Unites States Environmental Protection Agency
Region VIII, Montana Office

Statutory Five-Year Review Report

Silver Bow Creek/Butte Area Superfund Site
Clark Fork River Basin, Montana
With Emphasis on the Warm Springs Ponds Operable Units

I certify that the interim and final remedies selected for the operable units of the Silver Bow Creek/Butte Area Superfund Site remain protective of human health and the environment.

Approved and Transmitted to EPA Region VIII and Headquarters:

John F. Wardell   3/23/00

John F. Wardell, Director
Montana Office

Date

ADMINISTRATIVE RECORD SBC 1232

SILVER BOW CREEK/BUTTE AREA FIVE YEAR REVIEW REPORT

If you wish to receive a copy of the Silver Bow Creek/Butte Area Five Year Review Report or the Milltown Reservoir Ecological Risk Assessment Addendum on CD-ROM or via paper copy, please put your name and mailing address below. Be sure to indicate in what form you would like the document (CD-ROM or paper) and which document.

NAME	MAILING ADDRESS	DOCUMENT	FORM
WSP WSP ERAAV Susan Drumheller	c/o 100 N. 1st Ave, Sandpoint, ID 83864	Both	CD
Scott Bischke ERAAV	20A Graf St Bozeman, MT 59715		Both on CD ERA CD - Also ARCO's comm
Barry Duff	307 E. Parke Street Anaconda, MT 59711	SBC milltown	hardcopy both on CD
ERAAV Tova Woyciechowicz	723 Hastings Ave Msla, 59801	MILLTOWN ONLY - not 5 yr report	NONE
Frank A. Venturi	CD-WSP		

OVER

NAME	MAILING ADDRESS	DOCUMENT	FORM

Ⓥ Kathy, file bd) WSP 5yr Review

Distribution

Ⓥ bd ② Headquarters — Carol Bass
Ⓥ bd ① Ⓥ Daryl Reed
② Ⓥ Barry Duff
① Mary Capdeville
Hard Copy ① Jim Kuipers (CFRTAC)
Hard Ⓥ CTEC
① Ⓥ Geoff Smith (CFPOC)
Ⓥ CD NRD (Mark Kerr)
No ~~Kevin Kirley (DEQ)~~ (Daryl)
Paul Capps
① Ⓥ Duncan Adams — (do interview next day) → also ERIC & KATHY BOSHART, ① SILVER STATE POST
CD Don Skaar Ⓥ ~~Wayne Hadley~~
Bill Masella (TU)
Chris Marchion (DU)
Bruce Farling (TU)
Ⓥ CD Scott Hand deliver Bill Olsen (USFWS)
Ⓥ CD John Lambing (USGS)
① Ⓥ Ron Hanson (Powell County)
① Ⓥ Matt Vincent Cindy Gross (Tri-County)
CD ADL Planning Dept
Ⓥ CD Vicki Watson (UM) — text on email
Hard Ⓥ Phil Tourangeau (NPS)
x Bob Benson (CFRTAC) will use Geoff
Ⓥ CD Bill Kelly / Bill Schinderlein, ESA Consultants, Fort Collins
Ⓥ CD Joseph Michaletz, Geolex, Helena
Ⓥ CD Bill Bluck, CH2M Hill
Ⓥ CD Dennis Neuman, MSU

Repos.

Ⓥ MT Tech Library bd
Ⓥ Butte EPA bd
Ⓥ Anaconda Hearst bd
Ⓥ Kohrs Library bd
Ⓥ Mansfield bd
Ⓥ Missoula County bd
Ⓥ Records Center Ⓥ bd

Bob
Ⓥ Henry
Ⓥ Scott
Sam

Jack Marjerison (get his Missoula-area address from ARCO)

10

ERRATUM

Silver Bow Creek\/Butte Area Statutory Five Year Review

March 2000

Please note that a pagination error occurred. In reformatting a scanned document (after the scanned file crashed on the day we were producing the document for the information repositories), we changed page numbers. Unfortunately, we missed a significant error: page 39 proceeds to page 64. NO PAGES ARE MISSING; however, all subsequent pages are thus misnumbered. Interestingly enough, the table of contents accurately reflects the misnumbered pages. (What quality control!) Please forgive this error, and if any additional questions arise, please call Pam Hillery at (406) 441-1150 ext. 246.

Table of Contents

Five Year Review Report
Silver Bow Creek/Butte Area Superfund Site
With Emphasis on the Warm Springs Ponds Performance Review

List of Tables, Figures, and Appendices

Tables

PREFACE TO THE FIVE-YEAR REVIEW REPORT FOR THE SILVER BOW CREEK/BUTTE AREA SUPERFUND SITE

The EPA's Montana Office began preparing the Silver Bow Creek/Butte Area Superfund Site Five-Year Review Report during late fall1997. Although five-year reviews of Superfund sites are required by EPA headquarters directives to evaluate all operable units of a site, the Montana Office believes that the two operable units of the Warm Springs Ponds, the active and inactive areas, are of great interest to the public. Thus, EPA concentrated its review on the ponds.

Initially, the period of record used to evaluate the ponds' performance was January 1992 through October 1997, which coincided with the shakedown period. Through late 1997 and until mid-1998, EPA conducted its review, gathering and analyzing all the information that was available. While overall performance was deemed by EPA to be good to excellent, less than consistent compliance was achieved for three surface water quality parameters: arsenic, copper and zinc. When compared to State of Montana surface water quality standards, which were adopted by EPA as performance standards and written into both records of decision, arsenic, copper and zinc concentrations discharged from the ponds during the shakedown period failed to meet their respective performance standards on a consistent basis. Over the five-year period under review, arsenic and copper failed to meet standards approximately 15 percent of the time and zinc failed approximately eight percent of the time.

However, another required aspect of the performance review, the protectiveness evaluation, was also being conducted. The protectiveness evaluation was being conducted simultaneously with the Clark Fork River ecological risk assessment. Toxicity reference values, which were being developed by EPA's Duluth Laboratory scientists, in coordination with scientists representing the State of Montana and a neutral panel of three distinguished aquatic toxicologists, required considerable time and effort. The final toxicity reference values (both acute and chronic) for trout were not developed until late November 1999. The public review draft of the Clark Fork River ecological risk assessment was released in mid-December 1999. Thus, the protectiveness evaluation for the Warm Springs Ponds was held in abeyance until EPA was certain that all information contained in the risk assessment for the river was agreed upon and released to the public.

Having released the ecological risk assessment, which is undergoing public review, EPA now is faced with releasing the five-year review report for the ponds, but lacking nearly two years of additional performance data. EPA has decided to provide the updated information as an appendix, as opposed to going back and attempting to incorporate the additional data into original graphs, tables and figures. To do otherwise would require great expense in terms of both human and financial resources.

Reviewers will observe that the two additional years of surface water quality performance data (1998 and 1999) demonstrate that:

(a) arsenic chemistry remains about the same as during the shakedown period, where roughly one-third of the time performance standards cannot be met (however, no deleterious effect on aquatic life);

(b) copper and mercury concentrations leaving the ponds rarely exceeded performance standards (97 percent or more compliance); and

(c) zinc concentrations leaving the ponds were 100 percent compliant, as were cadmium, iron, lead and total suspended solids concentrations.

These impressive results for surface water quality were achieved, in part, because of operational improvements derived from experiences during the preceding shakedown period. Dam safety, ground water and other performance requirements, which are of particular concern to residents of the near-river portion of the valley and the City of Deer Lodge below the ponds, were met at all times.

U.S. Environmental Protection Agency, Region VIII
Silver Bow Creek/Butte Area Superfund Site Draft Final Five Year Review Report
With Emphasis on the Warm Springs Ponds Operable Units

Clark Fork River Basin, Montana
March 2000

1.0 Introduction

Region VIII of the U.S. Environmental Protection Agency (EPA) conducted a statutory five year review of the Silver Bow Creek/Butte Area (SBC/BA) Superfund Site and prepared this report pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, and Section 300.430(f)(4)(ii) of the National Contingency Plan (NCP). CERCLA requires EPA to conduct a review at least every five years at any site where a remedial action, once initiated, results in any hazardous substance, pollutant, or contaminant remaining at the site above levels that allow fo. unlimited use and unrestricted exposure.

Remedial action construction starts the clock for a site wide five year review. The Silver Bow Creek/Butte Area site is divided into operable units to facilitate cleanup activities. The Warm Springs Ponds operable units (the Active and Inactive Areas) were the first operable units to complete records of decision (RODs) at the site, and thus remedial action at the Ponds (begun in 1992) triggered the five year review. As a result, the focus in this five year review report is the Warm Springs Ponds operable units, because remedial actions included leaving and managing hazardous substances on site. EPA has been evaluating information since early 1997 in order to complete this review. As construction is complete for the Warm Springs Ponds operable units, the review will focus on this area. Other operable units will also be described and reviewed, but the review will be less extensive, due to their status.

Future five year reviews for the Silver Bow Creek/Butte Area NPL site will occur sequential to the signature date of this five year review (no later than 2005). However, Warm Springs Ponds will not always be the focus or emphasis of said reviews; other operable units' progress will receive more complete review as their cleanup activities accelerate. EPA expects that all operable units will have final remedy decisions when the next five year review is due, and the agency will conduct an even more extensive review.

EPA conducted this five year review in accordance with EPA's Office of Solid Waste and Emergency Response (OSWER) Directive No. 9355.7-02, entitled "Structure and Components of Five year reviews," May 23, 1991; Directive No. 9355.7-02A, entitled "Supplemental Five Year Review Guidance," July 26, 1994; and Directive No. 9355.7-03A, entitled "Second Supplemental Five Year Review Guidance," December 21, 1995.[1] Region VIII evaluated whether the response actions at the SBC/BA operable units remain protective of public health and the environment. Specifically, EPA evaluated whether the remedies selected and constructed are operating and

[1]Because this review was substantially drafted prior to issuance of new EPA five year review guidance, EPA headquarters directed Region 8 to use the cited guidance to complete this report.

functioning as designed, that institutional controls are in place and are protective, and that original cleanup levels remain protective.

Five year review reports summarize recent technical data obtained from monitoring, sampling or testing, as well as a rationale supporting conclusions drawn from such data. Such reviews also prescribe measures to correct any deficiency found. In the conduct of this five year review, Region VIII reviewed all pertinent site documents, including decision documents, explanations of significant differences, administrative orders, remedial design plans and reports, remedial action reports, construction completion reports, and as-built drawings. EPA reviewed applicable or relevant and appropriate requirements (ARARs), and on-site visits to all operable units of the site.

EPA reviewed state and federal ARARs promulgated or modified after the two Warm Springs Ponds records of decision were issued in September 1990 and June 1992. Subsequent to their issuance, the State of Montana revised the water quality standards for total arsenic in all state streams and in all domestic and municipal drinking water wells, from 0.05 mg/l (total recoverable analysis) to 0.018 mg/l. Standards (ARARs) for all of the remaining constituents identified by Exhibit 5 of the 1991 administrative order, for protection of water quality, remain unchanged. Also unchanged are the numerous standards for dam safety, air quality, contaminated soils and mine wastes, floodplain and floodway management, preservation of historic and cultural resources, wetlands, endangered species, and general land reclamation. The State modified an important streambed protection regulation; however, the ROD standard meets the current State standard.

OSWER Directive (December 21, 1995) "encourage[s] Regions to leverage resources by using potentially responsible parties (PRPs) to provide information for five year reviews." EPA has done so, particularly in respect to the Warm Springs Ponds performance review, as the potentially responsible party, the Atlantic Richfield Company (ARCO), is also the property owner and operator of the facility.

Region VIII conducted an expanded Type Ia review for this site. Type Ia five year reviews are appropriate at sites such as the Silver Bow Creek/Butte Area site, where remedial actions are ongoing, construction is incomplete, and the site does not qualify as a completed Superfund site. (See OSWER Directive No. 9355.7-02A.) EPA expanded this review, however, because (a) the site has a number of complex operable units with considerable ongoing activity, and (b) completion of site work will occur long past five years after initial work began.

The remainder of this five year review report provides a location description and history, identification of remedial objectives, and summary evaluation of protectiveness factors for each operable unit, with Warm Springs Ponds receiving special emphasis.

2.0 Site Description and History

This site is in southwestern Montana, in the headwaters of the Clark's Fork of the Columbia River, or more commonly Clark Fork River, and was originally named the Silver Bow Creek NPL Site on September 8, 1983. It included approximately 28 miles of Silver Bow Creek, from Butte, in Silver Bow County, downstream to the outlet of the Warm Springs Treatment Ponds, east of Anaconda, in Deer Lodge County.

On July 22, 1987, EPA enlarged the site and amended its name. Large areas in and around Butte were added and the site name became the Silver Bow Creek/Butte Area Superfund Site (52 Fed. Reg. 27,627). Shortly after, EPA enlarged the site by some 140 miles to include the Clark Fork River from the outlet of the Warm Springs Treatment Ponds downstream to the head of Milltown Reservoir near Missoula. (See Figure 1.)

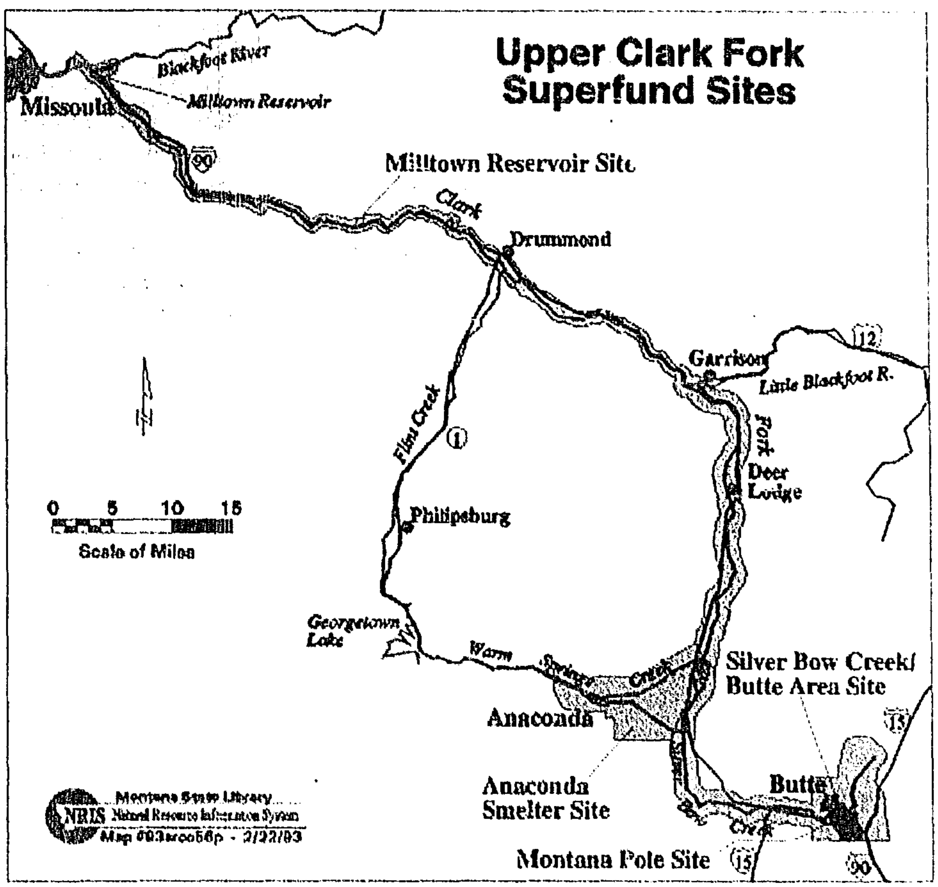


Figure 1.
Silver Bow Creek/Butte Area Location Map

The Montana Department of Health and Environmental Sciences (now, Department of Environmental Quality) completed site characterization studies, some feasibility studies and the first proposed plan for this site, the Warm Springs Ponds Proposed Plan of October 1989. As lead agency for the site, MDHES (now DEQ) had responsibility 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 operable units or subunits of the Butte Area portion of the site.

Shortly after the Warm Springs Ponds Proposed Plan was issued, however, EPA became the lead agency for all operable units and subunits except for Silver Bow Creek proper, which by then had become known as the Streamside Tailings Operable Unit. Within 18 months, EPA shifted the Clark Fork River Operable Unit from the Silver Bow Creek/Butte Area Superfund Site to the Milltown Reservoir Sediments Superfund Site, a site for which EPA has been the lead agency since its listing in 1983. That situation remains true today.

Mining began in the region with the discovery of gold in 1864 on Silver Bow Creek. By 1884, attention had shifted to silver and copper, and over 300 silver and copper (combined) mines, at least nine silver mines, many mills, and at least eight open air smelters were operating in the Butte area. The Anaconda Minerals Company or its predecessors owned and operated almost all of these mines, mills and smelters. Mining, milling and smelting continued until 1982, when the Atlantic Richfield Company, the successor corporation to the Anaconda Minerals Company, closed the Berkeley Pit operation in Butte. Montana Resources Inc. and others resumed mining and milling in 1986.

Over the major portion of this span of 130 years, mining, milling and related activities caused massive contamination of water, soil and air in the Clark Fork River Basin. Contamination of Silver Bow Creek occurred from the very outset of these activities, as mining, milling, smelting and other wastes were dumped directly into Silver Bow Creek. Contamination of lower Silver Bow Creek and the Clark Fork River was exacerbated by operations and massive releases from the Anaconda Smelter, a large mill and smelter operated by the Anaconda Minerals Company and its predecessors. The wastes from these various sources deposited along Silver Bow Creek and the Clark Fork River. Other sources of contamination include various railroad beds.

Around 1911, the Anaconda Copper Mining Company constructed an earth dam about 20 feet high near the confluence of Silver Bow, Willow, Mill and Warm Springs creeks. A settling pond for mill tailings formed, but soon breached. Around 1916, slightly upstream of the first dam, the Anaconda Company constructed a second earth dam about 18 feet high. These two dams created Warm Springs Ponds 1 and 2. Much later, between 1954 and 1959, a third dam was constructed above Pond 2 by the Anaconda Company; a dam 28 feet high which formed Pond 3. Between 1967 and 1969, the second and third dams were each raised five feet.

Also around 1967, the Anaconda Company began introducing a lime and water suspension into lower Silver Bow Creek, above Pond 3, from the Anaconda Smelter. The addition of lime suspension raised the pH of the creek water to encourage precipitation of metals within the Warm Springs Ponds. Prior to this action, the ponds functioned simply as settling ponds for tailings. Today, the three ponds contain some 19 million cubic yards of tailings and sediments.

While adding a treatment component and raising berms, the Anaconda Company, around 1969 or 1970, in response to a request by the Montana Department of Fish and Game (now Fish, Wildlife and Parks), constructed the Mill-Willow Bypass along the western aspect of the pond system. The bypass channel was constructed in order to divert what was believed to be relatively clean water, in Willow and Mill creeks, around the pond system and directly into the upper river.

Within a short period after construction of the bypass, however, the inlet of Pond 3 would become plugged with debris during spring runoff events, causing Silver Bow Creek to break through a fuse plug and flow into the bypass. Over several years of this phenomenon repeating itself, up until 1988 or 1989, the channel and banks of the bypass became choked with tailings deposited by Silver Bow Creek.

Throughout the 1980s, several fish kills were observed and recorded within the upper Clark Fork River. The massive kill of July 1989, when an estimated 5,000 trout died from exposure to contaminants along the lower bypass and upper river, directed much public attention toward the ponds and bypass. Thunderstorm runoff from salt-encrusted stream side tailings deposits was believed to be responsible for these fish kills.

Several months before, however, the State and EPA had already identified the Warm Springs Ponds as a high priority area for immediate attention by Superfund. The dams were thought to be highly susceptible to failure in a moderate to severe earthquake or flood. The Montana Dam Safety Bureau warned that the dams might not withstand even a moderate earthquake. The potential was high for the sudden release of a very large volume of water and sediments, should the dams fail. For Deer Lodge, just 20 miles downstream, and for the entire Deer Lodge valley, the human safety risks were high.

These significant issues and events set the stage for discussions between EPA and ARCO that led to a July 1990 Administrative Order on Consent for the Mill-Willow Bypass Expedited Response Action (also described as the Mill-Willow Bypass Non-time Critical Removal Action). Although the action was intended to remove tailings and contaminated soils and sediments from the bypass, other important aspects of this action involved the raising, strengthening and armoring of the dams, and construction of a new bypass floodway for safe passage of large floods around the ponds. By the end of that first year, 1990, the dams and floodway were safe.

Also by fall 1990, EPA, in consultation with the State, issued a Record of Decision for the Warm Springs Ponds Active Area. This first Record of Decision (ROD) for the Silver Bow Creek/Butte Area site adopted and carried forward the State's objectives, expressed in its 1989 Proposed Plan, for a cleanup of the ponds. In 1992, EPA signed a second record of decision for Pond 1 and the area immediately below, called the Inactive Area ROD. Together, the two RODs dictated remedial activities to address dam safety and water treatment issues. The RODs also established long term biological monitoring of the many species using the ponds as habitat.

Upstream, the Berkeley Pit was the subject of intense study resulting in a 1994 record of decision. The Mine Flooding ROD called for inflow control, continued research into treatment technologies, public education about the Pit, and eventual pumping and treating of Pit water when the Pit water nears a specific elevation. In 1995, EPA and the State signed two RODs: Streamside Tailings and the Rocker operable units. The remedy for Streamside Tailings is being implemented in phases, with design for the first reach of the stream complete and initial construction completed in 1999. The Rocker remedy was implemented pursuant to an EPA unilateral order, and is undergoing final remediation steps, contingency evaluation, and operation and maintenance.

Other major response actions, such as the Lower Area One Expedited Response Action, the Butte Stormwater TCRA, and the various Butte human health removal activities, have been implemented by EPA. Two remedial operable units–West Side and Active Area–have just begun RI/FS scoping activities. This review does not address these actions.

3.0 Overview of All Operable Units

Due to the ongoing work at several operable units, the following overview of all non-Warm Springs Ponds remedial operable units is brief. Rocker OU is the exception: there, the remedial action is largely complete. As the Rocker remedial action start occurred in 1997, EPA believes an evaluation of the OU would benefit from a few more years of monitoring. However, an initial statement of protectiveness is offered.

3.1 <u>Butte Mine Flooding Operable Unit</u>

Location

The Butte Mine Flooding Operable Unit (BMFOU) is located in and near the cities of Butte and Walkerville, Montana. It 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 cources of inflow to the Berkeley Pit/East Camp System (Pit system). BMFOU is within the Butte minings district in the upper Silver Bow Creek drainage and covers about 23 square miles.

The Berkeley Pit is the major feature of the operable unit, containing about 30 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 operable unit, is also part of the Mine Flooding OU. It is bulkheaded off from the Pit system and water levels are much higher.

Enforcement History and Actions

As noted above, the Butte Area was listed on the NPL when it was added to the original Silver Bow Creek NPL site in July 1987. The BMFOU is part of the Butte Area.

On March 31, 1989, EPA entered into an administrative order on consent (AOC) with ARCO and Dennis Washington (consenting potentially responsible parties, or PRPs) to implement a response action, conducted under Superfund removal authority, to control the rising water in the West Camp system. This AOC required the PRPs to convey the West Camp water from the Travona Shaft to the Butte Metro Wastewater Treatment Plant. The AOC also required that a contingency treatment plant be constructed if the Metro Plant can no longer accept the West Camp water. This action was implemented and is operating appropriately.

A remedial investigation/feasibility study was initiated in July 1990 under an AOC with the PRPs. The RI/FS was completed in 1994. The Record of Decision (ROD) was signed in September 1994. The ROD mandates several actions, including:

1. Control and treat surface water inflow before discharge;
2. Keep water levels below an elevation of 5410 feet (the "critical water level") throughout the Pit system, and treat any water pumped out of the system before discharge;
3. Maintain water levels below 5435' elevation in the West Camp system, and treat West Camp waters through the Butte Metro Plant or an alternate plant if the Metro Plant cannot continue to be used;
4. Institute a long-term, comprehensive monitoring program;
5. Produce a focused feasibility study 24 months prior to mine closure or when the Pit system reaches 5260' elevation. Evaluate all existing and emerging technology to provide EPA with information to select a final treatment technology for the Berkeley Pit water; and
6. 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.

A unilateral administrative order (UAO) was issued to ARCO, Montana Resources Inc., ASARCO, and Dennis Washington on June 11, 1996 to implement the remedial design/remedial action activities associated with the ROD.

Current Status

On April 15, 1996, the PRPs instituted the inflow control program by capturing and integrating the Horseshoe Bend (HSB) flow into the mining process. About four million gallons per day (mgd) is being used in the mining process. Excess lime is added to the diverted water and the metals are precipitated in the Yankee Doodle Tailings Pond. The cost for treating the HSB water is about $2.5 million per year. This program has reduced the rate of rise in the Pit from approxmiately 24 feet per year to about 12 feet per year. This increases the projected time until the Berkeley Pit/East Camp System has to be completely maintained from 2013 until 2021.

The West Camp system continues to be controlled by pumping approximately 0.3 mgd to the Butte Metro Plant.

The long-term monitoring program began in 1996. This comprehensive bedrock aquifer, alluvial aquifer, surface water, mine shaft, and process water monitoring system will continue in perpetuity, and will be modified as necessary in the future.

The Berkeley Pit Public Education Committee was appointed by the Butte-Silver Bow chief executive, and continues to perform outreach to the community to transfer information concerning the Mine Flooding project. They publish an update on the Pit, the "PitWatch," twice each year.

The water level in the Berkeley Pit as of January 2000 is at 5213' elevation as measured at the Anselmo Shaft. The Anselmo is the compliance point as it has the highest water level. This is about 197 feet below the critical water level. The water level in the system is projected to reach the 5410' elevation critical water level in 2021. Presently the time frame for the treatment technology review when the water level reaches the 5260' elevation critical water level is about 2008. Institutional controls to prevent domestic use of contaminated groundwater have begun.

Statement on Protectiveness

Remedial action implementation continues to provide protection of human health and the environment for the Butte Mine Flooding operable unit. Treatment of contaminated surface water and groundwater as well as associated monitoring must continue in perpetuity for this protectiveness to remain. Creation or expansion of treatment capability when the groundwater level approaches the 5410' elevation is also very important for continuation of protectiveness.

3.2 Butte Priority Soils Operable Unit RI/FS

Location

The Butte Priority Soils Operable Unit (BPSOU) includes most of the City of Butte and Town of Walkerville. The contaminants of concern are defined as any potentially hazardous metalloids or metals that could be associated with mining-related impacts (e.g. lead, arsenic, cadmium, copper, and zinc). The ongoing RI/FS is focused on contaminants in soil/mine waste, surface water and groundwater.

The purpose of the RI/FS is to gather sufficient information to support an informed risk management decision regarding remedial alternatives and ARAR compliance. The RI/FS objectives are as follows:

> Characterize the levels of arsenic and metals in soil material (i.e., soil, waste rock, and other mining related materials), surface water, and groundwater contained within the operable unit. From these characterizations, estimates may be made of the quantity of impacted material that may require remediation as well as assessments of environmental risks.
>
> Characterize the sources of concern and the source-receptor pathways. These characterizations will allow the sources to be eliminated or controlled in a way that mitigates future human and environmental exposures.

The RI/FS Work Plan was approved in May 1996. A great deal of data exists for the site and additional data has been collected since the effective date of the Work Plan. However, additional information is needed to completely characterize the site. Currently, the schedule calls for the completion of the RI/FS in 2000 and a ROD in 2001.

Besides the on-going RI/FS for the BPSOU, the EPA, in consultation with DEQ, conducted a number of Time Critical Removal Actions (TCRAs) or Expedited Response Actions (ERAs) throughout the operable unit. There were a number of reasons for these actions, the most important of these being the potential human health problems associated with direct contact with the lead in the mine waste and secondly, contamination of Silver Bow Creek due to metals associated with the storm water from the Butte Hill. These actions began in 1988 and are ongoing today. Below is a summary of each of these actions:

<u>Walkerville Time Critical Removal Action - 1988</u>

EPA addressed 23 residential yards and 4 earthen basements. EPA relocated over 300,000 cubic yards of contaminated mine waste from a number of mine dumps to an on-site repository and revegetated many acres of land to reduce soil erosion. Contaminants of concern included lead, arsenic and mercury. This action also addressed metals entering Missoula Gulch.

<u>Timber Butte Time Critical Removal Action - 1989</u>

This removal consisted of two residential yards and approximately 40,000 cubic yards of contaminated mine waste from the Timber Butte Mill site and addressed metals entering Grove Gulch. Contaminants of concern included lead and arsenic.

<u>Priority Soils Time Critical Removal Action - 1990-1991</u>

This action addressed 28 mine waste dumps located throughout Butte and Walkerville. It also included a major portion of a railroad line which runs through Butte. The railroad was contaminated from a concentrate spill. Contaminants of concern included lead and arsenic. This action also addressed metals entering Missoula and Buffalo Gulches.

<u>Colorado Smelter Time Critical Removal Action - 1992</u>

This action removed contaminated mine waste associated with the Colorado Smelter and addressed metals entering Silver Bow Creek. The waste was located in an on-site repository. Contaminants of concern included lead and arsenic. The action addressed mine waste located adjacent to a residential area, whose residents used the Colorado Smelter area to play on in the summer and as an ice skating rink in the winter.

<u>Anselmo Mine Yard/Late Acquisition/Silver Hill Time Critical Removal Action - 1992</u>

This action addressed contaminated mine waste dumps located in residential neighborhoods and also addressed contamination entering both Missoula and Buffalo Gulches.

<u>Walkerville Priority Soils Time Critical Removal Action - 1994</u>

This TCRA addressed four lead source areas (mine waste dumps) located in Walkerville. The areas were revegetated to prevent further storm water contamination.

<u>Priority Soils Expedited Response Action - Began 1994 (ongoing)</u>

Butte-Silver Bow County, with oversight and funding from ARCO, is abating lead in residential homes, which includes lead in soils, paint, water, and dust. They are also capping and reclaiming source areas above EPA's selected lead action levels. This is a five year program and will be evaluated in the Record of Decision.

<u>Stormwater Time Critical Removal Action - Began 1995 (ongoing)</u>

This action addresses storm water problems associated with the Missoula and Buffalo Drainage. Nearly two miles of concrete channels have been poured in Missoula Gulch. Also three sedimentation basins are being constructed in the Gulch to prevent sediment from reaching Silver Bow Creek. Since Missoula Gulch is the largest drainage on the Butte Hill, significant sediment reduction should result. This action also includes the Kelley Mine Yard area. The Kelley Mine Yard also contributes a great deal of sediment to the creek. Concrete channels were constructed in Buffalo Gulch to control storm water. The Alice Dump (approximately two million cubic yards) was partially removed and capped under this action and under the Priority Soils Expedited Response Action.

Railroad Time Critical Removal Action - 2000 (Ongoing)

This action will address contaminated railroad beds and associated residential and commercial areas throughout the operable unit. Contaminants of concern include arsenic and lead. The action will also address storm water concerns associated with the contaminated railroad material. This action should be completed in late 2000 or early 2001.

Manganese Stock Pile Time Critical Removal Action - 1992

This action removed several large piles of manganese from near Silver Bow Creek to a stable repository. This allowed the Lower Area One Expedited Response Action to proceed.

Lower Area One (LAO) Expedited Response Action

LAO includes the Colorado Tailings and Butte Reduction Works portions of the Butte Priority Soils Operable Unit (BPSOU) of the Silver Bow Creek/Butte Area Superfund Site. Elevated concentrations of heavy metals and arsenic have been observed in tailings, soils, surface water, and groundwater within LAO. Approximately 70% of the metals loading to Silver Bow Creek occurs within LAO.

In December 1991, EPA signed an Action Memorandum for a non-time critical removal action (N-TCRA) to be conducted at LAO. The selected response action included: (1) complete removal of accessible tailings and contaminated soils; (2) disposal of the contaminated materials at a satisfactory repository; (3) replacement of the excavated materials with appropriate backfill; (4) placement of a growth media over the site to facilitate the establishment of a productive and suitable plant community; (5) realignment and reconstruction of Silver Bow Creek within the site boundary; and (6) construction of a groundwater collection, extraction, and treatment system.

