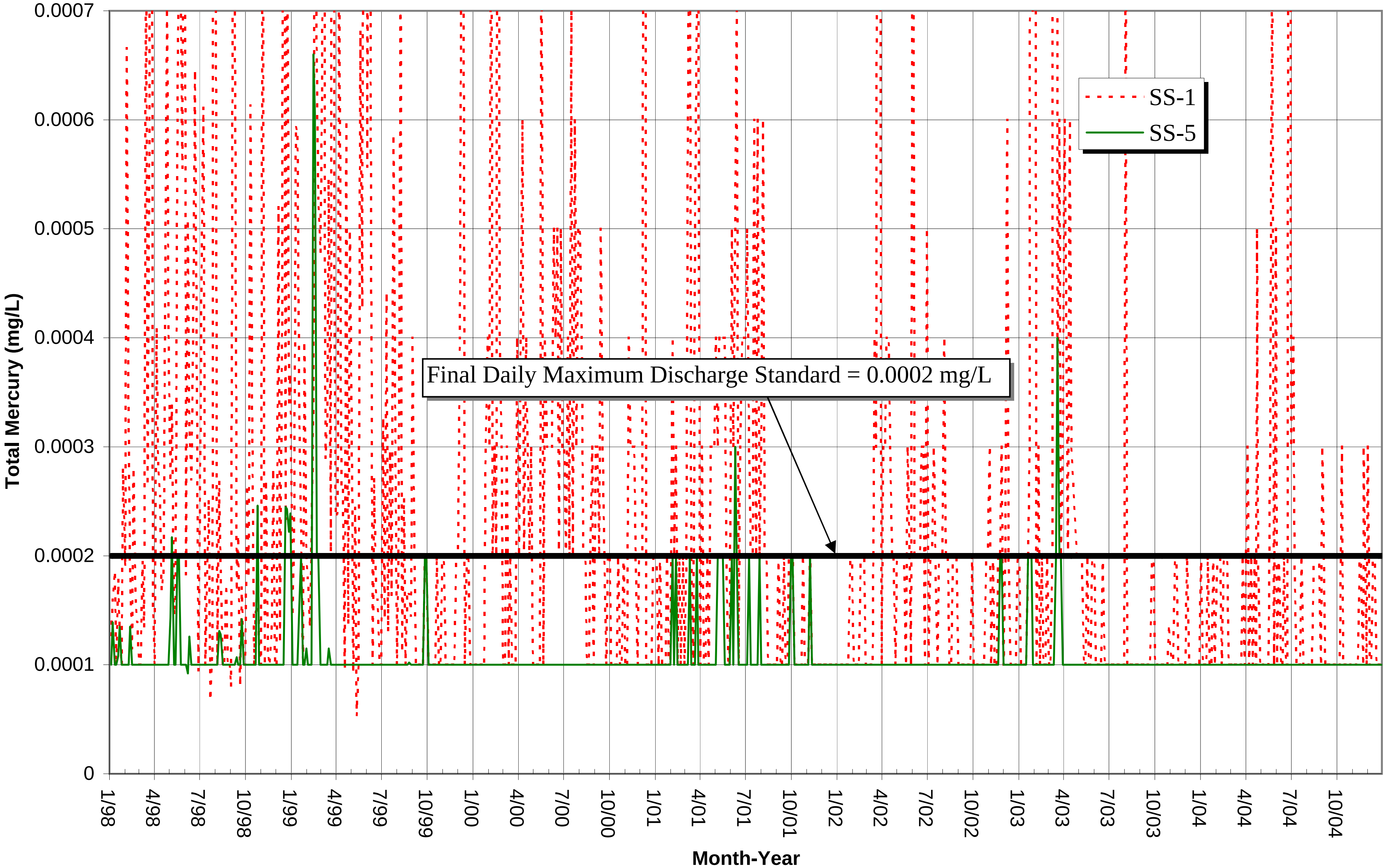
**Figure 5-18**
**Comparison of Influent (SS-1) and Effluent (SS-5) Total Mercury Concentrations with Final Daily Performance Standard**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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## Figure 5-19
## Comparison of Influent (SS-1) and Effluent (SS-5) Total Recoverable Selenium Concentrations with Final Daily Performance Standard

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

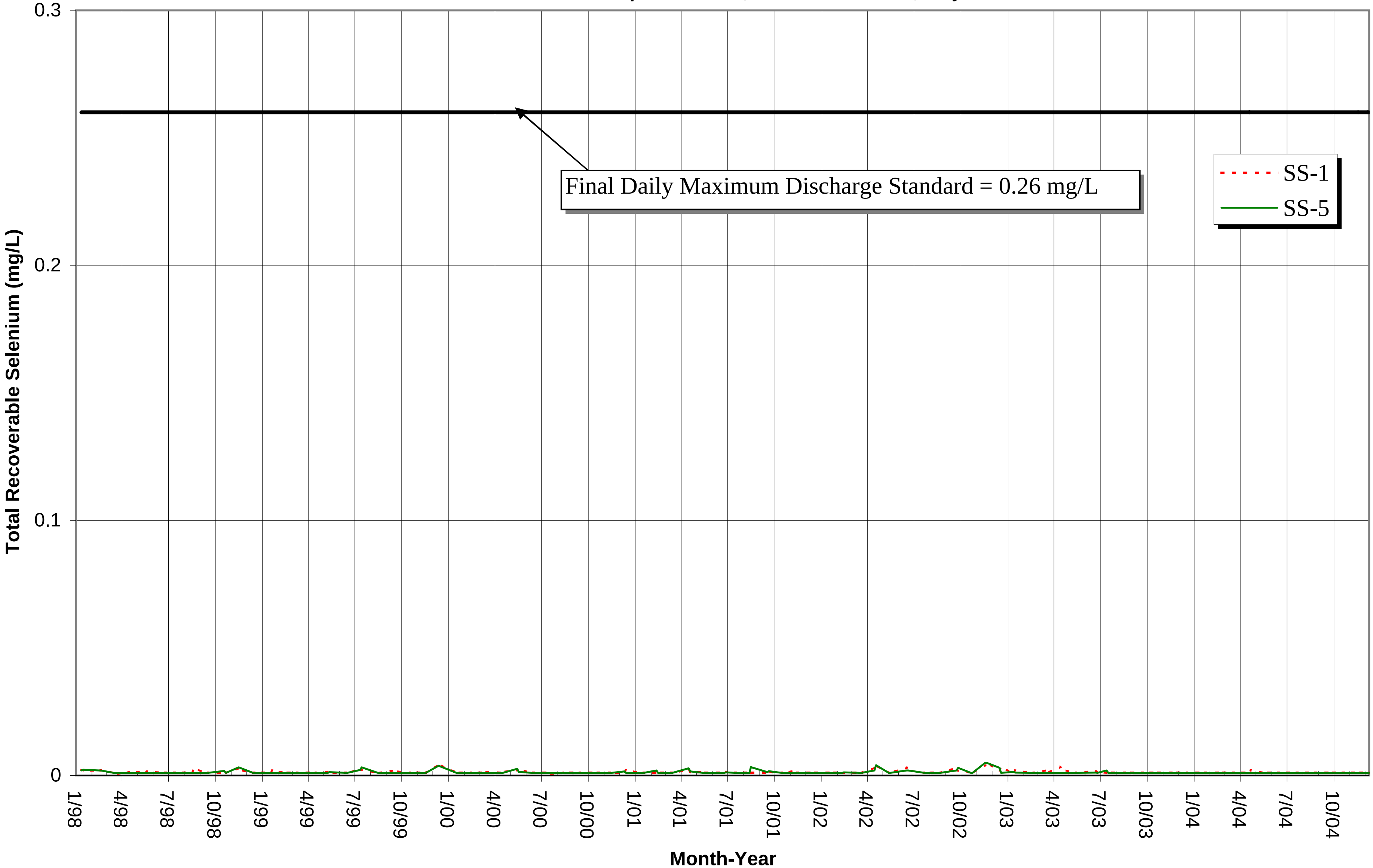


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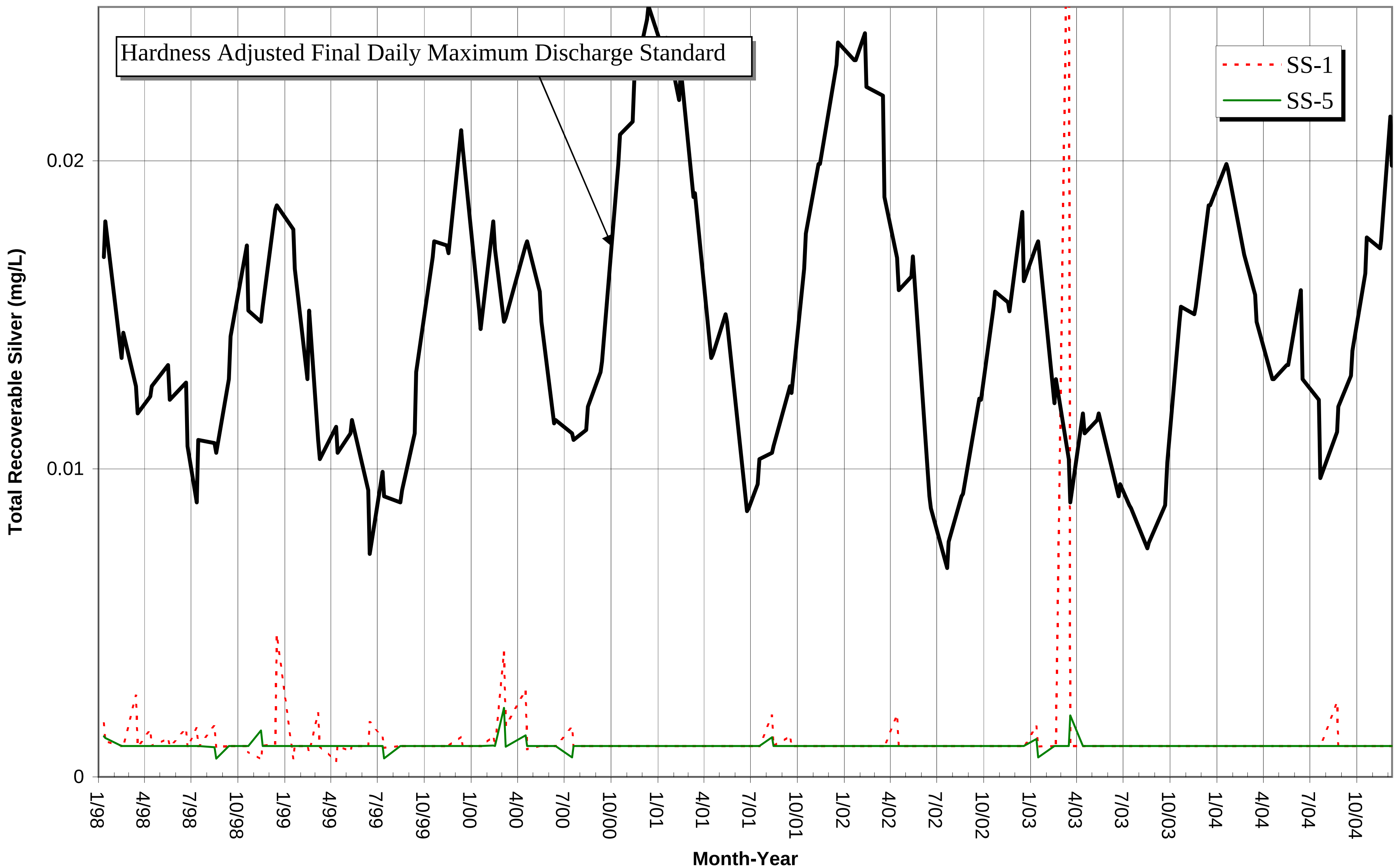
**Figure 5-20**
**Comparison of Influent (SS-1) and Effluent (SS-5) Total Recoverable Silver Concentrations with Final Daily Performance Standard**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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## Figure 5-21
## Comparison of Influent (SS-1) and Effluent (SS-5) Total Recoverable Zinc Concentrations with Final Daily Performance Standard

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

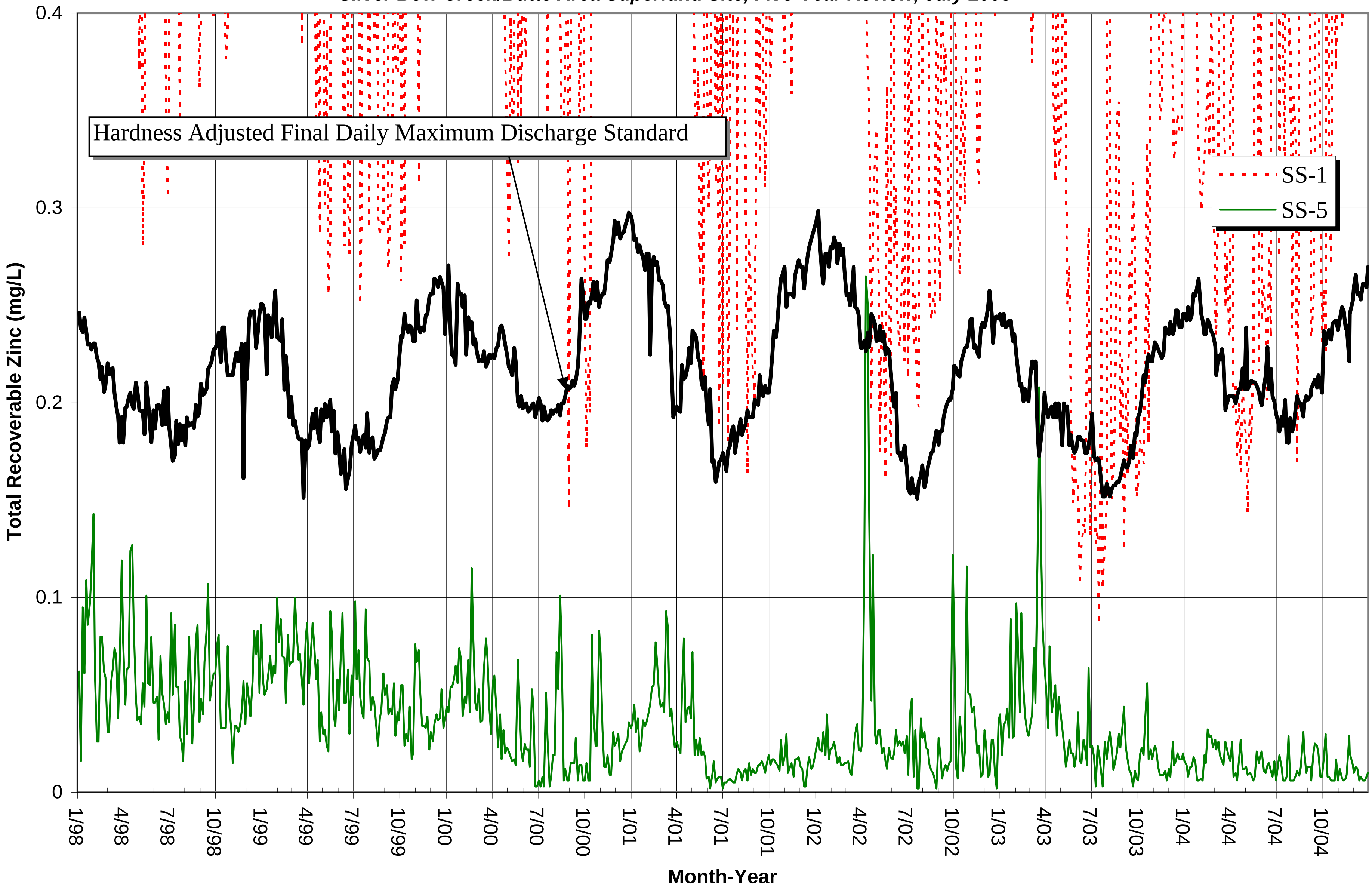


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**Figure 5-22**
**Arsenic Concentrations in Pond 3 Effluent Compared to East and West Wet Closure Ponds**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

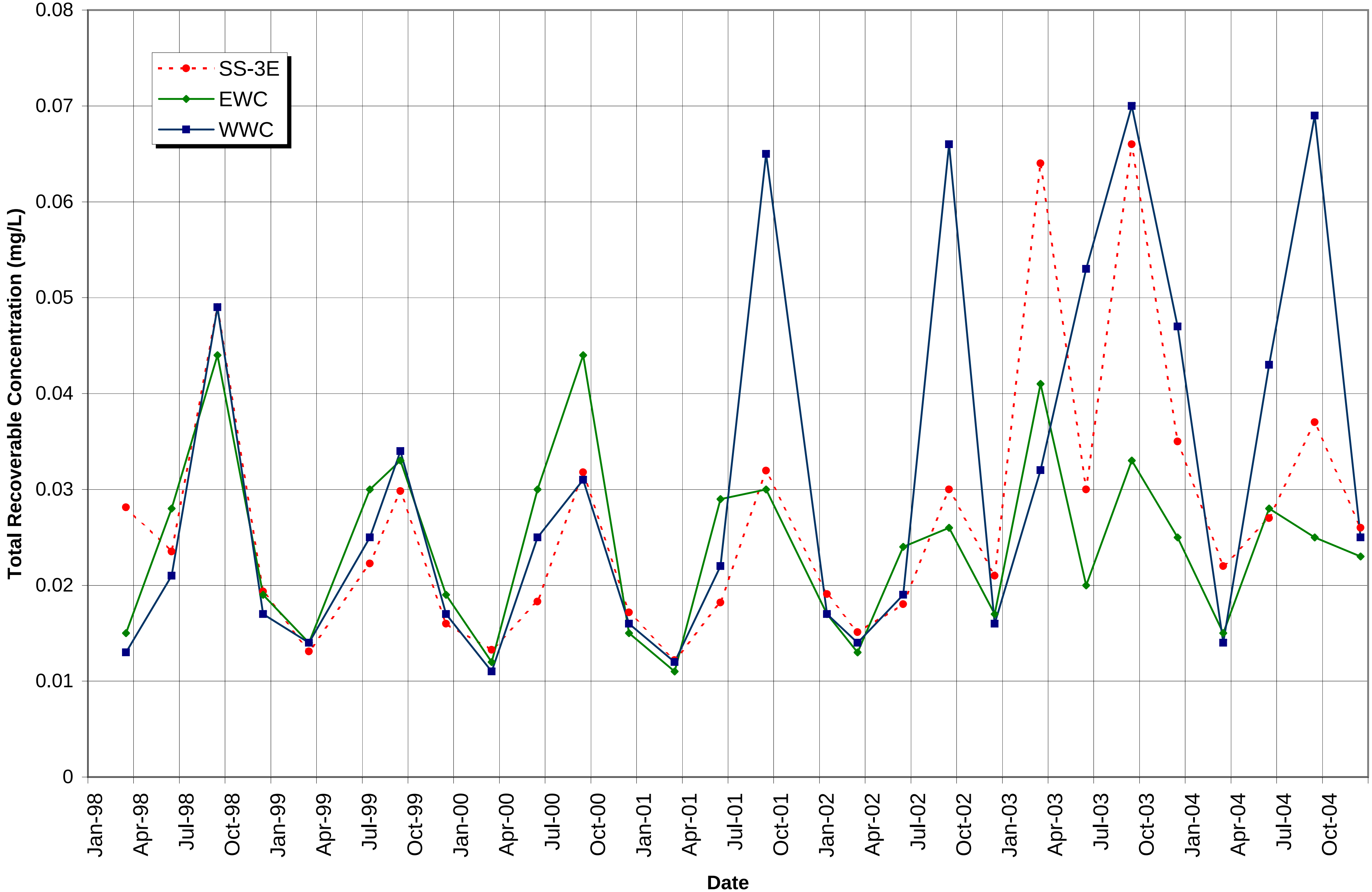


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**Figure 5-23**
**Copper Concentrations in Pond 3 Effluent Compared to East and West Wet Closure Ponds**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

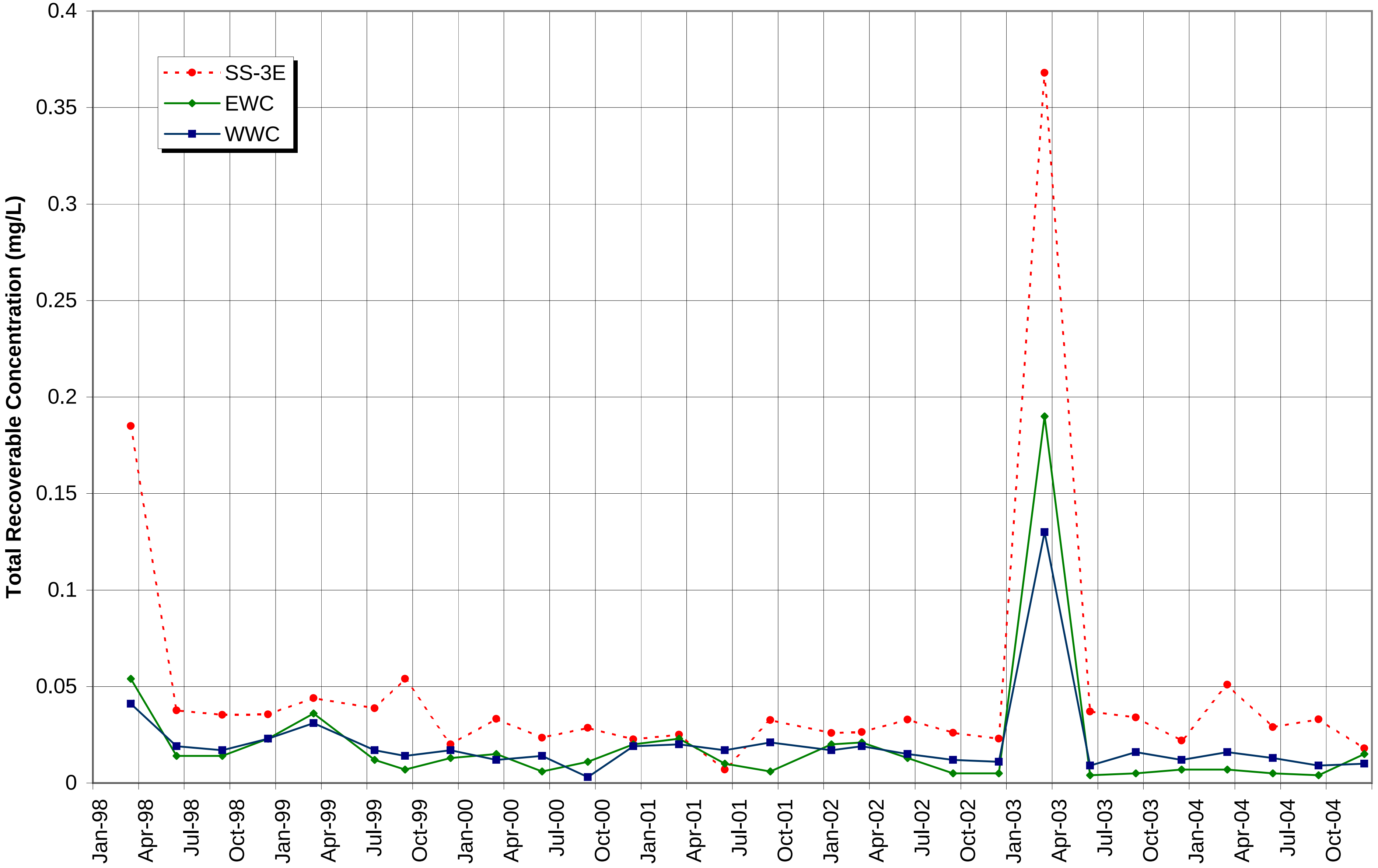


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**Figure 5-24**
**Iron Concentrations in Pond 3 Effluent Compared to East and West Wet Closure Ponds**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