Beginning in 1993 and ending in 1997, approximately 1.4 million cubic yards of contaminated material was removed from LAO. Most of the excavated area has been backfilled with the exception of areas which were exempted under a Reduced Backfill Plan approved in 1997. The reduced backfill area may or may not be backfilled pending the determination of how those areas will be utilized later as part of the water management and treatment decision.

In 1997, the portion of Silver Bow Creek within LAO was realigned and totally reconstructed. Growth media has been placed on all backfilled areas and seeded along with planting of woody species. Groundwater and surface water was monitored for two years (1998 and 1999) to characterize the resultant surface water and groundwater hydrologic regimes. This information will be used to make decisions regarding the construction of the groundwater collection, extraction, and treatment system. Following the two years of monitoring, the final design report and reclamation plan will be prepared and implemented, or the plan will be combined with the BPSOU ROD.

The LAO ERA is proceeding toward accomplishing project goals. Loading of metals to Silver Bow Creek has been reduced and groundwater controls are being implemented. When a water treatment technology is selected, collected groundwater will be treated before discharge to Silver Bow Creek.

Statement on Protectiveness

As the Priority Soils RI/FS is ongoing, EPA is unable to make a statement of protectiveness at this time. The past and continued implementation of removal actions are addressing immediate risks, and EPA will continue to move forward in implementing those actions.

3.3 Rocker Timber Framing and Treating Plant Operable Unit

Location and History

The Rocker Timber Framing and Treating Plant operable unit (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.

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 the Atlantic Richfield Company (ARCO), 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.

Stream monitoring during the Rocker remedial investigation did not demonstrate that there is ongoing contaminant migration from the operable unit to Silver Bow Creek (Streamside Tailings). Both the Rocker and Streamside Tailings cleanups will be coordinated to avoid duplication of effort.

In 1989, the State of Montana directed ARCO to remove contaminated soils and debris with concentrations exceeding 10,000 parts per million arsenic. Approximately 1,000 cubic yards 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.

A Record of Decision for the Rocker OU was signed in December 1995. During the 1996 field season, a field-scale pilot project was carried out to demonstrate the feasibility of implementing the remedy. EPA selected a remedy with State concurrence that addressed surface soil, alluvium and fill, and groundwater contaminated by wood treating compounds and mining waste. The ROD provided general direction regarding the remedy 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; and
- Implement institutional controls to ensure non-residential use of the OU, and prevent domestic groundwater use until cleanup is achieved.

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. Further development of groundwater resources was restricted to prevent migration of the contaminated groundwater into the deeper high quality groundwater systems in the area. 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.

Remedial Objectives

The primary objective of the groundwater portion of the remedy was to prevent further contamination of high quality groundwater resources in contact with the plume of arsenic-contaminated water. Included in this objective is 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 is 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.

All major elements of the final remedy at the Rocker OU are nearly complete.

- Groundwater concentrations of arsenic in the range of 1,000 to 32,000 parts per billion (ppb) were reduced to an average concentration of 30 ppb after treatment;

- Concentrations of arsenic in treated soil were at least ten times lower than necessary to allow disposal on the site;

- The Rocker water supply has been expanded to almost double its original capacity, including a water storage tank to meet peak periods of water demand.

Statement on Protectiveness

The Rocker Operable Unit 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.

3.4 Streamside Tailings Operable Unit

Location and History

The Streamside Tailings Operable Unit (SST OU) is a part of the Silver Bow Creek/Butte Area NPL site located between the towns of Butte and Anaconda, Montana. The Montana Department of Environmental Quality (DEQ) is the lead agency for the OU, which includes Silver Bow Creek from the Lower Area One in Butte 24 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, 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.

- Groundwater concentrations of arsenic in the range of 1,000 to 32,000 parts per billion (ppb) were reduced to an average concentration of 30 ppb after treatment;

- Concentrations of arsenic in treated soil were at least ten times lower than necessary to allow disposal on the site;

- The Rocker water supply has been expanded to almost double its original capacity, including a water storage tank to meet peak periods of water demand.

Statement on Protectiveness

The Rocker Operable Unit 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.

3.4 Streamside Tailings Operable Unit

Location and History

The Streamside Tailings Operable Unit (SST OU) is a part of the Silver Bow Creek/Butte Area NPL site located between the towns of Butte and Anaconda, Montana. The Montana Department of Environmental Quality (DEQ) is the lead agency for the OU, which includes Silver Bow Creek from the Lower Area One in Butte 24 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, 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.

Remedial Objectives

In November 1995, EPA and the Montana Department of Environmental Quality, as lead agency, signed a ROD. The ROD was modified by a 1998 Explanation of Significant Differences. The major components of the remedy are:

- 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 ground water 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.

Summary of the Remedial Action

Under a unilateral order issued by the Agencies in April 1996, ARCO proceeded with design of the remedy. In the spring of 1997, ARCO refused to do further design work until they were given credit for what they believed were restoration elements of the remedy. In May 1997, EPA and DEQ took over responsibilities for the design and implementation of the remedy.

An Explanation of Significant Differences was released in September 1998. In April 1999, a settlement between ARCO, EPA, and DEQ was finalized which provided $80 million plus interest for the remediation of the SST OU. A Final Design Report for Reach A of Subarea 1 was finalized in June 1999. Reach A is the first mile and a quarter beginning at the eastern most Interstate 90 bridge and continuing to just above Rocker. Construction of Reach A began in September 1999 and is expected to be completed in 2000. Design of the remedy for the next one mile is currently under way and will began in the summer of 2000. DEQ anticipates a ten year implementation schedule for the remedy.

Statement on Protectiveness

The remedy is in the initial stages of being implemented. Modifications or improvements cannot be recommended at this time. The current remedy as described in the Final Design Report and Explanation of Significant Differences is expected to be protective of human health and the environment.

4.0 Remedial Objectives for the Warm Springs Ponds

In its Proposed Plan for the Warm Springs Ponds (October 1989) the State of Montana identified objectives to guide the selection of a remedy and to be attained once the cleanup was completed. These remedial action objectives were:

(a) For pond bottom sediments, the remedial objective is to 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.

(b) For surface water, the remedial objectives are to:

(i) 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 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.

(ii) prevent ingestion of water within the operable unit above the Montana Public Water Supply Act's maximum contaminant levels 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 to one chance in 10,000,000.

(iii) inhibit the migration of tailings from the Mill-Willow Bypass to the Clark Fork River in order to reduce the potential for future exceedences of ambient water quality standards in the Clark Fork River.

(iv) 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 exceedences of ambient water quality standards in the Clark Fork River.

(c) For tailings deposits and contaminated soils, the remedial objective is to reduce the potential for direct human contact, inhalation, and ingestion of exposed tailings and contaminated soils posing excess cancer risks above one chance in 10,000 to one chance in 10,000,000.

(d) For ground water, the remedial objective is to reduce the levels of arsenic, cadmium and other contaminant concentrations in the groundwater of the Pond 1 area to achieve compliance with ground water maximum contaminant levels.

In its Proposed Plan, the State recognized and emphasized that the Warm Springs Ponds are "part of a larger picture." The State noted that "All threats to human health and the environment at Warm Springs Ponds can be attributed to contamination which has migrated to the Ponds from upstream sources," and "While surface water contamination upstream from the ponds likely will be reduced by future cleanup actions, until then and for the foreseeable future, that surface water will require treatment to reduce its toxicity as it flows downstream into the Clark Fork River." The State concluded: "Therefore, source control measures in some instances and migration management measures in other instances will need to be used to achieve the Superfund statutory mandate of assuring permanent protection of human health and the environment."

EPA concurred with the State then, and has since become increasingly more aware of the fact that the Warm Springs Ponds are the most downstream component of a very complex Superfund site. In this situation, the need for upstream source control measures cannot be overemphasized.

5.0 Summary of Response Actions for the Warm Springs Ponds

Three response actions have been completed at the Warm Springs Ponds: The Mill-Willow Bypass Expedited Response Action, Warm Springs Ponds Active Area Remedial Action, and Warm Springs Ponds Inactive Area Remedial Action. In accordance with EPA directives for five year review reports, a summary of the response action is required. In this instance, three response actions, each involving numerous components for implementation, are summarized.

5.1 Mill-Willow Bypass Expedited Response Action

The Mill-Willow Bypass Expedited Response Action was conducted pursuant to an Administrative Order on Consent (Docket No. CERCLA-VIII-90-15). This consent order was signed by EPA and ARCO on July 3, 1990. Two amendments were agreed upon by the parties (January 25, 1991, and June 12, 1991). The consent order and accompanying work plan, as twice amended, called for an expedited response action (non-time critical removal action) to raise, strengthen and armor the dams (berms) adjacent to the bypass; upgrade inlet and outlet structures; construct spillways and flood ways to allow safe passage of flood flows around the ponds; and remove tailings and contaminated soils and sediments from the bypass.

5.2 Active Area Remedial Action

The Warm Springs Ponds Active Area Remedial Action was conducted in response to the Record of Decision of September 1990, as modified by an Explanation of Significant Differences in June 1991. The modification created and separated the active and inactive areas, and deferred a decision for the inactive area for one year. Thus, the September 1990 Record of Decision, as modified, and the Administrative Order for Remedial Design and Remedial Action (effective date October 25, 1991) apply to the active area. The active area remedy may be summarized as follows:

(a) 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;

(b) 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;

(c) 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;

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

(e) 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;

(f) 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);

(g) Flood (wet-close) all dry portions of Pond 2; and

(h) Establish surface and ground water quality monitoring systems and perform all other activities necessary to assure compliance with all applicable or relevant and appropriate requirements.

This remedy selected for the Warm Sprngs Ponds Active Area is composed of a series of remedies, or elements. It represents a synthesis of the State's and EPA's original Alternative No. 3, as described in the 1989 Proposed Plan, and ARCO's Alternative No. 3A. This synthesis of remedies was adopted following months of review and consultation with the State of Montana, ARCO, affected communities and other stakeholders.

5.3 Inactive Area Remedial Action

The Warm Springs Ponds Inactive Area Remedial Action was conducted in response to the Record of Decision of June 1992. The unilateral administrative order issued in 1993 required ARCO to implement the remedy, and defined a new performance standard for controlling contaminated ground water within the inactive area. The administrative order for Remedial Design and Remedial Action, for the inactive area, became effective on July 19, 1993. The inactive area remedy may be summarized as follows:

(a) 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;

(b) 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;

(c) 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;

(d) 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;

(e) 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;

(f) 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;

(g) 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;

(h) 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;

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

(j) 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;

(k) 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;

(l) 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;

(m) 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 Warm Springs Ponds Active Area Unilateral Administrative Order;

(n) 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; and

(o) Implement institutional controls to prevent residential development, swimming, domestic well construction, and disruption of dry-closure caps.

5.4 Response Actions at the Warm Springs Ponds are Interim Actions

The response actions selected and implemented for the Warm Springs Ponds, including the Mill-Willow Bypass, Active and Inactive areas, are considered interim actions. However, they are not interim remedies, or actions, in the usual sense. Interim remedies usually address only portions of contaminated areas, or sites. Thus, interim remedies may not be the final response action for a particular site or set of circumstances.

The interim remedies selected for the Warm Springs Ponds utilize permanent solutions to the maximum extent practicable. The selected remedies are interim actions for the following reasons:

(a) Hazardous substances will remain on site and require long-term management in place;

(b) The selected remedies employ innovative methods for reducing or eliminating threats to human health and the environment, which will require monitoring over time to evaluate effectiveness; and

(c) Contaminated source areas upstream and up gradient have direct implications on the effectiveness and permanence of any remedy, or combination of remedies, selected for the Warm Springs Ponds.

Figure 2 illustrates the major features described above and identifies the water quality sampling sites within the pond system.

6.0 Summary of Performance Standards and Requirements for the Warm Springs Ponds

The 1991 and 1993 administrative orders for remedial design and remedial action (EPA Docket No. CERCLA-VIII-91-25 and EPA Docket No. CERCLA-VIII-93-23) define the performance standards and requirements that applied during remedial action construction, and performance standards and requirements that apply currently during post construction operation and maintenance (O&M). All of these performance standards and other requirements fall into one or more of the following categories:

a. Air-related Performance Standards. These standards pertain to lead and particulates in ambient air, opacity requirements, and general air quality requirements (primarily during remedy construction). Points and times of compliance are specified.

b. Occupational Health and Safety Standards. These standards are intended to limit exposures to hazardous substances and dust.

c. Ground Water Performance Standards. These standards pertain to the construction and maintenance of wells, prevention of pollution or prevention of spread of pollution, and long-term monitoring for compliance.

d. Surface Water Performance Standards. These standards pertain to the prevention of the spread of pollution of surface water and long-term monitoring of discharges for compliance.

e. Contaminated Soils and Mining Wastes Standards. These standards regulate the handling and disposal of soils and wastes and specify dry-closure requirements.

f. Floodplain and Floodway Management Act Standards. These standards provide for protection of the floodplain and for flood controls and safety plans.

g. Natural Streambed and Land Preservation Act Standards. These standards are designed to minimize soil erosion and stream bank sloughing, and their attendant sedimentation of streams, lakes or reservoirs.

h. Historic Features Preservation Standards. These standards preserve and protect features possessing historic, cultural or scientific significance.

i. Wetlands Protection Act Standards. These standards minimize or prevent loss of wetlands and specify requirements for wet- and dry-closure cells.

j. Endangered Species Protection Standards. These standards specify mitigative measures, in place primarily during construction, to protect threatened or endangered species.

k. Standards for Reconstruction, Reclamation and Restoration. These standards pertain principally to the bypass channel and floodway reconstruction. They specify dredge and fill requirements, the application of sound geomorphic principles in design and construction, restoration of terrestrial and aquatic habitat, and revegetation requirements.

l. Standards for Disposal of Hazardous Substances.

m. Dam Safety Standards. These standards specify berm construction requirements to protect against failure during large floods or earthquakes.

Exhibit 4 of the 1991 administrative order for remedial design and remedial action defines performance standards and other requirements for the active area in specific terms. Points of compliance and times of compliance are specified for contaminant-specific standards. Location-specific and action-specific standards are also identified. Exhibit 5 of the 1991 administrative order for remedial design and remedial action defines the performance standards for point source discharges from the active area, including effluent limitations, monitoring requirements and reporting requirements.

Exhibit 4 of the 1993 administrative order for remedial design and remedial action defines performance standards and other requirements for the inactive area in specific terms. Contaminant-specific, location-specific and action-specific requirements and standards, primarily for ground water, are defined in Exhibit 4. All three of the exhibits discussed here, for both the active and inactive areas, are appended to this report (appendices C, D, and E). Reviewers are urged to refer to these three exhibits.

7.0 Areas of Compliance and Noncompliance

As discussed in the Introduction, directives for five year reviews require EPA to review and evaluate whether the selected remedy, following remedial action construction, is operating and functioning as specified in the Record of Decision and as designed. In the case of the Warm Springs Ponds, the selected remedy is an array of remedies, involving an expedited response action, two records of decision, and two design processes.

In order to evaluate the operational and functional aspects of this array of remedies, two fundamental questions were considered:

(a) Were the remedies specified by the Records of Decision carried out and fully implemented?

(b) Are all performance standards or other requirements being met consistently?

In respect to the first question, to which the answer is yes, all actions specified by the Records of Decision were compared to and evaluated in terms of the responses that were implemented by ARCO, with EPA oversight. Sections 7.1 and 7.2, which follow, list each ROD-required action and identify the response actions that were constructed and implemented.

In respect to the second question, to which the answer is partially no, performance standards were compared to and evaluated in terms of measurements taken over the past five years. Section 7.3, which follows, identifies which standards are being met consistently and which standards are not being met consistently.

7.1 Responses Implemented to Satisfy Actions Required by Records of Decision

The several actions required by the Records of Decision and remedial design processes were examined individually, with each action being compared to the responses implemented. Collectively, the required actions and responses implemented were intended to satisfy the performance standards and other requirements identified above. However, as will be explained, some of the performance standards are not being satisfied consistently, despite the fact that the remedies were constructed as specified.

<u>A. Required Action</u>: Remove all tailings and contaminated soils from the Mill-Willow Bypass, consolidate them over existing dry tailings and contaminated soils within the Pond 1 or Pond 3 berms and provide adequate cover material which will be revegetated.

Response Implemented:

1. *Mill-Willow Bypass Removal Action*
- Cleared all trees and brush
- Stockpiled suitable topsoil
- Diverted Mill Creek and Willow Creek into Silver Bow Creek

- Constructed dewatering and sedimentation controls
- Excavated 435,000 cubic yards of tailings and associated soils from bypass
- Conducted soil sampling and analysis to confirm borrow material suitability
- Constructed 25-acre dry closure, including cap with 2-inch layer of crushed lime rock covered by 18 inches of soil; revegetated

2. *Phase III Construction*
- Excavated 123,600 cubic yards of tailings and associated soils from area around Pond 3 inlet
- Conducted sampling and analysis
- Constructed dry-closure within Pond 3 above pool level

3. *Phase IV Construction*
- Excavated 13,000 cubic yards of tailings and associated soils downstream of Pond 2
- Stockpiled wastes within Pond 1 for dry closure

<u>B. Required Action</u>: 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).

Response Implemented:

1. *Mill-Willow Bypass Removal Action*
- Stabilized and raised 3.8 miles of dikes with 376,500 cubic yards of embankment fill
- Constructed embankment drainage system
- Placed 124,700 cubic yards of soil-cement slope protection along Pond 3 and 2 dikes
- Excavated bypass flood plain and constructed a temporary bypass channel and sediment catchment ponds
- Flushed sediment from temporary channel into sediment catchment ponds

2. *Phase IV Construction*
- Extended north end of the bypass channel dike, in conjunction with Pond 2 outlet channel and drop structure, including embankment toe drain and soil-cement
- Reconstructed, reclaimed and restored the bypass channel and flood plain by the following actions:

  Constructed temporary downstream sedimentation controls near the bypass spillway;
  Mass graded the new bypass flood plain configuration;
  Constructed a meandering channel (150 cfs backfill capacity), including pools and riffles; added length to channel;
  Constructed 24 new wetlands ponds, some with islands;
  Placed topsoil;
  Seeded and planted selected species of willows, sedges and flood plain vegetation.

C. Required Action: 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.

Response Implemented:

1. *Phase III Construction*
- Constructed Pond 3 inlet structure with eight slide gates, trash rack, baffled discharge apron, and downstream flow measurement weir
- Constructed 1,950 feet of approach channel to inlet structure, including containment dikes, fuse plug, and emergency overflow spillway (west dike)
- Constructed 1,800 feet of flood-containment dikes at south end of Pond 3 with soil-cement slope protection (to tie into east hills slope)

D. Required Action: Raise and strengthen 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;

Response Implemented:

1. *Mill-Willow Bypass Removal Action*
- Stabilized and raised 3.8 combined miles of berms; height of dike established based on greater of criteria for flood protection within bypass or flood containment within pond system

2. *Foundation Preparation*
- Excavated weak, compressible soils to underlying competent sand and gravel at the downstream toes of Pond 2 and Pond 3
- Opened local rock quarry and 3.5-mile haul road
- Lined excavated areas with filter fabric
- Backfilled with rock from quarry or soil-cement screening operation

3. *Phase III Construction*
- Raised and strengthened the original Pond 2 and Pond 3 east-west berms, or dams
- Constructed internal drainage zone between the original dam face and new toe berm and raised embankment

4. *Phase IV Construction*
- Raised and strengthened the original Pond 2 Dam at the service spillway area
- Constructed an internal drainage zone between the original embankment and new raised embankment

E. Required Action: 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 Mill-Willow Bypass channel:

Response Implemented:

1. *Phase III Construction*
- Constructed 1,950 feet of approach channel to inlet structure, including containment dikes, fuse plug, and emergency overflow spillway to bypass
- Constructed a Pond 3 inlet structure designed to limit peak inflow to system
- Constructed Pond 3 emergency spillway (700-ft broad-crested weir structure)
- Constructed bypass spillway structure at the northwest corner of Pond 3
- Constructed Pond 3 outlet structures designed to limit peak outflow to Pond 2 to level providing acceptable treatment

2. *Phase IV Construction*
- Constructed divider dike between Silver Bow Creek and Mill and Willow Creeks upstream of the Warm Springs Ponds (several miles of dike)
- Upgraded Pond 2 service spillway
- Constructed Pond 2 service spillway outlet channel including reinforced concrete box culvert and energy dissipation drop structure
- Constructed Pond 2 emergency spillway (370-ft broad-crested weir overflow structure)
- Raised and modified Pond 3 west and east outflow channel dikes and connected west channel with the east channel
- Installed a flow control and measurement weir structure between Pond 3 and Pond 2

3. *Active Area Remedial Action Treatment Construction*
- Fixed treatment capacity for Silver Bow Creek influent up to the 100-year flood
- Removed pre-existing lime feed facilities
- Constructed new hydrated lime slurry feed system, with:
  - 18-ton storage silo (flood stage)
  - 90-ton storage silo (normal stage)
  - Lime feed, slurry mixing, and water and slurry piping systems
  - Aeration blower and dust collector systems (blower building)
  - Electrical and motor control center
  - Process monitor and operations control system
  - Emergency power generation
- Constructed auxiliary facilities:
  - Water supply wells
  - Influent sampling and flow measurement
  - Mixing baffle system
  - Downstream pH monitoring
  - Sanitary facilities (maintenance/garage building) and septic system
- Installed environmental (water quality and weather) monitoring and data collection stations on Pond 3 and Pond 2 dams

F. Required Action: Flood (wet close) all dry portions of Pond 2, or, if not wet closed, dry close and revegetate contaminated portions.

Response Implemented:

1. Active Area Remedial Action Earthwork Construction

- Constructed wet-closure system, including two 70-acre wet-closure cells separated by the Pond 2 inlet channel, wet-closure inlet channels, five outlet structures, and two 1-acre nesting islands;
- Dry-closed two additional sites including a total of 4.5 acres
- Constructed a Rainbow Bridge site access spur dike and wildlife and historical site observation deck (Historic Preservation Standards)
- Raised Pond 2 operating level to provide additional treatment and to flood additional tailings not otherwise wet or dry closed (lime contingency plan during filling)

G. Required Action: Allow the ponds to remain in place; Ponds 2 and 3 will continue to function as treatment ponds until upstream sources of contamination are cleaned up.

Response Implemented:

This required action was satisfied by responses described above and by adequate hydraulic capacity to process design inflows, routing of excess flows, and raising, stabilizing and armoring berms.

H. Required Action: Remove all 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.

Response Implemented:

1. Phase I Inactive Area Construction

- Removed tailings (5,200 cubic yards of tailings and associated soils along Pond 1, stockpiled within Pond 1)
- Conducted confirmation soil sampling and analysis

2. Phase II Inactive Area Construction

- Removed tailings (3,000 cubic yards of tailings and associated soils during construction of the relocated bypass channel; removed all tailings in 15-ft wide area beyond the upper edge of the new channel bank)
- Conducted confirmation soil sampling and analysis to confirm the absence of tailings along the upper 2,000 feet of new channel where no tailings were encountered during construction.

3. Phase IV Inactive Area Construction

- Removed tailings and constructed dry closure (removed tailings and associated soils near pumping station and dry-closed these wastes within the Pond 1 dry-closure area)

I. Required Action: 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.

Response Implemented:

1. Phase I Inactive Area Construction
- Conducted Mill-Willow bypass earthwork (excavated bypass floodway to required grade along Pond 2 dike)
- Conducted lower bypass earthwork (graded the floodway transition and excavated the bypass channel below Pond 2 discharge)

J. Required Action: Raise, strengthen and armor 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.

Response Implemented:

1. Phase IV Inactive Area Construction
- Installed soil-cement slope protection on the Pond 1 dike as far downstream as necessary to protect against erosion in floods up to the 0.5 PMF

K. Required Action: 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.

Response Implemented:

1. Phase IV Inactive Area Construction
- Stabilized the eastern third of the Pond 1 dam with an 1,800-foot long toe berm consisting of a rockfill foundation, drainage/filter zones with a subdrainage pipe network and ballast fill

L. Required Action: 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.

Response Implemented:

1. Phase IV Inactive Area Construction
- Placed soil-cement slope protection on the Pond 1 dike and flood extension dike as far downstream as necessary to protect against erosion in floods up to the 0.5 PMF
- Constructed flood extension dike, extending 2,500 feet toward the east hills with a 700-foot long wing dike extending toward the east hills

M. Required Action: Relocate the lowermost portion of the bypass channel and convert the present channel into a ground-water 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.

Response Implemented:

1. Phase I Inactive Area Construction
- Constructed Mill-Willow bypass temporary sediment controls (sedimentation control facilities within the Mill-Willow bypass extended from Active Area Phase I sedimentation pond to north end of Pond 1 dike ahead of reclamation)
- Constructed Mill-Willow bypass channel enhancements (channel improvements along Pond 1 to the upper drop structure)

2. Phase II Inactive Area Construction
- Extended and relocated the bypass channel. Constructed 2,500 feet of new meandering channel, including channel excavation, two riprap drop structures, a buried riprap erosion cutoff, and channel bank stabilization using riprap, bio- and geofabrics, and willow plantings
- Constructed temporary sediment controls for use during construction

3. Phase III Inactive Area Construction
- Constructed Mill-Willow bypass earthwork (Station 140+00 to Station 066+00 except enhancements and revegetation)

4. Phase IV Inactive Area Construction
- Decommissioned temporary sediment control facilities
- Constructed a groundwater interception trench. Excavated a 2,300-foot long, 5 to 20-foot deep trench up gradient of and parallel to the flood extension dike, with a deepened sump area at the east end.

N. Required Action: 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. While the pumpback system is in place, a hydraulic gradient standard will be attained. Monitoring wells and surface water performance standards will be met.

Response Implemented:

1. Phase I Inactive Area Construction
- Constructed Pond 2 toe ditch (2200 feet long, downstream of Pond 2 dam, deepened sump, pumps, piping, valving, and controls for temporary pumpback to Pond 2)
- Lowered the water level under the Pond 1 dry closure, reduced pore pressures in the embankment, to assure hydraulic gradient standard is met

2. Phase IV Inactive Area Construction
- Constructed Pond 2 toe-ditch outlet (reinforced concrete, stoplog controlled, outlet structure connected with the toe drain manifold to eliminate need for temporary pumpback)
- Connected the Pond 1 toe ditch with the north wet-closure cell as part of the groundwater gradient control and interception system.
- Constructed pumpback system. Deliver to Pond 2 for treatment, the combined inflows of groundwater seepage, Ponds 1 and 2 toe ditch flows, the soil-cement toe drain manifold flow, and the lower wet-closure discharge.
  - Pump station capacity, 22 cfs
  - 7,600-foot long 32-inch HDPE pipeline
  - Inlet trash rack, a traveling screen
  - Installed four pumps with provision for a fifth
  - Deepened section of groundwater interception trench as sump
- Installed groundwater monitoring system
  - Nine monitoring wells along interception trench
  - Six piezometers along the Pond 1 dike and reconstructed lower bypass
  - Staff gauges in bottom of the interception trench, Pond 1 and Pond 2 toe ditch, relocated bypass channel

O. Required Action: Construct wet-closure berms to enclose the submerged and partially submerged tailings and contaminated soils. Within the eastern portions 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.

Response Implemented:

1. Phase IV Inactive Area Construction
- Constructed lower wet closures. Wet-closure system below Pond 1 includes three wet-closure cells with associated dikes, stoplog controlled overflow-type outlet structures, and 1-acre nesting islands in each cell
- Constructed Pond 1 wet closure. Inlet and outlet structure and dike between the Pond 1 wet and dry closures

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

Response Implemented:

1. Phase IV Inactive Construction
- For chemical fixation, minimized pH shock to existing vegetation during initial flooding
- Added lime slurry to wet closures to increase the pH to 9.5
- Monitored pH of pooled water to minimize pH shock to vegetation
- Water retained until pH stabilized and acceptable metals concentrations monitored

Q. Required Action: 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.

Response Implemented:

1. Phase IV Inactive Construction
- Constructed hydraulic facilities. Outlet and inlet structures connecting Pond 2, Pond 1 and each lower wet closure in series
- Water level controls in each wet closure regulate flow through system
- Operation and maintenance over the life of the system will assure this requirement is met

R. Required Action: 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 soils cap. This dry-closed area will be contoured to control runoff and seeded with native vegetation.

Response Implemented:

1. Phase III Inactive Area Construction
- Completed Pond 1 dry closure. Dry-closure cover, including local grading for surface drainage control, riprapped dike between the Pond 1 wet and dry closures. Cover consists of 18 inches of soil over two inches of crushed limerock. Entire area vegetated

S. Required Action: Construct a runoff collection and outflow system within Pond 1. This system will allow floods originating in the eastern hills to flow into Pond 1, but not compromise the integrity of the wet and dry closures. It will be designed to receive one-half the probable maximum flood, which is estimated to be 8500 cfs at its peak.

Response Implemented:

1. Phase IV Inactive Area Construction
- East Hills Runoff Control Facilities.
  - Twin 60-inch CMP's from dry closure to bypass
  - 12-inch outlet to interception trench
  - Flood flow release control provisions in the Pond 1 inlet and outlet structures
  - Riprapped dike between Pond 1 wet and dry closures

T. Required Action: Install toe drains along the armored berm and construct a collection manifold for both the active and inactive area north of Station 164, as determined in preliminary remedial design. The water collected will be pumped either to Pond 2 or Pond 3 for treatment if it exceeds final point source discharge standards.

Response Implemented:

1. Phase I Inactive Area Construction

- Installed toe drain manifold system. System from Station 164+00 to the Pond 2 service spillway discharge channel consisting of horizontal drain extensions, tee fittings, buried manifold pipe and associated manholes

2. Phase IV Inactive Area Construction
- Installed toe drain manifold extension. Extended 2,376 feet to groundwater interception trench, including connection with Pond 2 toe ditch outlet pipe

U. Required Action: 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.

Response Implemented:
- Ecological monitoring implemented in accordance with the 1995 Biomonitoring Work Plan for the Warm Springs Ponds, prepared March 1995 and EPA-approved June 13, 1995

V. Required Action: Implement institutional controls to prevent residential development, domestic well construction, disruption of dry-closure caps, and swimming.

Response Implemented:

1. Institutional Controls being implemented are:
- Long term management including conservation easement
- A county permit development system, preventing residential development at the Warm Springs Ponds (designated for recreational and open space use only)
- Controlled groundwater area established through DNRC-established permanent potable water well ban within the two operable units
- Administrative orders and as-built documents and plans filed with County of Deer Lodge.
- Signs posted to ban swimming.

7.2 Response Actions Satisfy Requirements for Construction

Response actions summarized in Section 7.1 were conducted by ARCO, the respondent, under extensive EPA enforcement oversight. Response actions were conducted over a period from July 1990 through September 1995. Beginning with the Mill-Willow Bypass Expedited Response Action 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 ARCO has met all remedial action construction requirements that were set forth in the two Records of Decision (1990 and 1992) and three administrative orders (1990, 1991 and 1993). See Appendix I -- letter from EPA to ARCO concerning initial remedial action construction completion, dated September 29, 1995.

While remedial action construction requirements have been met, and EPA has determined that every reasonable effort has been made by ARCO to construct the remedies such that all requirements and performance standards would be met, in fact, some performance standards for limitations on surface water quality discharges have not been met consistently. Additionally, one performance standard for controlling groundwater flow was not met.

Therefore, much of the remainder of this Five Year Review Report will focus on an evaluation of these two aspects of overall pond performance which fail to achieve consistent compliance with performance standards. All other performance standards described in Section 6.0 above (e.g. standards for air quality, contaminated soils and wastes, flood plain protection, stream bed protection, wetlands protection, endangered species protection, historic features preservation, riparian reclamation, hazardous substances disposal and, most important, dam safety) have been met, or are being met, completely and consistently.