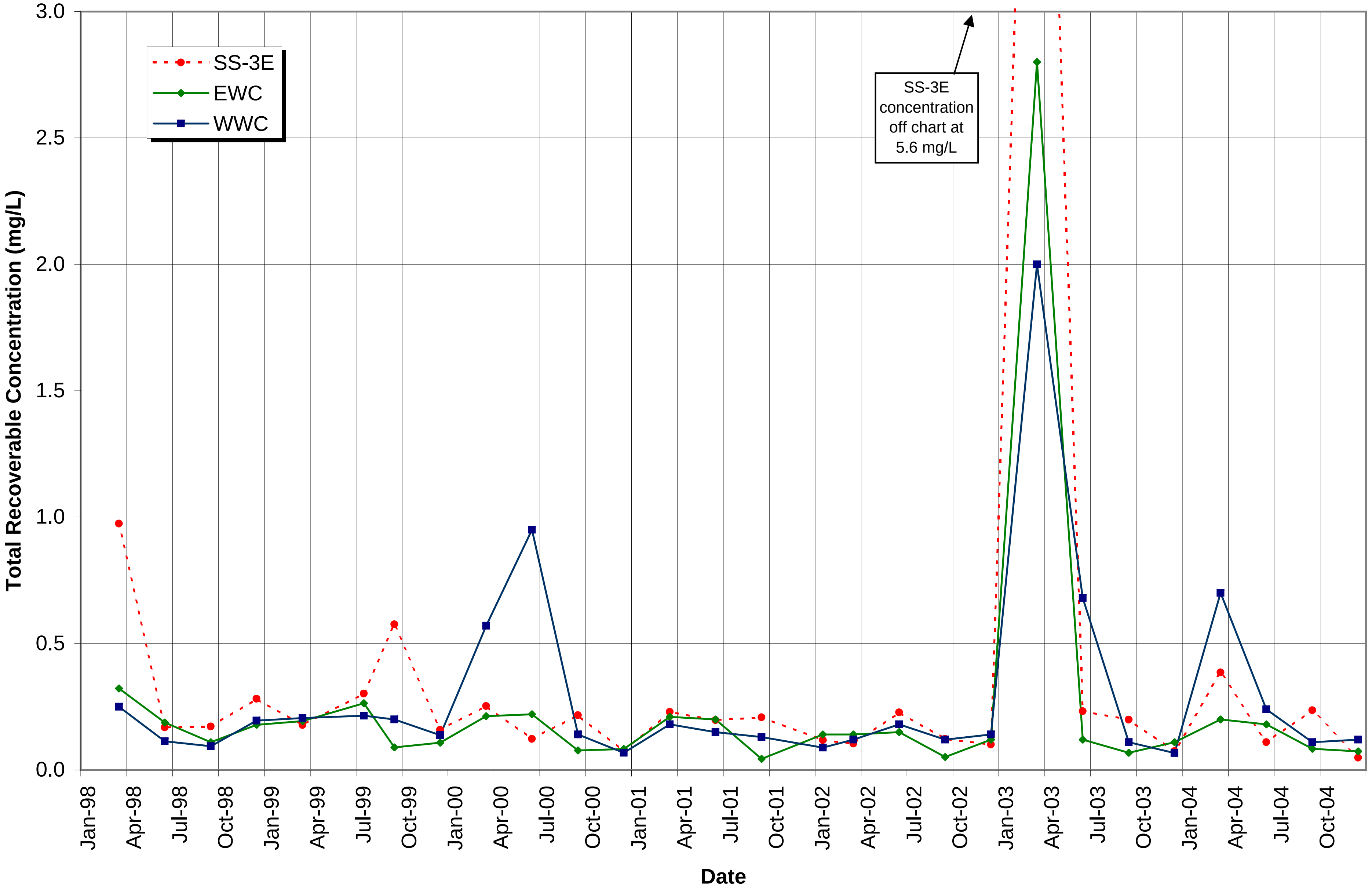


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**Figure 5-25**

**Zinc Concentrations in Pond 3 Effluent Compared to East and West Wet Closure Ponds**

***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

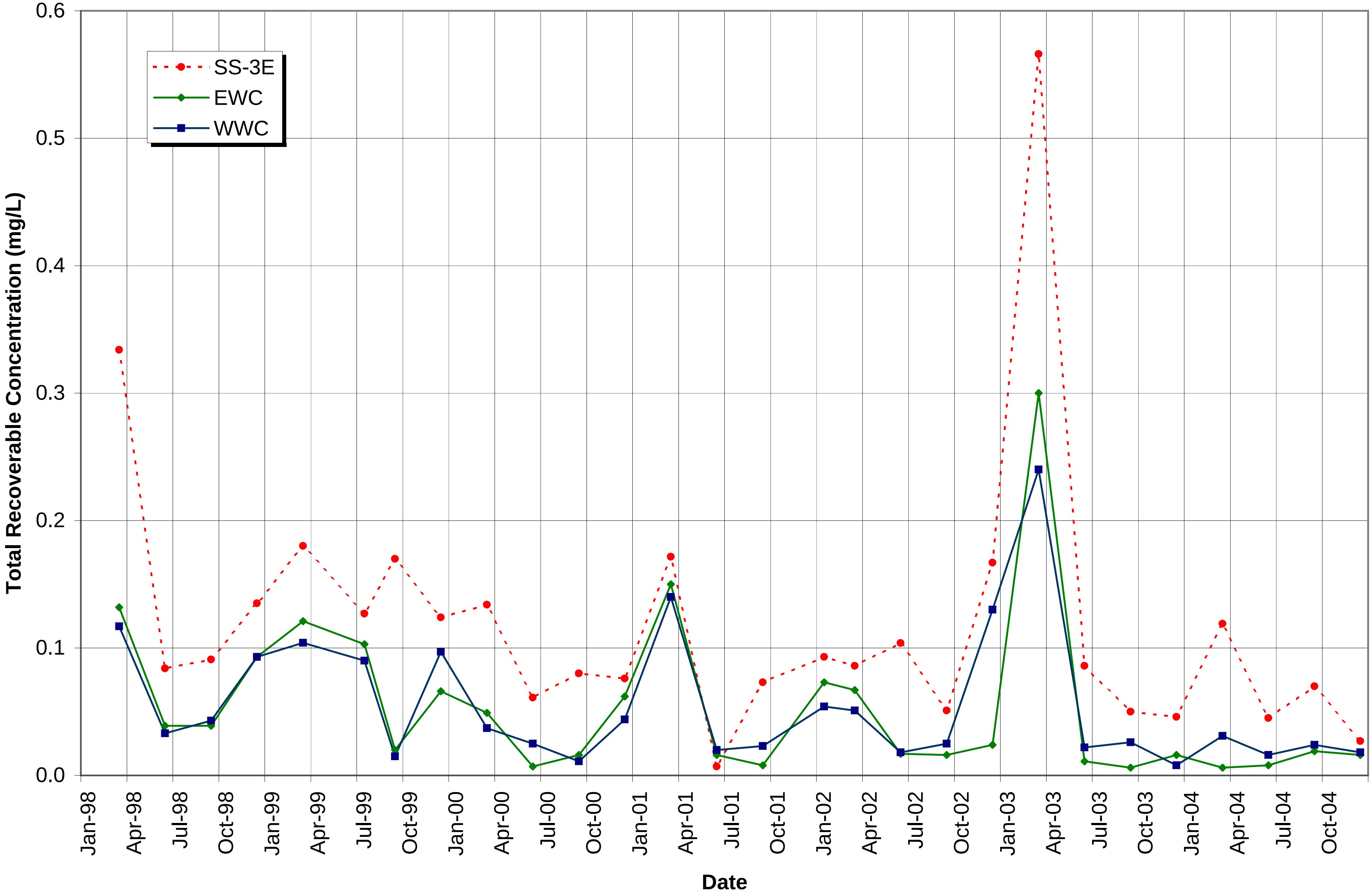


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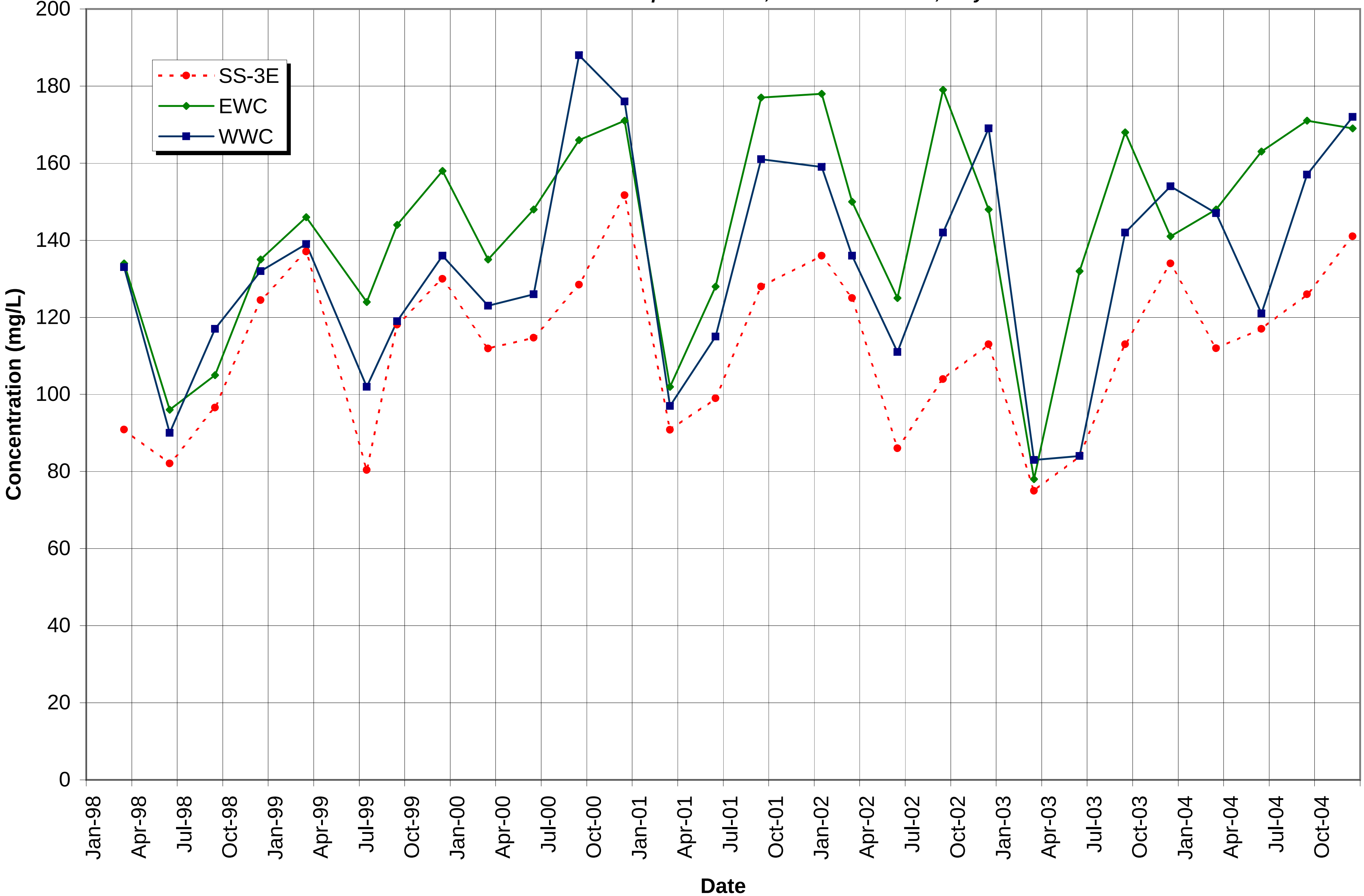
**Figure 5-26**

**Sulfate Concentrations in Pond 3 Effluent Compared to East and West Wet Closure Ponds**

***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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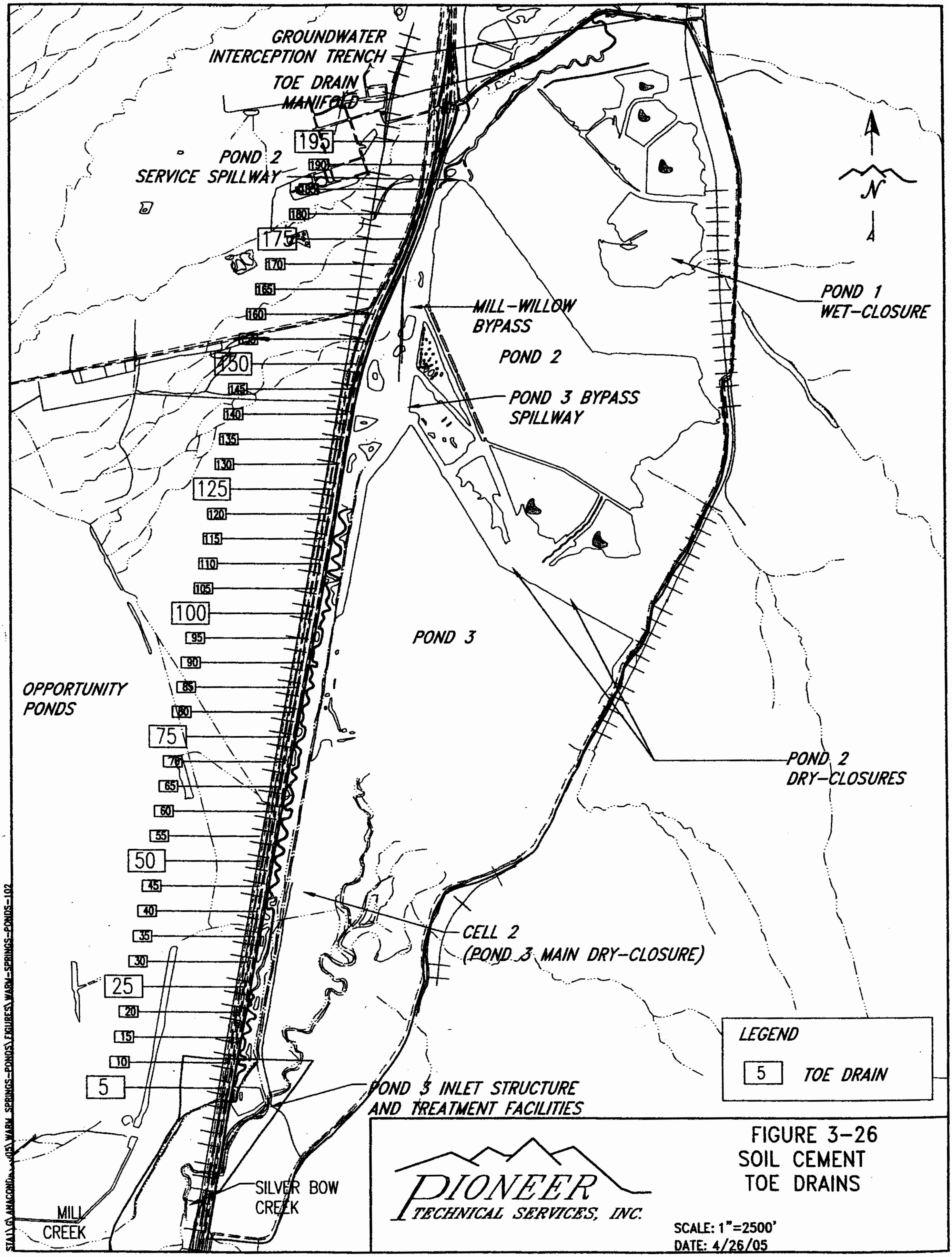


FIGURE 3-26
SOIL CEMENT
TOE DRAINS

## Figure 5-28
## Hardness Concentrations in the Mill-Willow Bypass
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

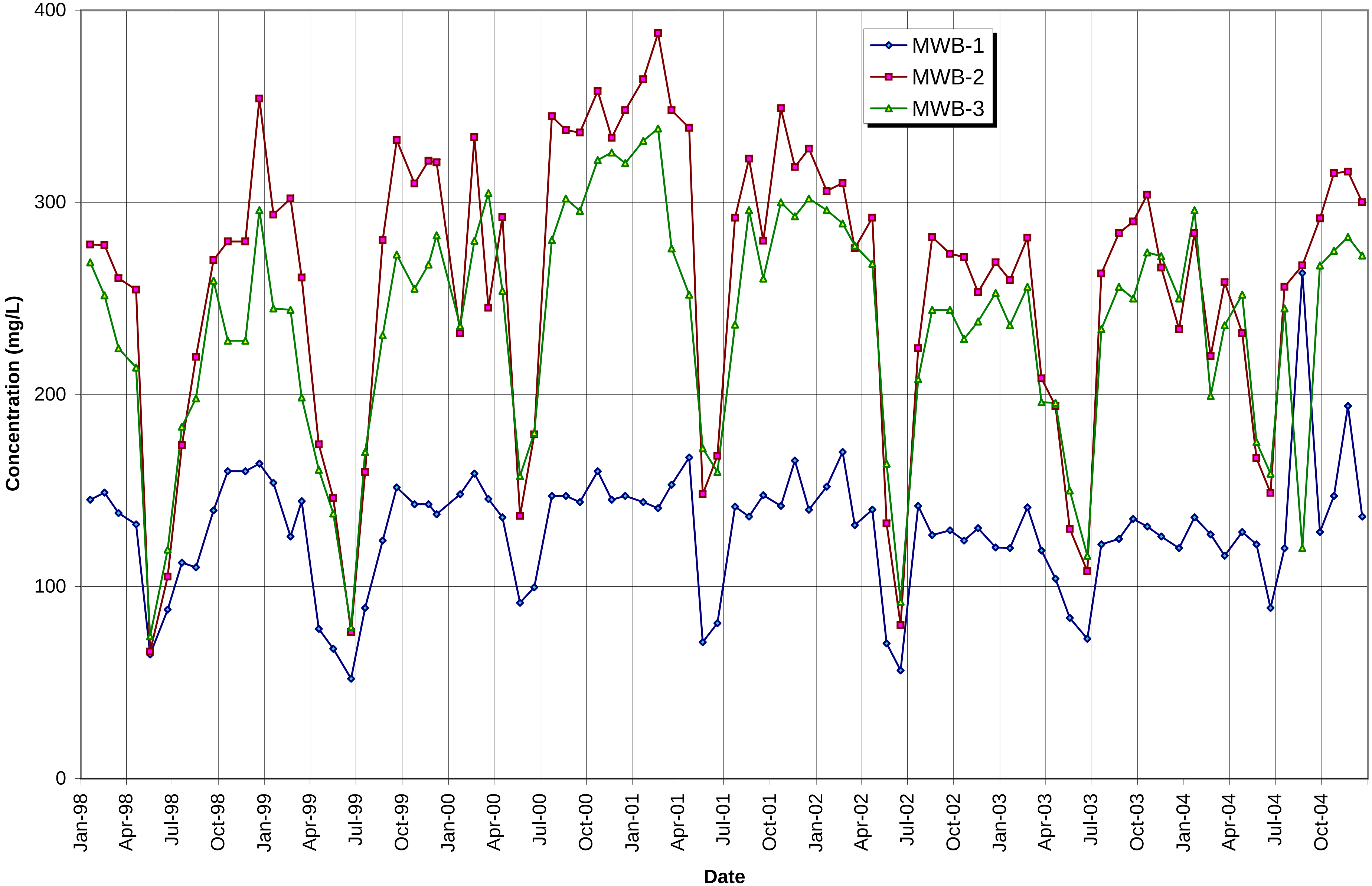


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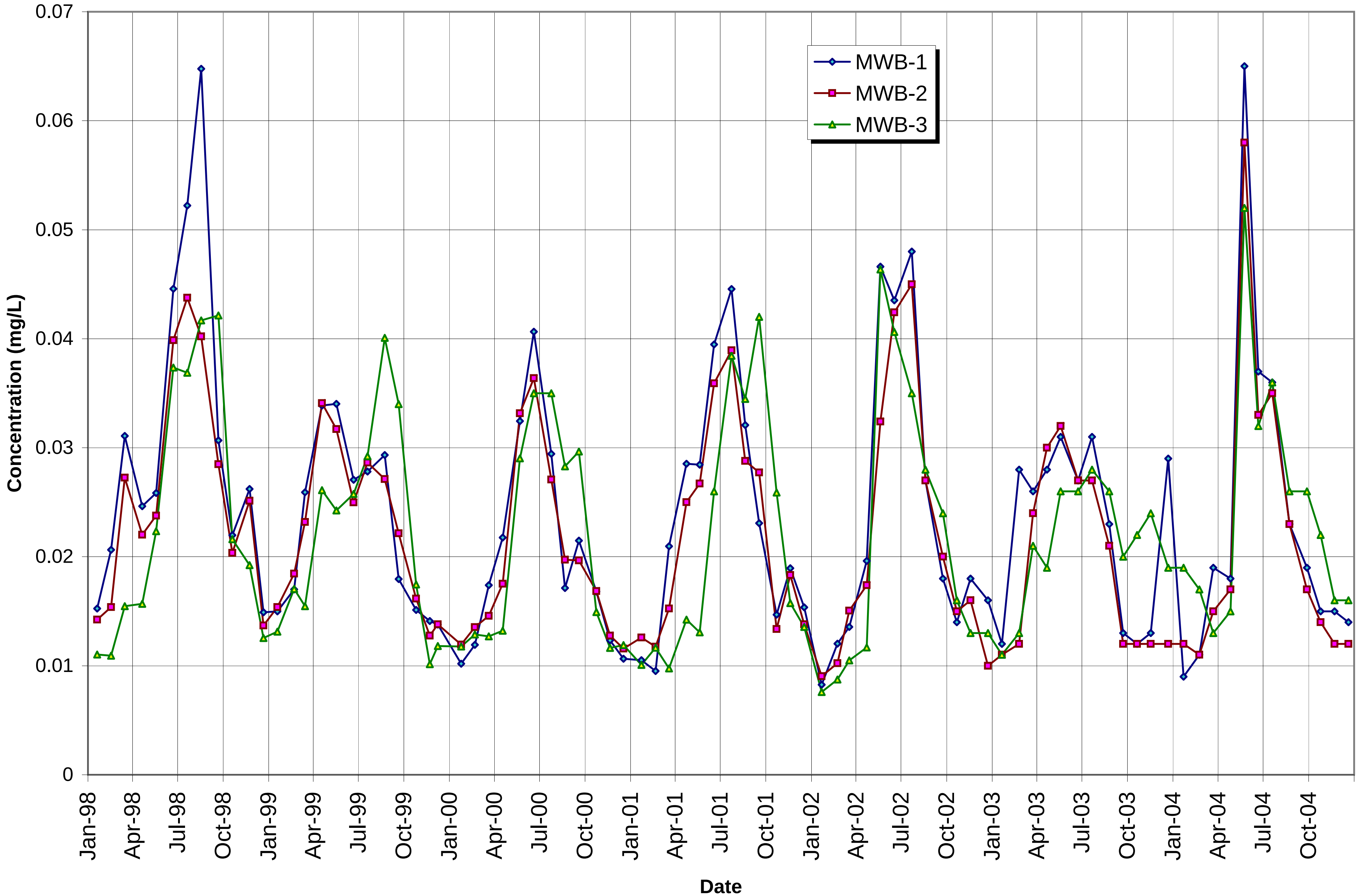
**Figure 5-29**
**Arsenic Concentrations in the Mill-Willow Bypass**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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## Figure 5-30
## Copper Concentrations in the Mill-Willow Bypass
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

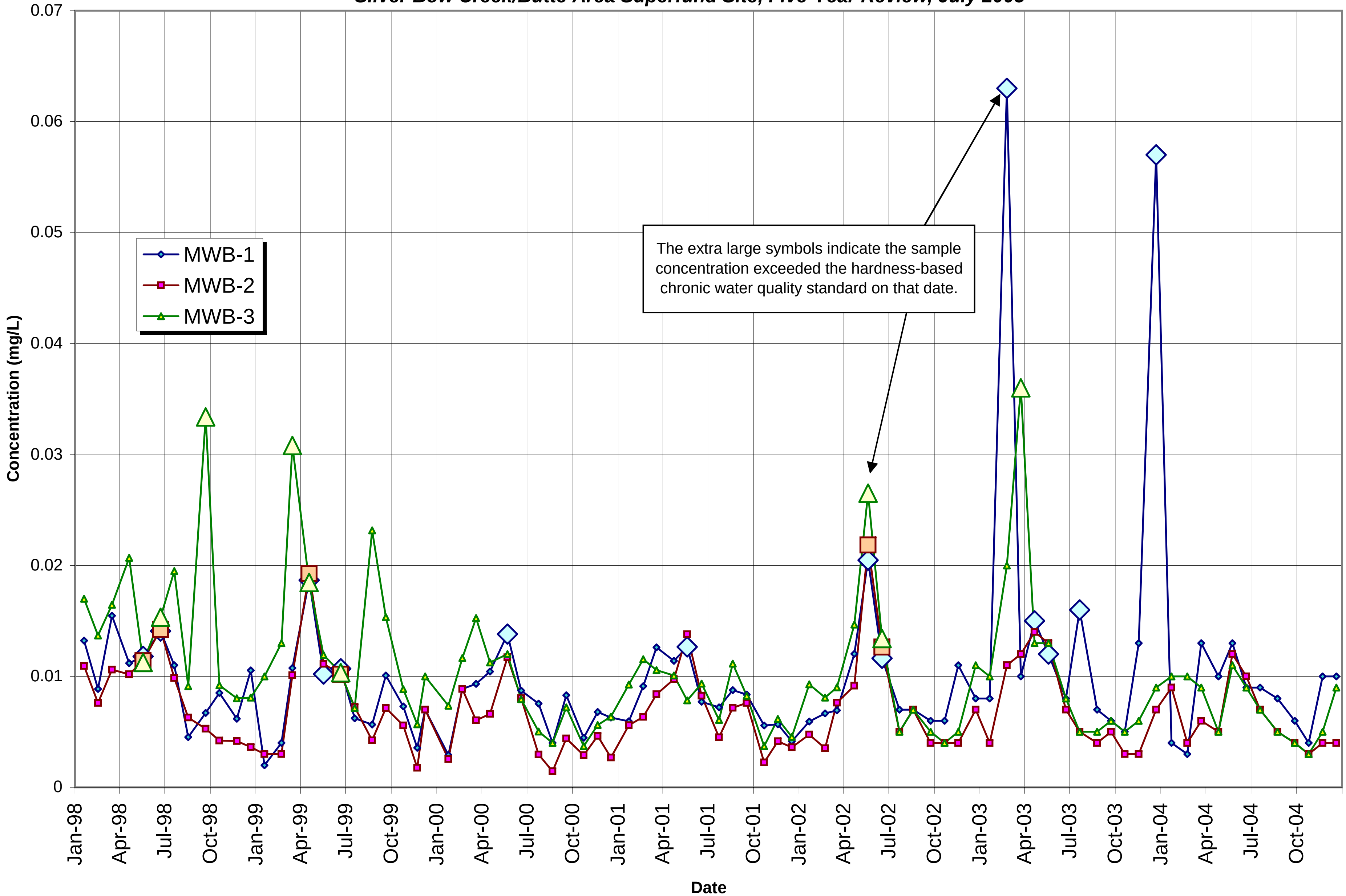


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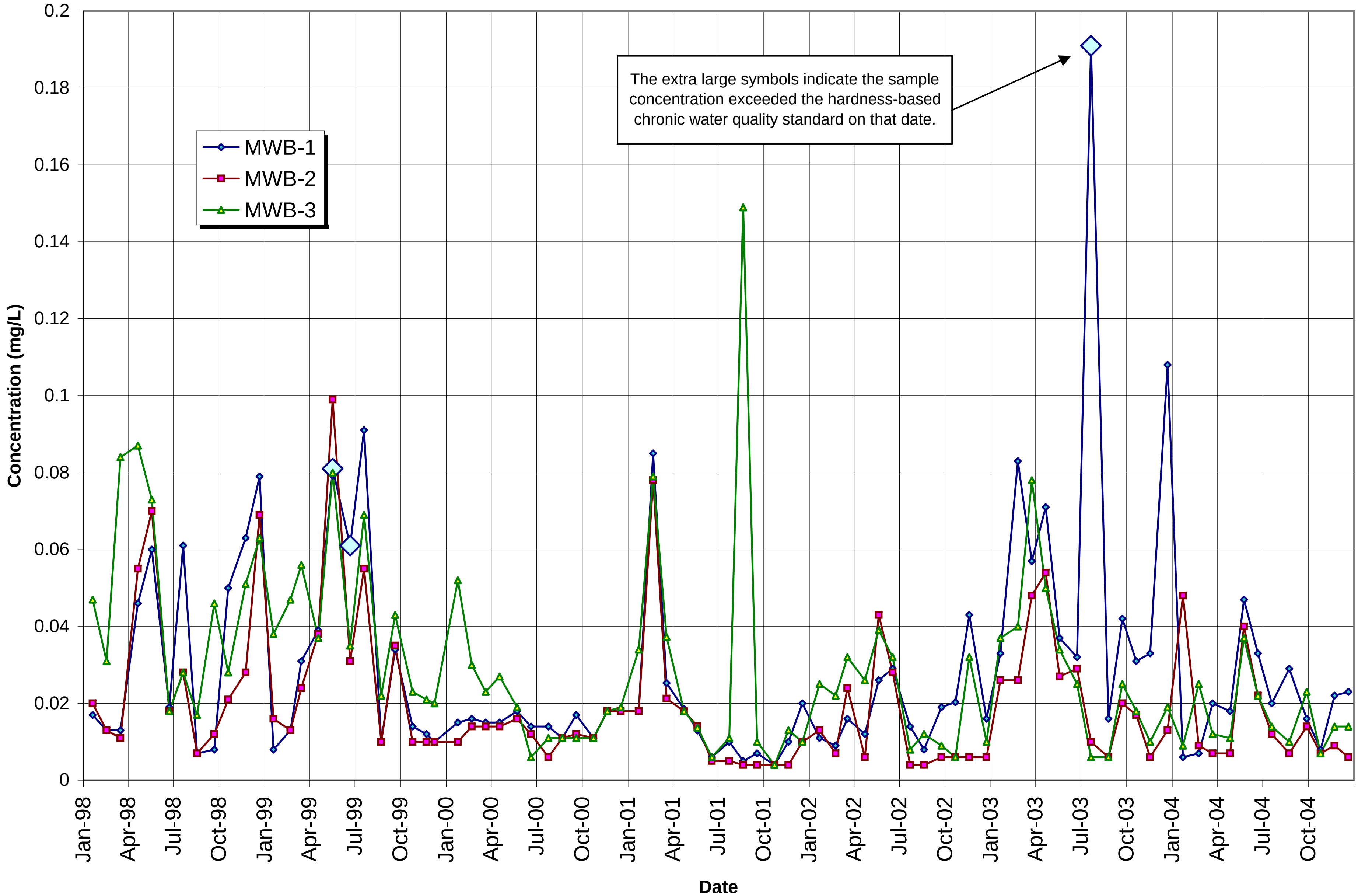
**Figure 5-31**
**Zinc Concentrations in the Mill-Willow Bypass**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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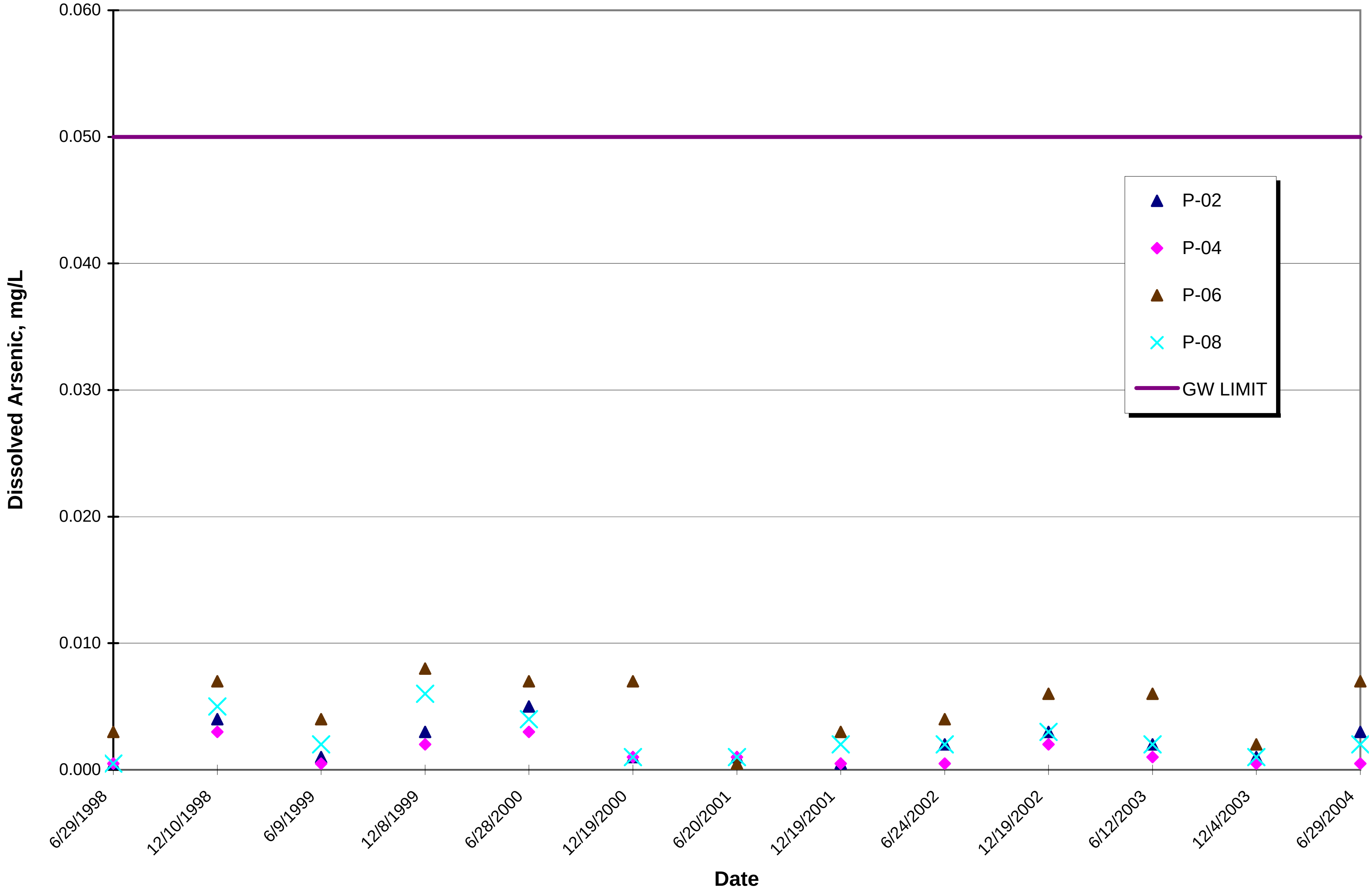
## Figure 5-32. Dissolved Arsenic in Down-gradient Piezometers
## June 1998 - December 2004
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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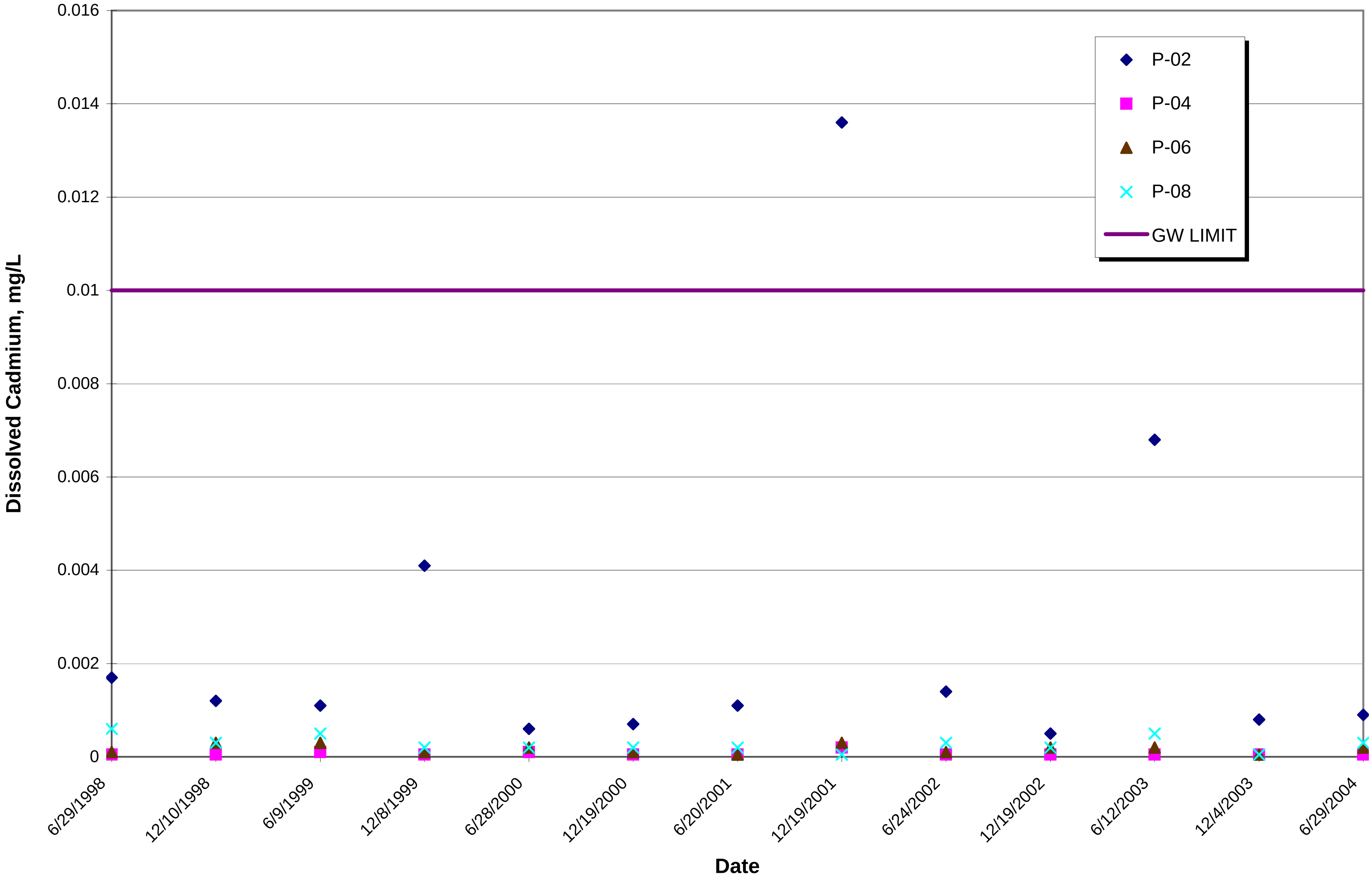
## Figure 5-33. Dissolved Cadmium in Down-gradient Piezometers June 1998 - December 2004

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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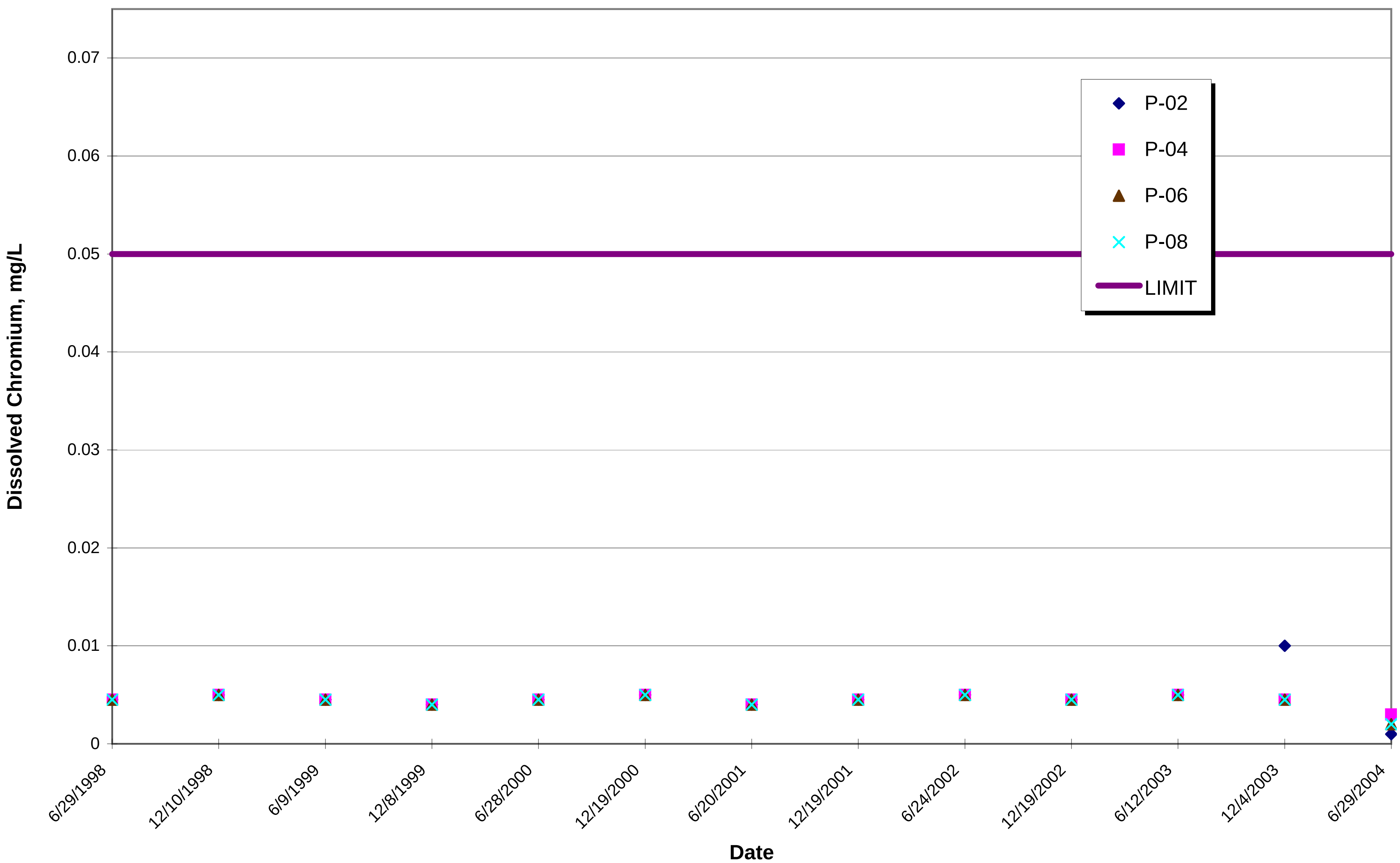
## Figure 5-34. Dissolved Chromium in Down-gradient Piezometers
## June 1998 - December 2004

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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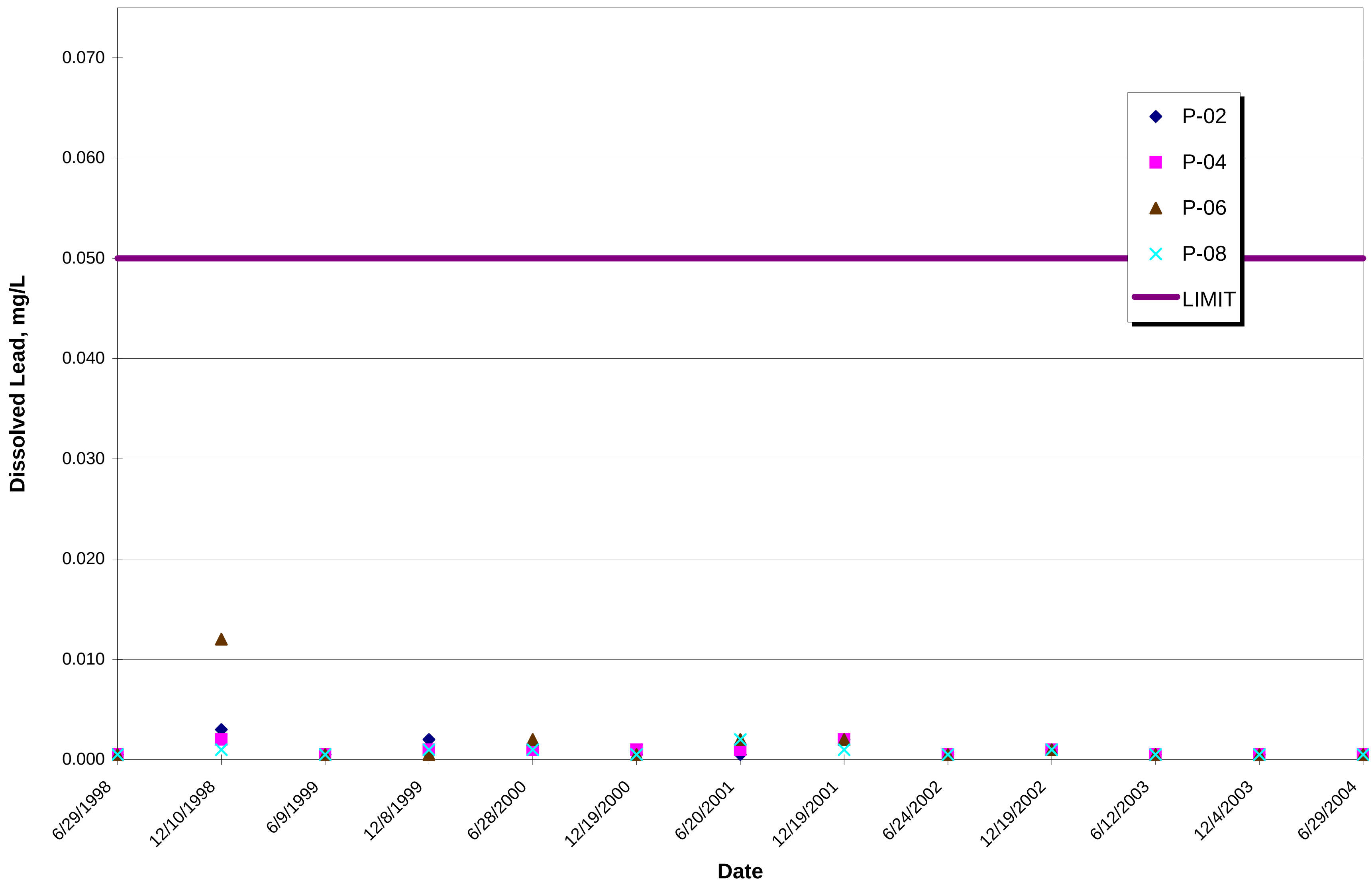
## Figure 5-35. Dissolved Lead in Down-gradient Piezometers
## June 1998 - December 2004

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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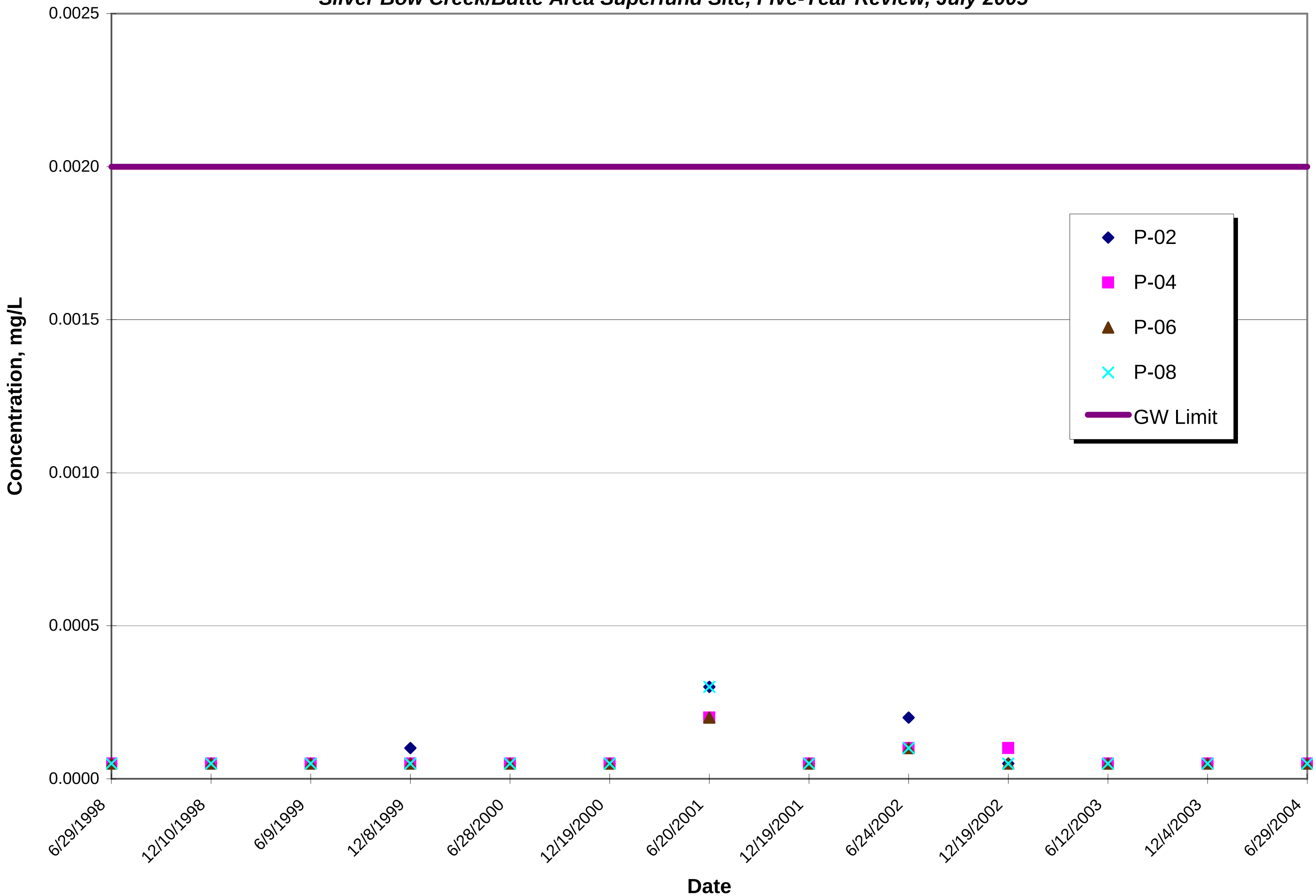
## Figure 5-36. Dissolved Mercury in Down-Gradient Piezometers
## June 1998 - December 2004
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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## Figure 5-37. Nitrate in Down-gradient Piezometers