7.3 Results of Performance Monitoring

An extensive set of data for the Warm Springs Ponds allowed EPA to evaluate performance. A discussion of the monitoring results follows.

7.3.1 Dam Safety and Stability

A principal driving force behind the decision to undertake an expedited response action at the Warm Springs Ponds, beginning in 1990, was a warning issued in 1989 by the Montana Dam Safety Bureau: The dams were deemed unsafe and the bureau warned that a moderate earthquake or flood might cause them to fail. For the City of Deer Lodge, some 20 miles downstream, and for the upper Deer Lodge valley, the human safety risks were unacceptable.

Thus, throughout design and construction associated with the expedited response action and remedial actions for both the active and inactive areas, and continuing into long-term operations and maintenance, dam safety and stability have been of paramount concern for EPA. Refer to Sections 5.0 through 5.3 above, which identify the numerous response actions required. The majority of response actions relate in some manner to dam safety and stability, hydraulic structures, flood ways and floodplain management, and management of impoundments.

The performance requirements for dam safety and stability are extensive. The most comprehensive description of performance requirements is presented in the two records of decision. See Attachment to Part II of the September 1990 Record of Decision and Attachment 2 to Part II of the June 1992 Record of Decision. Within these two attachments the following major categories of requirements are described:

a. Requirements for water conservation and flood control projects, including such projects intended for pollution abatement;

b. Requirements for dikes, berms, embankments, impounding reservoirs, and other watercourse improvements;

c. Requirements pertaining to protection of floodways up to the 100-year return interval flow;

d. Requirements for and limitations on construction of projects within a 100-year floodplain, including consideration for wildlife enhancements;

e. Requirements for design inflow, or safe passage of one-half the estimated probable maximum flood (0.5 PMF);

f. Requirements for wet- and dry-closures, including handling, disposal and management of waste within impoundments and floodplains;

g. Requirements for hazardous substances during construction; and

h. Requirements for inspections and general reporting for dam construction and reservoir operations.

Numerous provisions of the Montana Dam Safety Act, Floodplain and Floodway Management Act, Natural Streambed and Land Preservation Act, Resource Conservation and Recovery Act, and other applicable, or relevant and appropriate requirements pertain to and define the performance requirements for dam safety and stability at the Warm Springs Ponds. Additionally, design criteria developed and published by the former Soil Conservation Service and Bureau of Reclamation, regarding freeboard and wave runup for small and intermediate-sized projects, apply here. During every phase of design and construction, attention to the details of meeting these requirements and standards was thorough.

Refer to the attached correspondence from EPA to ARCO regarding Completion of Initial Construction. EPA's determination that initial construction completion requirements were met, and sometimes exceeded expectations, was a demonstration that all performance requirements for dam safety and stability, during response action construction, were also met or exceeded.

Refer again to Section 7.1, Responses Implemented to Satisfy Actions Required by the Records of Decision. Section 7.1, in addition to comparing required actions with responses implemented, provides a comprehensive checklist of constructed features that need to be inspected on a regular basis. The guidelines for inspections and maintenance of constructed facilities--mainly facilities designed for dam and reservoir operations--are found in the October 1995 Operations and Maintenance Plan for the Warm Springs Ponds, Section 9.2. The facilities requiring regular inspection and maintenance are:

a. embankments, including dams, dikes and berms;
b. hydraulic structures, including gates, orifice plates, trash racks, and weirs;
c. wet and dry closure cells;

d. water conveyance structures and channels;
e. embankment monitoring devices and staff gages; and
f. Mill-Willow bypass constructed features, including the upstream divider dike.

Dam safety inspections of constructed facilities are conducted once each year. During the first three years of Phase I Operations and Maintenance several interim inspections were conducted, either at EPA's request or at ARCO's discretion, in addition to the annual inspections.

The regular, annual dam safety inspections are conducted by teams of engineers who designed the facilities and oversaw construction, ARCO officials, EPA officials and oversight contractors representing EPA, and Montana Dam Safety Bureau officials. Over a period of a few to several days each year, virtually every feature is critically inspected, photographed, entered into a record log, and described in detail in an annual report. Each of the annual inspections conducted to date has resulted in maintenance requirements, or repairs and upgrades, including installation of embankment slope riprap for erosion protection and major repairs of portions of the main berms, through which seeps had developed.

The annual dam safety inspection for 19^8 considered several recommendations made following the 1997 annual inspection. See Table A1-New Maintenance and Monitoring Requirements, which was excerpted from the 1997 Annual Inspection Report. Tables A1 and A2, which follow, served as a partial checklist for the 1998 dam safety inspection.

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 3			
97R-5	Wave Erosion on Upstream Slope - Figure 97-6-11 illustrates wave erosion near the telephone pole west of the east abutment (30, 3, SE); wave erosion was also noted from the DF-53 pin to the monitoring building at the east outlet (30, 4, NE)-see Figure 97-6-12-and at 200 feet west of the corner (30, 4, NE).	Regrade, place Type A and Riprap	Fall 1997
97R-6	Sparse Trees on Upstream Slope - Some trees were noted on the upstream slope of Pond 3 Dike. It is recommended that they be removed.	FWR71028	Fall 1997
97R-7	Erosion Rills on Downstream Slope - Erosion rills were noted near the east abutment on the downstream side of the road (30, 3, SE).	Place top soil and revegetate.	Fall 1997
97R-8	Willows in Bypass Spillway - Willows were noted in the Bypass Spillway Channel; they should be removed to avoid flow restriction, (see Figure 97-6-19 and 97-6-23).	FWR71028	Fall 1997
97M-4	Exposed Geo-fabric Near the Toe on East End of Hog Hole Pond - Figure 97-6-7 shows the exposed geo-fabric.	Place top soil and revegetate.	Fall 1997

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 3 cont.:			
97M-5	Rodent Holes on Downstream Slope - Abandoned gopher holes were observed 100 feet east of the east outlet, 12 feet down from the dam crest, and 300 feet east of the east outlet, 8 feet down from the crest (30, 3, NW). Another rodent hole was observed at a location approximately 6 ¾ telephone poles east of east outlet, at the toe (30, 3, NW). These holes will be filled in.	FWR71028	Fall 1997
97M-6	Erosion on Access Road - Erosion was noted on the access road on the east side of the west outlet. The erosion is on the downstream shoulder of the berm, approximately 150 feet west of the corner (30, 4, NE).	Repair/Restore	Fall 1997
Pond 3 Approach Channel			
97R-9	Cutting Along Toe of Downstream Slope on East Dike - During the inspection, cutting was noted along the toe of the east side of the East Pond 3 Approach Channel dike; the ditch that has formed as a result should be repaired.	Place top soil and revegetate.	Fall 1997
97R-10	Channelization on Downstream Slope of East Dike - Channelization was observed in two areas along the east side of the East Dike, (See Figures 97-4-21 and 97-4-22).	Place top soil and revegetate.	Fall 1997

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 3 Inlet Channel			
97R-22	Cracking on Crest of East Dike - Surface cracking was observed on the west side of the crest of the east dike, just downstream of the water treatment plant.	Repair/Restore	Fall 1997
97R-23	Erosion of side of channel, (formerly 95-19).	Partial repair made in 1997. Extend riprap down to first baffle on east side of channel.	Fall 1997
Pond 3 Bypass Spillway			
97R-29	Potential for Channel Erosion Downstream of Spillway - The channel immediately downstream of the Pond 3 Bypass Spillway should be armored to prevent cutting on the outside of the meander (see Figures 97-3-17 and 97-3-18).	Repair/Restore	Spring 1998
97R-30	Willows noted near the intake structure should be removed.	FWR71028	Fall 1997
97M-32	Soil-Cement Erosion - It was noted that the soil-cement was eroding from both the north and south edges of the dam toe (on the downstream side).	Repair/Restore	Fall 1997
97M-33	Gully Formation - A gully is forming on the dike immediately south of the Spillway, as shown in Figure 97-3-12.	This will be addressed as part of the 1998 Revegetation Program.	Spring 1998
97M-34	Erosion Along West Edge of Structure, (see narrative), formerly 96-11).	This will be addressed as part of the 1998 Revegetation Program.	Spring 1998

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 3 Inlet Dry Closure			
97R-17	Sparse Vegetation at the Pond 3 Inlet Area Dry-Closure - There has been a loss of vegetation in an area of about 1/8 acre. This area, shown in Figure 97-2-25, is located on a downhill slope where erosion could occur; the area should be revegetated. In addition, other areas where equipment has traveled throughout the dry-closure have sparse vegetation and should also be revegetated.	FWR71027	Fall 1997
Pond 3 East Outlet Works			
97M-35	Crack in Concrete Impact Basin - A crack was observed on the right wing wall below the fence post at the concrete impact basin. This crack is documented in Figure 97-6-10.	FWR71028	Fall 1997
Pond 3 Upper Siphon			
97R-34	Flow Obstruction at Upper Inverted Siphon - The flow in the upper inverted siphon inlet is being obstructed by a large chunk of wire-reinforced concrete. The concrete needs to be removed.	FWR71028	Fall 1997

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 2			
97R-1	Upstream Embankment Erosion (see Figures 97-6-1 and 97-6-3) - Wave and/or ice action has eroded portions of the upstream side of the embankment. Moderate to severe vertical cuts were noted on the west side of the slope. Rip rap is missing or sparse, except at the outlet, where new rip rap was placed after the 1995 inspection; this rip rap was noted to be in good condition.	Regrade, place Type A and Riprap	Fall 1997
97R-2	Erosion Rills on Crest and Access Road - Erosion rills were noted on the embankment crest (19, 3, NE) and on the access road to the old seep sump pump (19, 2, SW).	Regrade, place Type A	Fall 1997
97R-3	Erosion at Spillway and Outlet - Erosion was noted at the north side of the culvert near the road and on the downstream sides of the roads on the west side of the sampling building.	Regrade, place Type A	Fall 1997

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 2			
97R-4	Soil Accumulation at Drop Inlet - The soil that has accumulated on the top of the walls of the drop inlet stop logs should be removed.	FWR71028	Fall 1997
97M-1	Excessive Vegetation on Upstream Slope of Pond 2 Dam/Dike - Excessive vegetation was noted along the shoulders of the dike. Gary Fischer of the DNRC recommended mowing along the shoulders and removing woody vegetation, as well as monitoring cattail growth and removing cattails as needed, to facilitate more thorough inspections in the future.	Regrade, place Type A and Riprap	Fall 1997
Pond 2 Inlet Channel			
97R-24	Erosion on Upstream Slopes of West and East Channel Dikes - Moderate erosion was noted on the upstream slope on the West Wet-Closure side (the west channel dike), and sloughing was observed on the upstream slope of the east channel bank, upstream of the measurement weir (30, 1, NE).	Regrade, place Type A and Riprap	Fall 1997
97R-25	Erosion on Upstream Slope of Dike Between East Wildlife Pond and Pond 3 West Outlet Channel - Erosion was noted on the dike between the east wildlife pond and the Pond 3 outlet channel where the dike narrows (30, 1, NE).	Regrade, place Type A and Riprap	Fall 1997

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 2 Wet Closure Outlets			
97R-31	Weed Removal along Outlet Structure between WWC and Pond 2 West Outlet - Weeds along the metal walkway at the outlet structure (30, 1, NE) need to be removed.	FWR71028	Fall 1997
97R-32	Wooden Tie Removal from Outlet Structure between WWC and Pond 2 Middle Outlet - A large wooden tie is in the stilling well of the intake at the outlet structure (30, 2, SW) and should be removed.	FWR71028	Fall 1997
97R-33	Seepage below structure, (formerly 96-16).	Monitor	Quarterly
97M-37	Water leaking beneath stop logs due to debris between lowermost log and seal on Outlet #1 (westernmost outlet in West Wet-Closure) - It is recommended that the debris be removed to obtain a proper seal and enable maintenance of desired wet-closure water levels. Note: The interiors of the structures were not accessed or examined.	FWR 71028	Fall 1997

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 2 Wet Closures			
97M-10	Erosion on Upstream slope of East Wet-Closure Dike - A very small amount of erosion was noted on the upstream side of the East Wet Closure Dike.	Regrade, place Type A and Riprap	Fall 1997
97M-11	Erosion on Upstream Slope of West Wet-Closure Inlet Dike - Moderate erosion was observed in areas where the rip rap has not been upgraded, (See Figure 97-6-24); those areas may need to be enhanced.	Regrade, place Type A and Riprap	Fall 1997
97M-12	Soft Spot on Crest of WWC Inlet Channel Dike - A low area was noted about 100 feet south of the end of the dike where a lime truck overturned; the surface soils in the area were described as "soft to walk on".	Repair Completed	August, 1997
97M-13	Erosion on Downstream Slopes of both WWC and EWC Inlet Channel Dikes - Erosion was noted on the opposite bank from the inlet discharge for both the WWC and the EWC sides.	Place top soil and revegetate.	Fall 1997

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 2 Flow Measurement Weir			
97M-36	Seepage around Wing Walls - Sand deposited at exit points indicated seepage around the downstream end of the west and east wing walls. The seep at the end of the west wing wall is shown in Figure 97-7-1.	Monitor	Quarterly
Pond 1			
97R-14	Erosion on Upstream Slope of Pond 1 Dike - Erosion was noted of the upstream slope of the Pond 1 Dike (19, 2, NE).	Regrade, place Type A and Riprap	Fall 1997
97R-15	Channelization on Downstream Slope - Channelization was observed across the downstream slope of Pond 1 Dike (19, 2, NE and 20, 1, NW); it is recommended that the area be covered with topsoil and revegetated. This area is pictured in Figures 97-1-19 through 97-1-21.	Place top soil and revegetate.	Fall 1997

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Pond 1 cont.:			
97R-16	Channelization on Downstream Slope of the South Cell Wet-Closure Dike - Channelization was noted on this slope that lies below the slope mentioned in Item 97R-15 (19, 2, NE and 20, 1, NW).	Place top soil and revegetate.	Fall 1997
97R-35	Channelization in Soil-Cement on Downstream Side of Spillway - As shown in Figure 97-1-7, channelization has occurred on the downstream slope below the emergency spillway, (formerly Item No. 95-15).	FWR71027	Fall 1997
97M-17	Erosion on Upstream Slope of Pond 1 Flood Extension Dike - Bank channelization, (See Figure 97-1-8), was observed on the upstream slope of the Pond 1 Flood Extension Dike.	Regrade, place Type A and Riprap	Fall 1997
97M-18	Erosion on Upstream Slope of South Wet-closure Dike Below Pond 1 - An erosion gully was noted on the upstream slope at the northeastern corner of the south cell dike.	Regrade, place Type A and Riprap	Fall 1997
Mill-Willow Bypass			
97R-18	Bank Erosion Along Mill-Willow Bypass, (see narrative).	Repair/Replace	Early Spring 1998
97R-19	Channel Cutting in Mill-Willow Bypass , (see narrative).	Repair/Replace	Early Spring 1998

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Mill-Willow Bypass cont.:			
97M-19	Channel Erosion - Channel erosion was noted both upstream of the first siphon and on the outside of the meander near Station 165+00. Both areas should be examined and considered for repair.	Repair/Replace	Early Spring 1998
97M-20	Channel Cutting - Channel cutting was observed between the pond and the Bypass, near Station 28+00. This area is just to be monitored. Channel cutting was observed at the north end of the Hog Hole Pond and at the pond west of the Hog Hole Pond. This area is to be monitored and repaired if necessary.	Repair/Replace	Early Spring 1998
97M-21	Back Current near Station 55+00 - The back current in this area does not appear to be very erosive but should be monitored.	Repair/Replace	Early Spring 1998
97M-22	Exposed Pipe - The upper siphon pipe was exposed on the stream bottom. This problem is not of great concern but should be monitored.	Monitor	Quarterly
Groundwater Interception Trench			
97M-29	Monitor the vegetation along the bank (See Figures 97-1-12 through 97-1-16).	Monitor	Quarterly
Pump Back Pipeline Outlet			
97R-27	Erosion in channel above pipe outlet	Repair/Restore	Fall 1997
97M-30	Monitor the cattail growth in the area and remove as necessary.	Monitor	Quarterly

Table A1 - New Maintenance and Monitoring Recommendations

No.	No. Description	Comments	Schedule
Lower Silver Bow Creek			
97M-23	Bank Erosion - Bank undercutting was observed at the USGS Station, (See Figure 97-1-4). Bank erosion was also noted downstream from the USGS Station, on the north bank where the large rip rap ends (See Figure 97-4-6) and just downstream of the spring stream bank revetment work on the east side of the channel. Figure 97-4-11 illustrates bank erosion found between the revetment bends 10 & 11, on the outside of the meander.	Repair/Replace	Early Spring 1998
97M-25	Gravel Bar Downstream of Bend 10, (see Narrative).	Monitor	Seasonally
97R-20	Bank Erosion Along Lower Silver Bow Creek - Bank erosion was noted upstream of the USGS station on the east bank; this area, shown in Figure 97-1-5, should be repaired. Erosion was also observed on the outside of the meander between spring stream bank revetment bends 10 through 12 (Figures 97-4-6 through 97-4-18) and downstream of the gravel bar, between bends 9 & 10 (Figure 97-4-20).	Repair/Replace	Early Spring 1998
97R-21	Mono-filament fabric Clean-up - Mono-filament remaining at the recent revetment area poses a threat to fish and other wildlife and should be cleaned up, (See Figure 97-4-18).	FWR71025	Fall 1997

Table A2 - Status of Ongoing Monitoring Items

No.	No. Description	Comments	Schedule
Pond 3			
97M-3	Seepage at toe 700 feet east of the East Outlet Structure, (formerly 95-5).	No change in seepage characteristics in 1996 or 1997.	Continue quarterly monitoring.
95-7	Possible seepage at toe near Piezometer AH-A26.	No change in seepage characteristics in 1996 or 1997.	Continue annual monitoring.
Pond 3 Bypass Spillway			
95-27	Cracking and chipping of outlet pipe interior lining	Not inspected in 1996 or 1997.	Continue annual monitoring
Pond 3 Inlet Approaches for Outlet Works			
97M-26	Channel Erosion - Some slight erosion was noted on the right side of the channel, about 30 feet downstream.	Continue to Monitor	Quarterly
Pond 3 Inlet Structure			
97R-28	Cracking and spalling of structural concrete, (formerly 95-26).	Some increased spalling along trash rack due to cleaning.	Continue annual monitoring
97M-31	Crack in Soil-Cement on Upstream Side of Inlet Structure - The crack is located at the very west end of the inlet structure. The loose material will be removed and replaced with concrete, (formerly Item No. 95-20).	Monitor	Quarterly

Table A2 - Status of Ongoing Monitoring Items

No.	No. Description	Comments	Schedule
Pond 3 Approach Channel			
97M-7A	Crack/potential sloughing, (formerly 95-9).	Monitor-rebuild if sloughs	Quarterly
97M-7B	Loose Material on Crest and Downstream Slope of Overflow Spillway - An approximately 1/2"-1" thick layer of loose soil-cement material was observed on the crest of the Overflow Spillway while the layer of loose material on the downstream slope is approximately 4 inches thick. See Figure 97-7-5, (formerly Item No. 95-10).	Monitor-rebuild if sloughs	Quarterly
Pond 3 Inverted Siphon Outlet Channel			
95-32	Sediment plugging channel and pipe	Dredge channel and clean pipe.	Prior to spring 1998
Pond 2			
97M-2	Seepage at downstream embankment near STA 48+00. Seepage at downstream embankment toe between Toe Drains 142 and 155, (formerly 95-2 and 95-3.	Seepage not detected in 1996 or 1997.	Continue annual monitoring for change in flow rate or sediment discharge
Pond 2 West Wet-Closure Dike			
97M-8 & 97M-9	Wave or Ice Erosion (formerly Item No. 95-11).	Partial repair made in NE corner in 1997.	Continue annual monitoring
Pond 2 Wet-Closure Outlets			
95-28	Settlement of Outlet #3	No significant change in 1996 or 1997.	Continue annual monitoring

Table A2 - Status of Ongoing Monitoring Items

No.	Description	Comments	Schedule
Pond 2 Outlet Drop Structure			
95-31	Water flowing between culverts at base	No significant change in 1996 or 1997.	Continue annual monitoring
Pond 2 Inlet Channel			
97M-27	Rut on Crest of North Dike between WWC and Pond 3 West Outlet Channel.	No significant change in 1996 or 1997.	Continue annual monitoring
Pond 1			
97M-16	Crack in upstream crest, (former 96-5).	Monitor	Quarterly
Pond 1 Dry Closure			
96-7	Water in NE corner	Monitor, no ponding was observed during 1997 inspection.	Yearly
95-16	Salt deposits on cover.	No salt deposits found	Continue annual monitoring
Mill-Willow/Silver Bow Creek Divider Dike			
97M-14	Embankment erosion/slumping at Stations 50+00, 52+50 and 62+25, (formerly 95-12).	No significant change in 1996 or 1997.	Continue annual monitoring
97M-15	Benching on the north side of the embankment near the gate - Near the north end of the MW/SBC Divider Dike, on ht north side of the embankment, there is benching on the slope.	No significant change in 1996 or 1997.	Continue annual monitoring

Table A2 - Status of Ongoing Monitoring Items

No.	Description	Comments	Schedule
Wildlife Pond Dikes			
95-13	Low dike freeboard	No significant change	Continue annual monitoring
Groundwater Interception Trench			
97M-28	Accumulation of iron precipitation on channel floor. Erosion gullies/seepage, (formerly 95-21 & 95-22).	No significant change	Continue annual monitoring to verify trench bottom maintains porosity. Continue annual monitoring of erosion/seepage
Soil-Cement Toe Drain			
95-36	Water flowing from underneath pipe at Toe Drain 165	To be observed by MSE	Continue annual monitoring

7.3.2 Groundwater

The second record of decision for the Warm Springs Ponds (June 1992) designated Pond 1 and the area below (north of) Pond 1 as the inactive area operable unit. The inactive area is not directly involved in the treatment of flows entering the 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. Sections 5.3 and 7.1 summarize response actions required for the inactive area. Briefly, the constructed features include raised, reinforced and armored berms; toe ditches; toe drains and manifolds; hydraulic gradients; the interception trench, screen and pump-back system; monitoring wells; and wet- and dry-closure cells. (See Figure 3.)

Although performance standards for the inactive area include requirements for dam safety and stability, floodplain protection, land reclamation wetlands protection, threatened and endangered species protection, and others, this section is a review of performance monitoring for groundwater only.

The 1993 administrative order 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. Exhibit 4 of the order is attached to this report and reviewers are urged to refer to all of the performance standards identified therein. 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

Note: After the 1993 administrative order became effective, the State of Montana revised its state numeric standard for arsenic in groundwater. The revised state numeric standard is now 0.020 mg/l total arsenic.

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 trench to the east side of Pond 2 via a 32-inch pipe that is 7,600 feet long. When operational, the point of compliance for groundwater is the north, or downgradient side of the interception trench. Monitoring wells P-02, P-04, P-06 and P-08 are the measurement points of compliance when the pump-back system is operational. (See Figure 3 and Tables P-02, P-04, P-06 and P-08.)

Erratum

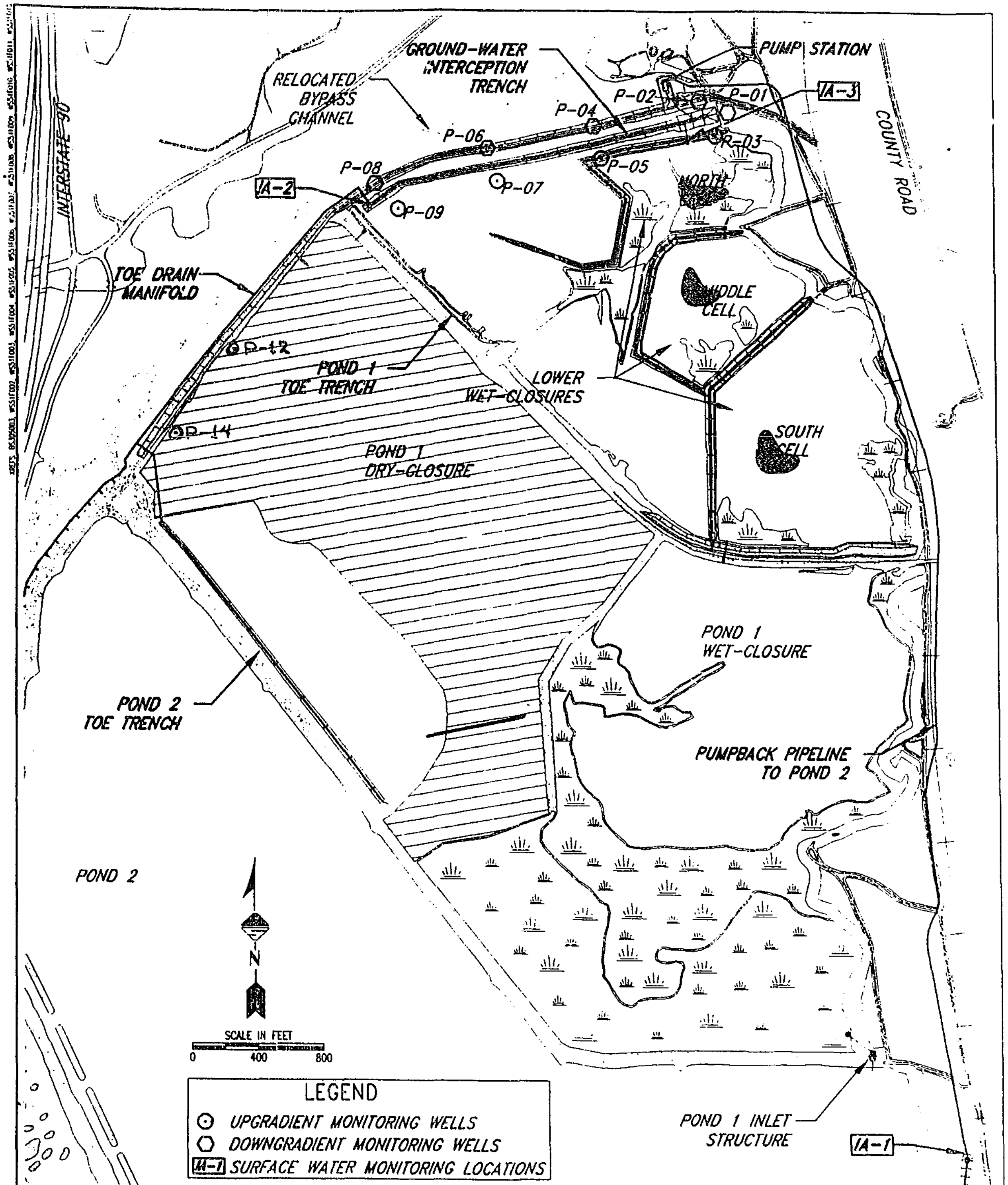
The preceding page and following pages should be numbered 40-82.

At such time as the pump-back system is deemed by EPA to be no longer needed, the points of compliance for ground water will shift to the south, or up gradient side of the interception trench. Monitoring wells 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. (See Figure 3 and Tables P-01, P-03, P-05, P-07 and P-09.)

As shown in the tables for even-numbered wells, groundwater that moves toward the lower bypass and Clark Fork River from the Warm Springs Ponds has consistently met performance standards. As shown in the tables for odd-numbered wells, only three samples have been greater than the MCL: At monitoring well P-03, which is currently not a point of compliance because the pump-back system is operational and has been operational since construction was completed in 1995, two cadmium samples (May 30, 1995, and December 27, 1995) and one arsenic sample (June 26, 1997) were greater than their respective MCL.

As specified by the 1993 administrative order for the inactive area, when ARCO demonstrates that all groundwater performance standards have been consistently met at all monitoring wells, both up gradient and downgradient 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. In either case, the interception trench will continue to function, although in the latter case its water level will increase, and long-term monitoring will continue in order to assure that migration of groundwater will not adversely affect the lower bypass or Clark Fork River. EPA is assessing the possibility that the pump-back system may be shut down following public comment on this five year review report. If such an action is carried out and it is determined following analysis of the data that migration of ground water is adversely affecting the lower bypass or river, then EPA will require ARCO to resume operation of the pump-back system.

Reviewers of this five year review report are directed to the two reports prepared by ESA Consultants Inc., for ARCO. Sections 4.0 and 7.2 of the main report (April 1997) and Section 3.2 of the addendum (February 1998) present additional information concerning the inactive area and groundwater monitoring.



WARM SPRINGS PONDS

INACTIVE AREA SAMPLING LOCATIONS

FIGURE 3

Table P-01.
Warm Springs Ponds
Groundwater Monitoring Piezometer P-01
Water Quality Summary

Constituent	Units	Sampling Date				
		5/30/95	12/27/95	6/7/96	12/30/96	6/26/97
Gradient to Trench	(ft/ft)	0.0341	0.0647	0.0619	0.0645	0.0538
Nitrate/Nitrite as N	mg/L as N	0.10	<0.05	<0.05	<0.05	<0.05
Sulfate	mg/L as SO_4	1110	496	293	248	234
Arsenic, Dissolved	mg/L as As	0.005	0.001	0.005	0.010	0.005
Cadmium, Dissolved	mg/L as Cd	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Dissolved	mg/L as Cr	0.013	<0.009	<0.008	<0.009	<0.009
Copper, Dissolved	mg/L as Cu			0.009	0.005	0.002
Iron, Dissolved	mg/L as Fe			0.839	0.684	0.595
Lead, Dissolved	mg/L as Pb	<0.001	<0.001	0.001	<0.001	<0.001
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0001	0.0001	0.0002	<0.0001
Selenium, Dissolved	mg/L as Se			<0.001	<0.001	<0.001
Silver, Dissolved	mg/L as Ag			<0.004	0.001	<0.001
Zinc, Dissolved	mg/L as Zn			0.064	0.053	0.039

Table P-02.
Warm Springs Ponds
Groundwater Monitoring Piezometer P-02
Water Quality Summary

Constituent	Units	Sampling Date				
		5/30/95	12/27/95	6/7/96	12/30/96	6/26/97
Gradient to Trench	(ft/ft)	0.0346	0.0296	0.0324	0.0309	0.0179
Nitrate/Nitrite as N	mg/L as N	0.79	0.15	0.78	<0.05	0.92
Sulfate	mg/L as SO_4	173	784	562	399	213
Arsenic, Dissolved	mg/L as As	0.005	<0.001	0.003	0.009	0.002
Cadmium, Dissolved	mg/L as Cd	0.0079	0.0066	0.0027	0.0016	0.0014
Chromium, Dissolved	mg/L as Cr	<0.008	<0.009	<0.008	<0.009	<0.009
Copper, Dissolved	mg/L as Cu			0.010	0.008	0.020
Iron, Dissolved	mg/L as Fe			<0.016	0.033	<0.009
Lead, Dissolved	mg/L as Pb	<0.001	<0.001	0.001	<0.001	<0.001
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0001	<0.0001	0.0001	<0.0001
Selenium, Dissolved	mg/L as Se			<0.001	0.001	<0.001
Silver, Dissolved	mg/L as Ag			<0.004	0.002	<0.001
Zinc, Dissolved	mg/L as Zn			1.12	0.851	0.443

Table P-03.
Warm Springs Ponds
Groundwater Monitoring Piezometer P-03
Water Quality Summary

Constituent	Units	Sampling Date				
		5/30/95	12/27/95	6/7/96	12/30/96	6/26/97
Gradient to Trench	(ft/ft)	0.0298	0.0810	0.0719	0.0752	0.0590
Nitrate/Nitrite as N	mg/L as N	<0.05	0.13	<0.05	<0.05	<0.05
Sulfate	mg/L as SO_4	1190	661	348	239	232
Arsenic, Dissolved	mg/L as As	0.003	<0.001	0.011	0.023	*0.063
Cadmium, Dissolved	mg/L as Cd	*0.0353	*0.0295	0.0036	0.0011	0.0025
Chromium, Dissolved	mg/L as Cr	<0.008	<0.009	0.012	<0.009	<0.009
Copper, Dissolved	mg/L as Cu			0.052	0.033	0.029
Iron, Dissolved	mg/L as Fe			0.069	<0.012	0.133
Lead, Dissolved	mg/L as Pb	0.002	<0.001	0.001	0.002	<0.001
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0001	<0.0001	0.0002	0.0001
Selenium, Dissolved	mg/L as Se			<0.001	0.001	<0.001
Silver, Dissolved	mg/L as Ag			<0.004	0.002	<0.001
Zinc, Dissolved	mg/L as Zn			0.179	0.091	0.064

* Denotes values which would have exceeded performance standards, had interception and pump-back system not been in place.