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

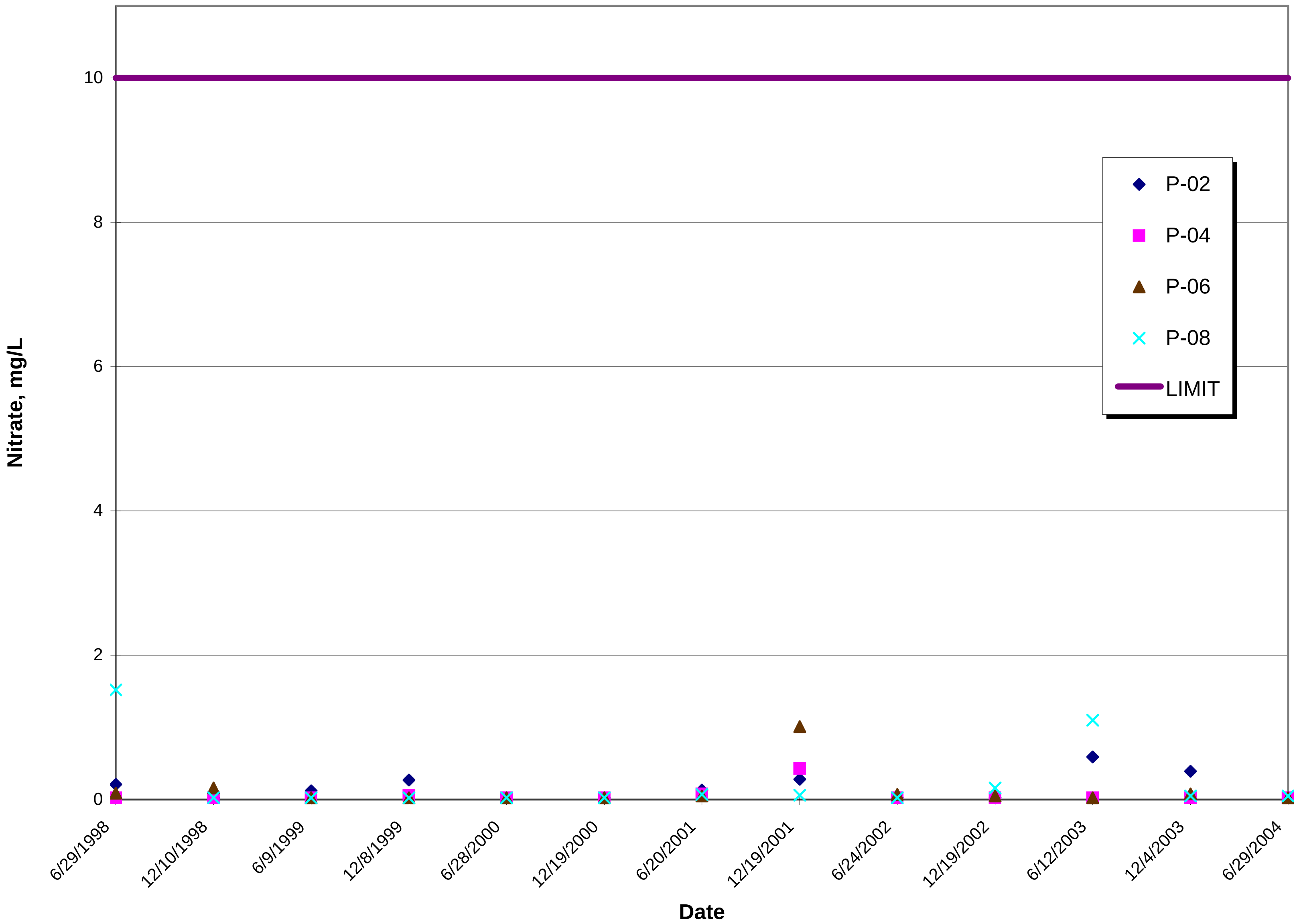


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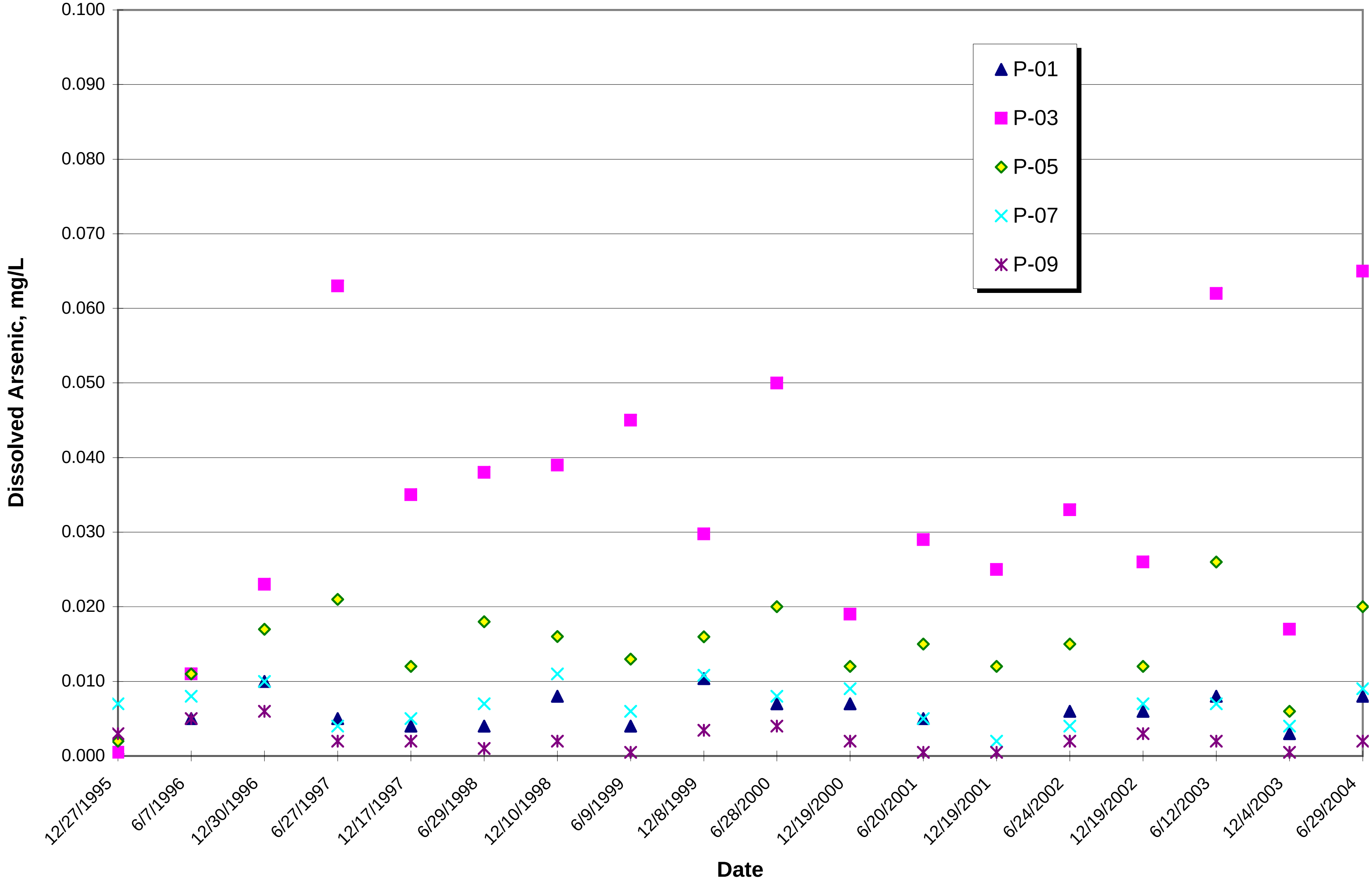
**Figure 5-38. Dissolved Arsenic in Up-gradient Piezometers**
**June 1998 - December 2004**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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## Figure 5-39. Dissolved Cadmium in Up-gradient Piezometers
## June 1998 - December 2004

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

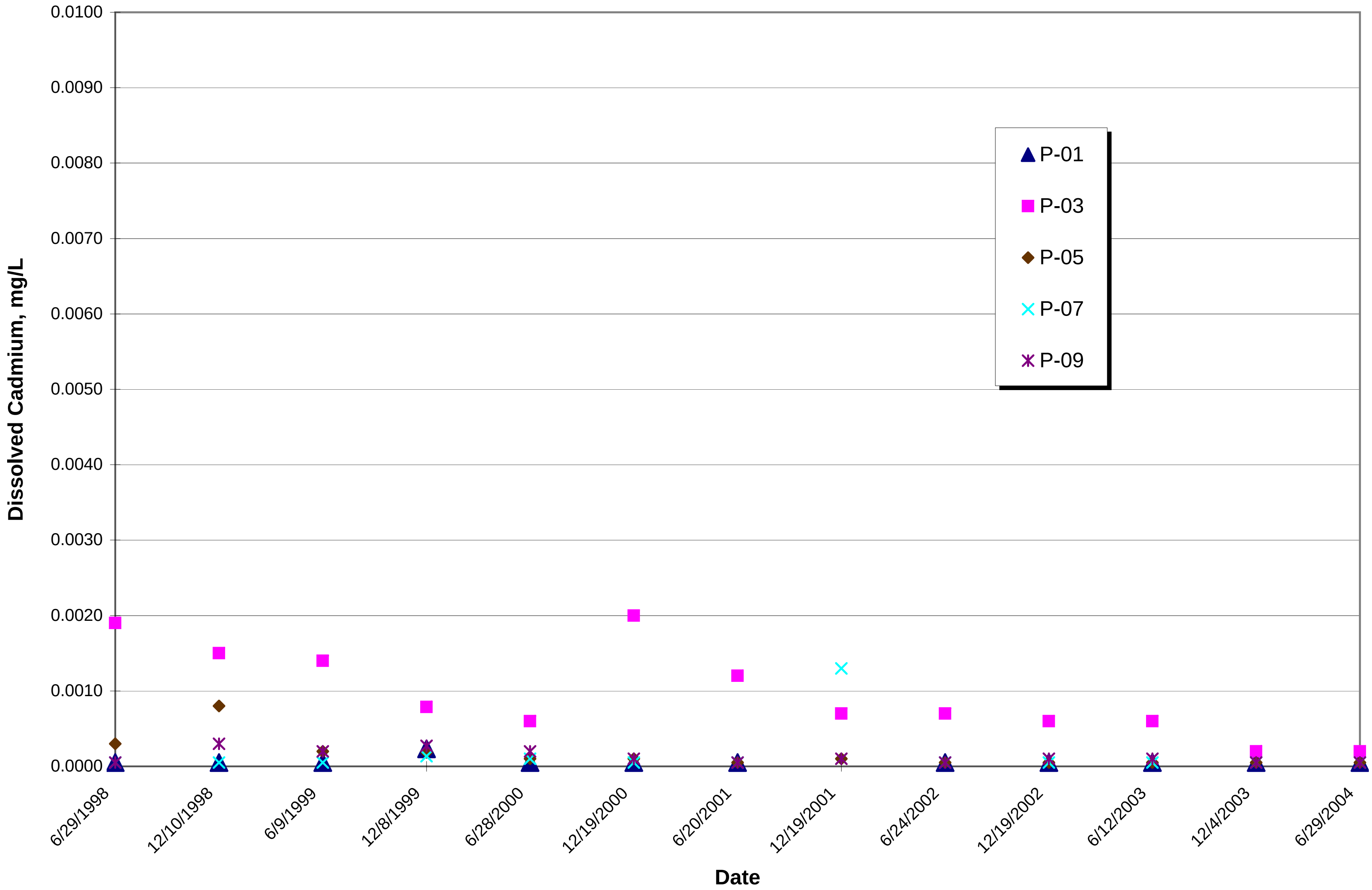


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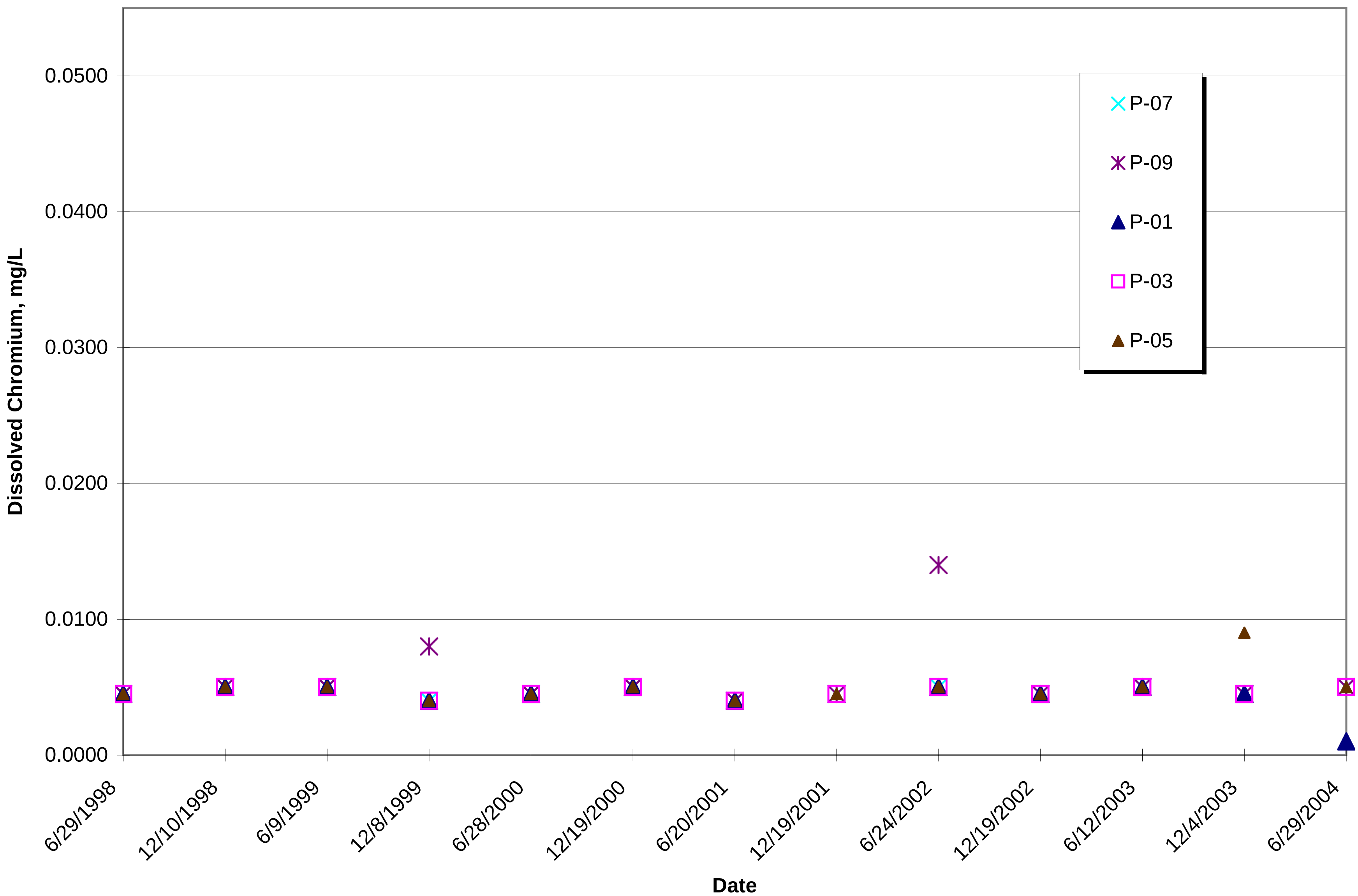
**Figure 5-40. Dissolved Chromium in Up-gradient Piezometers**
**June 1998 - December 2004**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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## Figure 5-41. Dissolved Lead in Up-gradient Piezometers
## June 1998 - December 2004

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

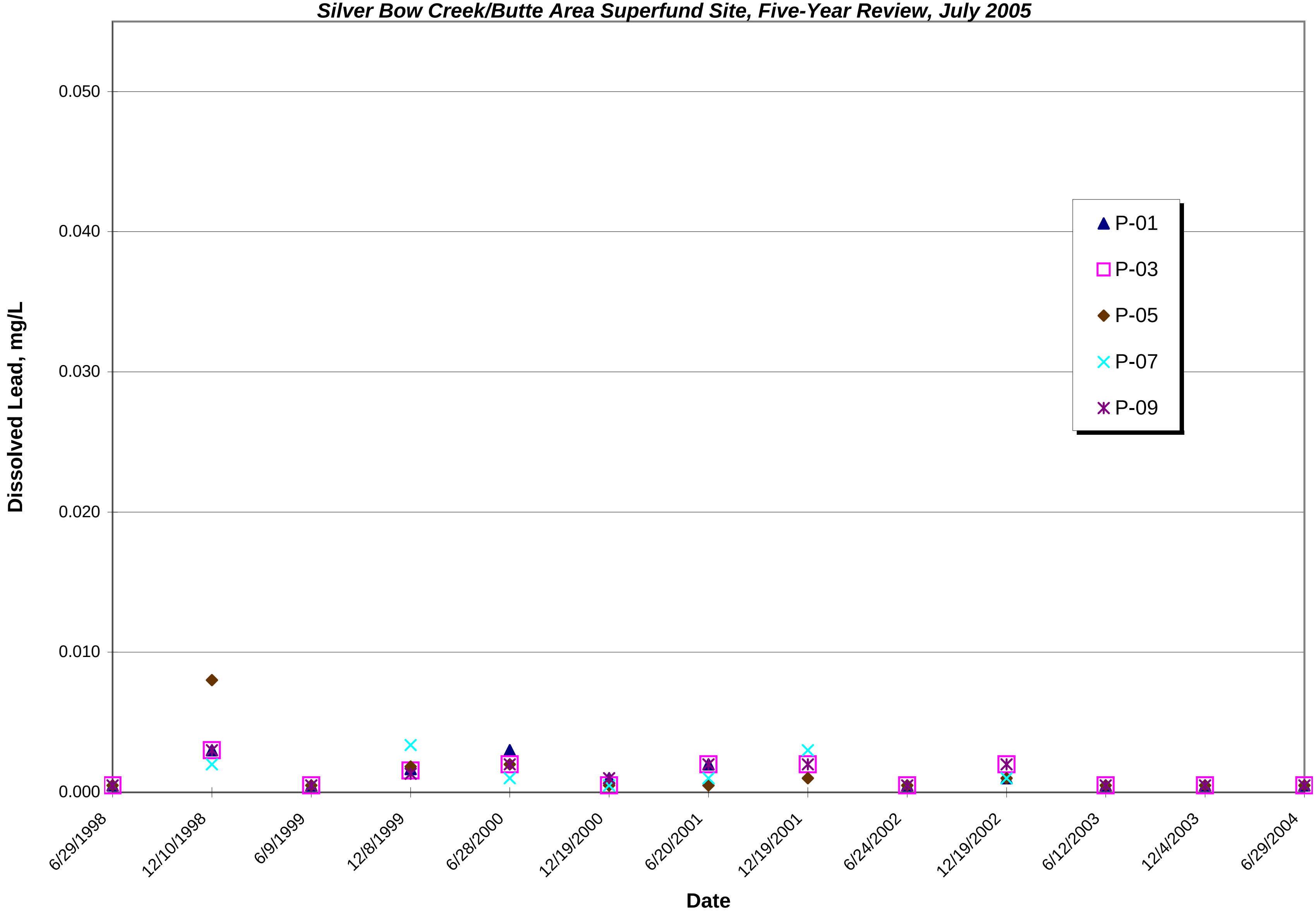


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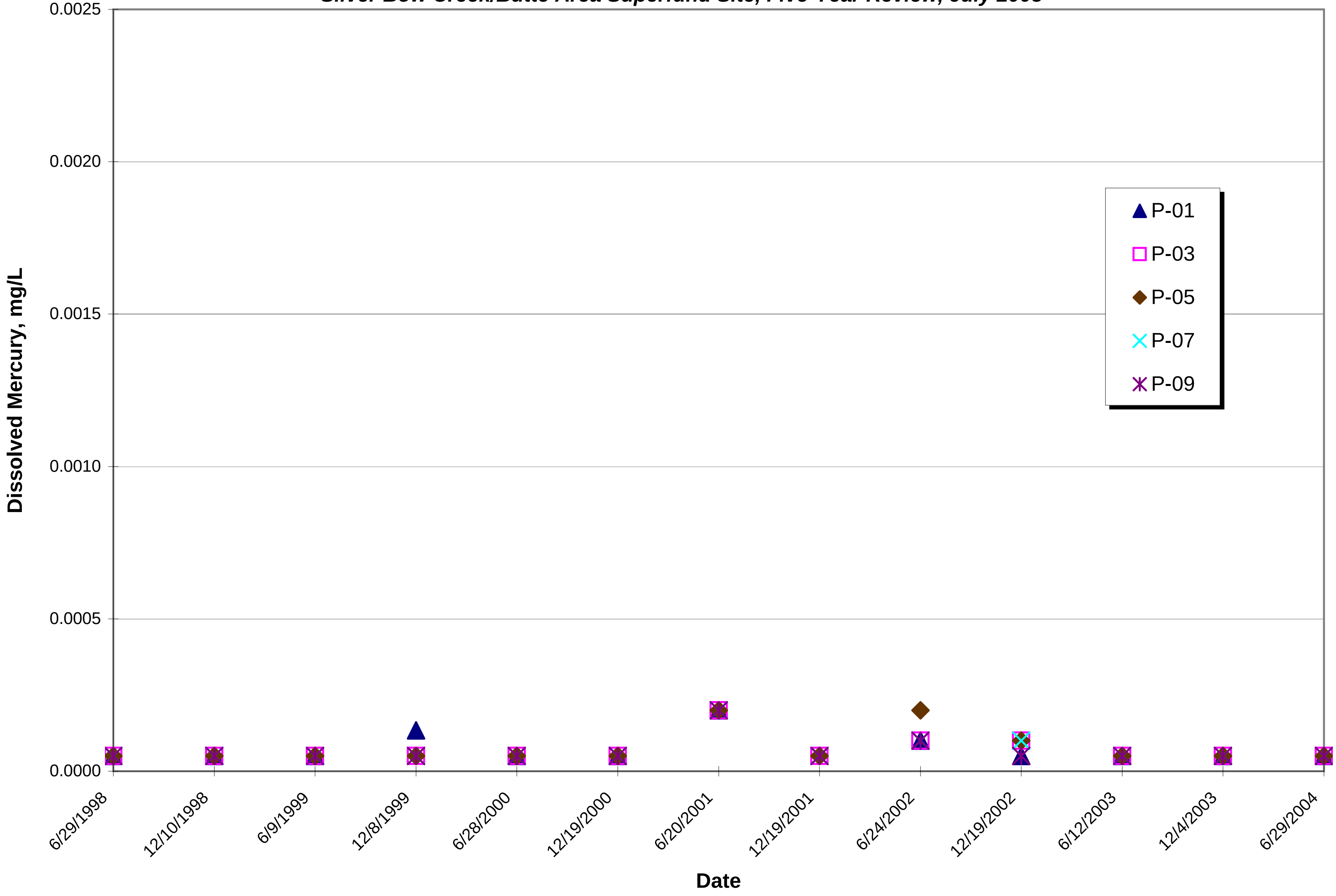
**Figure 5.-42. Dissolved Mercury in Up-gradient Piezometers**
**June 1998 - December 2004**
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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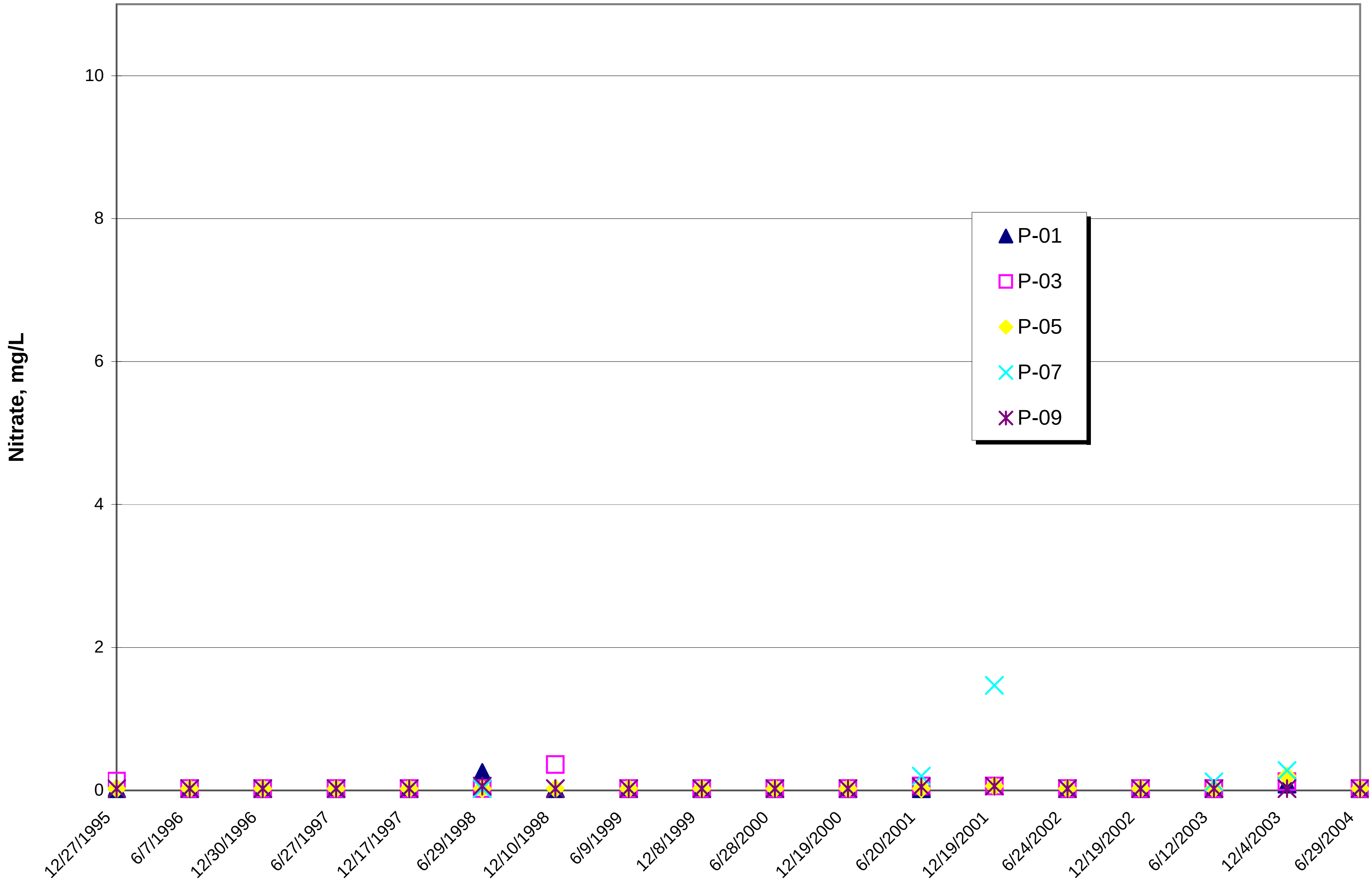
## Figure 5-43. Nitrate in Up-gradient Piezometers
## June 1998 - December 2004
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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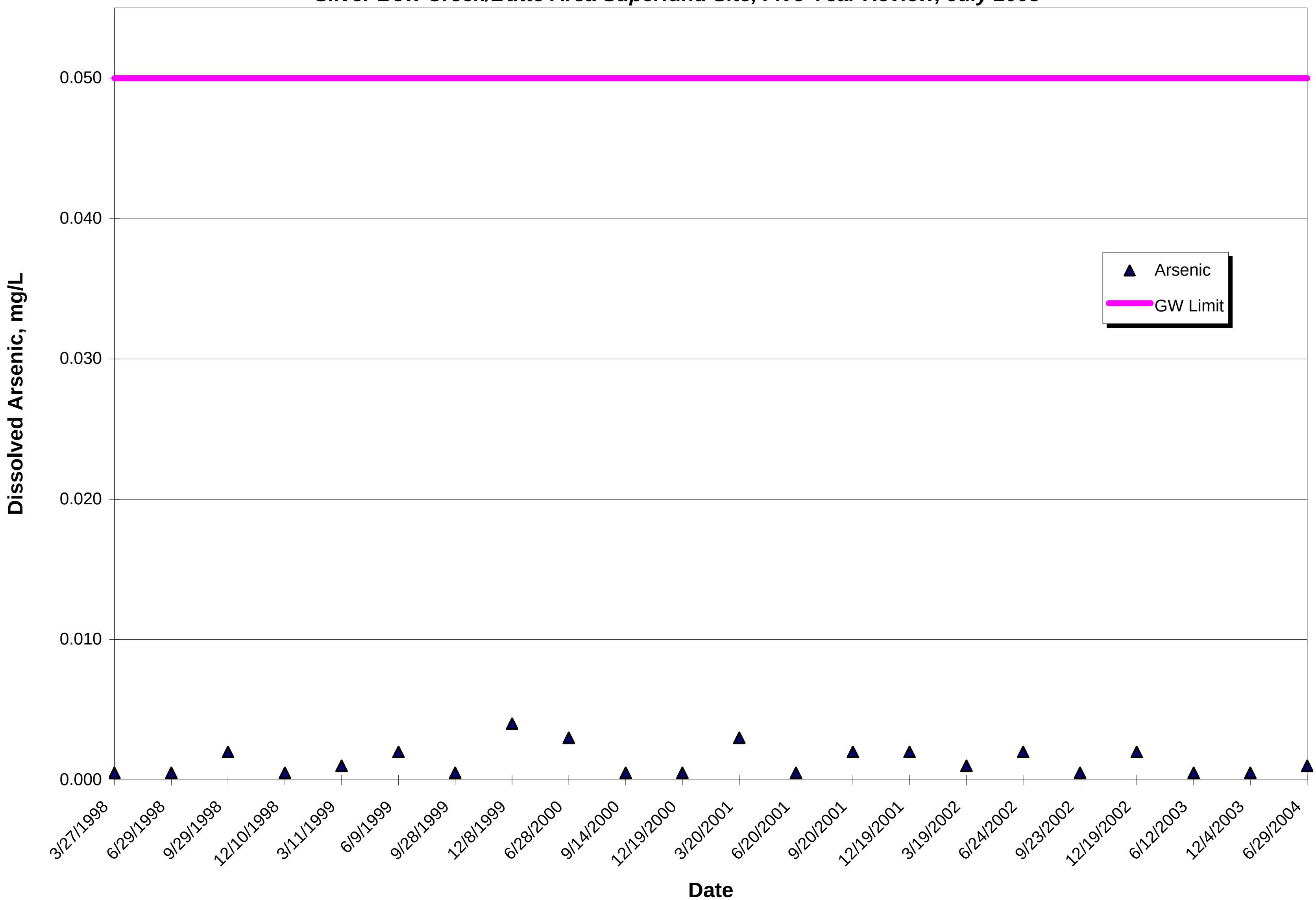
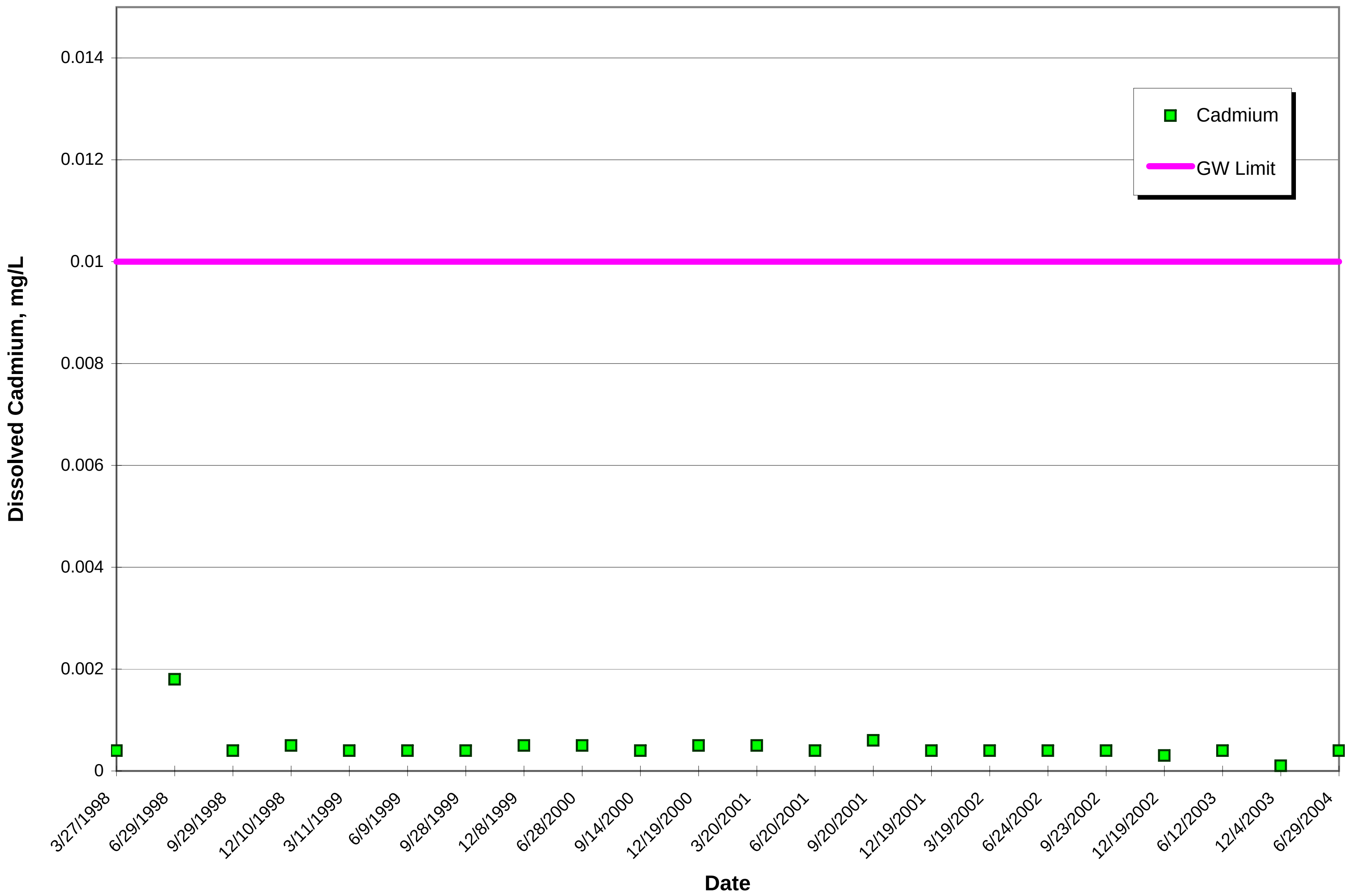
## Figure 5-44. Dissolved Arsenic in Piezometer P-14
## March 1998 - June 2004
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*



## Figure 5-45. Dissolved Cadmium in Piezometer P-14
## March 1998 - June 2004
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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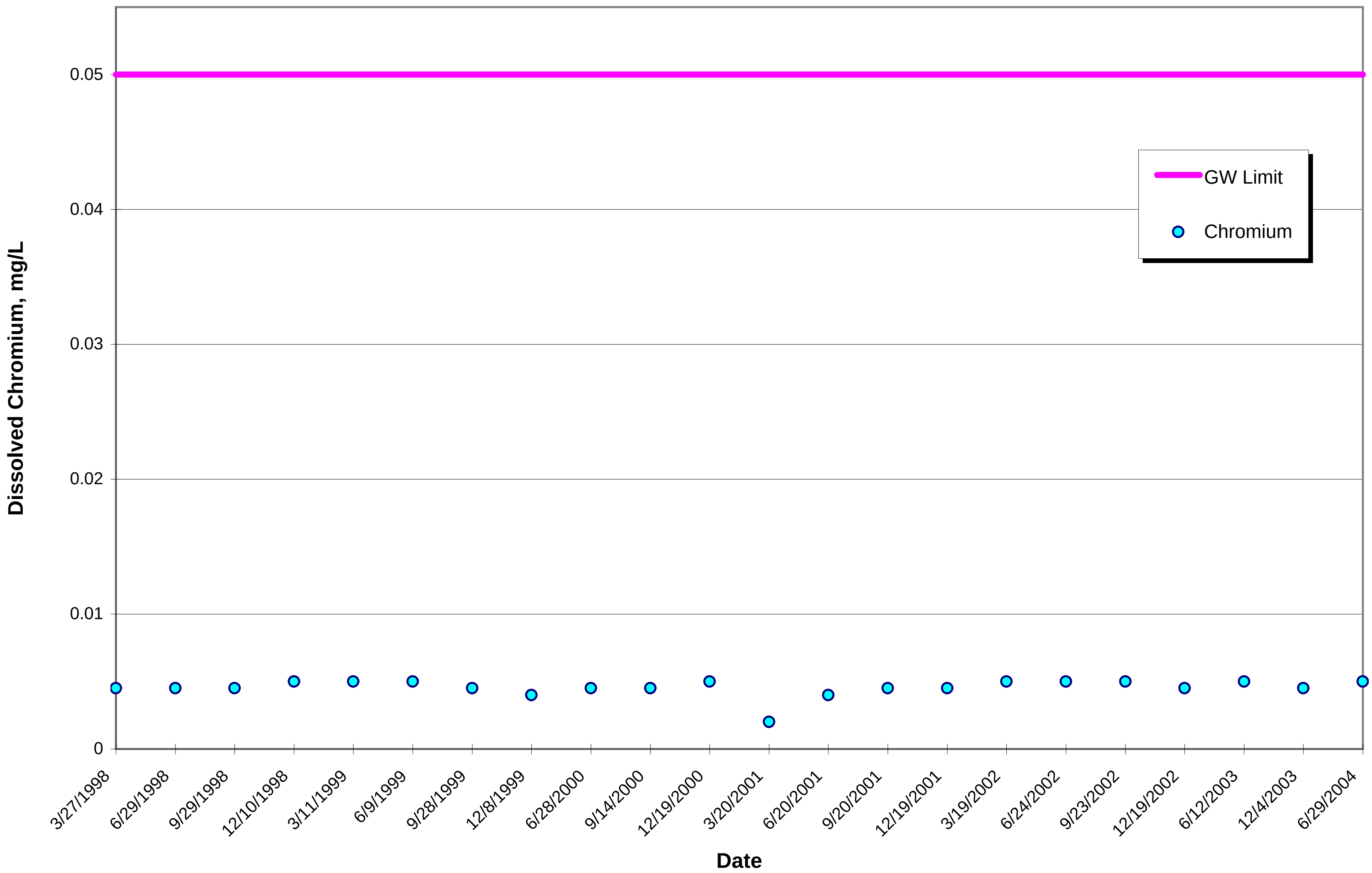
## Figure 5-46. Dissolved Chromium in Piezometer P-14
## March 1998 - June 2004
*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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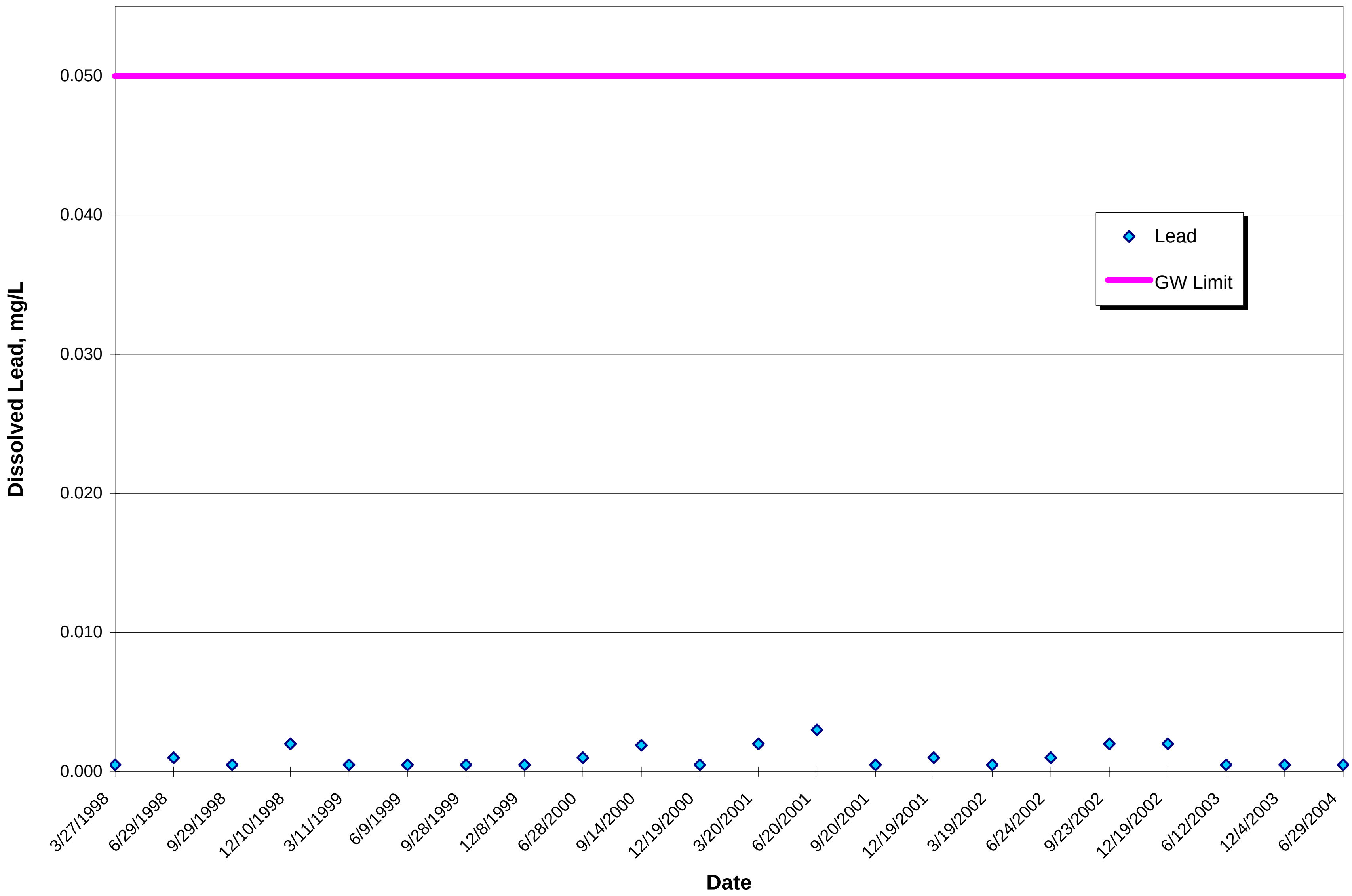
## Figure 5-47. Dissolved Lead in Piezometer P-14
## March 1998 - June 2004
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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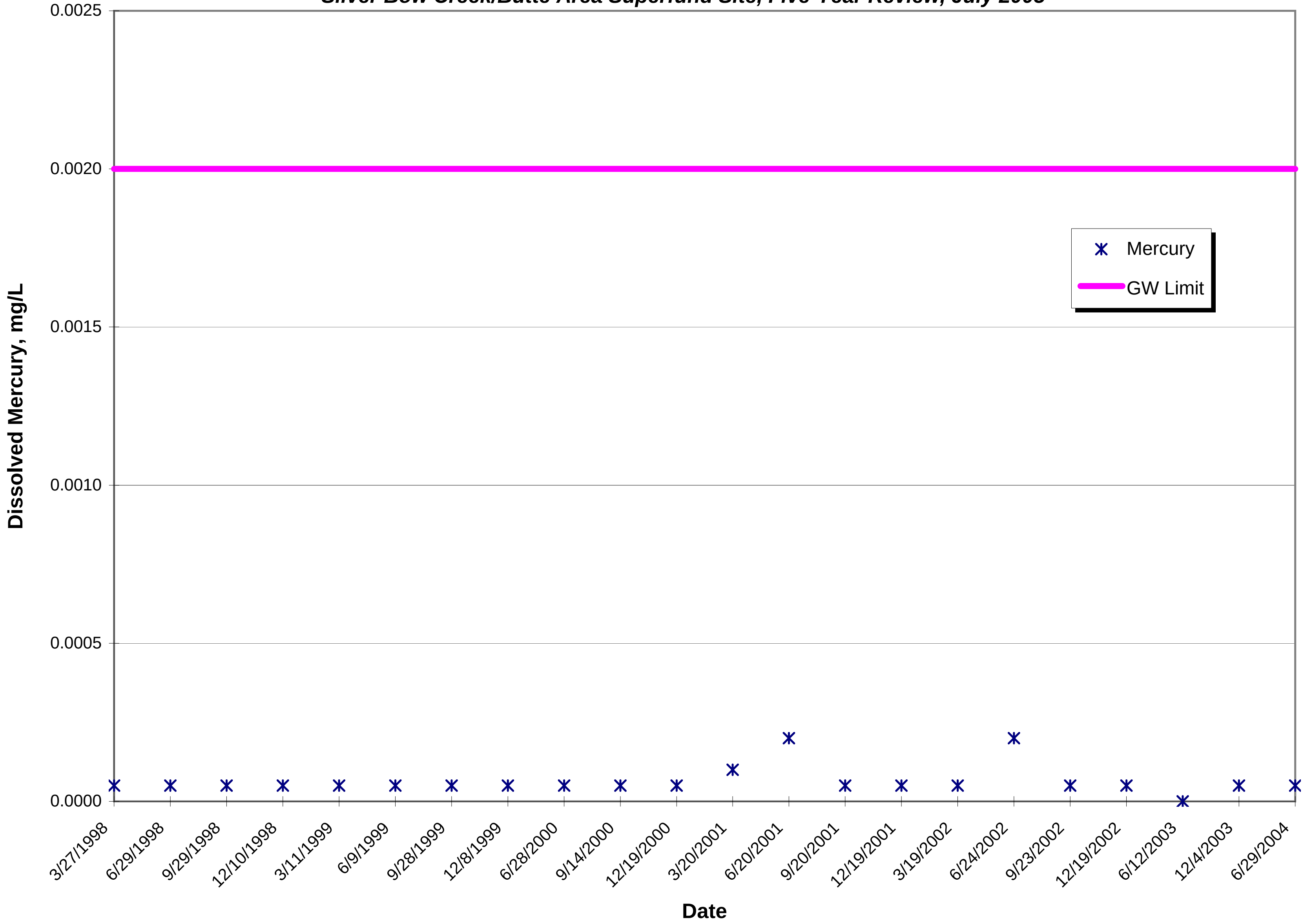
## Figure 5-48. Dissolved Mercury in Piezometer P-14
## March 1998 - June 2004

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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## Figure 5-49. Nitrate in Piezometer P-14
## March 1998 - June 2004