Table P-04.
Warm Springs Ponds
Groundwater Monitoring Piezometer P-04
Water Quality Summary

Constituent	Units	Sampling Date				
		5/30/95	12/27/95	6/7/96	12/30/96	6/26/97
Gradient to Trench	(ft/ft)	0.0169	0.0128	0.0185	0.0139	0.0230
Nitrate/Nitrite as N	mg/L as N	<0.05	<0.05	0.09	<0.05	<0.05
Sulfate	mg/L as SO_4	860	874	754	735	814
Arsenic, Dissolved	mg/L as As	0.003	<0.001	0.004	0.007	<0.001
Cadmium, Dissolved	mg/L as Cd	0.0003	0.0002	0.0002	<0.0001	0.0002
Chromium, Dissolved	mg/L as Cr	<0.008	<0.009	<0.008	<0.009	<0.009
Copper, Dissolved	mg/L as Cu			0.005	0.003	0.004
Iron, Dissolved	mg/L as Fe			<0.016	<0.012	<0.009
Lead, Dissolved	mg/L as Pb	<0.001	<0.001	0.001	<0.001	<0.001
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0001	0.0001	0.0002	0.0001
Selenium, Dissolved	mg/L as Se			<0.001	<0.001	<0.001
Silver, Dissolved	mg/L as Ag			<0.004	0.002	<0.001
Zinc, Dissolved	mg/L as Zn			<0.009	0.027	<0.008

Table P-05.
Warm Springs Ponds
Groundwater Monitoring Piezometer P-05
Water Quality Summary

Constituent	Units	Sampling Date 5/30/95	12/27/95	6/7/96	12/30/96	6/26/97
Gradient to Trench	(ft/ft)	0.0263	0.0619	0.0629	0.0584	0.0580
Nitrate/Nitrite as N	mg/L as N	<0.05	<0.05	<0.05	<0.05	<0.05
Sulfate	mg/L as SO_4	1190	953	360	941	368
Arsenic, Dissolved	mg/L as As	0.003	0.002	0.011	0.017	0.021
Cadmium, Dissolved	mg/L as Cd	0.0005	0.0002	0.0003	<0.0001	0.0001
Chromium, Dissolved	mg/L as Cr	<0.008	<0.009	0.012	<0.009	<0.009
Copper, Dissolved	mg/L as Cu			0.009	0.002	0.006
Iron, Dissolved	mg/L as Fe			0.026	<0.012	<0.009
Lead, Dissolved	mg/L as Pb	<0.001	<0.001	<0.001	0.001	<0.001
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0001	0.0002	0.0001	<0.0001
Selenium, Dissolved	mg/L as Se			<0.001	0.002	<0.001
Silver, Dissolved	mg/L as Ag			<0.004	0.002	<0.001
Zinc, Dissolved	mg/L as Zn			<0.009	0.011	<0.008

Table P-06.
Warm Springs Ponds
Groundwater Monitoring Piezometer P-06
Water Quality Summary

Constituent	Units	Sampling Date 5/30/95	12/27/95	6/7/96	12/30/96	6/26/97
Gradient to Trench	(ft/ft)	0.0139	0.0093	0.0130	0.0110	0.0170
Nitrate/Nitrite as N	mg/L as N	0.09	<0.05	0.26	<0.05	0.99
Sulfate	mg/L as SO_4	318	587	255	546	165
Arsenic, Dissolved	mg/L as As	0.004	0.003	0.004	0.011	0.004
Cadmium, Dissolved	mg/L as Cd	0.0003	0.0001	0.0003	<0.0001	0.0001
Chromium, Dissolved	mg/L as Cr	<0.008	<0.009	0.008	<0.009	<0.009
Copper, Dissolved	mg/L as Cu			0.007	0.004	0.006
Iron, Dissolved	mg/L as Fe			<0.016	<0.012	<0.009
Lead, Dissolved	mg/L as Pb	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0001	0.0001	0.0002	<0.0001
Selenium, Dissolved	mg/L as Se			<0.001	<0.001	<0.001
Silver, Dissolved	mg/L as Ag			<0.004	0.001	<0.001
Zinc, Dissolved	mg/L as Zn			<0.009	<0.010	<0.008

Table P-07.
Warm Springs Ponds
Groundwater Monitoring Piezometer P-07
Water Quality Summary

Constituent	Units	Sampling Date				
		5/30/95	12/27/95	6/7/96	12/30/96	6/26/97
Gradient to Trench	(ft/ft)	0.0189	0.0192	0.0223	0.0213	0.0230
Nitrate/Nitrite as N	mg/L as N	0.05	<0.05	<0.05	<0.05	<0.05
Sulfate	mg/L as SO_4	765	717	537	750	650
Arsenic, Dissolved	mg/L as As	0.009	0.007	0.008	0.010	0.004
Cadmium, Dissolved	mg/L as Cd	0.0002	<0.0001	0.0001	<0.0001	<0.0001
Chromium, Dissolved	mg/L as Cr	<0.008	<0.009	<0.008	<0.009	<0.009
Copper, Dissolved	mg/L as Cu			0.007	0.005	0.007
Iron, Dissolved	mg/L as Fe			4.87	4.93	4.69
Lead, Dissolved	mg/L as Pb	0.002	<0.001	<0.001	0.001	<0.001
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Selenium, Dissolved	mg/L as Se			<0.001	<0.001	<0.001
Silver, Dissolved	mg/L as Ag			<0.004	0.002	<0.001
Zinc, Dissolved	mg/L as Zn			1.01	0.961	0.823

Table P-08.
Warm Springs Ponds
Groundwater Monitoring Piezometer P-08
Water Quality Summary

Constituent	Units	Sampling Date				
		5/30/95	12/27/95	6/7/96	12/30/96	6/26/97
Gradient to Trench	(ft/ft)	0.0118	0.0014	0.0098	0.0085	0.0132
Nitrate/Nitrite as N	mg/L as N	1.09	<0.05	2.22	<0.05	4.21
Sulfate	mg/L as SO_4	262	160	175	157	365
Arsenic, Dissolved	mg/L as As	0.004	<0.001	0.004	0.011	<0.001
Cadmium, Dissolved	mg/L as Cd	0.0011	0.0002	0.0006	<0.0001	0.0005
Chromium, Dissolved	mg/L as Cr	<0.008	<0.009	0.013	<0.009	<0.009
Copper, Dissolved	mg/L as Cu			0.016	0.004	0.023
Iron, Dissolved	mg/L as Fe			<0.016	0.066	<0.009
Lead, Dissolved	mg/L as Pb	<0.001	<0.001	<0.001	0.002	<0.001
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0001	0.0001	0.0002	<0.0001
Selenium, Dissolved	mg/L as Se			<0.001	<0.001	<0.001
Silver, Dissolved	mg/L as Ag			<0.004	0.001	<0.001
Zinc, Dissolved	mg/L as Zn			0.057	0.041	0.062

Table P-09.
Warm Springs Ponds
Groundwater Monitoring Piezometer P-09
Water Quality Summary

Constituent	Units	Sampling Date				
		5/30/95	12/27/95	6/7/96	12/30/96	6/26/97
Gradient to Trench	(ft/ft)	0.0096	0.0078	0.0104	0.0099	0.0089
Nitrate/Nitrite as N	mg/L as N	<0.05	<0.05	<0.05	<0.05	<0.05
Sulfate	mg/L as SO_4	612	613	687	725	655
Arsenic, Dissolved	mg/L as As	0.005	0.003	0.005	0.006	0.002
Cadmium, Dissolved	mg/L as Cd	<0.0001	<0.0001	0.0001	<0.0001	0.0001
Chromium, Dissolved	mg/L as Cr	0.009	<0.009	<0.008	<0.009	<0.009
Copper, Dissolved	mg/L as Cu			0.003	0.003	0.005
Iron, Dissolved	mg/L as Fe			0.171	0.231	0.225
Lead, Dissolved	mg/L as Pb	<0.001	<0.001	0.001	0.002	<0.001
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0001	0.0001	0.0003	<0.0001
Selenium, Dissolved	mg/L as Se			<0.001	<0.001	<0.001
Silver, Dissolved	mg/L as Ag			<0.004	0.002	<0.001
Zinc, Dissolved	mg/L as Zn			0.158	0.192	0.176

Warm Springs Ponds
Groundwater Monitoring Piezometer P-12
Water Quality Summary

Constituent	Units	Sampling Date		
		10/2/95	12/27/95	3/27/96
Alkalinity	mg/L as $CaCO_3$	208	211	200
Hardness Calculation	mg/L as $CaCO_3$	358		363
Nitrate/Nitrite as N	mg/L as N	<0.05	<0.05	<0.05
TSS	mg/L	48.0	10.0	7
TVS	mg/L	17.0	<4	<4
Sulfate	mg/L as SO_4	164	193	191
Turbidity	NTUs	64	53.4	45.6
Arsenic, Total Recoverable	mg/L as As	0.004	0.005	0.008
Cadmium, Total Recoverable	mg/L as Cd	0.0005	0.0004	0.0005
Chromium, Total Recoverable	mg/L as Cr	<0.010	<0.009	<0.008
Copper, Total Recoverable	mg/L as Cu	0.051	0.009	0.050
Iron, Total Recoverable	mg/L as Fe	5.38	4.97	4.80
Lead, Total Recoverable	mg/L as Pb	<0.001	<0.001	0.001
Mercury, Total Recoverable	mg/L as Hg	<0.0002	<0.0001	<0.0001
Selenium, Total Recoverable	mg/L as Se			
Silver, Total Recoverable	mg/L as Ag			
Zinc, Total Recoverable	mg/L as Zn	0.378	0.356	0.343
Arsenic, Dissolved	mg/L as As	0.004	0.005	0.005
Cadmium, Dissolved	mg/L as Cd	0.0004	0.0003	0.0005
Calcium, Dissolved	mg/L as Ca	122		
Chromium, Dissolved	mg/L as Cr	<0.010	<0.009	<0.008
Copper, Dissolved	mg/L as Cu	0.003	<0.002	0.025
Iron, Dissolved	mg/L as Fe	4.52	4.47	4.24
Lead, Dissolved	mg/L as Pb	<0.001	<0.001	0.001
Magnesium, Dissolved	mg/L as Mg	12.9		
Mercury, Dissolved	mg/L as Hg	<0.0002	<0.0001	<0.0001
Selenium, Dissolved	mg/L as Se			
Silver, Dissolved	mg/L as Ag			
Zinc, Dissolved	mg/L as Zn	0.302	0.366	0.300

File: Sbrown2; Sheet: P12; Date: 5/12/98

Warm Springs Ponds
Groundwater Monitoring Piezometer P-14
Water Quality Summary

Constituent	Units	Sampling Date									
		5/30/95	10/2/95	12/27/95	3/27/96	6/7/96	9/27/96	12/30/96	3/8/97	6/26/97	9/19/97
Alkalinity	mg/L as $CaCO_3$	176	212	184	168	168	164	150	174	168	188
Hardness Calculation	mg/L as $CaCO_3$	318	474		317	303			328	283	
Nitrate/Nitrite as N	mg/L as N	<0.05	0.56	<0.05	0.06	0.27	<0.05	<0.05	0.47	1.28	0.11
TSS	mg/L	57.0	40	<4	<4	<4	<4	4	8	15	7
TVS	mg/L	<4	15	<4	<4	4	<4	4	8	<4	<4
Sulfate	mg/L as SO_4	166	367	124	178	150	132	151	165	162	147
Turbidity	NTUs	39	23	1.04	1.19	1.44	0.82	0.52	2.83	0.44	5.68
Arsenic, Total Recoverable	mg/L as As	0.004	0.002	<0.001	0.003	0.004		0.010	0.008	0.001	0.003
Cadmium, Total Recoverable	mg/L as Cd	0.0004	0.0006	0.0003	0.0005	0.0005		0.0003	0.0010	0.0003	0.0004
Chromium, Total Recoverable	mg/L as Cr	<0.008	<0.010	<0.009	<0.008	<0.008		<0.009		<0.009	
Copper, Total Recoverable	mg/L as Cu	0.004	0.053	<0.002	0.010	0.009		0.004	0.010	0.005	0.003
Iron, Total Recoverable	mg/L as Fe	0.088	1.03	0.057	0.042	0.120		0.018	0.405	0.054	0.165
Lead, Total Recoverable	mg/L as Pb	<0.001	<0.001	<0.001	0.002	<0.001		0.001	0.003	<0.001	0.002
Mercury, Total Recoverable	mg/L as Hg	0.0001	<0.0002	<0.0001	<0.0001	0.0001		0.0001	0.0001	<0.0001	<0.0001
Selenium, Total Recoverable	mg/L as Se					<0.001		0.002	0.005	<0.001	
Silver, Total Recoverable	mg/L as Ag					0.004		<0.001	0.005	<0.001	
Zinc, Total Recoverable	mg/L as Zn	0.105	0.199	0.100	0.120	0.128		0.090	0.138	0.096	0.095
Arsenic, Dissolved	mg/L as As	0.003	<0.001	<0.001	0.001	0.005		0.012	0.006	0.002	<0.001
Cadmium, Dissolved	mg/L as Cd	0.0004	0.0005	0.0003	0.0005	0.0006		0.0003	0.0008	0.0004	0.0004
Calcium, Dissolved	mg/L as Ca	98.6	145			90.7		88.6	98.1		
Chromium, Dissolved	mg/L as Cr	<0.008	<0.010	<0.009	<0.008	0.013		<0.009		<0.009	0.003
Copper, Dissolved	mg/L as Cu	0.004	0.005	0.003	0.012	0.010		0.005	0.008	0.004	
Iron, Dissolved	mg/L as Fe	<0.021	<0.019	<0.014	<0.016	<0.016		<0.012	<0.012	<0.009	<0.024
Lead, Dissolved	mg/L as Pb	<0.001	<0.001	<0.001	0.001	<0.001		0.001	0.003	<0.001	0.003
Magnesium, Dissolved	mg/L as Mg	17.5	27			18.5		18.2	20.1		
Mercury, Dissolved	mg/L as Hg	<0.0001	<0.0002	<0.0001	<0.0001	0.0001		0.0002	0.0001	0.0002	<0.0001
Selenium, Dissolved	mg/L as Se					<0.001		<0.001	0.005	<0.001	
Silver, Dissolved	mg/L as Ag					<0.004		0.001	0.002	<0.001	
Zinc, Dissolved	mg/L as Zn	0.108	0.165	0.101	0.105	0.104		0.105	0.123	0.084	0.098

File: Sbrown3; Sheet: P14; Date: 5/12/98

7.3.2.1 Incomplete Gradient for Controlled Groundwater Flow

In order to prevent contaminated groundwater, which underlies the Warm Springs Ponds, from escaping either to the area north of the ponds or to the lower bypass west of Pond 1, the Inactive Area Record of Decision (June 1992) required a groundwater interception, collection and pump-back system. This system is comprised of an interception trench, debris collection screen house, pumps (both primary and back-up), pump-back lines to Pond 2, hydraulic gradient controls, and monitoring wells and piezometers. (See Section 7.1 and the Warm Springs Ponds Five Year Review Report by ESA Consultants Inc. for more details.)

The system was constructed as designed; however, after construction, monitoring showed the hydraulic control gradient to be incomplete. Slightly down gradient from the Pond 2 discharge structure, along the inner aspect of the Pond 1 berm, paired monitoring devices showed groundwater escaping the gradient and discharging into the adjacent bypass. While the hydraulic control gradient remains incomplete at this location, escaping groundwater is sufficiently often sampled and analyzed, and its quality meets performance standards for groundwater being discharged to surface water. Long-term monitoring will continue.

7.3.3 Surface Water

This section describes surface water quality sampling methods, sampling locations and constituents analyzed. Results of analysis are then compared to surface water quality performance standards.

Table 1 is a summary of sampling and analytical methods used to monitor surface water quality at the Warm Springs Ponds. Table 2 describes the numerous active area sample locations, which facilitate a thorough understanding of pond system performance in terms of water quality improvement, or treatment. While EPA is mainly concerned with total recoverable analysis of metals, as sampled from the inlet of Pond 3 (SS-1) and the outlet of Pond 2 (SS-5), other analytical results, such as for dissolved metals concentrations and for intermediate sampling locations throughout the pond system, provide necessary information.

Table 3 describes the constituents typically analyzed and evaluated. Since January 1992, performance standards monitoring of Pond 2 outflows (SS-5) has been measured using 24-hour composite samples collected and analyzed twice each week, year around. In August 1993, composite samples were initiated also at the inlet of Pond 3 above the lime addition facility (SS-1) and at the east outlet of Pond 3 (SS-3E). For the remaining sampling locations, field grab samples are the method used, with some locations being sampled more regularly than others. Figure 2 shows these sampling locations.

Exhibit 5 of the EPA's first administrative order for remedial design and remedial action (EPA Docket No. CERCLA - VIII-91-25) defines monitoring requirements and effluent limitations for the two controlled discharge structures. They are the Pond 2 discharge structure (SS-5) and Pond 3 bypass spillway (SS-3B). Pond 2 (SS-5) discharges all of the time and the Pond 3 bypass spillway

(SS-3B) discharges only periodically, during periods of high inflows. The bypass spillway was last opened in the spring of 1995, for about six to eight weeks. Daily grab samples were taken from Pond 3, near the outlet of the bypass spillway, and analytical results are presented in Table 4.

As shown in Table 4, the bypass spillway was opened to release high inflows during April, May, and June 1993; a few days in October 1993; and from mid-May through mid-July 1995.

Discharges from the two uncontrolled emergency spillways, which are located along the western berms of Ponds 3 and 2, are not regulated. Neither of these two emergency spillways has yet discharged water, and neither is expected to discharge except under extraordinary circumstances.

Six metals are regulated by effluent limitations: Cadmium, copper, iron, lead, mercury and zinc. Also regulated by effluent limitations are total arsenic, total suspended solids (TSS) and pH. Table 5 displays the surface water effluent limitations, or discharge performance standards, which apply to the two controlled outflow points.

Tier I standards became effective when the first administrative order for remedial design and remedial action became effective: October 25, 1991. Tier I standards remained in effect until October 25, 1995. Notice in Table 5 that all regulated parameters except TSS and pH were required to meet more stringent performance standards under Tier II than required under Tier I. Tier II performance standards were in effect from October 25, 1995 through October 24, 1997. The Final Performance Standards, which became effective on October 25, 1997, are in most instances more stringent than the Tier II standards. The Final Standards are equivalent to the State of Montana's stream standards for a B-2 classification stream.

Notice in Table 5 the values shown in bold print. These values express standards which are hardness-dependent, and thus they are adjusted upward or downward as the measured hardness of the water is adjusted. For example, the final daily maximum standard for total recoverable copper in Table 5 is shown as 0.026 mg/l and the monthly average standard is 0.017 mg/l. These values are based on a water hardness of 150 mg/l. As water hardness decreases, the standard becomes more stringent; such that at a hardness of 100 mg/l the daily maximum standard for total recoverable copper is 0.018 mg/l and the monthly average standard is 0.012 mg/l. Exhibit 5 of the 1991 Administrative Order for Remedial Design and Remedial Action, which defines performance standards for surface water discharges from Ponds 2 and 3, lists standards for hardness-dependent regulated constituents at a hardness of 100 mg/l.

The following brief summary demonstrates, for copper and zinc only, the manner in which varying water hardness measurements affect standards for two hardness-dependent regulated constituents. In addition to standards for copper and zinc, standards for cadmium, lead and silver are also hardness-dependent.

Water Hardness	Peformance Standard (mg/l)			
	Copper		Zinc	
	Daily	Monthly	Daily	Monthly
100 mg/l	0.018	0.012	0.12	0.11
130 mg/l	0.023	0.015	0.15	0.13
160 mg/l	0.028	0.018	0.17	0.16
200 mg/l	0.034	0.021	0.21	0.19

Briefly, water hardness is a measure of the amount of calcium carbonate present in the water column. EPA researchers and others have demonstrated that as calcium carbonate is increased in the water column, the toxicity of cadmium, copper, lead, silver and zinc decreases. Reviewers interested in a more detailed discussion of the effects of varying hardness values on regulated constituents are referred to the Warm Springs Ponds Five Year Review Report (ESA Consultants Inc., April 1997) and the Warm Springs Ponds Five Year Review Report Addendum (ESA Consultants Inc., February 1998).

EPA compares the daily and monthly average concentrations of regulated constituents being discharged, principally from the Pond 2 outlet structure (SS-5), to the corresponding acute (daily) and chronic (monthly) average performance standards. Table 6 is a summary of these comparisons for the daily, or acute standards.

7.3.3.1 Performance Compared to Tier I Daily Standards

As displayed in Table 6, arsenic, cadmium, iron, lead, mercury, and total suspended solids concentrations leaving Pond 2 during the four-year period from October 1991 through October 1995 met their corresponding daily performance standard 100 percent of the time. During the same four-year period, copper met the daily Tier I standard 94 percent of the time; zinc met the daily standard 98 percent of the time; and pH met the standard 93 percent of the time. Refer also to the graphs and accompanying one-page summaries for regulated constituents in 7.3.3.6.

7.3.3.2 Performance Compared to Tier I Monthly Standards

Table 7 compares monthly Tier I performance standards with calculated monthly average concentrations. Cadmium, iron, lead, mercury and total suspended solids concentrations in water leaving Pond 2 met their corresponding standard in every month of the Tier I period. Arsenic and zinc concentrations met the monthly Tier I standards in 42 of 45 months, or 93% of the time, but failed to meet their corresponding monthly Tier I standard in three of 45 months. Copper concentrations met the monthly Tier I standard in 37 of 45 months (82% of the time), but failed to meet the standard in eight of 45 months, or 17% of the time. Refer also to the graphs and one-page summaries for regulated constituents in Section 7.4.3.6.

7.3.3.3 Performance Compared to Tier II Daily Standards

On October 25, 1995, and continuing through October 24, 1997, more stringent Tier II performance standards replaced the Tier I standards. As displayed in Table 6, cadmium, lead and total suspended solids concentrations leaving Pond 2 (SS-5) during the Tier II period met their corresponding daily performance standard 100% of the time. Iron, mercury and pH met their corresponding daily standard 97% of the time; zinc met the daily standard 89% of the time; arsenic 74% of the time; and copper 72% of the time. Refer also to the graphs and one-page summaries for regulated constituents in Section 7.4.3.6.

7.3.3.4 Performance Compared to Tier II Monthly Standards

A comparison of calculated monthly concentrations of the regulated constituents with monthly Tier II performance standards (see again Table 7) demonstrates that cadmium, lead and total suspended solids met their corresponding monthly standard in every month of the Tier II period. Iron and mercury each failed to meet their corresponding monthly standard once in 25 months; zinc failed twice in 25 months; arsenic failed in seven of 25 months and copper failed in nine of 25 months, which is more than one-third of the time. Refer also to the graphs and one-page summaries for regulated constituents in Section 7.3.3.6.

7.3.3.5 Annual Minimum, Maximum and Average Concentrations of Regulated Constituents

Table 8 displays annual minimum, maximum and average concentrations of all regulated constituents, both entering and leaving the pond system. Note in particular the maximum and average concentrations of copper entering and leaving the ponds (SS-5) during the period when Tier I and Tier II standards were in place. The maximum incoming concentrations were between 0.905 mg/l and 1.755 mg/l, and the maximum outgoing concentrations were between 0.033 mg/l and 0.554 mg/l. The average incoming copper concentrations were between 0.087 mg/l and 0.262 mg/l, and the average outgoing copper concentrations were between 0.019 mg/l and 0.058 mg/l. Significantly, copper concentrations leaving the ponds are often one order of magnitude lower than incoming copper concentrations. Attention is directed toward copper in this comparison because copper exceeded daily and monthly performance standards more than any other regulated constituent.

Note in Table 8 the minimum, maximum and average concentrations observed in the years 1996 and 1997. These years correspond closely with the Tier II period. Total recoverable copper concentrations leaving the ponds, having failed to meet the monthly Tier II standard more than one-third of the time, averaged 0.034 mg/l to 0.037 mg/l during these two years. The monthly average standard was at that time between 0.020 mg/l and 0.028 mg/l, depending upon water hardness. Average incoming copper concentrations during 1996 and 1997 were, respectively, 0.162 mg/l and 0.262 mg/l.

Minimum, maximum and average influent and effluent arsenic, metals and TSS concentrations were also calculated for the entire period from January 1992 through August 1997.

These data generally reflect the extended shakedown period and are presented in Table 9 (total recoverable and total analysis) and Table 10 (dissolved analysis).

TABLE 1: SAMPLING AND ANALYSIS TECHNIQUES

Sampling and Analysis Technique	Description
Field Grab (FG) Sample	Sample taken from a single point and time.
Field Composite (FC) Sample	Sample composed of multiple samplings over a range of points or time.
Field Analysis	Analyses performed in the field.
Laboratory Analysis	Analyses performed in the laboratory.
Total Metals Analysis	Includes all metals, inorganically and organically bound, both dissolved and particulate. A vigorous acid digestion is performed to the total sample to separate all elements adsorbed and absorbed.
Total Recoverable Metals Analysis	Includes all metals loosely bound, both dissolved and particulate. A moderately vigorous acid digestion is performed to destroy metal complexes and prepare the sample for the final determination.
Dissolved Metals Analysis	Those constituents which will pass through as 0.45 micron membrane filter prior to preservation.

excerpted from ESA, 1997

TABLE 2: STATION LOCATIONS (ACTIVE AREA)

Station	Location
SS-1	Pond 3 Inlet Structure above Lime Addition
SS-2	Pond 3 Inlet Channel below Lime Addition
SS-3B	Pond 3 Bypass Spillway
SS-3E	Pond 3 East Outlet Structure
SS-3W	Pond 3 West Outlet Structure
SS-4	Pond 3 Flow Measurement Weir - Combination of SS-3E and SS-3W Flows
SS-5	Pond 2 Service Spillway - Main Effluent from Pond 2
EWC	Pond 2 East Wet-Closure
WWC	Pond 2 West Wet-Closure
MWB-1	Mill-Willow Bypass Station 1 - Above Warm Springs Ponds
MWB-2	Mill-Willow Bypass Station 2
MWB-3	Mill-Willow Bypass Station 3 - Below Warm Springs Ponds
IA-1	At the discharge of the Inactive Area Pumpback Pipeline to Pond 2
IA-2	Pond 1 Wet Closure North Cell Discharge
IA-3	Soil-Cement Toe Drain Manifold Discharge into Ground-Water Interception Trench

excerpted from ESA, 1997

TABLE 3: ANALYTICAL CONSTITUENTS

Constituent	Units	Constituents	Units
Physical and Aggregate Measurements		Nutrients	
Alkalinity	mg/L as $CaCO_3$	Ammonia (NH_3)	mg/L as N
Color	standard units	Nitrate (NO_3)	mg/L as N
Conductivity	μmhos/cm	Nitrate/Nitrite	mg/L as N
Dissolved Oxygen (DO)	mg/L	Ortho-Phosphate	mg/L as P
Hardness	mg/L as $CaCO_3$	Total Kjeldahl	mg/L as N
pH	standard units	Total Phosphorous	mg/L as P
Temperature	°C		
Total Dissolved Solids (TDS)	mg/L	Trace Elements	
Total Suspended Solids (TSS)	mg/L	Aluminum	mg/L as Al
Total Organic Carbon (TOC)	mg/L	Arsenic	mg/L as As
Dissolved Organic Carbon (DOC)	mg/L	Cadmium	mg/L as Cd
Turbidity	NTUs	Copper	mg/L as Cu
Volatile Suspended Solids (VSS)	mg/L	Iron	mg/L as Fe
Major Ions		Manganese	mg/L as Mn
Calcium	mg/L as Ca	Mercury	mg/L as Hg
Magnesium	mg/L as Mg	Lead	mg/L as Pb
Sodium	mg/L as Na	Selenium	mg/L as Se
Potassium	mg/L as K	Silver	mg/L as Ag
Sulfate	mg/L as SO_4	Zinc	mg/L as Zn
Chloride	mg/L as Cl		
Silica	mg/L as SiO_2		

Note: Trace elements can be analyzed as total, total recoverable, and dissolved.

excerpted from ESA, 1997

Table 4:
Analytical Results of Grab Samples from Pond 3
During Operation of Bypass Spillway (SS-3B)