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

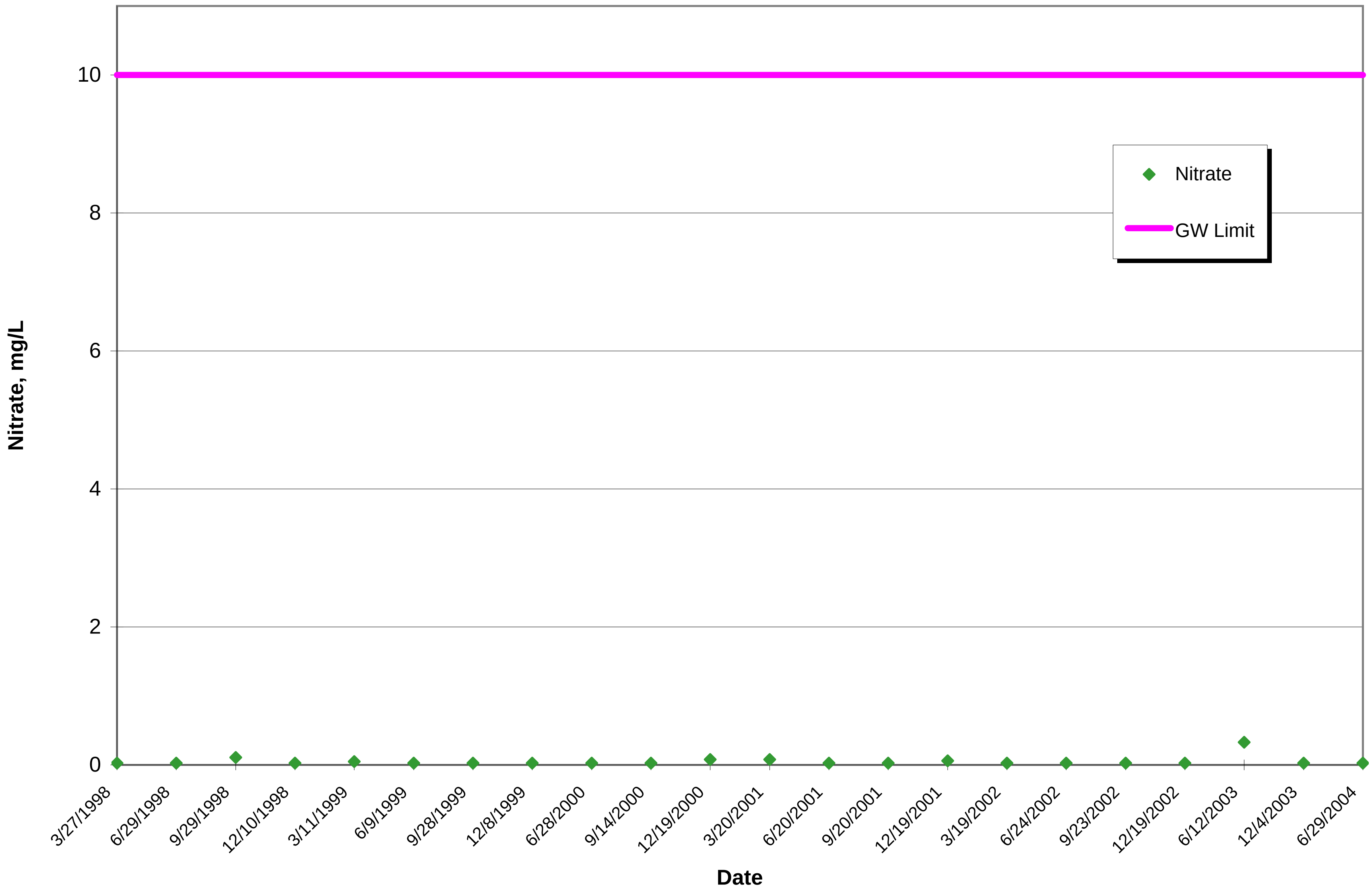


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**Figure 5-50. Total Recoverable Arsenic Concentrations in Toe Drain Manifold (IA-3) Relative to Pond 3 (SS-3E), Pond 2 (SS-5) and the Mill-Willow Bypass (MWB-2)**

***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

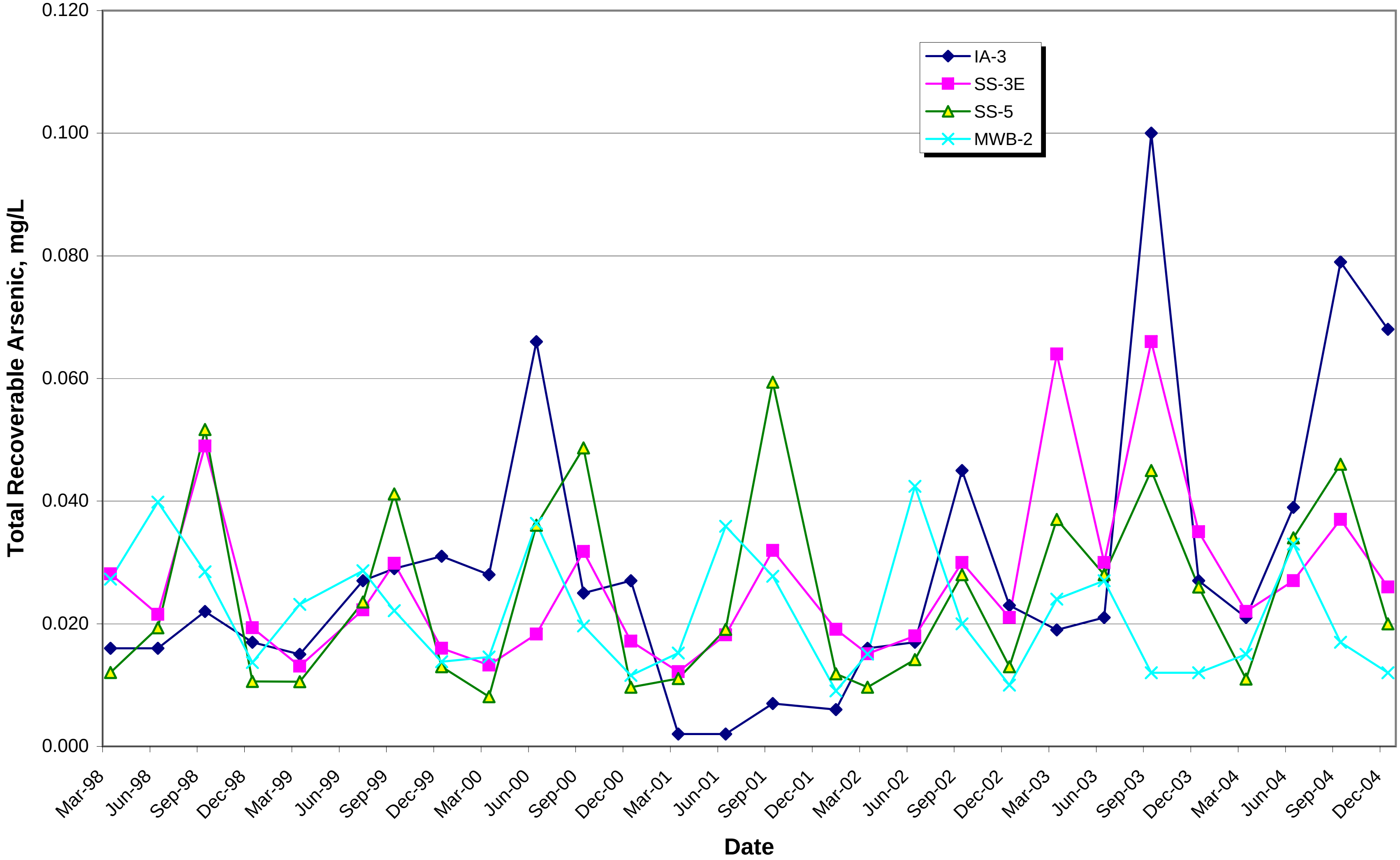


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**Figure 5-51. Total Recoverable Iron Concentrations in Toe Drain Manifold (IA-3) Relative to Pond 3 (SS-3E), Pond 2 (SS-5), and the Mill-Willow Bypass (MWB-2)**

***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

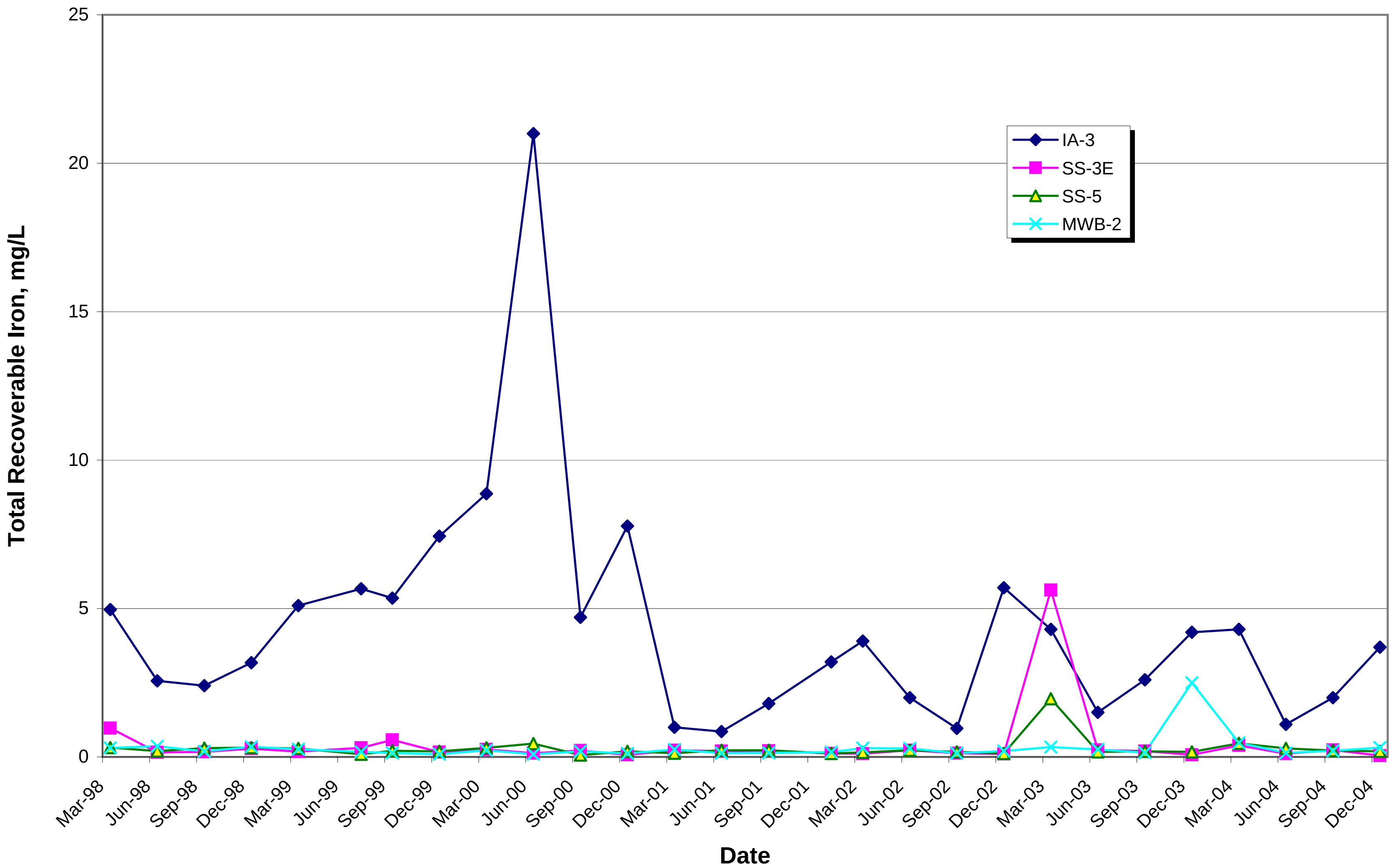


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**Figure 5-52. Total Recoverable Cadmium Concentrations in Inactive Area Wet Closure Discharge (IA-2) Relative to Pond 3 (SS-3E) and Pond 2 (SS-5)**

***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

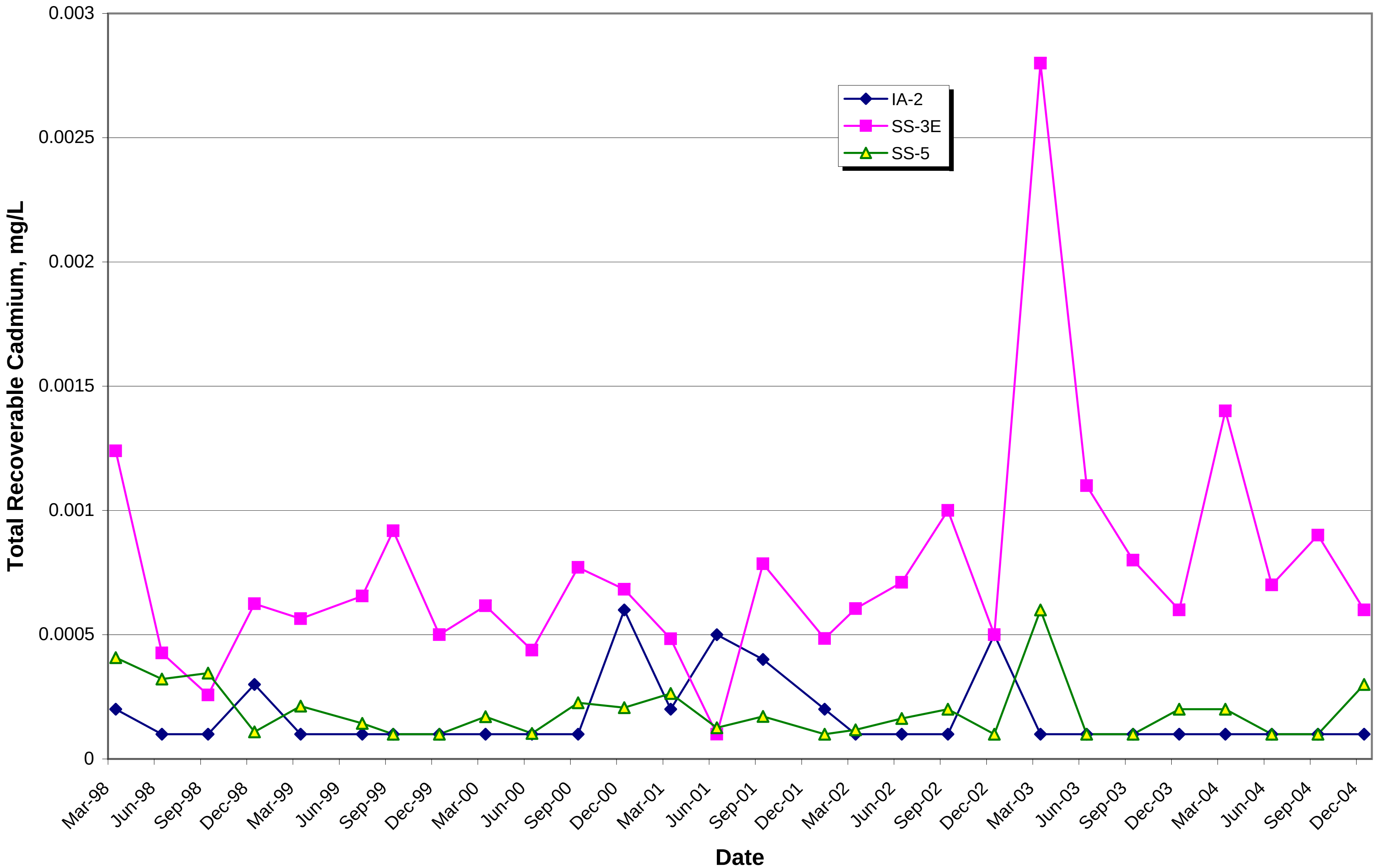


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**Figure 5-53. Total Recoverable Copper Concentrations in Inactive Area Wet Closure Discharge (IA-2) Relative to Pond 2 (SS-3E) and Pond 3 (SS-5)**
***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

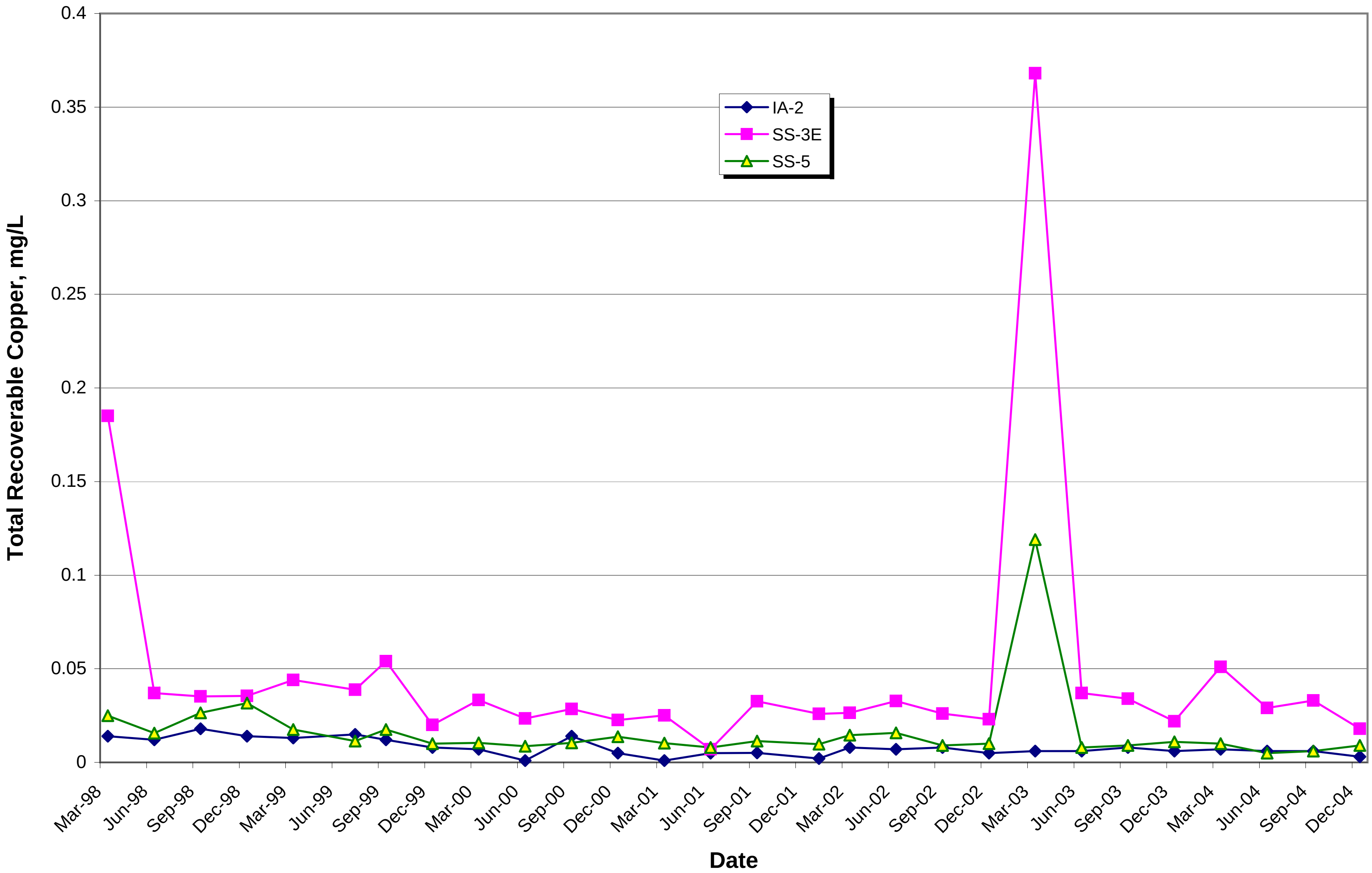


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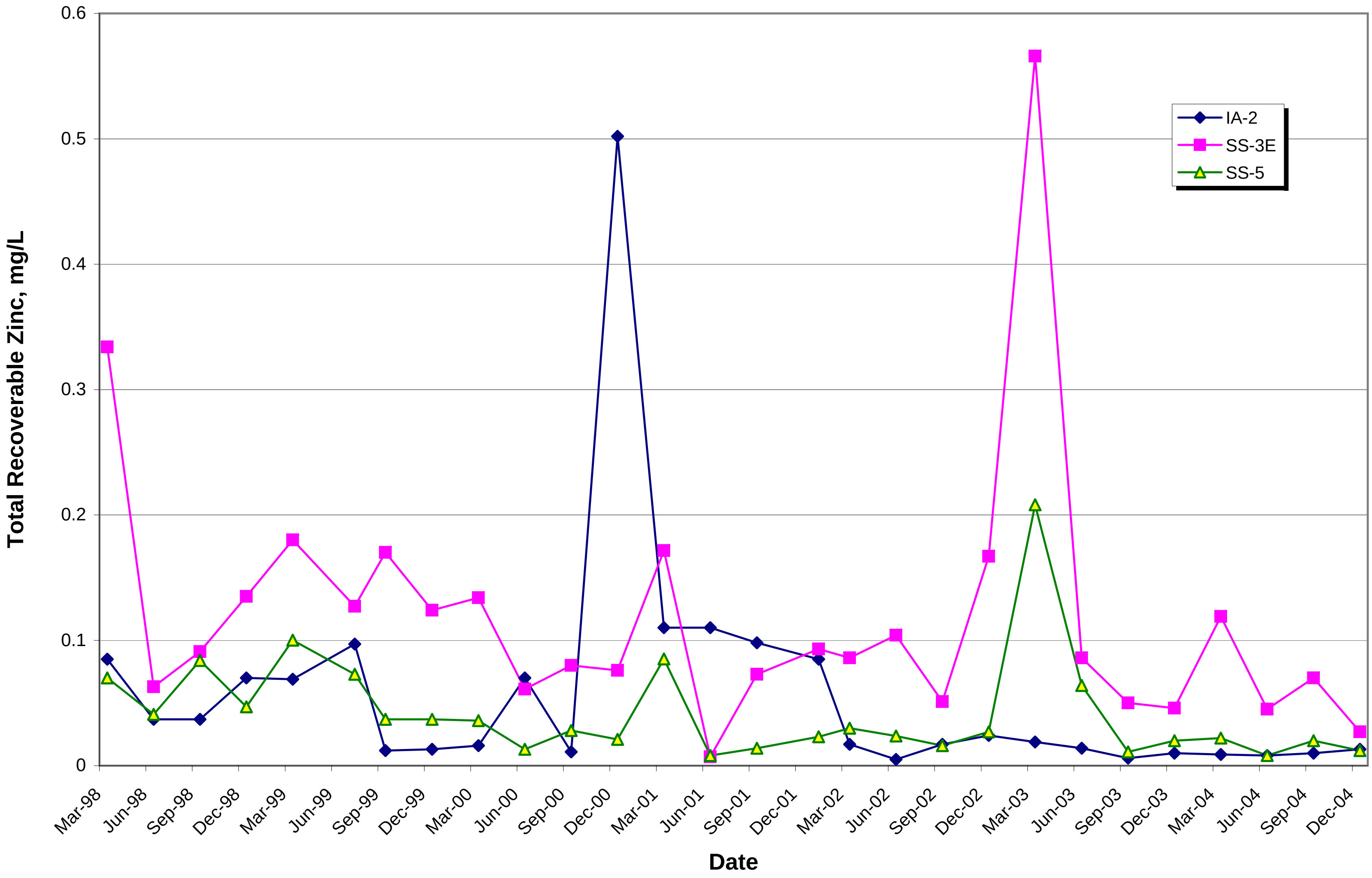
**Figure 5-54. Total Recoverable Zinc Concentrations in Inactive Area Wet closure Discharge (IA-2) Relative to Pond 3 (SS-3E) and Pond 2 (SS-5)**

***Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005***

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## Figure 5-55. Total Recoverable Arsenic Concentrations in Inactive Area Wet Closure Discharge (IA-2) Relative to Pond 3 and Pond 2 (SS-5)

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

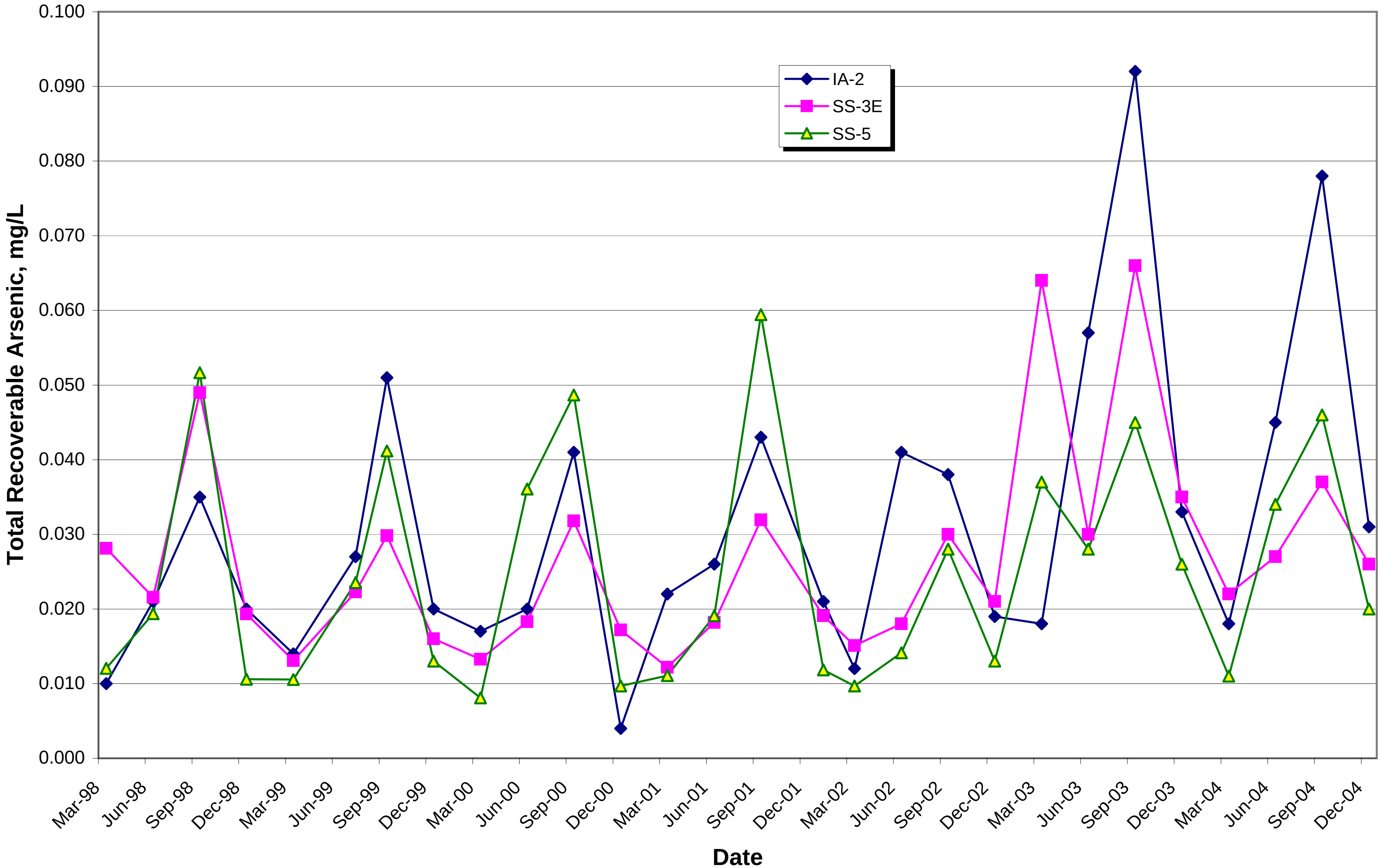


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**Figure 5-56. Total Recoverable Copper Concentrations in Pump-back Pipeline (IA-1) Relative to Pond 3 (SS-3E) and Pond 2 (SS-5)**

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

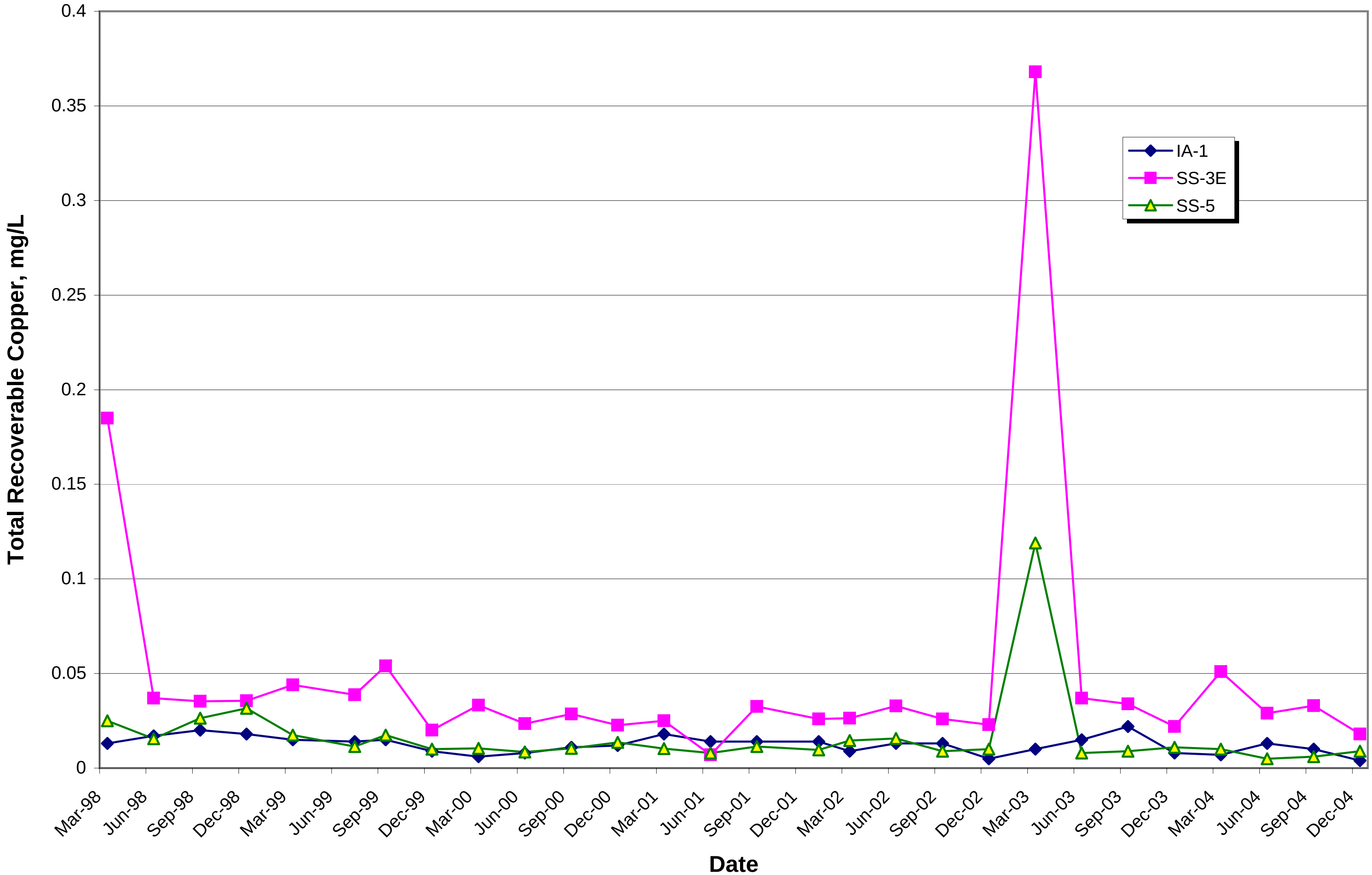


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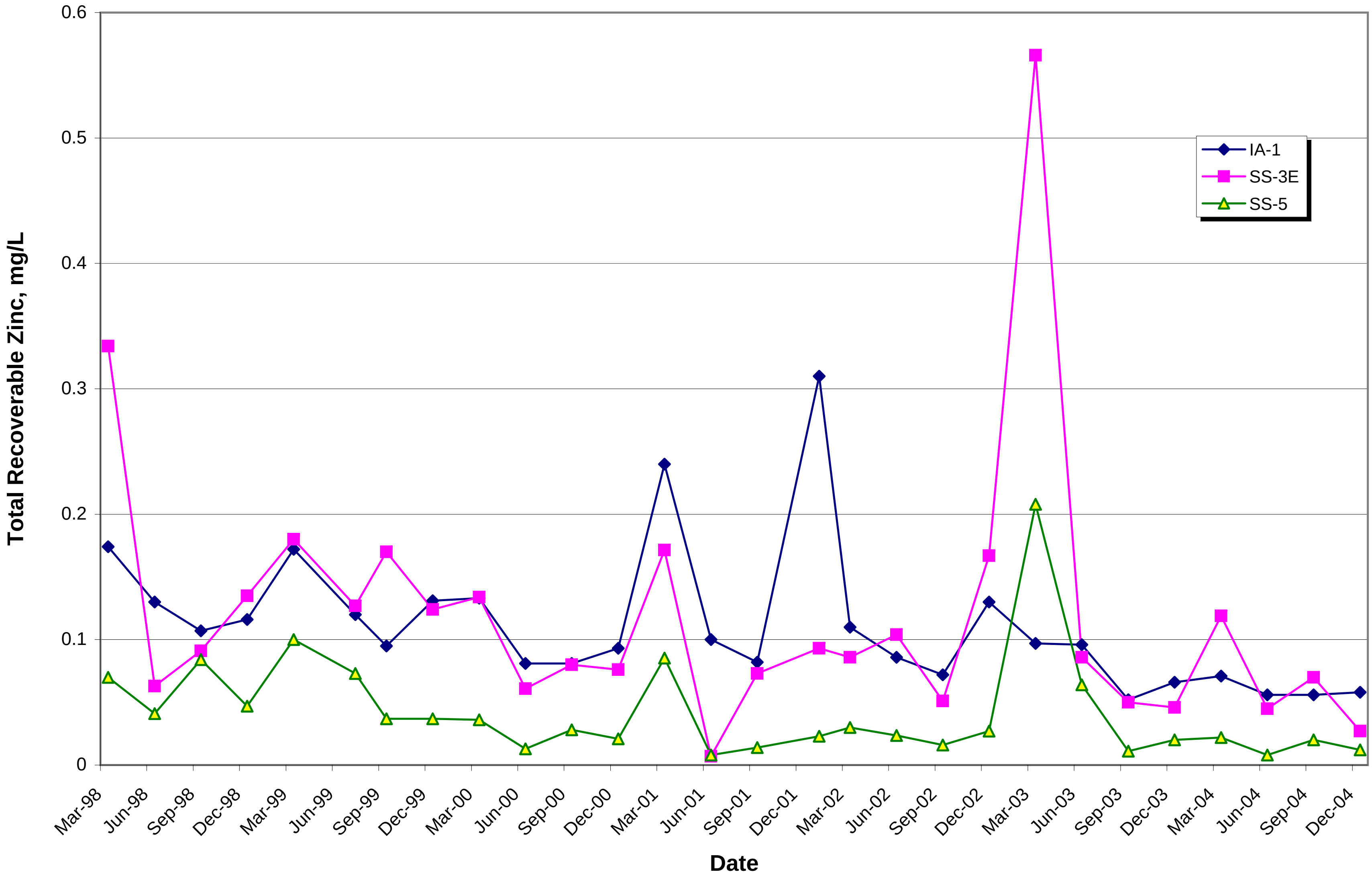
**Figure 5-57. Total Recoverable Zinc concentrations in Pump-back Pipeline (IA-1) Relative to Pond 3 (SS-3E) and Pond 2 (SS-5)**

*Silver Bow Creek/Butte Area Superfund Site, Five-Year Review, July 2005*

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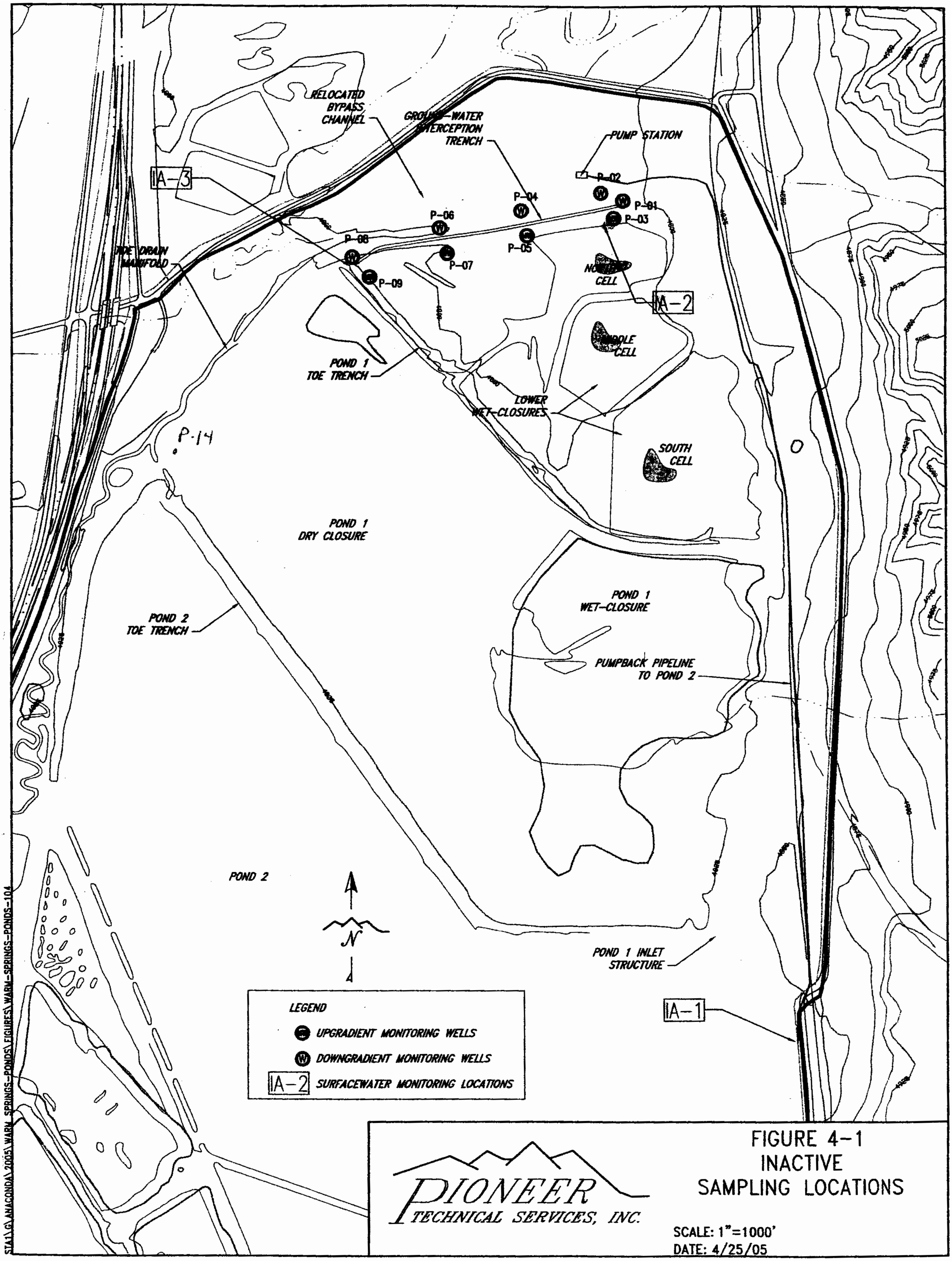


FIGURE 4-1
INACTIVE
SAMPLING LOCATIONS

SCALE: 1"=1000'
DATE: 4/25/05

# Appendices

# Appendix A

## 5-Year Review Notification for Local Newspapers

# Appendix B

## Summaries of Telephone Interviews (Molignoni, Bouck, Peoples, Kerns, Sesso, and Ueland), Written Responses to Interview Questions (Skrukrud, Dziak, Brockman, Benson, and CTEC), a letter from MDEQ (Chavez), and an unsolicited letter (Kuipers)

**Telephone interview with Al Molignoni (6/9/05)**

Mr. Molignoni is a resident who lives near the Rocker OU.

**1. What is your overall impression of the project?**
The project was not a success. There are still rebound effects and EPA did not clean up the aquifer as planned. They are still doing work, so maybe it will be cleaned up eventually – by EPA or Mother Nature.

**2. What effects have site activities/operations had on the surrounding community?**
There were not too many effects. EPA was in and out pretty quickly. The most visible and lasting effect is the grassy mound where the contaminated soils are stored. It doesn't look natural and sticks out. It just looks like a Superfund site.

**3. Are you aware of any community concerns regarding the Rocker OU?**
The biggest concern is that people cannot drill wells anymore because of the Institutional Controls. Because the cost of water is rising, people have to cut back on watering to stay within their household budgets. This has a negative impact on the aesthetics of the community.

**4. Do you feel the remedy in Rocker is effective?**
Yes, as long as they keep the Institutional Controls in place.

**5. Do you feel well informed about the site progress and activities?**
I used to, but EPA has cut back on the communication over the last year or so. Even though the site is pretty quiet, people still need to be updated fairly regularly. A public meeting where we can ask questions would be a good thing at least once a year, if not more often.

**6. Do you have any other comments or suggestions?**
Put some additional vegetation, like trees or bushes, out on the grassy mound to make it look more natural.

**Telephone interview with Linda Bouck, Anaconda-Deer Lodge County, Planning Department (7/5/05)**

Ms. Bouck is the head of the Planning Department for Anaconda-Deer Lodge County. The Planning Department has significant input with the adjacent Anaconda Smelter NPL Site and more limited involvement with the Silver Bow Creek / Butte Area Superfund Site. Her comments primarily address the SST OU and Warm Springs Ponds OU.

**1. What is your overall impression of the project?**
The SST OU seems to be going along fairly well – everything is going as planned. The Warm Springs Ponds OU has a few issues that concern the county. The primary issue is a concern with the long-term preservation and maintenance of the Rainbow Bridge. ARCO was supposed to ensure that this historic bridge would be preserved. However, that is not occurring. Since remediation of Warm Springs Ponds OU began, the bridge has been flooded and pieces of the concrete base are broken.

**2.What effects have site activities/operations had the Anaconda/Deer Lodge County?**
There are occasional problems with chain of command. For instance, the DEQ located a haul road that splits a county road (Stewart Street crossing), they did not clear it first with the transportation director. Another issue that has arisen is that of standing, stagnant water in the borrow pits. With the recent concerns about the spread of West Nile Virus across the state, the county is worried about having breeding areas for mosquitoes.

**3.Are you aware of any community concerns regarding the site?**
The main community concerns are those with citizens of Opportunity. For many years, a significant number of people had used pasture owned by ARCO but leased long-term to the community. When the SST OU remediation began, these people were no longer allowed to graze livestock on the land, which has been a hardship for them. Several citizens in Opportunity have recently formed a citizen's group to deal with Superfund issues.

**4.Do you feel the remedy is protective?**
We can't say at this time whether or not the remediation is protective. The remedy needs time to cure, or age, to see how things will work out. There were no significant concerns with the proposed remedy when it was proposed or implementation began. However, there have been some issues that lead the county to question if the work is being done as planned. For instance, if such a visible component of the remediation as the Rainbow Bridge preservation is not being handled successfully, there may be other issues that are not so visible that are also going wrong. This concern was reinforced by problems with cleanup at the Anaconda Site where beryllium contamination at depth was found in a remediated area.

**5.Do you feel well informed about the site progress and activities?**
Yes, but there needs to be more effort informing the County Commissioners. The DEQ should hold a pre- and post-construction meeting each year with the commissioners that will bring them up to speed so that they can answer questions from the community. DEQ should also consider speaking to the community group from Opportunity. Connie Daniels would be a good county commissioner to interface with on this issue.

**6.Do you have any other comments or suggestions?**
No.

**Telephone interview with Don Peoples, Montana Economic Revitalization and Development Institute (MERDI) (6/3/05)**

**1. What is your overall impression of the project?**
Reasonable progress is being made.

**2.What effects have site activities/operations had on the surrounding community?**
There have been many aesthetic improvements resulting from site operations. Recreational opportunities have been increased by the addition of numerous walking trails. Also, with the cooperation of the agencies and Atlantic Richfield, MERDI has been instrumental in the redevelopment of over 30 acres of Brownfield area east of Arizona Street in the BPSOU. This redevelopment includes a sports complex. This has had many aesthetic and economic benefits for the community.

**3.Are you aware of any community concerns regarding the BPSOU?**
The recent controversy over attic dust has somewhat polarized the community. People are also concerned that the cleanup is both protective and supportive of future redevelopment.

**4.Do you feel the proposed remedy at the BPSOU is effective?**
Yes, providing they continue to monitor the Parrott Tailings that are left in place. The underlying groundwater is contaminated – that is a given. We need to be sure that the contamination does not migrate to any other aquifers.

**5.Do you feel well informed about the site progress and activities?**
Yes. Because our company works in redevelopment of this area, I am better informed than the average person in Butte about the cleanup. We have done pro bono reviews of the remedy, at the request of Atlantic Richfield, to provide our opinion on the protectiveness and overall merits of the proposed remedy. For the most part, we agree with the proposed remedy. But we have expressed concerns over some issues such as funding for long-term O&M and redevelopment.

**6.Do you have any other comments or suggestions?**
MERDI is concerned with two issues: there needs to be a redevelopment fund that is of sufficient size to make an impact of the community, and the O&M funding must be sufficient so that the county is not stuck with the costs for O&M in the future. Finally, the remedy must obviously be protective of human health, but it should also allow for (and support) future redevelopment of the area.

**Telephone interview with Mike Kerns, Butte-Silver Bow County Commissioner (6/11/05)**

Mr. Kerns has been a commissioner for 19 years and has been involved with the project since the early years. He also works at the Port of Montana, which is very near Ramsey Flats (SST OU) and the Rocker OU. His comments primarily address the SST OU, Rocker OU, and BPSOU.

**1. What is your overall impression of the project?**
The SST OU is coming along fabulously. The new contractor (an Irish company who also owns Helena Sand and Gravel) is fabulous. They are very fast, and it looks nice when they move on. They are really impressive. EPA is also doing a good job in Rocker, and we are hoping that the ROD for the Butte Hill (BPSOU) will also be successful.

**2.What effects have site activities/operations had on the surrounding community?**
The effects have been positive. Many mine waste areas have been turned into green spaces, and it has greatly improved the aesthetics in the area. Additionally, the health risks have been greatly decreased to EPA's work.

**3.Are you aware of any community concerns regarding the site?**
Attic dust at the Butte Hill (BPSOU) is a new concern that resulted from Imagine Butte's survey of the low-income community in that area. Interest in the Mine Flooding OU seems to have died down. There is also some debate as to whether EPA should make ARCO remove the Parrott Tailings or leave them in place. I am not aware of any concerns for Rocker or SST OU.

**4.Do you feel the remedy is protective?**
Yes. Anyone who has been to the SST OU can see that it is working. For the BPSOU, I would prefer to see the water treatment plant become part of the final remedy, rather than the lagoons that are now in place. Jon Sesso, Jimmy Johnson, and others in BSB have been working hard to make sure that the community will benefit in the long run.

**5.Do you feel well informed about the site progress and activities?**
Yes. EPA does a good job of keeping people aware of what is going on. It is hard to keep people's interest alive about a complicated subject over so many years. It was easier in Missoula, where they only had one issue to deal with and it was over a relatively short time frame.

**6.Do you have any other comments or suggestions?**
No.

**Telephone interview with Jon Sesso, Butte Silver Bow Planning Department (6/20/05)**
*Summarized by EPA and edited and approved by Mr. Sesso.*

**1. What is your overall impression of the SST OU and MFOU?**
The Superfund projects take way too long to complete. Also, EPA does not put enough emphasis on public involvement.

At the SSTOU, the remediation seems to be proceeding as planned although there are still some unresolved issues regarding long-term operation and maintenance (O&M) of the remediation and stewardship of the subsequent reclamation. The state appears to think it is premature about committing to a level of O&M&M (operation, maintenance, monitoring), especially in relation to the greenway (as the final end use) but that is a vital part of the success of the remediation.

At the MFOU, the public generally felt that their concerns and input were not attended to during the whole ROD / Consent Decree process. Also, it was a disappointment that innovative treatment technologies (i.e., resource recovery stages) were not fast tracked as part of the process selected.

**2.What effects have site activities/operations had on BSB and the surrounding community?**
Involvement in the Superfund process has been a burden for the BSB government. The existing personnel resources were not sufficient to take on the extra tasks of reviewing documents and active participation in other Superfund activities. We were fortunate to maintain in-house staff continuity, and this burden has been made more manageable by grants from the State and ARCO to hire additional personnel. BSB is doing a good job keeping up with the process with these additional resources.