LabID	Date	Time	Flow (mgd)	pH (s.u.)	TSS (mg/L)	AsTR (mg/L)	AsDis (mg/L)	CdTR (mg/L)	CdDis (mg/L)	CuTR (mg/L)	CuDis (mg/L)	FeTR (mg/L)	FeDis (mg/L)
WI160	4/4/93	8:45 AM			15	0.021	0.019	0.0006	0.0002	0.061	0.038	0.496	0.030
WI175	4/7/93	11:36 AM	44.3	9.4	17	0.023	0.020	0.0007	0.0006	0.061	0.043	0.503	0.060
WI249	4/11/93	9:48 AM	49.8	9.8	28	0.020	0.019	0.0008		0.055	0.035	0.450	0.056
WI300	4/14/93	9:20 AM	66.6	9.5	13	0.019	0.018	0.0006	0.0002	0.045	0.025	0.304	< 0.010
WI351	4/18/93	11:45 AM	60.1	9.9	29	0.021	0.020	0.0004	0.0003	0.037	0.029	0.279	0.054
WI407	4/21/93	12:42 PM	66.6	9.5	18	0.025	0.022	0.0009	0.0004	0.052	0.024	0.517	< 0.010
WI429	4/25/93	11:45 AM	63.8	9.9	37	0.016	0.016	0.0005	0.0003	0.037	0.023	0.539	0.038
WI591	4/28/93	10:53 AM	39.7	8.8	9	0.018	0.019	0.0005	0.0005	0.034	0.032	0.274	
WI788	5/2/93	12:16 PM	41.9	9.6	6	0.022	0.021	0.0005	0.0003	0.031	0.023	0.173	0.035
WI818	5/5/93	12:07 PM	34.7	9.4	5	0.020	0.018	0.0004	0.0003	0.030	0.021	0.186	0.053
WI989	5/9/93	12:00 PM	45.0	8.7	< 4	0.019	0.018	0.0004	0.0004	0.031	0.026	0.198	0.079
WJ180	5/12/93	9:54 AM	36.9	8.4	6	0.021	0.021	0.0004	0.0003	0.034	0.028	0.214	0.033
WJ248	5/16/93	11:10 AM	66.6	8.1	< 4	0.022	0.025	0.0006	0.0002	0.035	0.025	0.561	< 0.013
WJ286	5/19/93	11:25 AM	128.0	8.2	< 4	0.029	0.033	0.0010	0.0008	0.054	0.045	0.227	0.145
WJ385	5/23/93	8:10 AM	108.6	8.1	11	0.034	0.035	0.0005	0.0005	0.036	0.026	0.238	0.017
WJ436	5/26/93	8:52 AM	63.8	8.3	9	0.030	0.036	0.0010	0.0008	0.032	0.034	0.209	0.142
WJ486	5/30/93	7:22 AM	64.7	8.0	< 4	0.033	0.031	0.0007		0.030	0.026	0.244	0.128
WJ501	6/2/93	9:10 AM	49.8	8.1	4	0.034	0.029	0.0006		0.034	0.030	0.229	0.085
WK014	6/17/93	10:25 AM	108.6	8.7	< 4	0.025	0.024	0.0015	0.0004	0.027	0.027	0.116	0.028
WK022	6/20/93	7:45 AM	84.0	8.8	6	0.029	0.028	0.0006	0.0005	0.057	0.039	0.176	0.056
WK282	6/23/93	8:42 AM	62.9	8.6	6	0.027	0.026	0.0006		0.032	0.028	0.218	0.060
WK393	6/27/93	12:33 PM	24.6	8.6	< 4	0.029	0.033	0.0005	0.0004	0.030	0.025	0.149	0.043
WM062	10/3/93				10	0.023		0.0003	0.0002	0.023	0.017	0.038	< 0.014
WM139	10/10/93	10:28 AM		9.0	< 4	0.022	0.020	0.0003	0.0003	0.020	0.016	0.162	0.076
WM234	10/13/93	4:10 PM	39.0	9.1	< 4	0.022	0.020	0.0007	0.0003	0.023	0.018	0.133	0.048
W004190	5/11/95			8.9	9	0.018	0.018	0.0003	0.0002	0.023	0.018	0.224	0.053
W004196	5/14/95		75.9	9.0	11	0.019	0.019	0.0004	0.0002	0.030	0.018	0.249	0.048
W004203	5/17/95		69.3	9.1	8	0.020	0.024	0.0005	0.0002	0.038	0.026	0.233	0.064
W004210	5/21/95		41.2	9.0	5	0.025	0.023	0.0006	0.0003	0.046	0.028	0.323	0.085
W004216	5/24/95		45.9	9.0	4	0.026	0.023	0.0005	0.0002	0.042	0.024	0.310	0.042
W004225	5/28/95		31.5	9.1	< 4	0.025	0.025	0.0006	0.0002	0.032	0.020	0.219	0.046
W004911	5/31/95		54.0	9.1	< 4	0.025	0.026	0.0004	0.0002	0.031	0.024	0.173	0.046
W004975	6/4/95		68.4	9.1	< 4	0.025	0.026	0.0003	0.0002	0.027	0.019	0.215	0.056
W004981	6/7/95		365.2	8.8	9	0.034	0.031	0.0004	0.0002	0.080	0.039	0.774	0.159
W004991	6/11/95		172.7	9.1	10	0.036	0.031	0.0012	0.0003	0.091	0.044	0.870	0.145
W004997	6/14/95		199.1	8.8	< 4	0.033	0.030	0.0010	0.0003	0.072	0.040	0.487	0.093
W005003	6/18/95	10:57 AM	168.8	9.0	< 4	0.030	0.030	0.0005	0.0003	0.053	0.038	0.427	0.154
W005009	6/21/95	10:38 AM	195.1	9.1	4	0.031	0.029	0.0007	0.0004	0.048	0.032	0.527	0.118
W005020	6/25/95	10:17 AM	123.3	9.0	7	0.030	0.035	0.0006	0.0004	0.048	0.043	0.368	0.097
W005026	6/28/95	12:25 PM	95.4	9.1	9	0.029	0.032	0.0005	0.0004	0.044	0.033	0.378	0.107
W005917	7/2/95	1:01 PM	50.6	9.1	7	0.030	0.027	0.0006	0.0004	0.038	0.026	0.263	0.080
W005923	7/5/95	12:28 PM	32.1	9.0	< 4	0.031	0.028	0.0006	0.0003	0.038	0.019	0.382	0.056
W005929	7/9/95	10:45 AM	10.4	9.1	< 4	0.028	0.027	0.0006	0.0002	0.030	0.020	0.190	0.033
W005935	7/12/95		22.8	9.0	< 4	0.029	0.027	0.0016	0.0003	0.027	0.016	0.141	0.025

Table 4 Continued:

LabID	Date	Time	PbTR (mg/L)	PbDis (mg/L)	HgTot (mg/L)	HgDis (mg/L)	SeTR (mg/L)	SeDis (mg/L)	AgTR (mg/L)	AgDis (mg/L)	ZnTR (mg/L)	ZnDis (mg/L)
WI160	4/4/93	8:45 AM	0.009	< 0.001	0.0002	< 0.0002					0.120	< 0.006
WI175	4/7/93	11:36 AM	0.009	0.002	0.0003	< 0.0002					0.133	0.038
WI249	4/11/93	9:48 AM	0.007	0.003	< 0.0002	< 0.0002					0.122	0.022
WI300	4/14/93	9:20 AM	0.006	0.002	< 0.0002	< 0.0002					0.072	< 0.006
WI351	4/18/93	11:45 AM	0.003	0.004	< 0.0002	< 0.0002	< 0.002	< 0.002	< 0.001	< 0.001	0.067	0.038
WI407	4/21/93	12:42 PM	0.004	0.004	< 0.0002	< 0.0002	< 0.002	< 0.002	< 0.001	< 0.001	0.134	0.015
WI429	4/25/93	11:45 AM	0.004	< 0.001	< 0.0002	< 0.0002					0.059	0.048
WI591	4/28/93	10:53 AM	0.005	0.002	< 0.0002	< 0.0002					0.076	0.072
WI788	5/2/93	12:16 PM	0.004	0.001	< 0.0002	< 0.0002					0.055	0.024
WI818	5/5/93	12:07 PM	0.004	0.001	< 0.0002	< 0.0002					0.045	
WI989	5/9/93	12:00 PM	0.003	< 0.001	< 0.0002	< 0.0002	< 0.002	< 0.002	< 0.001	< 0.001	0.063	0.061
WJ180	5/12/93	9:54 AM	0.002	< 0.001	< 0.0002	< 0.0002	< 0.002	< 0.002	< 0.001	< 0.001	0.065	< 0.006
WJ248	5/16/93	11:10 AM	0.002	0.002	< 0.0002	< 0.0002					0.041	< 0.006
WJ286	5/19/93	11:25 AM	0.003	0.004	0.0003	0.0002					0.067	0.041
WJ385	5/23/93	8:10 AM	0.003	< 0.001	0.0003	< 0.0002					0.072	0.007
WJ436	5/26/93	8:52 AM	0.002	0.002	< 0.0002	< 0.0002					0.068	0.061
WJ486	5/30/93	7:22 AM	0.001	0.002	< 0.0002	< 0.0002					0.077	0.058
WJ501	6/2/93	9:10 AM	0.002	0.002	0.0003	< 0.0002					0.071	0.052
WK014	6/17/93	10:25 AM	0.002	0.002	< 0.0002	< 0.0002					0.050	0.035
WK022	6/20/93	7:45 AM	0.005	0.002	< 0.0002	< 0.0002					0.095	0.047
WK282	6/23/93	8:42 AM	< 0.001	0.003	< 0.0002	< 0.0002					0.089	0.035
WK393	6/27/93	12:33 PM	0.002	< 0.001	< 0.0002	< 0.0002					0.064	0.035
WM062	10/3/93		0.004	< 0.001	< 0.0002	< 0.0002					0.049	0.016
WM139	10/10/93	10:28 AM	0.002	< 0.001	< 0.0002	< 0.0002	< 0.002	< 0.002	< 0.001	< 0.001	0.041	0.016
WM234	10/13/93	4:10 PM	0.002	< 0.001	< 0.0002	< 0.0002	< 0.002	< 0.002	< 0.001	< 0.001	0.041	< 0.009
W004190	5/11/95		0.002	< 0.001	< 0.0002	< 0.0002					0.038	0.011
W004196	5/14/95		0.003	< 0.001	< 0.0002	< 0.0002	0.001	0.003	< 0.001	< 0.001	0.052	< 0.011
W004203	5/17/95		0.003	0.001	< 0.0002	0.0003	0.002	0.002	< 0.001	< 0.001	0.058	0.022
W004210	5/21/95		0.004	0.001	< 0.0002	< 0.0002					0.089	0.033
W004216	5/24/95		0.003	0.001	< 0.0002	< 0.0002					0.083	0.019
W004225	5/28/95		0.005	0.004	< 0.0002	< 0.0002					0.062	< 0.011
W004911	5/31/95		0.002	0.003	< 0.0002	< 0.0002					0.062	0.012
W004975	6/4/95		0.002	< 0.001	< 0.0002	< 0.0002					0.056	0.027
W004981	6/7/95		0.021	0.002	0.0003	< 0.0002					0.107	0.034
W004991	6/11/95		0.016	0.002	0.0002	< 0.0002					0.127	0.015
W004997	6/14/95		0.009	0.002	0.0002	< 0.0002					0.079	< 0.011
W005003	6/18/95	10:57 AM	0.006	0.002	0.0003	< 0.0002					0.062	0.034
W005009	6/21/95	10:38 AM	0.007	0.001	0.0003	< 0.0002					0.098	0.034
W005020	6/25/95	10:17 AM	0.005	0.002	< 0.0002	< 0.0002	< 0.002	< 0.002	< 0.001	< 0.001	0.082	0.021
W005026	6/28/95	12:25 PM	0.006	0.002	< 0.0002	< 0.0002	< 0.002	< 0.002	< 0.001	< 0.001	0.082	0.036
W005917	7/2/95	1:01 PM	0.004	0.002	< 0.0002	< 0.0002					0.053	0.047
W005923	7/5/95	12:28 PM	0.004	0.002	< 0.0002	< 0.0002					0.085	0.037
W005929	7/9/95	10:45 AM	0.002	< 0.001	< 0.0002	< 0.0002					0.049	0.019
W005935	7/12/95		0.002	< 0.001	< 0.0002	< 0.0002					0.049	0.024

Note:

(1) A single grab sample, taken June 11, 1995, slightly exceeded the Tier I daily standard for total recoverable copper. All other Tier I daily standards were consistently met during periods of discharge from the bypass spillway (SS - 3B).

TABLE 5: TIER I, TIER II, AND FINAL PERFORMANCE STANDARDS FOR WARM SPRINGS PONDS DISCHARGES

	Tier I Interim Standards Effective October 25, 1991 - October 24, 1995		Tier II Interim Standards Effective October 25, 1995 - October 24, 1997		Final Discharge Standards Effective October 25, 1997	
Constituent	Daily Maximum (mg/L)	Monthly Average (mg/L)	Daily Maximum (mg/L)	Monthly Average (mg/L)	Daily Maximum (mg/L)	Monthly Average (mg/L)
Arsenic	0.05	0.02	0.02	0.02	0.02	0.02
Cadmium	0.01	**0.0062**	**0.0062**	**0.0062**	**0.0062**	**0.0016**
Copper	0.09	0.035	0.035	**0.026**	**0.026**	**0.017**
Iron	2.2	1.5	1.5	1.5	1.5	1.0
Lead	0.1	0.1	**0.137**	**0.137**	**0.137**	**0.0053**
Mercury	0.001	0.0002	0.0002	0.0002	0.0002	0.0002
Selenium	—	—	—	—	0.26	0.035
Silver	—	—	—	—	**0.0082**	0.00012
Zinc	0.3	**0.16**	**0.16**	**0.16**	**0.16**	**0.15**
TSS	45.0	45.0	45.0	45.0	45.0	30.0
pH	6.9-9.5 units	—	6.5-9.5 units	—	6.5-9.5 units	—

Notes:

(1) Mercury as total analysis; other metals as total recoverable analysis.

(2) The limitations in bold type are based on a hardness value of 150 mg/L. Adjustment factors for hardness contained in the "Quality Criteria for Water 1986," or "Gold Book," are applied to these limitations. Hardness is measured in the discharge and adjustments to the limitations are calculated for composite samples.

(3) TSS means total suspended solids.

excerpted from ESA, 1997

TABLE 6: DAILY TIER I AND TIER II PERFORMANCE STANDARDS EXCEEDENCE SUMMARY

Constituent	Daily Tier I Standards October 25, 1991 - October 24, 1995			Daily Tier II Standards October 25, 1995 - October 24, 1997		
	No. of Measurements	No. of Exceedences	% of Exceedences	No. of Measurements	No. of Exceedences	% of Exceedences
TSS	413	0	<1	209	0	<1
pH	1399	100	7	729	21	3
Arsenic	383	0	<1	209	55	26
Cadmium	375	0	<1	209	0	<1
Copper	386	25	6	209	59	28
Iron	386	0	<1	209	6	3
Lead	386	0	<1	209	0	<1
Mercury	413	0	<1	209	6	3
Selenium	---	---	---	---	---	---
Silver	---	---	---	---	---	---
Zinc	386	7	2	208	22	11

Notes:

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

excerpted from ESA, 1998

TABLE 7: MONTHLY TIER I AND TIER II PERFORMANCE STANDARDS EXCEEDENCE SUMMARY

Constituent	Monthly Tier I Standards October 25, 1991 - October 24, 1995			Monthly Tier II Standards October 25, 1995 - October 24, 1997		
	No. of Measurements	No. of Exceedences	% of Exceedences	No. of Measurements	No. of Exceedences	% of Exceedences
TSS	47	0	<1	25	0	<1
pH	---	---	---	---	---	---
Arsenic	45	3	7	25	7	28
Cadmium	44	0	<1	25	0	<1
Copper	45	8	18	25	9	36
Iron	45	0	<1	25	1	4
Lead	45	0	<1	25	0	<1
Mercury	47	0	0	25	1	4
Selenium	---	---	---	---	---	---
Silver	---	---	---	---	---	---
Zinc	45	3	7	25	2	8

Notes:

(1) Mercury as total analysis; other metals as total recoverable analysis.

excerpted from ESA, 1998

Table 8.
Minimum, Maximum and Average Concentration of Regulated Constituents Entering and Leaving the Warm Springs Ponds January 1992 through October 1997. (mg/l)

		SS-1			SS-5		
Constituent	Date	Min	Max	Avg	Min	Max	Avg
pH	1991	7.4	8.2	7.9	7.9	8.6	8.3
	1992	7.0	9.6	8.2	7.1	10.0	8.9
	1993	7.0	9.5	8.0	7.4	9.6	8.8
	1994	7.7	9.1	8.3	8.6	9.9	9.2
	1995	7.3	9.2	8.1	8.0	9.8	8.9
	1996	7.2	9.1	8.1	7.7	9.5	8.8
	1997	6.9	8.9	7.9	7.8	9.8	8.9
TSS	1991	<4	16	9	<4	5	3
	1992	<4	513	14	<4	21	5
	1993	<4	547	24	<4	18	4
	1994	<4	67	9	<4	32	7
	1995	<4	298	26	<4	22	5
	1996	<4	362	21	<4	34	6
	1997	<4	316	44	<4	19	6
Arsenic	1991						
	1992	0.008	0.170	0.021	0.004	0.017	0.010
	1993	0.010	0.236	0.030	0.007	0.029	0.018
	1994	0.012	0.074	0.022	0.010	0.033	0.020
	1995	0.010	0.168	0.028	0.007	0.031	0.017
	1996	0.009	0.237	0.022	0.008	0.043	0.019
	1997	0.011	0.106	0.027	0.009	0.035	0.021
Cadmium	1991						
	1992	0.0004	0.0111	0.0016	<0.0001	0.0031	0.0005
	1993	0.0007	0.0088	0.0019	<0.0001	0.0012	0.0005
	1994	0.0005	0.0096	0.0012	<0.0001	0.0008	0.0003
	1995	0.0007	0.0110	0.0022	<0.0001	0.0026	0.0003
	1996	0.0007	0.0102	0.0024	<0.0001	0.0048	0.0004
	1997	0.0010	0.0197	0.0036	<0.0001	0.0008	0.0003
Copper	1991						
	1992	0.040	1.48	0.138	0.009	0.338	0.051
	1993	0.021	1.75	0.157	0.014	0.157	0.040
	1994	0.036	0.905	0.087	0.008	0.033	0.019
	1995	0.038	1.53	0.212	0.011	0.076	0.024
	1996	0.062	1.69	0.160	0.009	0.262	0.037
	1997	0.091	1.37	0.262	0.011	0.106	0.034

Table 8 Continued

Constituent	Date	SS-1			SS-5		
		Min	Max	Avg	Min	Max	Avg
Iron	1991						
	1992	0.237	21.9	0.931	0.077	0.510	0.186
	1993	0.017	10.9	0.878	0.043	0.885	0.198
	1994	0.221	2.44	0.546	0.129	1.10	0.325
	1995	0.385	14.8	1.41	0.042	0.998	0.326
	1996	0.272	24.6	1.35	0.072	3.72	0.457
	1997	0.480	14.2	1.85	0.043	1.20	0.333
Lead	1991						
	1992	0.003	0.338	0.018	<0.001	0.009	0.004
	1993	<0.001	0.496	0.020	<0.001	0.012	0.003
	1994	0.004	0.073	0.010	<0.001	0.005	0.001
	1995	0.006	0.41[illegible]	0.036	<0.001	0.021	0.003
	1996	0.004	0.683	0.031	<0.001	0.097	0.007
	1997	0.002	0.382	0.039	<0.001	0.023	0.004
Mercury	1991	<0.0002	0.0005	0.0002	<0.0002	0.0002	<0.0002
	1992	<0.0002	0.0015	<0.0002	<0.0002	0.0003	<0.0002
	1993	<0.0002	0.0030	0.0002	<0.0002	0.0005	<0.0002
	1994	<0.0002	0.0004	<0.0002	<0.0002	0.0004	<0.0002
	1995	<0.0002	0.0034	0.0004	<0.0002	0.0006	<0.0002
	1996	<0.0002	0.0062	0.0003	<0.0002	0.0007	<0.0002
	1997	<0.0001	0.0027	0.0004	<0.0001	0.0003	<0.0002
Selenium	1991						
	1992	<0.002	0.006	0.003	<0.002	0.005	0.003
	1993	<0.002	0.004	<0.002	<0.002	0.005	<0.002
	1994	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	1995	<0.001	0.002	0.001	<0.001	0.002	<0.002
	1996	<0.002	0.003	<0.002	<0.002	0.005	<0.002
	1997	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Silver	1991						
	1992	<0.001	0.004	0.001	<0.001	0.002	<0.001
	1993	<0.001	0.003	0.001	<0.001	0.002	<0.001
	1994	<0.001	0.004	0.001	<0.001	0.003	<0.001
	1995	<0.001	0.008	0.002	<0.001	0.005	<0.001
	1996	<0.001	0.011	0.002	<0.001	0.003	<0.001
	1997	<0.001	0.008	0.002	<0.001	0.001	<0.001
Zinc	1991						
	1992	0.110	3.011	0.471	0.016	0.482	0.093
	1993	0.150	2.845	0.512	0.008	0.332	0.086
	1994	0.111	3.203	0.349	0.004	0.170	0.043
	1995	0.173	3.093	0.599	0.008	0.148	0.043
	1996	0.162	2.801	0.640	0.010	0.373	0.071
	1997	0.236	3.705	0.844	0.009	0.319	0.094

Note: Metals are reported as total recoverable analyses, except mercury (total).

Table 9: Influent (SS-1) and Effluent (SS-5) Concentrations of Total Recoverable Trace Elements and Total Suspended Solids (TSS) January 1, 1992 - August 31, 1997.

Parameter	SS-1			SS-5		
	min.	max.	avg.	min.	max.	avg.
Arsenic	0.008	0.237	**0.025**	0.004	0.043	**0.017**
Cadmium	0.0004	0.0197	**0.0021**	<0.0001	0.0048	**0.0004**
Copper	0.021	1.76	**0.165**	0.008	0.338	**0.034**
Iron	0.017	24.6	**1.15**	0.042	3.72	**0.310**
Mercury	<0.0001	0.0062	**0.0002**	<0.0001	0.0007	**0.0001**
Lead	<0.001	0.683	**0.026**	<0.001	0.097	**0.004**
Zinc	0.110	3.71	**0.554**	<0.004	0.482	**0.071**
TSS	<4	550	**22**	<4	34	**5.6**

Notes:

(1) Values are expressed in milligrams per/liter (mg/l).

(2) Mercury and TSS as total analysis.

Table 10: Influent (SS-1) and Effluent (SS-5) Concentrations of Dissolved Trace Elements, October 1991 through October 1997.

Parameter	SS-1			SS-5		
	min.	max.	avg.	min.	max.	avg.
Arsenic	<0.001	0.049	**0.015**	0.004	0.039	**0.016**
Cadmium	<0.0001	0.0087	**0.0014**	<0.0001	0.0010	**0.0002**
Copper	<0.001	0.354	**0.053**	0.002	0.110	**0.020**
Iron	0.011	0.859	**0.103**	<0.007	1.177	**0.053**
Lead	<0.001	0.025	**0.002**	<0.001	0.021	**0.001**
Mercury	<0.0001	0.0005	**0.0001**	<0.0001	0.0005	**0.0001**
Selenium	<0.001	0.005	**0.001**	<0.001	0.003	**0.001**
Silver	<0.001	0.001	**0.001**	<0.001	0.003	**0.001**
Zinc	<0.006	2.478	**0.361**	<0.004	0.241	**0.029**

Note: Metals are reported as dissolved analyses.

7.3.3.6 Graphs and Summaries of Performance: Predicting Future Performance From Previous Five Years' Data

Figures As-1, Cd-1, Cu-1, Fe-1, Hg-1, Pb-1, Zn-1, TSS-1, and pH-1 graphically illustrate for each regulated constituent the past five years' influent and effluent concentrations and the final daily maximum (acute) standard. Each figure is accompanied by a summary page, which compares Tier I and Tier II performance standards with results of water quality monitoring. It also assumes, for the sake of comparison and future projection only, that the final daily standard for each regulated constituent was in place over the past five years. This exercise predicts how the ponds might be expected to perform, if the next five years of flow conditions generally mimic earlier flows.

For example, Figure Zn-1 is a multiple graph of total recoverable zinc concentrations entering the ponds (SS-1) and leaving the ponds (SS-5) from January 1992 through October 1997, as compared to the hardness-adjusted final daily maximum discharge standard. Incoming zinc concentrations were generally between 0.349 mg/l (1994) and 0.844 mg/l (1997). Following treatment within Ponds 3 and 2, effluent zinc concentrations were generally between 0.017 mg/l (1994) and 0.102 mg/l (1993). See again Table 8, and note that the hardness-adjusted final daily standard for total recoverable zinc generally falls between 0.15 mg/l and 0.20 mg/l, but can be as high as 0.23 mg/l when water hardness exceeds 200 mg/l.

Note in Figure Zn-1 that effluent zinc concentrations would have slightly exceeded the hardness-adjusted final daily standard for brief periods around April 1993, February 1996, and February through March of 1997, had the final standards been in effect.

Figure Cu-1, for total recoverable copper, illustrates that copper concentrations, like zinc and the other metals, drop significantly as a result of treatment within the pond system. In the case of copper, however, the frequency and duration of concentrations that would have exceeded the hardness-adjusted final daily maximum discharge standard, had final standards been in effect, are greater than any other metal.

Average incoming copper concentrations over the past five years were generally between 0.087 mg/l (1994) and 0.262 mg/l (1997), while maximum incoming copper concentrations exceeded 1.300 mg/l in every year except 1994 (0.905 mg/l maximum). Following treatment within Ponds 3 and 2, effluent total recoverable copper concentrations generally fell within the range of 0.019 mg/l (1994) to 0.045 mg/l (1993). See again Table 8 and note that the hardness-adjusted final daily maximum standard for total recoverable copper generally falls between 0.023 mg/l and 0.034 mg/l, but can be greater than 0.035 mg/l when water hardness exceeds 200 mg/l.

Reviewers are urged to examine Figures As-1, Cd-1, Fe-1, Hg-1, Pb-1, TSS-1 and pH-1 in the same manner as above, comparing and contrasting the graphics with Figures Cu-1 and Zn-1, as well as with Table 8. Also for comparison, Figures As-2, Cd-2, Cu-2, Fe-2, Hg-2, Pb-2 and Zn-2 are provided. These figures graphically illustrate for the metals and arsenic their dissolved concentrations, both influent (SS-1) and effluent (SS-5), as compared to corresponding federal ambient water quality criteria for protection of aquatic life.

Arsenic

Tier I performance standards for total recoverable arsenic concentrations were 0.05 mg/l (daily maximum) and 0.02 mg/l (monthly average). Hardness adjustment does not apply to performance standards for arsenic.

Between October 25, 1991, and October 24, 1995, a total of 383 separate 24-hour composite samples were analyzed for total recoverable arsenic and compared to Tier I standards. All 383 samples (100 percent) met the daily standard. Of the 45 measurements used to calculate monthly average concentrations, three months (7 percent) failed to meet the monthly standard and 42 months (93 percent) met the monthly standard.

The more stringent Tier II performance standards for total recoverable arsenic concentrations, both daily maximum and monthly average, were 0.02 mg/l.

Between October 25, 1995, and October 24, 1997, a total of 209 separate 24-hour composite samples were analyzed for total recoverable arsenic and compared to the Tier II standards. Fifty-five samples (26 percent) failed to meet the daily standard and 154 samples (74 percent) met the daily standard. Of the 25 measurements used to calculate monthly average concentrations, seven months (28 percent) failed to meet the monthly standard and 18 months (72 percent) met the monthly standard.

From October 25, 1991, through October 24, 1997, which encompasses both the Tier I and Tier II periods, treatment within the ponds removed an estimated 32 percent of all arsenic (total recoverable) that entered the system. The average total recoverable arsenic concentration entering Pond 3 (SS-1) during this extended period was 0.025 mg/l, with many concentrations exceeding 0.05 mg/l. The average total recoverable arsenic concentration leaving the ponds (SS-5) during the same extended period was 0.017 mg/l.

The final standards for arsenic are the same as the Tier II standards. ARCO compared the Tier II and final daily maximum discharge standard for total recoverable arsenic to the several hundred daily measurements that were analyzed between January 1992 and October 1997. The following graph (Figure As-1) illustrates that the pond system capabilities for treatment of arsenic are marginal during late summers. This is because arsenic behaves different from the heavy metals in an alkaline precipitation system. Therefore, the degree of arsenic removal occurring here is limited, but is nevertheless beneficial.

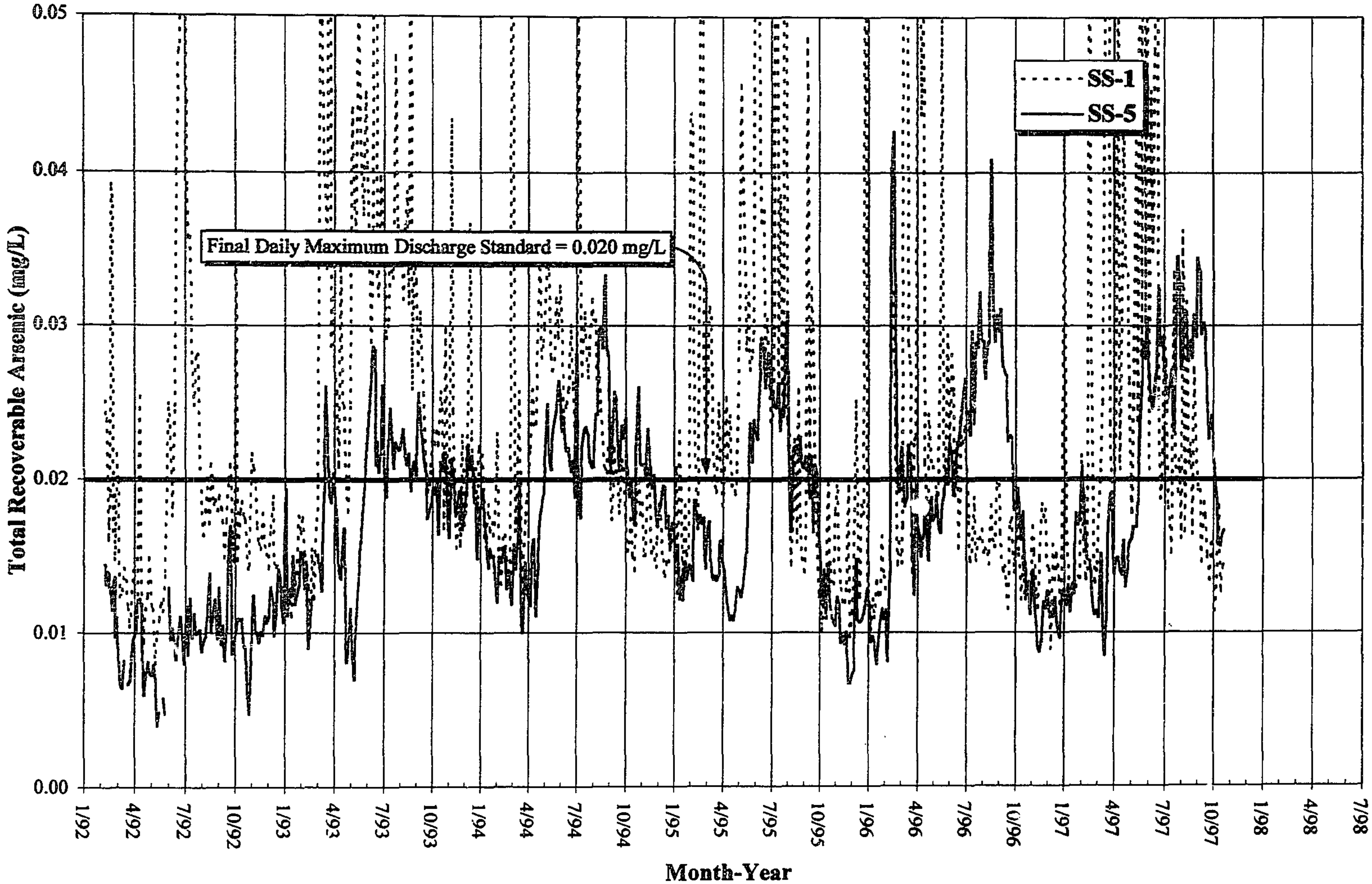


Figure As-1. **Comparison of influent (SS-1) and effluent (SS-5) total recoverable arsenic concentrations (1992-1997) with final daily performance standard. This comparison with the final standard is for reference only, as final standards generally did not apply during shakedown.**

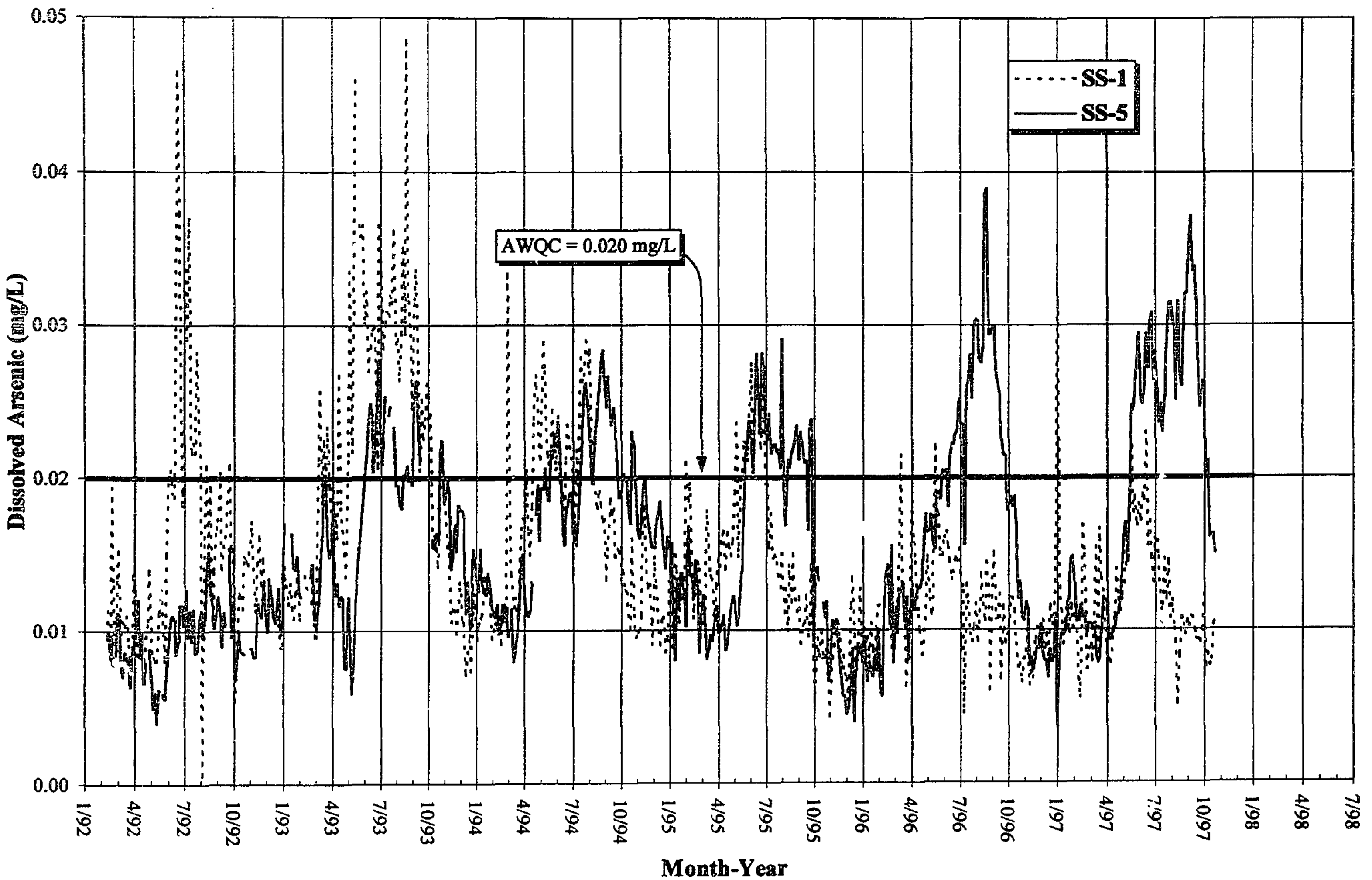


Figure As-2. **Comparison of influent (SS-1) and effluent (SS-5) dissolved arsenic concentrations (1992-1997) with federal ambient water quality criteria (AWQC).**

Cadmium

Tier I performance standards for total recoverable cadmium concentrations were 0.01 mg/l (daily maximum) and 0.0062 mg/l (monthly average). A hardness adjustment was allowed for cadmium in Tier I.