The activities at SST have not had an immediate impact on the citizen's of BSB. Once the remediation is complete and the Greenway is finished, the community will benefit from the added recreational benefits, but most people are not affected at this time. For the MFOU, the site operations themselves have not had a significant impact on the community. However, the unresolved concerns associated with the OU (see below) have had a negative impact on the community.

**3.Are you aware of any community concerns regarding the SSTOU or MFOU?**
For SST, there have not been a lot of community concerns. There is a general feeling that perhaps the public health-related concerns at other OUs have not yet received as much attention as did the impacts to fish in the SST OU. There is also a concern that the long-term stewardship of both the remediation and restoration activities planned for the site will not get as much attention as needed

For MFOU, there has been some community concern related to the potential for future catastrophic events, such as a large earthquake, or that the critical water level was not the most appropriate decision point. What would happen and how would the contamination be remediated if Montana Resources (MR), ARCO and EPA are gone? Also, people who reside near the MFOU have current concerns about the potential health impacts from the fog that rises off the pit in winter and whether contaminated water in the bedrock aquifer will affect their wells in the alluvial aquifer. EPA says there is no health threat with the fog, but the entire community is not convinced. Some people also have a general disappointment that the water treatment technology selected did not include a resource recovery stage. There is also residual anger at the Atlantic Richfield Co for shutting off the pumps in the first place. There are also issues related to confusion over the reclamation obligations of the current mine operations by MR and remedial obligations by MR and Arco under Superfund.

**4.Do you feel the remedies at the SST OU and MFOU are protective?**
For SST, the remedy appears to be protective. It is based primarily on threats to fish and other organisms in the water – not on a threat to human health. DEQ is making good decisions on over excavating where needed, such as at Ramsey Flats. The area is definitely in much better shape than it was before. They are also making good decisions on scheduling, by accelerating cleanup of some areas, such as the rest stop on the way to Anaconda, without compromising the quality of the cleanup. Long term O&M of the remediation and restoration will be the key to overall protectiveness of the remedy.

For MFOU, BSB hopes that the remedy is protective and that the scientists who defined the hydrogeologic system are correct. There is less confidence that anyone really knows for sure if the critical water level of 5410 feet is accurate. If it is, then the remedy appears to be protective.

**5.Do you feel well informed about the site progress and activities?**
Yes, but BSB is directly involved in the activities, and is therefore better informed than most people in Butte. The public sees BSB staff members as an advocate for them. There is a reasonable level of trust that the people in local government are looking out for all citizens of Butte. In general, EPA does not spend the effort needed in Butte to inform and engage the citizens.

**6.Do you have any other comments or suggestions?**
EPA, DEQ, and ARCO need to ensure that the long-term O&M&M is adequately planned, implemented, and funded. There appears to be a belief among regulators that once the remediation is complete, all land uses can be allowed, i.e., like the way they were before the contamination occurred. However, the area has been damaged and wastes are left in place in many areas. The local community's standards for how we maintain things may be higher than what the regulators or PRP's would otherwise do. We need to get on the same page in this regard. For example, we believe restoration projects are a part of the overall O&M strategy and a good way to help achieve that end, i.e., if people perceive a benefit from something like the Greenway project, they are much more likely to treat it gently and not tear it up.

Also, everyone has to recognize that, given the fact that most remedies selected for this Site involve wastes-left-in-place, these sites will require a lot more money at the backend of the project, relative to typical Superfund sites where a small amount of very toxic material is removed. The track record for stewardship, ICs, and O&M at Superfund sites in general is not so good. Leaving the wastes in place is likely the most practical option and can / will be protective, but we must face the concerns related to maintaining these sites for generations to come. The vigilance has to be maintained at a level sufficient to weather the losses of institutional knowledge that will occur when the people currently working on the projects turn over. EPA's 5-year review process and other monitoring processes have to be substantial and have the teeth needed to ensure that remediation is being maintained as promised.

**Note**: Mr. Sesso also had concerns relating to the Butte Priority Soils OU (BPSOU). Although a ROD has not yet been signed and remediation has not technically started, there has been a lot of remediation done under the TCRA and ERA process. The community was told that these early actions would be consistent with the ROD and would be thoroughly reviewed for completeness and effectiveness prior to the ROD. Anything that was not successful would be upgraded as part of the ROD. Now, the EPA and to a certain extent the DEQ have concluded that all past actions are good enough. Yet, it appears to some members of the community that no cognitive review was done (i.e., no field analysis, etc.), because some of the past actions clearly have room for upgrading and improvement. BSB expects that EPA *intends* to require these improvements to be made as part of long-term monitoring and maintenance, but EPA has not yet expressed that in any official way (i.e., until the ROD is released), and thus, during the process to release the Proposed Plan for BPSOU, the Agency has not done an adequate job of relaying information about the status of these previous actions to the public.

**Telephone interview with Don Ueland, Rancher (6/13/05)**

Don Ueland is a local rancher who has sold property along Silver Bow Creek to Atlantic Richfield. He and his family also have the first water right coming out of Warm Springs Ponds and have dealing with AR over water rights issues. Also, he lives near the Rocket OU and is familiar with what is going on at most of the OUs.

**1. What is your overall impression of the project?**
The work done to date is wonderful. Total removal of the mine wastes from the streamside was more than what was needed, but is very positive. The streamside looks better than the natural environment nearby. The Warm Springs Ponds are doing their job, and the Mill Willow Bypass is great – especially the meanders. I am generally very happy with the cleanup.

**2.What effects have site activities/operations had on the surrounding community?**
The major impact has been a temporary influx of money into the community from jobs and expenses associated with the construction work. Not aware of any negative impacts.

**3. Are you aware of any community concerns regarding the site?**
Most people were not terribly concerned with the contamination prior to the cleanup. The area had been contaminated for over 100 years, and people just lived with it – it was the way things were. There were no obvious health effects that people were aware of, and the environmental effects seemed to be limited to poor plant growth and the occasional fish kill. Most people are aware that a cleanup has taken place, although many do not know the details. They can tell that the area looks better. Not aware of any specific community concerns – other than a desire for the economic boost to continue.

**4.Do you feel the remedy is protective?**
Yes. It is certainly better than it was before. Although we won't know for sure for many years, it seems to be working well. I trust that AR and the regulators will keep up the monitoring and will do what is right to ensure protectiveness.

**5.Do you feel well informed about the site progress and activities?**
Not really. It would be nice if EPA and DEQ could send out more fact sheets or get stories in the newspaper to keep people up to date. It is a complicated site and people get confused just trying to keep all the pieces separate. The fact sheet inserts in the Anaconda paper are helpful.

**6.Do you have any other comments or suggestions?**
No.

**Written submission from Dori Skrukrud**

June 29, 2005

Karen L. Ekstrom
CDM
28 N. Last Chance Gulch
Helena, MT 59601
(406) 495-1414 x311

RE: Response to questions regarding the protectiveness of the clean up actions taken to date at the Silver Bow Creek / Butte Area Superfund Site for EPA for the 5-year review

Dear Karen:

I have responded to your questions regarding the protectiveness of the cleanup action taken to date on Silver Bow Creek, as that is the area that I am most involved with in my activities related to the development of the Silver Bow Creek Greenway project.

1. What is your overall impression of the project?

   The Greenway Service District has been closely involved with the remedial activities along Silver Bow Creek as efforts to coordinate remediation with habitat restoration along the Silver Bow Creek Corridor. Overall, we believe that the project remediation goals and objectives are being met by the actions taken by the MT Department of Environmental Quality (DEQ). DEQ has demonstrated the ability to respond to our restoration objectives to improve the character and the quality of the corridor and their remediation strategies have adapted to varying conditions within the corridor to achieve remediation and restoration goals, including the removal of additional tailings in areas where tailings were slated to have remained for "in situ" treatment.

2. What effects have site operations had on the community?

   I believe that the site operations have had a positive effect on the community. The ongoing activities of the remedial efforts are tangible and the outcome, the new stream corridor and healthy vegetative cover, represent a new beginning for the stream corridor that is apparent to anyone who visits or sees the corridor.

   I am unaware of any adverse effects on the community – every effort is made to work with property owners and adjoining landowners to cause as little disruption in day-to-day activity for the community.

3. Are you aware of any community concerns regarding the site or its operation?

   The one concern is the uncertainty of funding and plans for long-term operations, maintenance and management of the remedy. Sufficient funds and plans must be in place to protect and preserve the remedy in perpetuity. Community members have discussed these concerns with those agencies associated with the project; the reality is that operations, maintenance and management are a reality for this site and must be readily acknowledged and planned for to ensure the health of the corridor.

4. Do you feel the remedy is protective?

   The remedial actions including tailings removal, stream reconstruction and riparian, floodplain and uplands revegetation strategies, coupled with restoration enhancements and the long-term land use strategy for the corridor to remain as open space for the public benefit will be protective of the remedy. It is imperative, however, that the costs of operations, maintenance and management be acknowledged and funded.

5. Do you feel well informed about site progress and activities?

   The DEQ has been responsive to requests for updates on the status of the project and available to the public in many forums.

6. Do you have any comments or suggestions?

   We need to discuss the need for a solid operations, maintenance and management plans for the corridor and receive assurances that funds will be available to implement these strategies.

Thank you for requesting input.

Sincerely,

Dori Skrukrud, Project Manager
Silver Bow Creek Greenway
A Greenway Service District Project

**Written submission from Dave Dziak, MT Fish Wildlife and Parks**

**Streamside Tailings and Warm Springs Ponds question Review.**

**Streamside tailings –**

**Question 1.**
My overall impression is that work that has been completed has vastly improved the condition of Silver Bow Creek. Definitely the looks of the area have changed dramatically in a positive direction.

**Question 2.**
I have on a very limited basis toured sub-area 2 as construction was taking place. I do make a point of looking at the area as I drive by / or near while working or otherwise.

**Question 3.**
I have received a couple of calls on "problem" beaver that inhabit some of the completed areas on Silver Bow creek. These calls have been from state personnel concerned about possible destruction of re-vegetated areas. I have also received calls regarding bridges and structures built over the stream without permits.

**Question 4.**
I believe the remedy is somewhat protective, as it has removed to some degree of tailings from the immediate stream banks. My concern is that much of the railroad grades that parallel the stream still contain high concentrations of heavy metals and the possible leaching of these metals back into the system. My other concern is for water quality as it comes into the system from the Butte area. This of course relies greatly on Butte mine flooding and the Treatment plant system when it comes on line.

**Question 5.**
Most of the information I receive comes from local newspaper articles or sections of the newspaper that devote a section for the work that has been done. I have attended a few meetings both public and state sanctioned. I also receive an update once in a while on the work being performed as a signed attendee of a local meeting.

**Question 6.**
Comments: I have concerns with the Greenway project and the expected increase use of the area by the public. Items that need to be addressed will be trail maintenance, ORV travel, trespass and injured wildlife.

**Warm Springs Ponds (WSP) –**

**Question 1.**
My overall impression of WSP is that it is a "water treatment faculty" first and foremost. Water quality remains an issue as the ponds continue to exceed water quality standards in Arsenic and high PH values. Also though the system was not designed as a Municipal Public treatment system it contains nutrient loads that exceed effluent reporting values.

Waterfowl habitat has changed from a shallow water system with dense vegetative shoreline cover to deep water, non-vegetative, steep armored rock shoreline. On a positive side the clean up of the Mill-Willow Bypass has been a good step.

**Question 2.**
I have been on WSP both as an employee of ARCO and an employee of state government since 1975. I have witnessed first hand the changes that have been made both positive and negative at the site. I continue to monitor waterfowl use of the area through waterfowl counts, nest searches and hunter information.

**Question 3.**
There have been both complaints and violations that agencies and ARCO have been made aware of.

**Question 4.**
I feel the remedy to some degree has been effective. No doubt there are still issues with water quality both as water comes into the system and as it flows out of the system.

**Question 5.**
I am well informed about site progress and activities.

**Question 6.**
A solution to water quality problems needs to found.

**Written submission from Ken Brockman, U.S. Bureau of Reclamation**

**From:** KBrockmanPE@aol.com
**Sent:** Monday, July 04, 2005 11:20 AM
**To:** Ekstrom, Karen
**Subject:** Silver Bow Creek 5 year review

Karen,

I wanted to take a closer look at the completed portions of the project before I replied so it took a couple of days longer than I expected. As you probably know, this is about an 11 year project that started in September, 1999. Construction has occurred under several contracts over the last several years. The first mile (Reach A) was completed in late 2000, so I suppose this is the subject of the 5 year review. Since then the State has also completed Reaches B and C (about 2 miles), Reaches D&E (another two miles) and are currently constructing Reaches F,G and H, a 3 mile stretch that will get them to the head of Durant Canyon. This contract is scheduled for completion in 2006. The State has also been working on a mile or so of tailings removal near the downstream end at Highway 1.

You should also note that some of the questions you ask are more appropriate for a final construction report than for a project that has supposedly been complete for 5 years. It seems to me that questions for a 5 year review would focus on whether the remedy is still performing as designed, whether there are any unforeseen maintenance issues, any modifications that have been necessary, etc.

My comments relate to only Reach A.

**What is your overall impression of the project?**

The project is going well and has been a success. The design is done in stages from upstream to downstream and is evolving as new information is obtained during construction. The vegetation along the streambank is excellent. The vegetation on the floodplain is very good with the exception of several small areas where I believe the soil has conductivity levels that prevent vegetation from growing.

**What is the current state of construction?**

Reach A was essentially completed in 2000. However, the creek flow control dike and bypass channel that protected the new channel and floodplain during the grow-in period were removed in late 2004/early 2005. The regraded areas were seeded in the Spring of 2005.

**Have you encountered any problems that changed or will change the remedy?**

There were no major problems encountered. There were several minor problems that resulted in minor adjustments to the design as it progressed downstream, but these were mostly reactions to what was learned during construction.

**Have any problems impacted construction or implementability?**

No problems that impacted construction or implementability come to mind.

**Do you have any comments, suggestions, or recommendations?**

The Greenway trails that were constructed as part of the floodplain were never finished by the Greenway organization.  These trails are deteriorating due to vegetation encroaching on the trail.  Also, the bridges planned for the trail to cross the creek were never installed. Future work on the trail and bridges could damage the good vegetation on the floodplain and creek banks.  Work on the Greenway Trail should be coordinated better with work on the remedy.  This would also allow for the area to be re-opened for public use.

**Written submission from CTEC**

**CTEC responses to CDM questions regarding the 2005 Statutory Five-Year Review Report Silver Bow Creek/Butte Area Superfund Site. July 8, 2005**

1. **What is your overall impression of the project?**
   CTEC believes that cleanup at the Silver Bow Creek / Butte Area Site has done a lot for beginning the restoration of economic and environmental health to the Upper Clark Fork Basin. Many of the cleanup actions performed in Butte and in the watershed below Butte have shown to be appropriate ways of removing hazardous waste and / or managing waste in place. However, CTEC contends that some of the remedy solutions could go further in protecting human health and the environment while still being cost effective--for instance mandating cleanup of contaminated attic dust and more aggressive, less time consuming approaches of removing or containing waste.

2. **What effect have site activities had on the surrounding area?**
   Site activities have had many positive affects including lessening people's exposure to toxic substances, beginning the process of restoring ecological health, and increasing people's awareness of hazardous waste in their community. Some negative affects may include the "Superfund stigma" and depressed property values owing to the perception that dangerous exposure to wastes still exists.

3. **Are you aware of any concerns regarding the site or its operation?**
   There are many concerns owing to site complexity. The Silver Bow Creek / Butte Area Site covers an incredibly large area; soil, water, and air are contaminated, and a large population lives within and on the contaminated media. Major concerns include a lack of an adequate <u>site-wide</u> exposure and toxicological assessment for contaminated attic dust. Concerns also exist that site remedies are not aggressively implemented and pathways of exposure contaminated waste exist to humans and the environment that have been know about for decades; an example of this has been the slow response to treating contaminated runoff on the Butte Hill and the slow response to remediation of lead and arsenic sources in Butte residences.

4. **Do you feel the proposed remedy is protective?**
   This question is too complicated and there are too many remedies within the Silver Bow Creek / Butte Area Site to adequately describe here. The answer is yes and no.

5. **Do you feel well informed about site progress and activities?**
   Yes, CTEC believes that EPA and ARCO do a good job of documenting site activities and monitoring. CTEC found that the Year 2000 Statutory Five-Year Review Report Silver Bow Creek / Butte Area Superfund Site appeared to be biased towards promoting site successes and was not always objective in describing site failures. CTEC hopes that the forthcoming Five Year Review Report will provide objective analysis of site short-comings such as recontamination of remediated portions of the Silver Bow Creek Stream-side Tailings OU and exceedences of performance standards at Warm Springs Ponds OU.

6. **Do you have any comments or suggestions?**

Please see the attached review and comments of the Year 2000 Statutory Five-Year Review Report Silver Bow Creek / Butte Area Superfund Site.

**Written submission from Bob Benson, Clark Fork River Technical Assistance Committee (CFRTac)**

RECEIVED MAY 31 2005

Karen Ekstrom

Community Involvement Specialist, CDM

Dear Karen,

As I mentionrd on the phone the other day, I have not been as deeply involved in the upstream Superfund sites, but have tried to keep up with what is going on, particularly at WSP. So some of these answers will beshort.

1. The parts of the project I have seen (SBC & WSP) seem to be well planned and given the glitches that are inevitable on big undertakings, seem to be progressing pretty well. Visually portions of SBC and the bypass at WSP give the impression at least that things are on the mend.

2.Don't know about SBC. At WSP I had heard there was some concerns over traffic and dust when the ponds were being reconstructed. This is only heresay however, as our TAG was limited to Milltown at that time.

3. Pretty much covered in 2 above.

4.Think the jury is still out on this. For SBC we wont really know until the work is complete, stabiliztion measures are all in place, and vegetation has been established and grown. The real proof will be a 50 yr. flood event! At WSP the last meeting I was at in Opportunity indicated there is still some concern over Arsenic. Our technical advisor. Jim Kuipers wrote a white paper on arsenic and I have looked at discharge data from time to time but to be honest about it, I don't understand very well arsenic transport and fate, and what it may mean to water downstream and at Milltown pond. If the fish biologists are correct, the liming operations at the pond are probably a contributor to the algea blooms we see all along the river in summer. But this is of course confounded by ag operations, sewers and septics, and other runoff sources of nutrients.

5. Fairly well informed. I could do more on my own to get more info. However, I have noticed that the media have not given much coverage unless there is some unusual event like the dead birds at the pit. And that is where most people get their info.

6. Maybe getting more media coverage on how things are going at these sites such a field trip in connection with the 5-yr review. (realize that there is probably much better coverage in Butte area than we get here in Missoula). I think also that what would be of interest to landowners along the river in the Deerlodge valley would be some information on type, duration, and other experiences of land owners along SBC.

Please excuse the sloppy typing - my secretary retired when I did!

Bob Benson

Bob Benson

Montana Department of
ENVIRONMENTAL QUALITY

July 28, 2005

Environmental Protection Agency
Scott Brown, Regional Project Manager
10 West 15th Street
Helena, MT 59601

Dear Mr. Brown;

The Department of Environmental Quality (DEQ) would like to take this opportunity to respond to comments received on the Silver Bow Creek Five-Year Review.

In a telephone interview with Linda Bouck of Anaconda-Deerlodge County's Planning Department, Ms. Bouck states that DEQ did not clear our proposed haul road crossing on a county road with the transportation director. In fact, the DEQ on-site project manager and the design engineer took the plans to the Anaconda-Deerlodge Roads Department, spoke with Larry Sturm, the county's Road Shop Supervisor, and asked for any comments he had on the project. The county does not have a Transportation Department, or a Transportation Director according to the Chief Executive's office.

At the time, this was the procedure for such activities. As construction neared, the department was informed that issues regarding the roads should be brought before the county commissioners. This was a change in policy since the time we approached the Roads Department. DEQ then contacted the Chief Executive's office to be placed on the schedule. Both the on-site project manager and I went to two consecutive meetings to present the proposed crossing and for the commissioners' vote. Very limited input was received at these meetings regarding the crossing. I feel that DEQ adequately followed the chain of command, even as it changed.

In the written comments for Dave Dziak of the Montana Fish, Wildlife and Parks (FWP), he states he 'received calls regarding bridges and structures built over the stream without permits.' The department feels it is important to clarify that in a superfund cleanup, permits are not required per 42 USC § 9621(e)(1), although substantive compliance with the law and rules associated with those permits is required as stated in the CERCLA Compliance with Other Laws Manual, August 8, 1988. Unfortunately, while the majority of the construction of these structures fulfilled the substantive compliance requirements, there were errors on the part of the contractor that led to sediment discharge on Silver Bow Creek. DEQ worked with the contractor and FWP to resolve these issues and agreed to inform FWP of our activities on or near Silver Bow and Willow Creeks.

I appreciate the opportunity to respond to these comments and will continue to work towards the successful remediation of Silver Bow Creek.

Sincerely,

Joel Chavez
Construction Services Section Supervisor
Mine Waste Cleanup Bureau
Remediation Division

April 19, 2004

Scott Brown
U.S. EPA Region 8 (8MO)
10 W. 15 th St.; Suite 3200
Helena, MT 59626

Dear Scott:

We appreciated the opportunity to meet with you and others on April 1st, 2004 to discuss the Warm Springs Ponds (WSP). We feel the meeting was very constructive and we would like to express our interest in working with you to address the concerns raised by CFRTAC and others at the meeting. We agree that the upcoming Five-Year Review Report and underlying review process would be a timely and appropriate opportunity to work to address any issues concerning the WSPs. Specifically, we would recommend the five-year review address the following items:

1. Human and ecological risk analysis of exceedances of arsenic performance standards.
2. Optimization of WSPs operation for removal of arsenic (to address seasonal arsenic desorption).
3. Ground and surface water and contaminant mass balance to allow for better understanding of WSPs overall performance and monitoring.
4. Short-term future potential impacts on WSPs from increases in Silver Bow Creek flow due to discharges from Butte Mine Flooding OU water treatment; nitrogen treatment by Butte Silver Bow potentially affecting biology of ponds; and ongoing upstream cleanup and other activities.
5. Long-term future of ponds once Silver Bow Creek cleanup and other activities have been completed (dry versus wet closure; managing agency; financial assurance for operation and maintenance).

We appreciate your efforts to provide access to the WSPS database maintained by ARCO and look forward to having done so in the near future (Pioneer Technical Services has contacted our technical advisor and has indicated the database will be forthcoming). We also look forward to being invited to future additional technical meetings. We believe that sufficient interest exists for EPA to consider a formal technical review process over the coming year in which we and others could participate.

If you have any questions or comments please contact me at XXX-XXXX or Jim Kuipers, our technical advisor, at 782-3441.

Sincerely,

CFRTAC

Cc: Bob Fox, EPA
John Wordell, EPA
Darrel Reed, MDEQ
Doug Martin, MNRDP
Tom Malloy, BSB County
Scott Payne, CTEC
Bill Olsen, USFWS
David Nimick, USGS
Don Skaar, MFWP

# EPA Conducting Mandatory 5-Year Review of Silver Bow Creek/ Butte Area Site

The U.S. Environmental Protection Agency (EPA) will be conducting a required 5-year review of the response actions (cleanup work) done to date for the Silver Bow Creek/Butte Area Superfund Site. This site extends from Butte to the Warm Springs ponds, near Anaconda. The site has eight operable units (OUs).

The emphasis of the review is on the site's five most active OUs:

- Butte Mine Flooding
- Rocker Timber Framing and Treatment Plant
- Streamside Tailings
- Warm Springs Ponds – Active Area
- Warm Springs Ponds – Inactive Area

Site contamination is the result of over 100 years of historic mining activities. Contaminants of concern are heavy metals and arsenic. Cleanup has included source removals, wet closures and capping, groundwater and surface water controls, stream rehabilitation, land reclamation, water treatment systems, and flood controls.

The review assesses the protectiveness of the various response actions done to date. The results of the 5-year review will be made available to the public this summer.

EPA welcomes public comments regarding work done at any of the OUs. Public comments received by EPA will be appended to the final 5-year review document when it is sent to EPA headquarters. If you have comments about the response actions, *please send them in writing to:*

Scott Brown
EPA Review Coordinator
10 West 15th Street, Suite 3200
Helena, MT  59626