Between October 25, 1991, and October 24, 1995, a total of 375 separate 24-hour composite samples were analyzed for total recoverable cadmium and compared to Tier I standards. All 375 samples (100 percent) met the daily standard. Of the 44 measurements used to calculate monthly average concentrations, all 44 months (100 percent) met the monthly standard.

The more stringent Tier II performance standards for total recoverable cadmium concentrations, both daily maximum and monthly average, were 0.0039 mg/l. A hardness adjustment was allowed for cadmium in Tier II.

Between October 25, 1995, and October 24. 1997, a total of 209 separate 24-hour composite samples were analyzed for total recoverable cadmium and compared to the Tier II standards. All 209 samples (100 percent) met the daily standard. Of the 25 measurements used to calculate monthly average concentrations, all 25 months (100 percent) met the monthly standard.

From October 25, 1991, through October 24, 1997, which encompasses both the Tier I and Tier II periods, treatment within the ponds removed an estimated 81 percent of all cadmium (total recoverable) that entered the system. The average total recoverable cadmium concentration entering Pond 3 (SS-1) during this extended period was 0.0021 mg/l, with some concentrations exceeding 0.01 mg/l. The average total recoverable cadmium concentration leaving the ponds (SS-5) during the same extended period was 0.0004 mg/l.

Although the final standards did not become effective until October 25, 1997, ARCO compared the hardness-adjusted final daily maximum discharge standard for total recoverable cadmium to the several hundred daily measurements that were analyzed between January 1992 and October 1997. The following graph (Figure Cd-1) illustrates that although incoming cadmium concentrations are generally already below the protective standard, treatment within the ponds substantially reduces cadmium to low concentrations, including during spring runoff events.

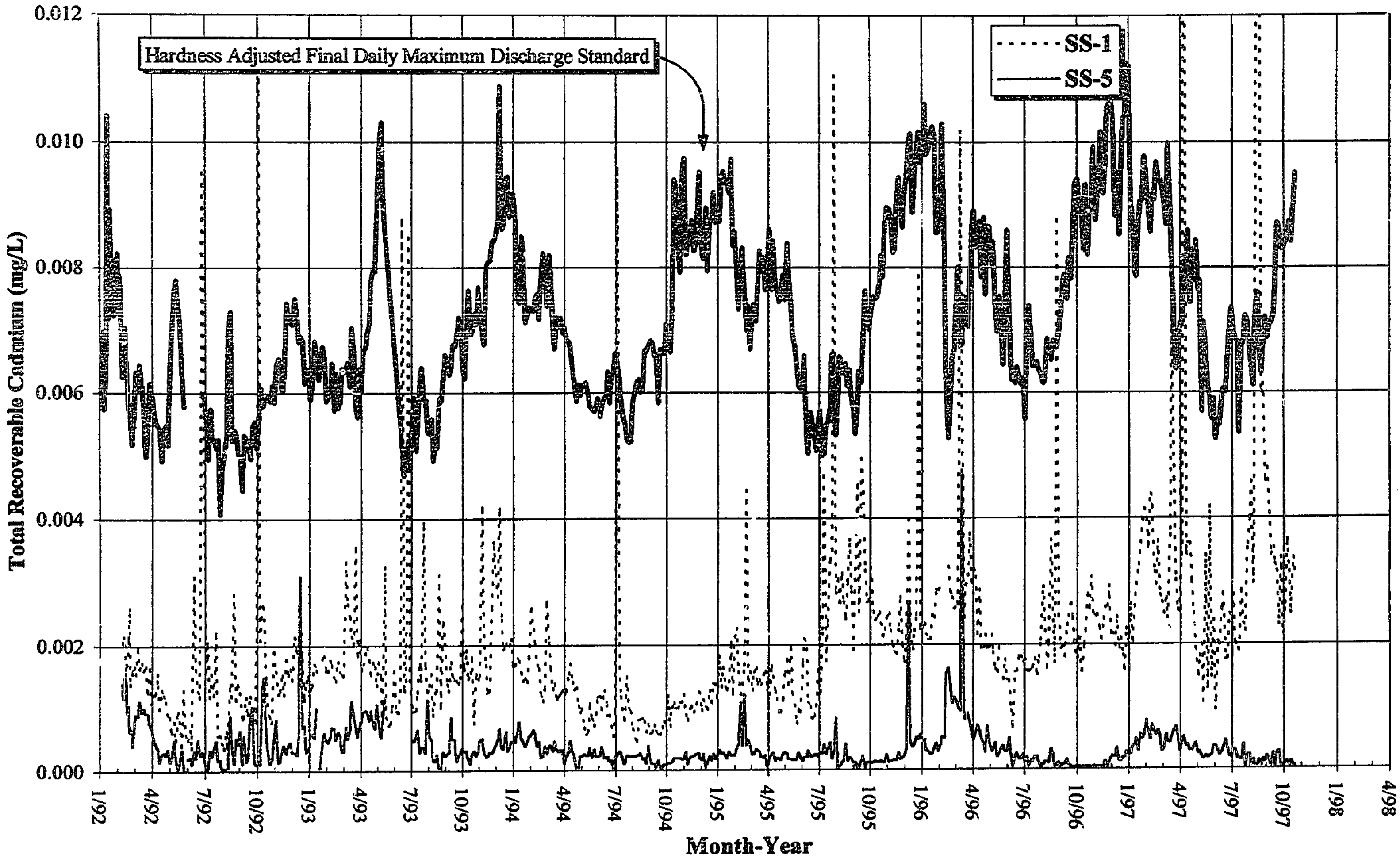


Figure Cd-1. Comparison of influent (SS-1) and effluent (SS-5) total recoverable cadmium concentrations (1992-1997) with final daily performance standard. This comparison with the final standard is for reference only, as final standards generally did not apply during shakedown.

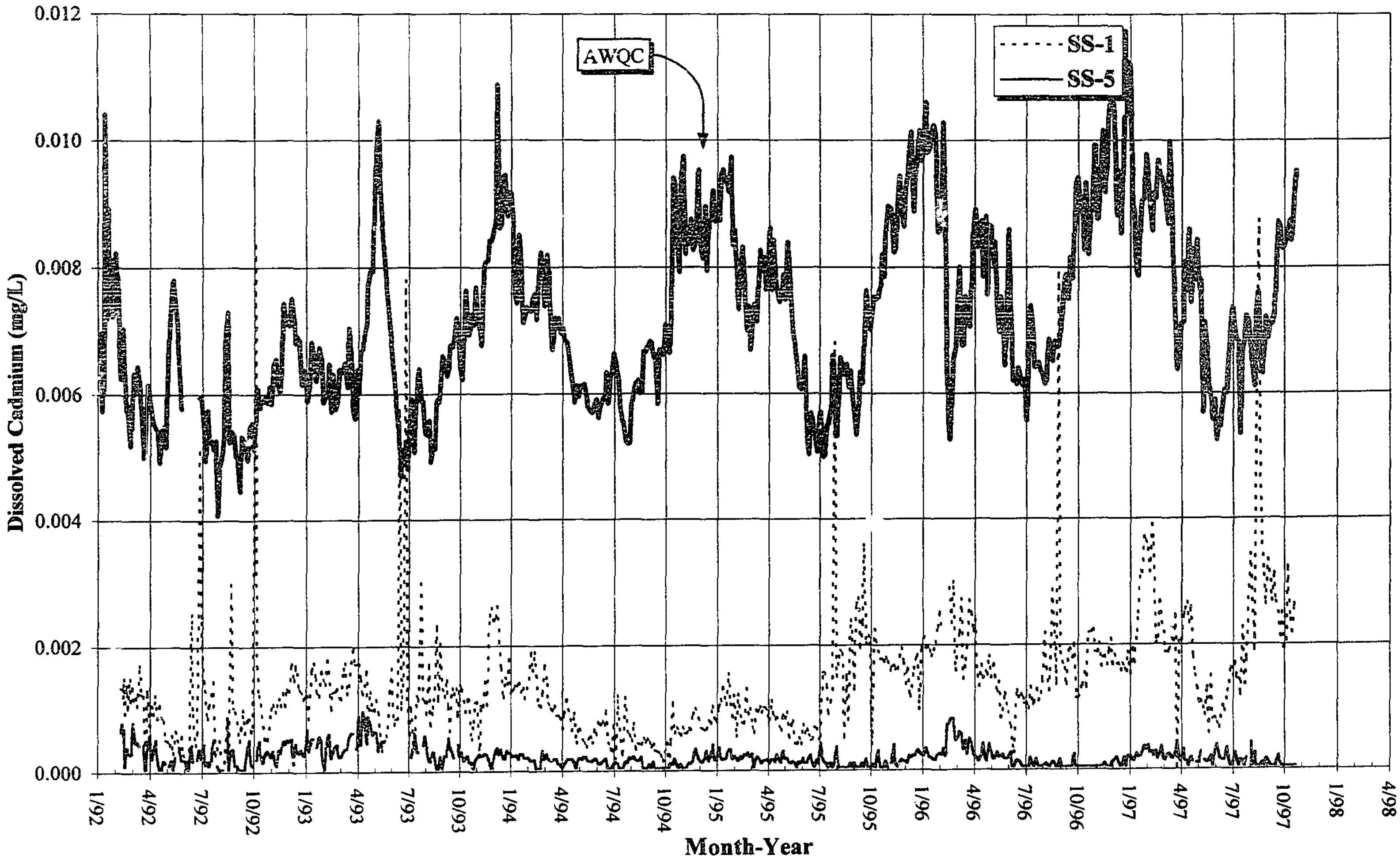


Figure Cd-2. Comparison of influent (SS-1) and effluent (SS-5) dissolved cadmium concentrations (1992-1997) with federal ambient water quality criteria (AWQC).

Copper

Tier I performance standards for total recoverable copper concentrations were 0.09 mg/l (daily maximum) and 0.035 mg/l (monthly average). No adjustment for hardness was allowed in Tier I.

Between October 25, 1991 and October 24, 1995, a total of 386 separate 24-hour composite samples were analyzed for total recoverable copper and compared to Tier I standards. Twenty five samples (six percent) failed to meet the daily standard and 361 samples (94 percent) met the daily standard. Of the 45 measurements used to calculate monthly average concentrations, eight months (18 percent) failed to meet the monthly standard and 37 months (82 percent) met the monthly standard.

The more stringent Tier II performance standards for total recoverable copper concentrations were 0.035 mg/l (daily maximum) and 0.018 mg/l (monthly average). Adjustment for hardness was allowed in Tier II.

Between October 25, 1995, and October 24, 1997, a total of 209 separate 24-hour composite samples were analyzed for total recoverable copper and compared to Tier II standards. Fifty nine samples (28 percent) failed to meet the daily standard and 150 samples (72 percent) met the daily standard. Of the 25 measurements used to calculate monthly average concentrations, nine months (36 percent) failed to meet the monthly standard and 16 months (64 percent) met the monthly standard.

From October 25, 1991, through October 24, 1997, which encompasses both the Tier I and Tier II periods, treatment within the ponds removed an estimated 80 percent of all copper (total recoverable) that entered the system. The average total recoverable copper concentration entering Pond 3 (SS-1) during this extended period was 0.167 mg/l, with many concentrations exceeding 1.0 mg/l. The average total recoverable copper concentration leaving the ponds (SS-5) during the same extended period was 0.034 mg/l.

Although the final standards did not become effective until October 25, 1997, ARCO compared the hardness-adjusted final daily maximum discharge standard for total recoverable copper to the several hundred daily measurements that were analyzed between January 1992 and October 1997. The following graph (Figure Cu-1) illustrates that the pond system capablilities for treatment of copper compare favorably overall to the final daily standard, with spring runoff events generally exceeding treatment capabilities. The figure also illustrates that influent (SS-1) total recoverable copper concentrations are significantly reduced, often by an order of magnitude, within the pond system.

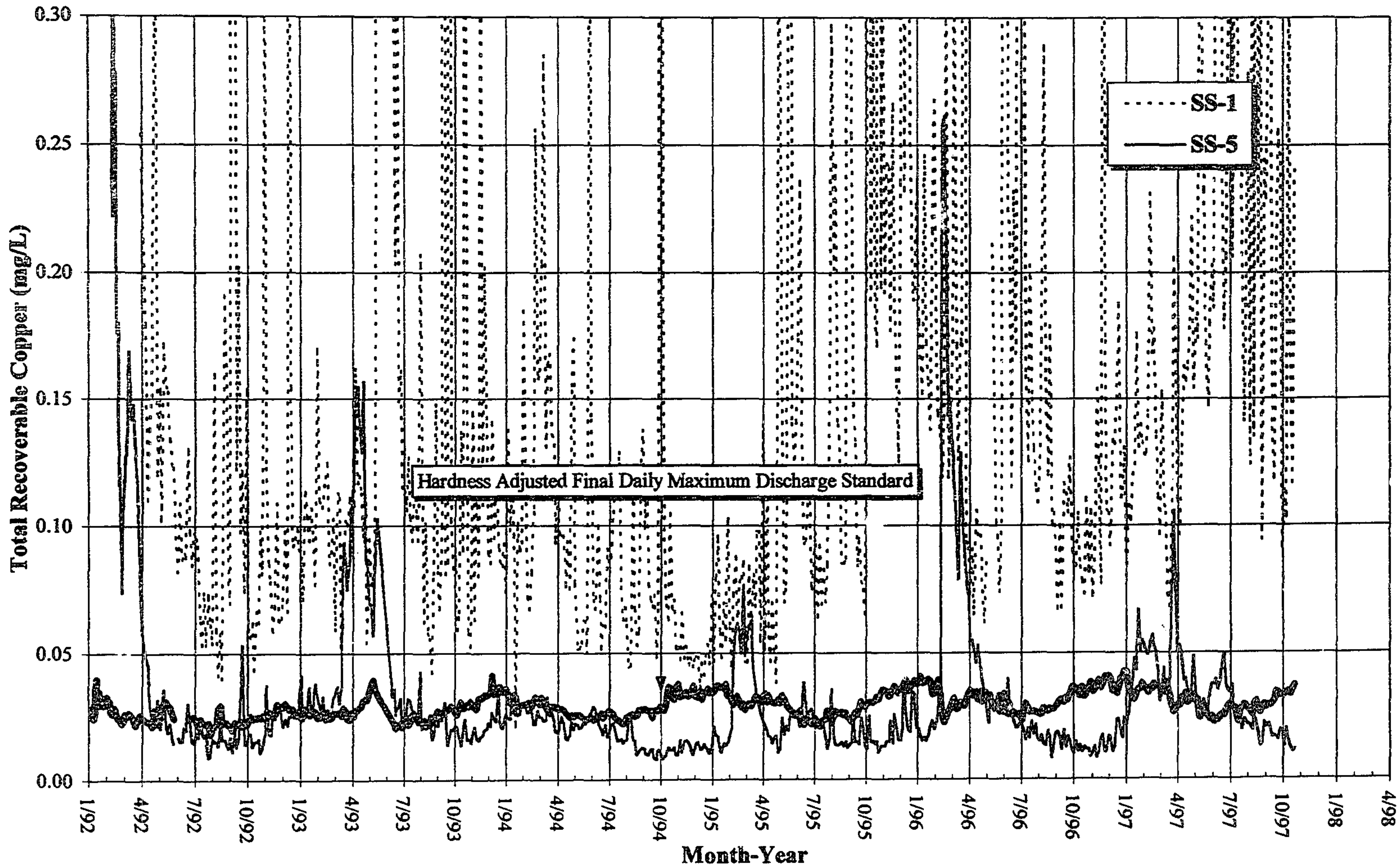


Figure Cu-1. Comparison of influent (SS-1) and effluent (SS-5) total recoverable copper concentrations (1992-1997) with final daily performance standard. This comparison with the final standard is for reference only, as final standards generally did not apply during shakedown.

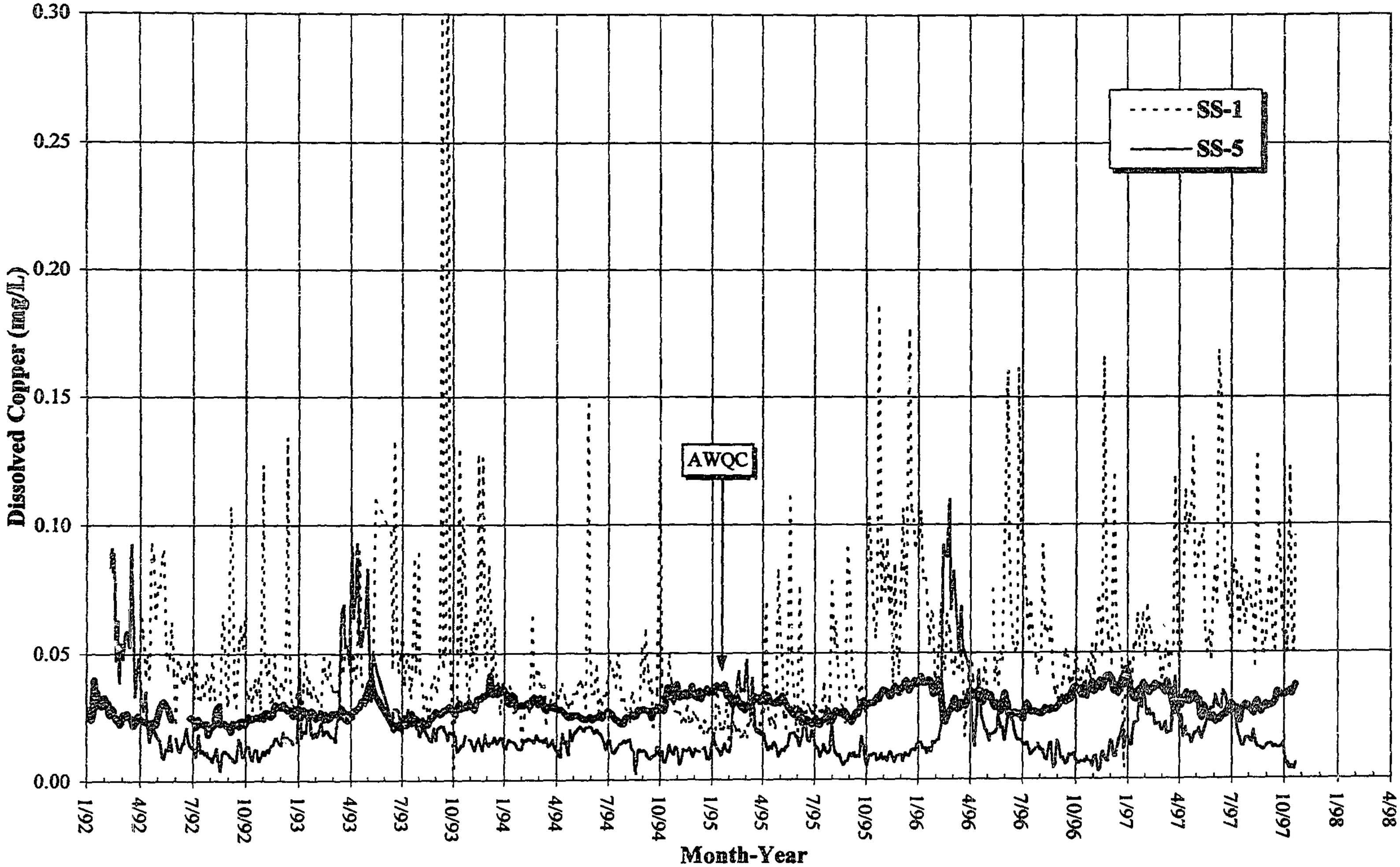


Figure Cu-2. Comparison of influent (SS-1) and effluent (SS-5) dissolved copper concentrations (1992-1997) with federal ambient water quality criteria (AWQC).

Iron

Tier I performance standards for total recoverable iron concentrations were 2.2 mg/l (daily maximum) and 1.5 mg/l (monthly average). Hardness adjustment does not apply to performance standards for iron.

Between October 25, 1991, and October 24, 1995, a total of 386 separate 24-hour composite samples were analyzed for total recoverable iron and compared to Tier I standards. All 386 samples (100 percent) met the daily standard. Of the 45 measurements used to calculate monthly average concentrations, all 45 months (100 percent) met the monthly standard.

The slightly more stringent Tier II performance standards for total recoverable iron concentrations, both daily maximum and monthly average, were 1.5 mg/l. This number also represents the final daily maximum and monthly average standards for iron.

Between October 25, 1995, and October 24, 1997, a total of 209 separate 24-hour composite samples were analyzed for total recoverable iron and compared to the Tier II standards. Six samples (3 percent) failed to meet the daily standard and 203 samples (97 percent) met the daily standard. Of the 25 measurements used to calculate monthly average concentrations, one month (4 percent) failed to meet the monthly standard and 24 months (96 percent) met the monthly standard.

From October 25, 1991, through October 24, 1997, which encompasses both the Tier I and Tier II periods, treatment within the ponds removed an estimated 73 percent of all iron (total recoverable) that entered the system. The average total recoverable iron concentration entering Pond 3 (SS-1) during this extended period was 1.14 mg/l, with many concentrations exceeding 5.0 mg/l. The average total recoverable iron concentration leaving the ponds (SS-5) during the same extended period was 0.3 mg/l.

Although the final standards did not become effective until October 25, 1997, ARCO compared the final daily maximum discharge standard for total recoverable iron to the several hundred daily measurements that were analyzed between January 1992 and October 1997. The following graph (Figure Fe-1) illustrates that the pond system capabilities for treatment of iron compare favorably to the final daily standard, with a spring runoff event of 1996 slightly exceeding treatment capabilities. The figure also illustrates that influent (SS-1) total recoverable iron concentrations are substantially reduced by treatment within the pond system, to levels well below the protective standard.

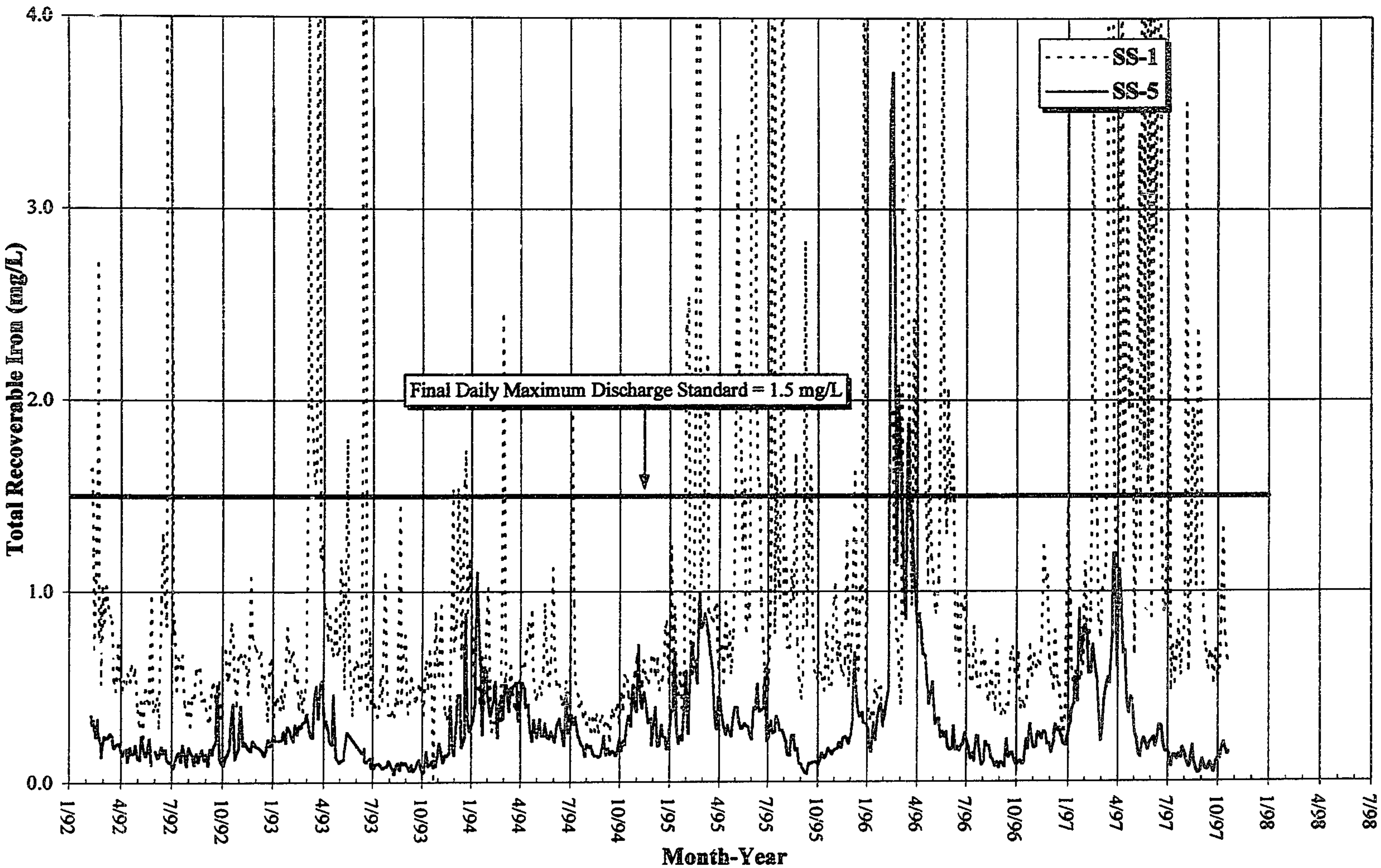


Figure Fe-1. **Comparison of influent (SS-1) and effluent (SS-5) total recoverable iron concentrations (1992-1997) with final daily performance standard. This comparison with the final standard is for reference only, as final standards generally did not apply during shakedown.**

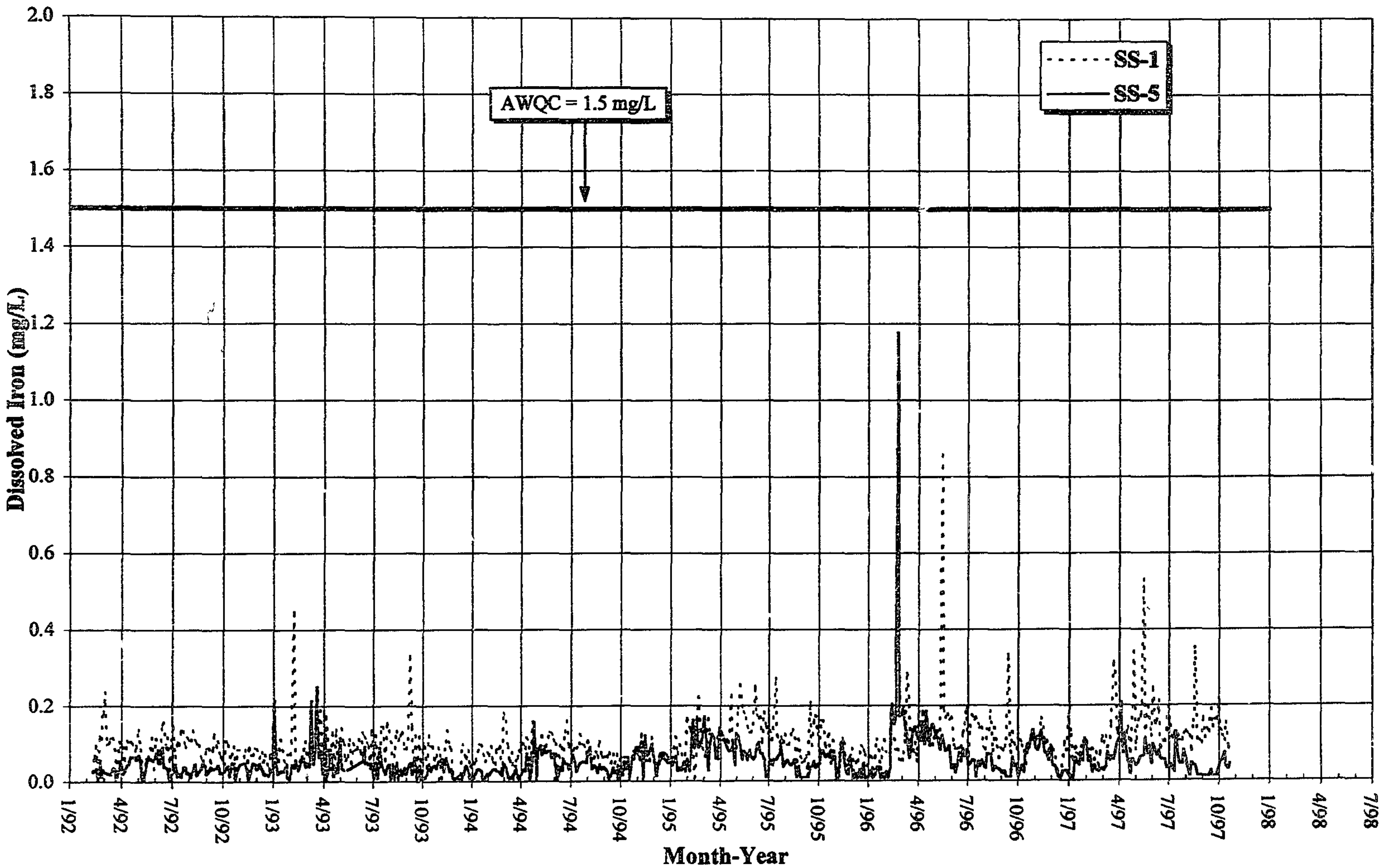


Figure Fe-2. **Comparison of influent (SS-1) and effluent (SS-5) dissolved iron concentrations (1992-1997) with federal ambient water quality criteria (AWQC).**

Mercury

Tier I performance standards for total mercury concentrations were 0.001 mg/l (daily maximum) and 0.0002 mg/l (monthly average). Hardness adjustment does not apply to performance standards for mercury.

Between October 25, 1991, and October 24, 1995, a total of 413 separate 24-hour composite samples were analyzed for total mercury and compared to Tier I standards. All 413 (100 percent) met the daily standard. Of the 47 measurements used to calculate monthly average concentrations, all 47 months (100 percent) met the monthly standard.

The more stringent Tier II performance standards for total mercury concentrations, both daily maximum and monthly average, were 0.0002 mg/l. This number also represents the final daily maximum and monthly average performance standards for mercury, as 0.0002 mg/l was the analytical detection limit until early 1997. (The detection limit dropped to 0.0001 mg/l earlier this year.)

Between October 25, 1995, and October 24, 1997, a total of 209 separate 24-hour composite samples were analyzed for total mercury and compared to the Tier II standards. Six samples (3 percent) failed to meet the daily standard and 203 samples (97 percent) met the daily standard. Of the 25 measurements used to calculate monthly average concentrations, one month (4 percent) failed to meet the monthly standard and 24 months (96 percent) met the monthly standard.

From October 25, 1991, through October 24, 1997, which encompasses both the Tier I and Tier II periods, treatment within the ponds removed an estimated 50 percent of all mercury (total) that entered the system. The average total mercury concentration entering Pond 3 (SS-1) during this extended period is assumed to be 0.0002 mg/l, although many samples exceeded 0.0006 mg/l. The average total mercury concentration leaving the ponds (SS-5) during the same extended period is assumed to be one-half of the analytical detection limit, or 0.0001 mg/l. This is standard practice when protective standards are equivalent to the analytical detection limit.

ARCO compared the final daily maximum discharge standard for total mercury to the several hundred daily measurements that were analyzed between January 1992 and October 1997. The following graph (Figure Hg-1) illustrates that incoming mercury concentrations have often exceeded the aquatic life protection standard, particularly over the past three years; however, substantial treatment and removal are occurring within the pond system.

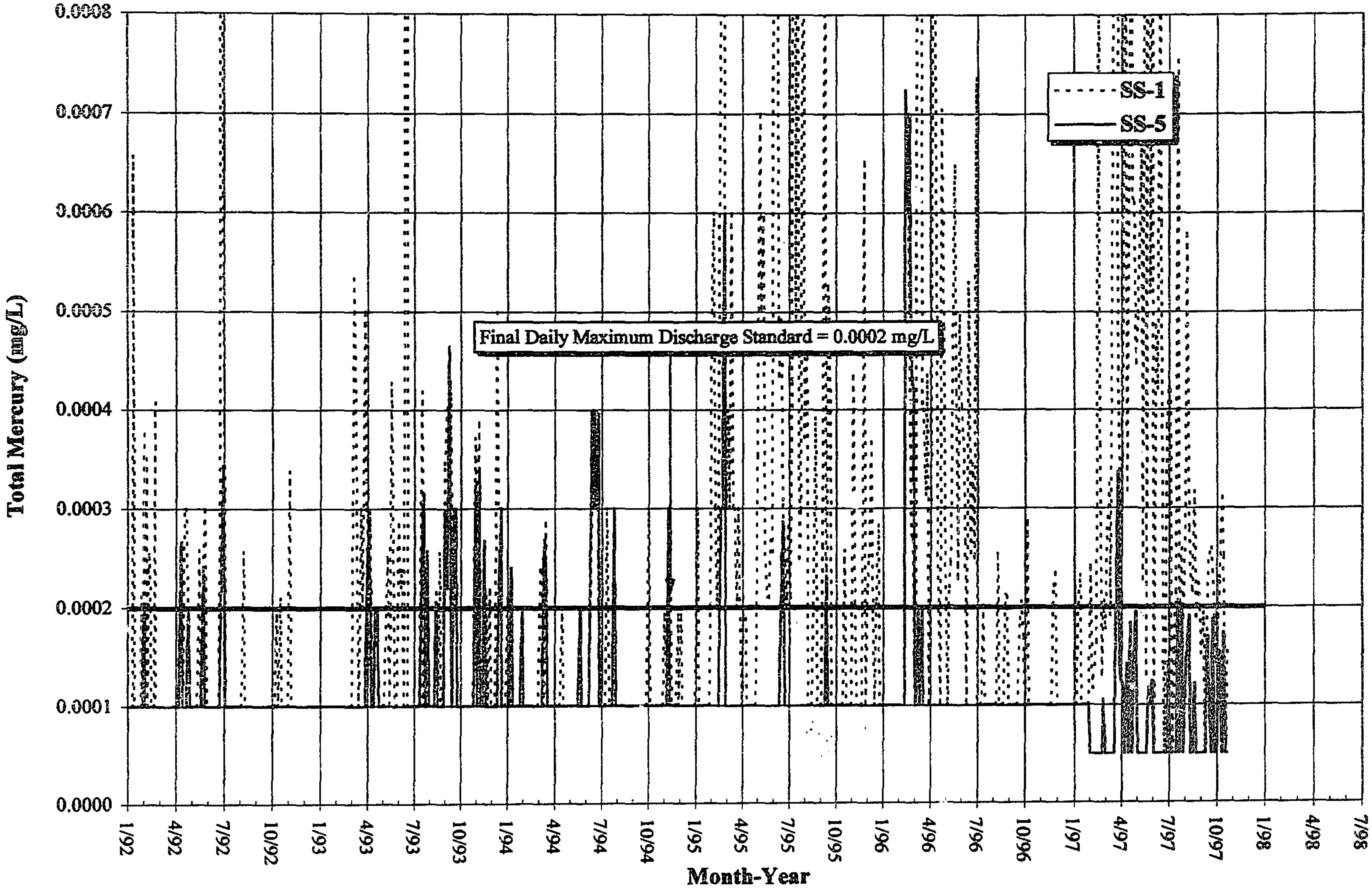


Figure Hg-1. Comparison of influent (SS-1) and effluent (SS-5) total mercury concentrations (1992-1997) with final daily performance standard. This comparison with the final standard is for reference only, as final standards generally did not apply during shakedown.

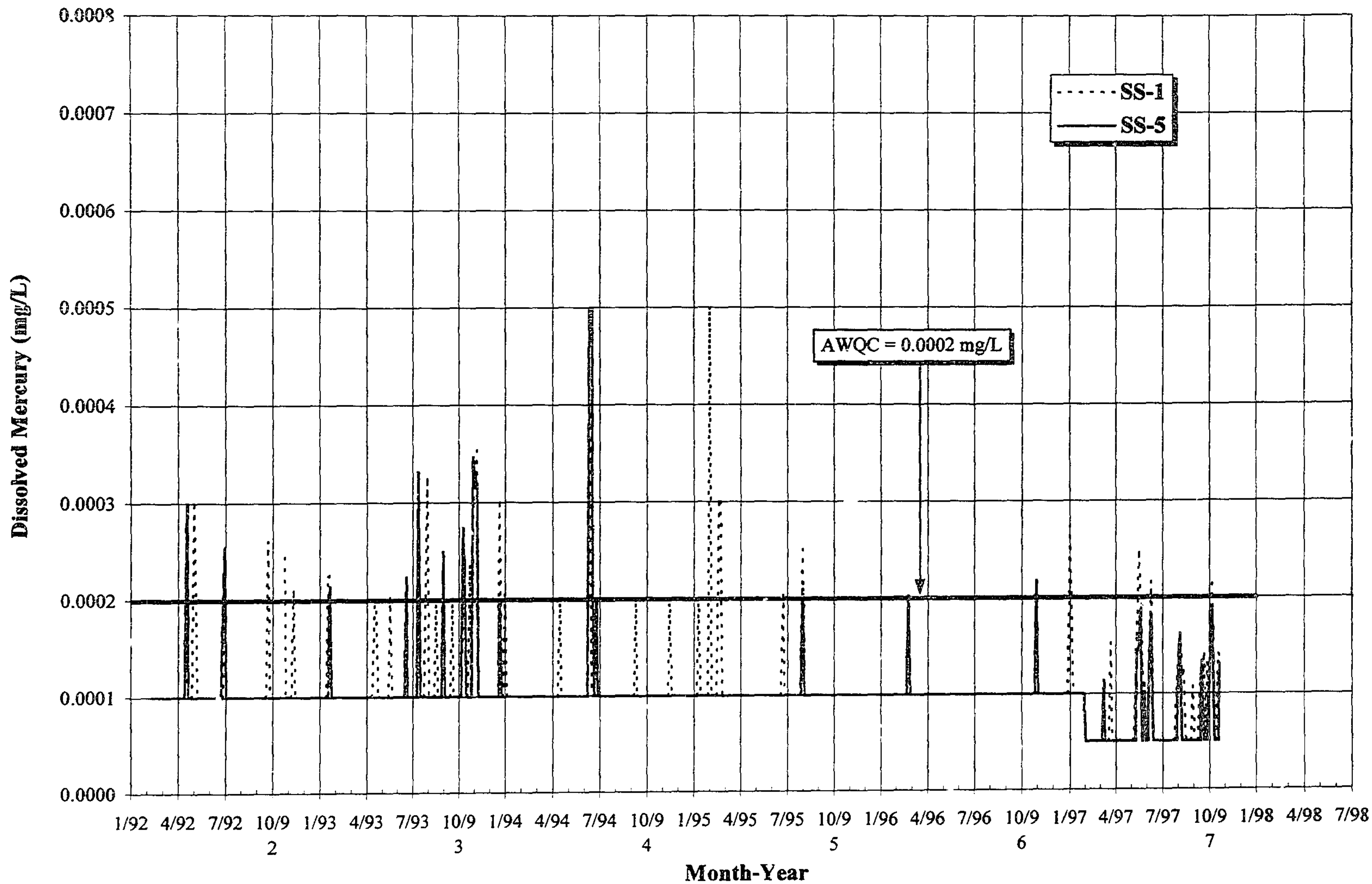


Figure Hg-2. Comparison of influent (SS-1) and effluent (SS-5) dissolved mercury concentrations (1992-1997) with federal ambient water quality criteria (AWQC).

Lead

Tier I performance standards for total recoverable lead concentrations were 0.1 mg/l (daily maximum) and 0.1 mg/l (monthly average). A hardness adjustment was allowed for lead in Tier I.

Between October 25, 1991, and October 24, 1995, a total of 386 separate 24-hour composite samples were analyzed for total recoverable lead and compared to Tier I standards. All 386 samples (100 percent) met the daily standard. Of the 45 measurements used to calculate monthly average concentrations, all 45 months (100 percent) met the monthly standard.

The more stringent Tier II performance standards for total recoverable lead concentrations, both daily maximum and monthly average, were 0.082 mg/l. A hardness adjustment was allowed for lead in Tier II.

Between October 25, 1995, and October 24, 1997, a total of 209 separate 24-hour composite samples were analyzed for total recoverable lead and compared to the Tier II standards. All 209 samples (100 percent) met the daily standard. Of the 25 measurements used to calculate monthly average concentrations, all 25 months (100 percent) met the monthly standard.

From October 25, 1991, through October 24, 1997, which encompasses both the Tier I and Tier II periods, treatment within the ponds removed an estimated 84 percent of all lead (total recoverable) that entered the system. The average total recoverable lead concentration entering Pond 3 (SS-1) during this extended period was 0.025 mg/l, with some concentrations exceeding 0.04mg/l. The average total recoverable lead concentration leaving the ponds (SS-5) during the same extended period was 0.004 mg/l.

Although the final standards did not become effective until October 25, 1997, ARCO compared the hardness-adjusted final daily maximum discharge standard for total recoverable lead to the several hundred daily measurements that were analyzed between January 1992 and October 1997. The following graph (Figure Pb-1) illustrates that although incoming lead concentrations generally fall below the protective standard, treatment within the pond system substantially reduces lead concentrations to low levels, including during spring runoff events.

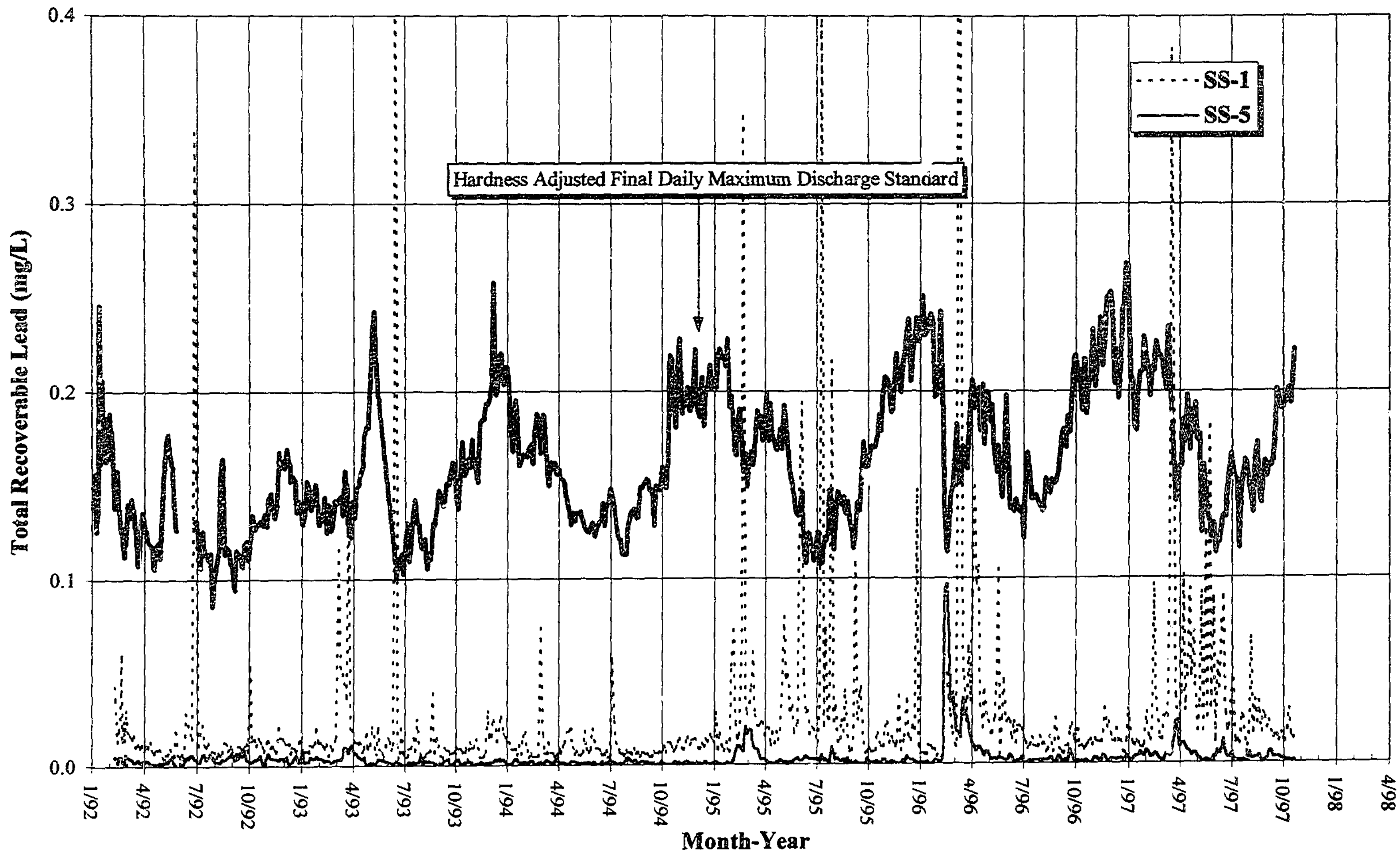


Figure Pb-1. Comparison of influent (SS-1) and effluent (SS-5) total recoverable lead concentrations (1992-1997) with final daily performance standard. This comparison with the final standard is for reference only, as final standards generally did not apply during shakedown.

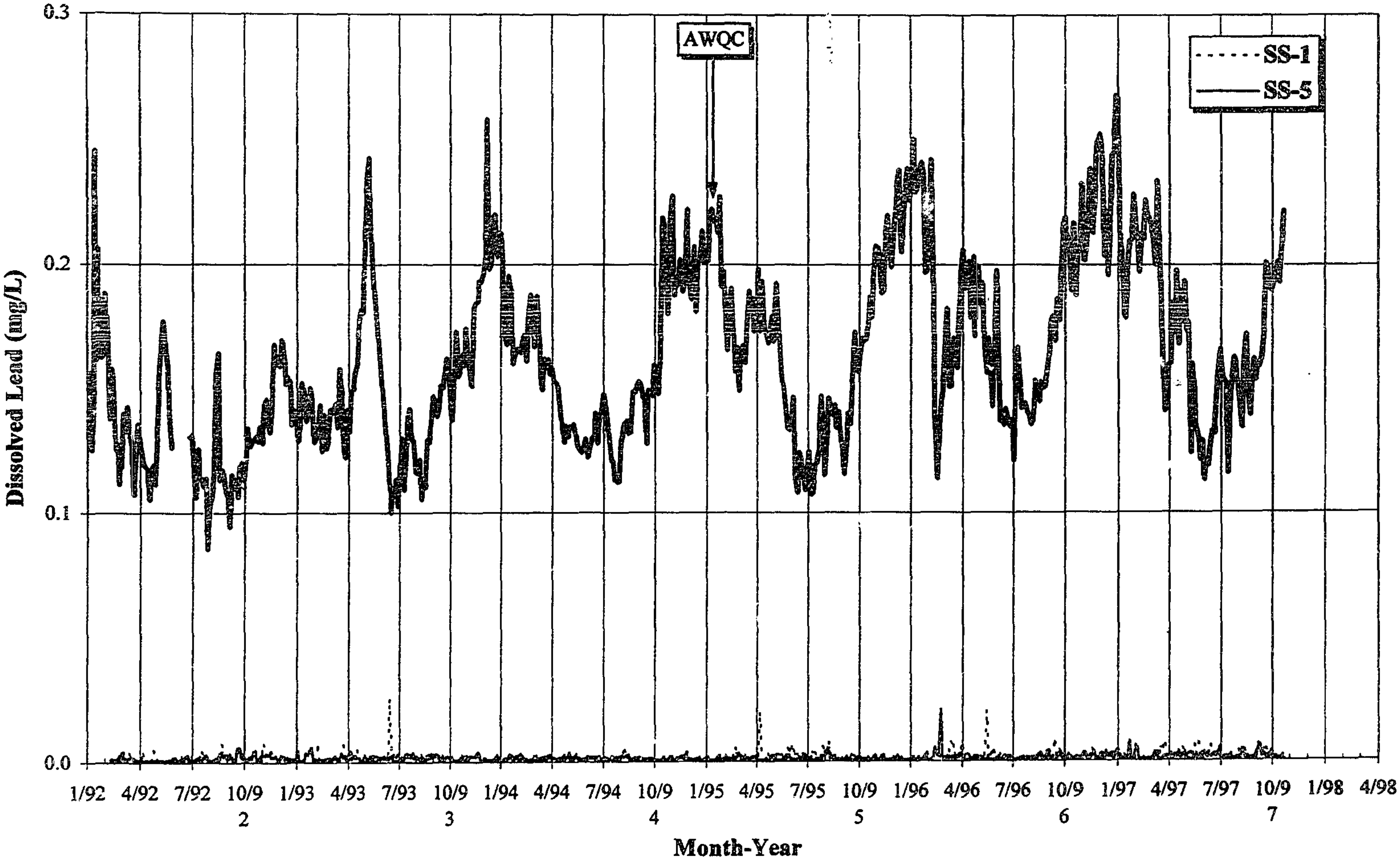


Figure Pb-2. Comparison of influent (SS-1) and effluent (SS-5) dissolved lead concentrations (1992-1997) with federal ambient water quality criteria (AWQC).

Zinc

Tier I performance standards for total recoverable zinc concentrations were 0.3 mg/l (daily maximum) and 0.16 mg/l (monthly average). A hardness adjustment was allowed for zinc in Tier I.

Between October 25, 1991, and October 24, 1995, a total of 386 separate 24-hour composite samples were analyzed for total recoverable zinc and compared to Tier I standards. Seven samples (two percent) failed to meet the daily standard and 379 samples (98 percent) met the daily standard. Of the 45 measurements used to calculate monthly average concentrations, three months (seven percent) failed to meet the monthly standard and 42 months (93 percent) met the monthly standard.

The Tier II performance standards for total recoverable zinc concentrations, both daily maximum and monthly average, were 0.12 mg/l. A hardness adjustment was allowed for zinc in Tier II.

Between October 25, 1995, and October 24, 1997, a total of 208 separate 24-hour composite samples were analyzed for total recoverable zinc and compared to the Tier II standards. Twenty two samples (11 percent) failed to meet the daily standard and 186 samples (89 percent) met the daily standard. Of the 25 measurements used to calculate monthly average concentrations, two months (eight percent) failed to meet the monthly standard and 23 months (92 percent) met the monthly standard.

From October 25, 1991, through October 24, 1997, which encompasses both the Tier I and Tier II periods, treatment within the ponds removed an estimated 88 percent of all zinc (total recoverable) that entered the system. The average total recoverable zinc concentration entering Pond 3 (SS-1) during this extended period was 0.561 mg/l, with many concentrations exceeding 1.2 mg/l. The average total recoverable zinc concentration leaving the ponds (SS-5) during the same extended period was 0.07 mg/l.

Although the final standards did not become effective until October 25, 1997, ARCO compared the hardness-adjusted final daily maximum discharge standard for total recoverable zinc to the several hundred daily measurements that were analyzed between January 1992 and October 1997. The following graph (Figure Zn-1) illustrates that the pond system capabilities for treatment of zinc compare favorably overall to the final daily standard, with spring runoff events of 1992, 1993, 1996 and 1997 exceeding treatment capabilities. The figure also illustrates that influent (SS-1) total recoverable zinc concentrations are significantly reduced, often by an order of magnitude, within the pond system.

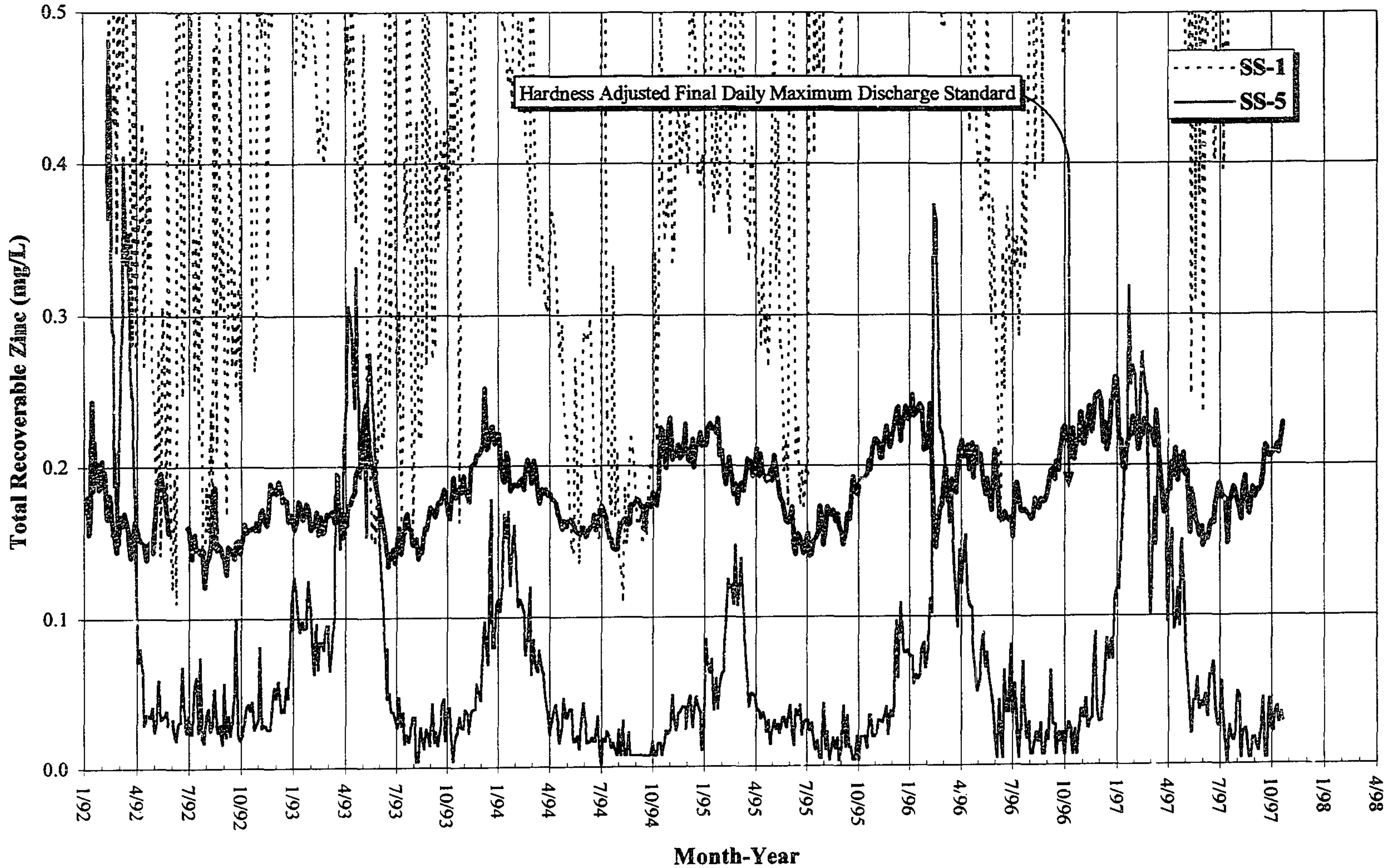


Figure Zn-1. Comparison of influent (SS-1) and effluent (SS-5) total recoverable zinc concentrations (1992-1997) with final daily performance standard. This comparison with the final standard is for reference only, as final standards generally did not apply during shakedown.

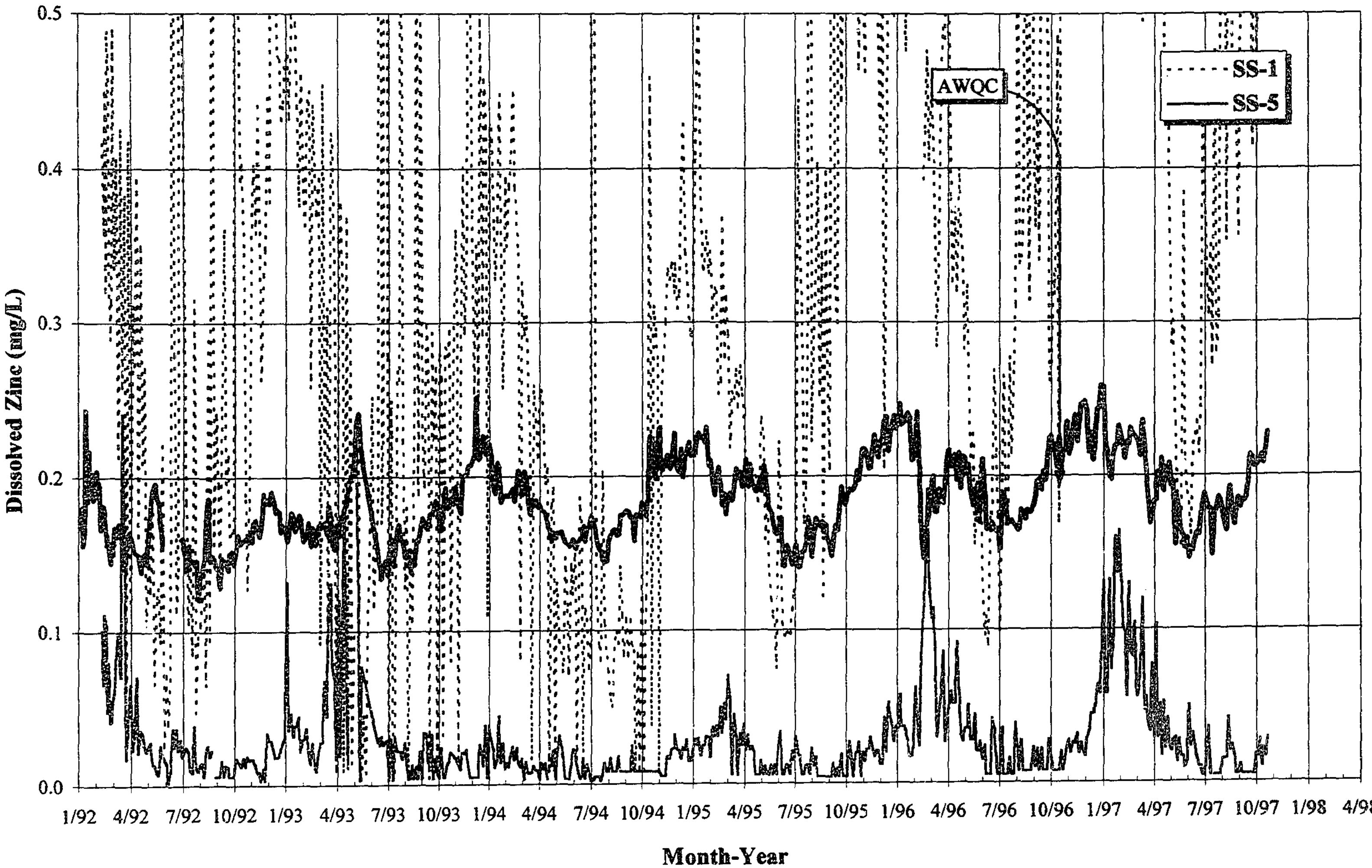


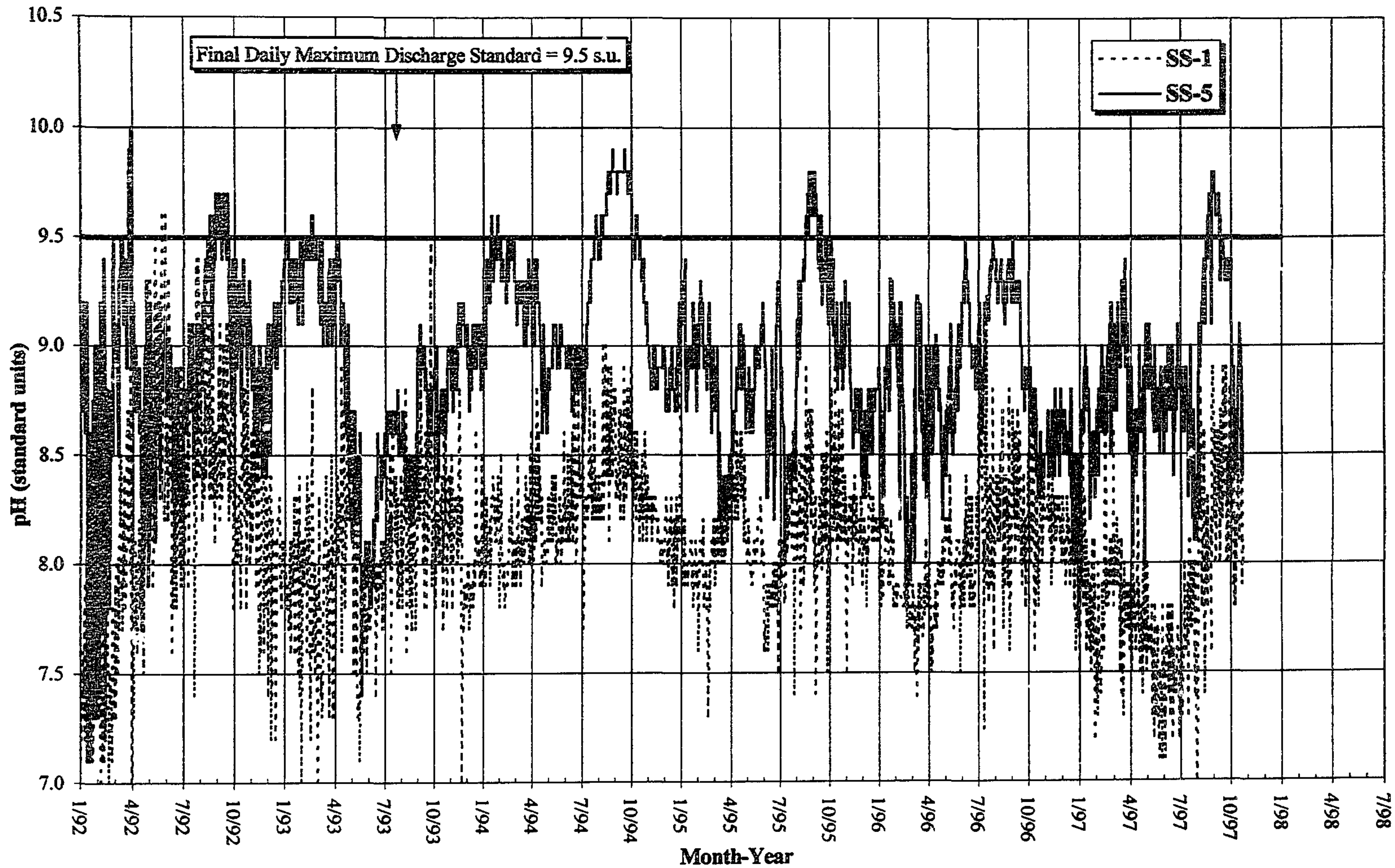
Figure Zn-2. **Comparison of influent (SS-1) and effluent (SS-5) dissolved zinc concentrations (1992-1997) with federal ambient water quality criteria (AWQC).**

pH

The Tier I, Tier II and final daily maximum performance standard for pH is expressed as a range of pH 6.5 to pH 9.5. Only the daily maximum standard applies to pH.

Between October 25, 1991, and October 24, 1997, a total of 2,128 daily pH measurements were recorded, with 121 measurements greater than pH 9.5. These exceedences occur invariably during the late summer months as a consequence of warmer temperatures and natural biological activity. Lime addition at the inlet during this period is generally suppressed or discontinued altogether.

Figure pH - 1 illustrates pH measurements over the period of record and compares them to the pH of incoming water (SS - 1) generally falls between pH 7.0 and pH 8.5. The addition of lime at the inlet, to achieve a desired pH of 9.3 to 9.5, greatly enhances the precipitation of metals within the pond system.



Final Daily Maximum Discharge Standard = 9.5 s.u.
SS-1
SS-5
pH (standard units)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
1/92
4/92
7/92
10/92
1/93
4/93
7/93
10/93
1/94
4/94
7/94
10/94
1/95
4/95
7/95
10/95
1/96
4/96
7/96
10/96
1/97
4/97
7/97
10/97
1/98
4/98
7/98
Month-Year

Figure pH-1.

Total Suspended Solids

The Tier I and Tier II performance standards for total suspended solids (TSS) concentrations were 45 mg/l (daily maximum) and 45 mg/l (monthly average). The final daily maximum performance standard remains at 45 mg/l; however, the final monthly average performance standard is 30 mg/l.

Between October 25, 1991, and October 24, 1997, a total of 622 separate 24-hour composite samples were analyzed for total suspended solids and compared to standards. All 622 samples (100 percent) met the daily standard. Of the 72 measurements used to calculate monthly average concentrations, all 72 months (100 percent) met the monthly standard.

ARCO compared the daily maximum discharge standard for total suspended solids to the several hundred daily measurements that were analyzed between January 1992 and October 1997. The following graph (Figure TSS-1) illustrates that the pond system removes substantial amounts of suspended sediments, reducing concentrations to levels consistently below the protective standards.

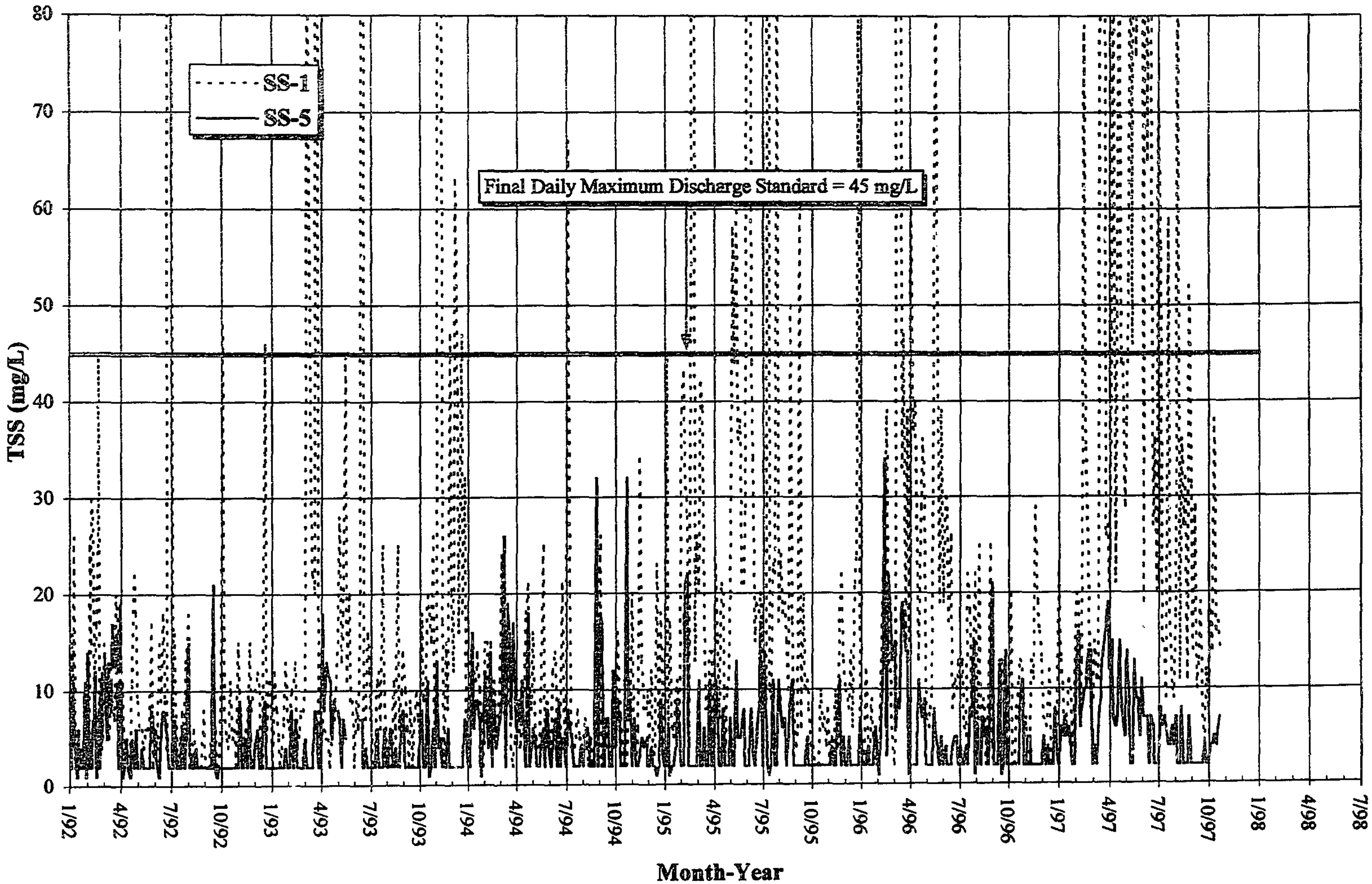


Figure TSS-1. **Comparison of influent (SS-1) and effluent (SS-5) total suspended solids concentrations (1992-1997) with final daily performance standard. This comparison with the final standard is for reference only, as final standards generally did not apply during shakedown.**

7.3.4 Mill-Willow Bypass Reconstruction, Reclamation, and Streambank Preservation

The bypass was designed and constructed as the primary floodway. In addition to receiving Willow and Mill creeks, the bypass is capable of safely passing large flood flows around the Warm Springs Ponds. The channel within the bypass was constructed between fall 1992 and fall 1994. Its floodplain consists of a mixture of wet to moist low terraces that support well-developed stands of vegetation. On the eastern side of the bypass, the side slopes associated with dikes are faced with soil-cement to protect them from erosion during floods. Primary stability techniques for the bypass relied on fall seeding of the stream banks and floodplain with native grasses and the planting of willow cuttings and seedlings along the banks.

Overall, the vegetative development within the bypass has been good to excellent. A 1996 inspection of the area documented that five major vegetative species accounted for 76 % of the total cover by all species. The vegetated sites are dominated by perennial species that appear to be stable or are increasing in abundance. While weeds occur, they are present at low levels. Many native wetland species have become established.

Overbank flows that occurred in the bypass in 1995, 1996, and 1997, although hindering stabilization and revegetation efforts, were anticipated during design. Releases from Pond 3 during 1995, followed by high discharge and sediment loads from the upper bypass during 1996 and 1997, have caused minor aggradation (loss of channel capacity) and minor channel instability in the section of the bypass below the Pond 3 bypass spillway. High flows also damaged some of the stream bank stabilization and erosion control measures that were constructed in the relocated reach of Silver Bow Creek below the inactive area.

High flows during 1996 and 1997, however, aided in armoring the stream bed in the upper portions of the bypass. This armoring helps stabilize the channel and this process is anticipated for the first few years of high stream flows through the reach. More stability and less bank failure are anticipated in the next few years as the bed continues to armor and bank vegetation continues to improve. In addition, there are signs that the relocated reach of Silver Bow Creek below Pond 2 is reaching equilibrium. A firm armor layer is developing on the channel bed and banks. There is variability in stream gradient through this reach, suggesting that further channel adjustments may occur in future years.

The bypass, as reconstructed, also provides enhanced wetlands and wildlife habitat. Construction of nest boxes in several ponds has served to increase the habitat suitable for waterfowl nesting. Willows planted along the active channel are propagating rapidly, despite heavy browsing by deer. Approximately 40,000 have been hand-planted along the bypass.

From June 1, 1992 until May 17, 1995, Mill and Willow creeks were diverted into Silver Bow Creek above Pond 3 to allow for construction activities in the bypass. Flows were returned in full on September 27, 1995. Since September 1995, flows through the bypass (as measured at MWB-1) have averaged 60 cfs and ranged from a high flow of 280 cfs in May of 1997 to a low flow of 12 cfs in December 1997.

7.3.5 Wetlands Protection

In accordance with a formal federal interagency agreement between the U.S. EPA and U.S. Fish and Wildlife Service, all activities within the Clark Fork River basin that involve wetlands are supervised and evaluated by the Fish and Wildlife Service. The national standards for wetlands protection, which essentially require no net loss of wetlands nationwide, are requirements recognized and carefully monitored at the Warm Springs Ponds.

Initially, a pre-remedy inventory of wetlands was performed basin-wide, and included the Warm Springs Ponds. That inventory is accessible at any of EPA's various document repositories, at Butte, Anaconda, Deer Lodge or Missoula. The inventory was performed by ARCO, with oversight by the Fish and Wildlife Service, and it involved aerial photography and ground-truthing to determine the functional ratings of each wetlands area.

Several actions were taken during remedial action construction at the ponds to meet wetlands protection standards defined in Exhibit 5. All of the wet-closure cells, which were constructed primarily for the purpose of inundating exposed tailings deposits, were designed and constructed such that their size, depth and other physical features would maximize the functionality of wetlands ponds. Additionally, 24 individual wetlands ponds were created within the reconstructed Mill-Willow bypass floodway and several thousands of sprigs (willows and wetlands sedges) were hand-planted around these "pair ponds." Also, high-scoring wetlands areas that existed prior to the cleanup were left undisturbed during construction, or in some instances enhanced or enlarged.

Each year, at four separate stations throughout the pond system, transects are set up in wetlands areas in order to measure plant production, abundance and diversity. These measurements are carried out with oversight and evaluation being supervised by the Fish and Wildlife Service. Figure 4W shows the locations of these annual transects.

Wetlands protection performance is monitored also through other measurements that are routinely taken during annual biomonitoring of the Warm Springs Ponds. For example, invertebrate taxa richness measurements are conducted in areas classified as wetlands. Whereas only two to four species of invertebrates were found to be present in newly-created wet-closure ponds in 1995, up to 18 to 21 species were found in those ponds during the 1997 surveys. The presence of 18 to 21 species compares favorably with surveys of other wetlands areas which are not affected by metals. See Table 11.

EPA recently queried Fish and Wildlife Service officials who oversee wetlands performance monitoring at the Warm Springs Ponds: Are there indications from data collected recently that would indicate desirable or essential conditions for healthy wetlands are not in place here? The answer is no. EPA and Fish and Wildlife Service will, however, continue to require wetlands performance monitoring for at least the next several years, until a final accounting of basin wetlands areas is conducted.

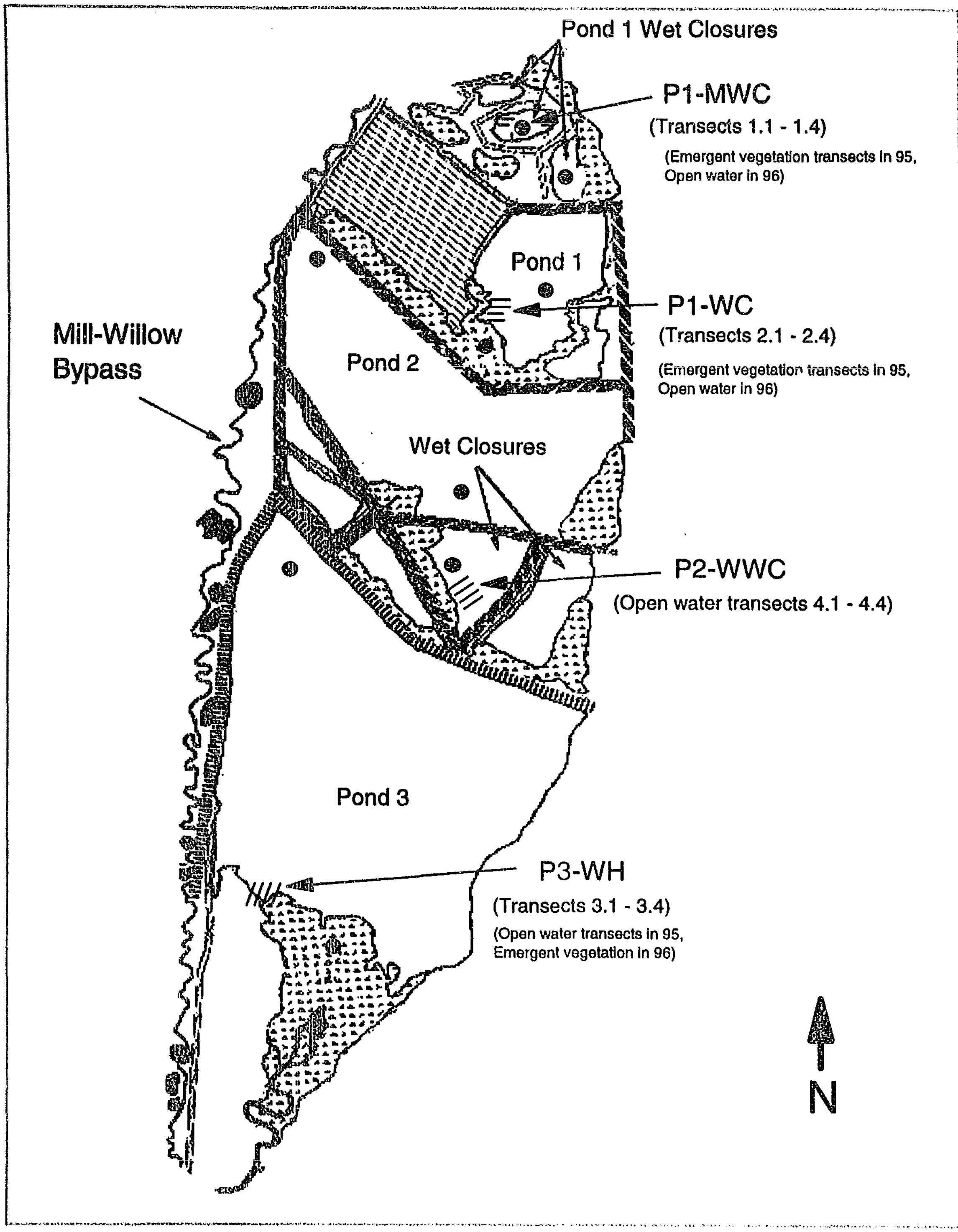


Figure 4W. Warm Springs Ponds 1995-96 Sampling Locations for Plant Productivity, Abundance, and Diversity.

Table 11

Benthic Macroinvertebrate Indices in WSP [illegible] 1995, 1996, and 1997

Location	Year	Total Density (#/m²)		*Hyalella azteca* Density (#/m²)		Taxa Richness (Quantitative) (#/Sample)		Taxa Richness (Qualitative) (#/Sample)	Shannon-Weiner Diversity (Log 10)	
P1-WA	1995 (3)	2,009 ± 1,189	A	1,435 ± 1,083	A	7.33 ± 1.53	A	12	0.51 ± 0.17	A
	1996 (3)	1,242± 944	A	164 ± 145	A	5.0 ± 2.64	A	9	0.47 ± 0.29	A
	1997 (3)	950 ± 365	A	621 ± 168	A	5.3 ± 2.9	A	18	0.46 ± 0.21	A
P1-MWC	1995 (3)	3.59 ± 6.2	B	0 ± 0.00	A	0.33 ± 0.58	B	2	0 ± 0.00	A
	1996 (3)	1,823 ± 1,516	A	115 ± 199	A	5.0 ± 2.64	A	11	0.52 ± 0.24	A
	1997 (3)	1,066 ± 291	A	274 ± 384	A	5.0 ± 1.0	A	18	0.55 ± 0.06	A
P1-WC	1995 (3)	28.7 ± 49.7	B	14.4 ± 24.9	B	0.67 ± 1.16	B	9	0.10 ± 0.17	A
	1996 (3)	1,486 ± 558	AB	116 ± 52.8	AB	7.0 ± 1. 0	A	17	0.66 ± 0.18	A
	1997 (3)	2,032 ± 931	A	534 ± 402	A	8.7 ± 0.6	A	20	0.76 ± 0.08	A
P1-WAN	1995 (3)	28.7 ± 24.9	A	14.4 ± 24.9	A	0.67 ± 0.58	A	13	0 ± 0.00	A
	1996 (3)	274 ± 190	A	91.4 ± 63.3	A	3.0 ± 1.0	A	18	0.45 ± 0.16	A
	1997 (3)	2,302 ± 3,608	A	1,316 ± 1,947	A	4.7 ± 5.5	A	21	0.29 ± 0.32	A
P2-WWC	1995 (3)	100.5 ± 72.3	B	8.61 ± 14.9	B	2.33 ± 1.16	B	11	0.17 ± 0.15	A
	1996 (3)	2,124 ± 456	B	488 ± 433	B	7.33 ± 3.51	AB	10	0.44 ± 0.22	A
	1997 (3)	12,047 ± 8,111	A	7,589 ± 5,567	A	13 ± 3	A	11	0.56 ± 0.03	A
P2-NW	1995 (3)	555 ± 210	A	265 ± 88.9	A	6.67 ± 1.16	AB	7	0.63 ± 0.04	A
	1996 (3)	2,284 ± 1,619	A	1,986±1,427	A	4.33 ± 1.53	B	16	0.24 ± 0.01	B
	1997 (3)	6,647 ± 4,161	A	4,446 ± 2,674	A	9.7 ± 2.3	A	8	0.51 ± 0.1	AB
P2-S	1995 (3)	6,437 ± 4,536	A	5,647 ± 3,869	A	7.67 ± 1.16	A	7	0.23 ± 0.03	A
	1996 (3)	2,430 ± 2,032	A	2,302 ± 1,948	A	2.33 ± 1.15	B	12	0.09 ± 0.10	A
	1997 (3)	15,824 ± 9,055	A	12,608 ± 6,789	A	9.3 ± 2.5	A	18	0.32 ± 0.14	A

Note: All values reported as means ± standard deviation with the number of replicates for each location listed in parentheses after the year.
Letters indicate statistical differences among means for the three years; values within a column and row having the same letter were not found to be significantly different ($p \leq 0.05$) for that particular analyte and site.

Table 11Continued.

Benthic Macroinvertebrate Indices in WSP — 1995, 1996, and 1997

Location	Year	Total Density (#/m^2)		*Hyalella azteca* Density (#/m^2)		Taxa Richness (Quantitative) (#/Sample)		Taxa Richness (Qualitative) (#/Sample)	Shannon-Weiner Diversity (Log 10)	
P3-WH	1995 (3)	5,052 ± 3234	AB	3,215 ± 2,681	A	9.0 ± 0.00	B	11	0.48 ± 0.14	A
	1996 (3)	4,650 ± 2201	B	3,229±1,607	A	6.0 ± 1.73	B	12	0.38 ± 0.08	A
	1997 (3)	14,064 ± 5107.2	A	8,280 ± 6,045	A	16.7 ± 1.5	A	22	0.69 ± 0.21	A
P3-N	1995 (3)	5,103 ± 1,022	A	587 ± 72.5	A	8.67 ± 0.58	A	10	0.52 ± 0.08	A
	1996 (3)	4,941 ± 2,028	A	3,475 ± 2,665	A	3.67 ± 0.58	B	15	0.31 ± 0.09	A
	1997 (3)	2,266 ± 728	A	420 ± 456	A	4.7 ± 1.2	B	11	0.52 ± 0.14	A

Note: All values reported as means ± standard deviation with the number of replicates for each location listed in parentheses after the year.
Letters indicate statistical differences among means for the three years; values within a column and row having the same letter were not found to be significantly different ($p \leq 0.05$) for that particular analyte and site.

Excerpted from ENSR/R2 1998.

7.3.6 Biomonitoring

Biomonitoring at the Warm Springs Ponds is designed to be a long-term program. By means of an unbiased set of ecological measurements, biological systems that live in direct contact with metals in the water column, pond bottom sediments and surrounding terrestrial soils are being evaluated in terms of their "ecological health."

The objectives of the biomonitoring program were developed prior to completion of remedial action construction. They are described in the Final Draft Biomonitoring Plan for the Warm Springs Ponds (U.S. EPA, December 1994) and may be summarized as follows:

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

These objectives, as well as the biomonitoring plan itself, were developed cooperatively by the U.S. Fish and Wildlife Service, Montana Fish, Wildlife and Parks, ARCO, U.S. EPA and Montana Department of Environmental Quality. A federal inter-agency agreement with EPA enables the Fish and Wildlife Service to act as the lead agency and oversee all sampling, analysis and reporting of the biomonitoring program, and advise EPA.

Recognizing that the pond system was designed to receive and treat contaminated water and sediments from upstream, for decades into the future or perhaps indefinitely, biomonitoring of plants and animals that inhabit the area, particularly aquatic species, was designed with the understanding that the organisms live in direct contact with elevated levels of metals. As such, the Warm Springs Ponds biomonitoring program is an analysis of trends over time; a weight of evidence approach as opposed to drawing conclusions from one year's or even a few years' results.

A long term program is necessary to enable scientists to discriminate between normal biologic variations, which express themselves from year to year, as opposed to variations that may be linked to exposures to metals. Over a period of five to seven years, the ponds' communities are expected to begin to produce meaningful results regarding the ecological health of the system.

Each successive year's data build upon our understanding of the previous years' data, and each year's data further enable us to compare the biologic responses observed here with biologic responses observed at reference sites. The reference sites include other wetlands and ponds systems throughout Montana, such as Benton Lake, Lee Metcalf Waterfowl Refuge and other refuges monitored by the U.S. Fish and Wildlife Service.

The measurement endpoints selected for this biomonitoring program include:

a. metals concentrations in water and bottom sediments;
b. toxicity of bottom sediments to selected organisms;
c. metals concentrations in tissues of key receptors;
d. abundance and diversity of zooplankton and benthic invertebrates;
e. abundance and diversity of higher plants; and
f. abundance and diversity of waterfowl.

Measurements are taken from nine sampling sites that represent both the differing types of wetlands treatment areas and the range of maturity levels present. For example, the uppermost sampling location (P3-WH) is within the wetlands at the head of Pond 3, which receives direct input from Silver Bow Creek and was flooded in 1993. In contrast, the Pond 1 wet-closure sampling location (P1-WC) is far removed from Silver Bow Creek and has had several decades to mature as a wetlands area. Figure 5BM shows the nine sampling locations; they remain consistent from year to year.

Sampling is conducted during the summer months. Analysis of the data, interpretation and report preparation, all conducted by ARCO with oversight by the U.S. Fish and Wildlife Service and EPA, require several months. Each late summer or fall, EPA meets with ARCO to review the previous year's results and consider minor improvements to the work plan. These reviews have been open to all interested parties and are publicized well in advance. Attendance by other federal and state agency personnel, as well as interested individuals, was encouraged for reviews of each year's analytical results.

In addition to the original work plan (1994), reports on the results of biomonitoring completed each year since 1995 have been distributed to repositories and several special interest groups. Results and interpretations of each year's biomonitoring report are distributed following incorporation of comments provided by the reviewing agencies, in particular the Fish and Wildlife Service.

The annual reports of biomonitoring describe the methods and results of all sampling and analysis of field data, summary of findings, and conclusions and recommendations. The 1996 report compares its results with those of 1995, just as the 1997 report compares its results with the two previous years' results.

Water samples are taken from the water column near the pond bottom at each sampling location and analyzed for metals concentrations, pH, dissolved oxygen, specific conductance and temperature. A comparison of water samples taken in 1996, for the two locations mentioned above (P3-WH and P1-WC), shows that total recoverable copper concentrations taken from Pond 3 were, at 51 micrograms per liter, about three times higher than copper concentrations taken from the more mature Pond 1, at 15 micrograms per liter. Dissolved copper concentrations were 21 ug/l from Pond 3 and less than 3 ug/l from Pond 1. The EPA's chronic ambient water quality criterion for copper in waters such as at these locations (hardness-dependent) is about 20 ug/l.

Interestingly, bottom sediment samples taken from the same two locations in 1996 showed similar total copper concentrations: For P3-WH total copper was 2,250 milligrams per kilogram and for P1-WC total copper was slightly higher at 3,240 milligrams per kilogram. Total zinc concentrations at these two locations in 1996 were as follows: P3-WH was 6,190 mg/kg and P1-WC was considerably less at 2,770 mg/kg.

The purpose for giving typical examples such as those above is to emphasize that a single year's data may not render meaningful interpretations. As additional years of data are gathered, and as the entire spectrum of biomonitoring information is viewed as a whole--water and sediment chemistry; toxicity tests using laboratory organisms; and tissue metals measurements for benthic invertebrates, pelagic invertebrates, rooted plants, bottom-feeding fish and waterfowl--the ponds' ecological health will be better understood.

Sediment toxicity testing has been conducted each year. When subjected to laboratory water and bottom sediments taken from five locations within the Warm Springs Ponds, under carefully controlled laboratory conditions, a large percentage of test organisms did not survive in the 1995 or 1996 tests. The test organism is a freshwater amphipod, Hyalella azteca, and as many as 65 to 75% of the laboratory test individuals did not survive the tests in 1996, while 88% of the control organisms survived in 1996.

Mortality was highest in 1995 and 1996 when test organisms were subjected to sediments taken from Ponds 3 and 2, and mortality was lowest (32 to 35% mortality) when test organisms were subjected to bottom sediments taken from Pond 1 and wet-closures below Pond 1. The 1997 laboratory toxicity tests resulted in very low mortality (5 to 15% mortality) when test organisms were subjected to sediments taken from P3-WH, P2-WWC, P2-NW, and P1-WC. However, none of the test organisms survived in 1997 when subjected to sediments taken from P1-MWC, which is one of the three most recently-constructed wet-closure cells.

Noteworthy is the fact that Hyalella azteca, known to be an invertebrate sensitive to metals, is abundant throughout the Warm Springs Ponds, including the recently-constructed wet-closures below Pond 1.

Beginning with the 1997 results, ranges of tissue copper residues were presented for various locations around the ponds, and comparisons with other USFWS refuges (reference sites) were possible. Figure 6BM shows the ranges and means of tissue copper residues for suckers and corixids (a water bug), for various locations within the Warm Springs Ponds, and for USFWS reference sites. Note that corixids taken from the most mature location, P1-WC, show a range and mean quite similar to corixids taken from the Lee Metcalf Refuge in the Bitterroot Valley.

Each year's biomonitoring report is a substantial collection of information and the program has met EPA's requirements for performance monitoring. Examples of results discussed above are illustrative only, and are not intended to summarize or portray the biomonitoring program in its entirety. Interested reviewers are urged to refer to the biomonitoring plan and reports for each year, and to participate in the annual reviews each autumn.

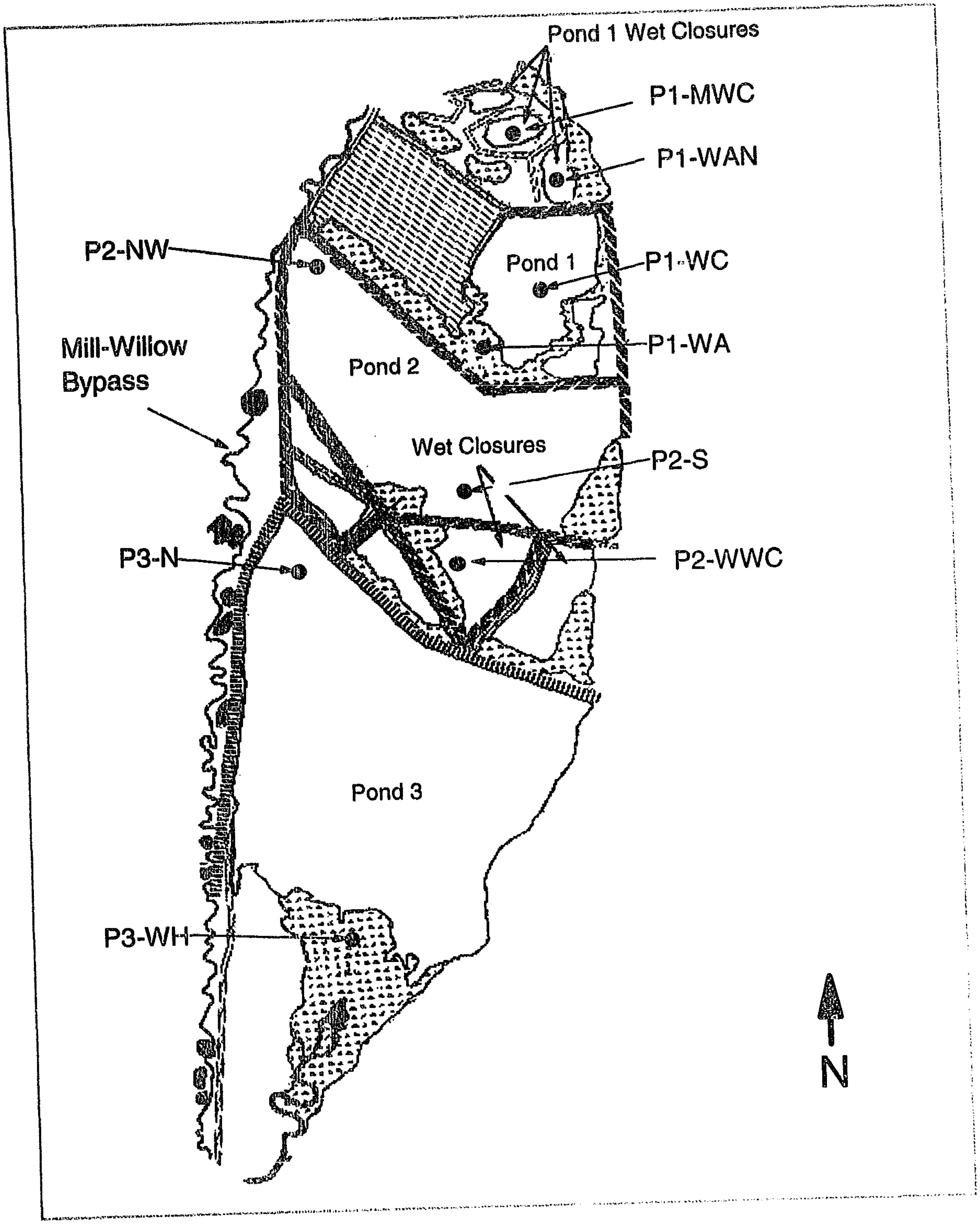
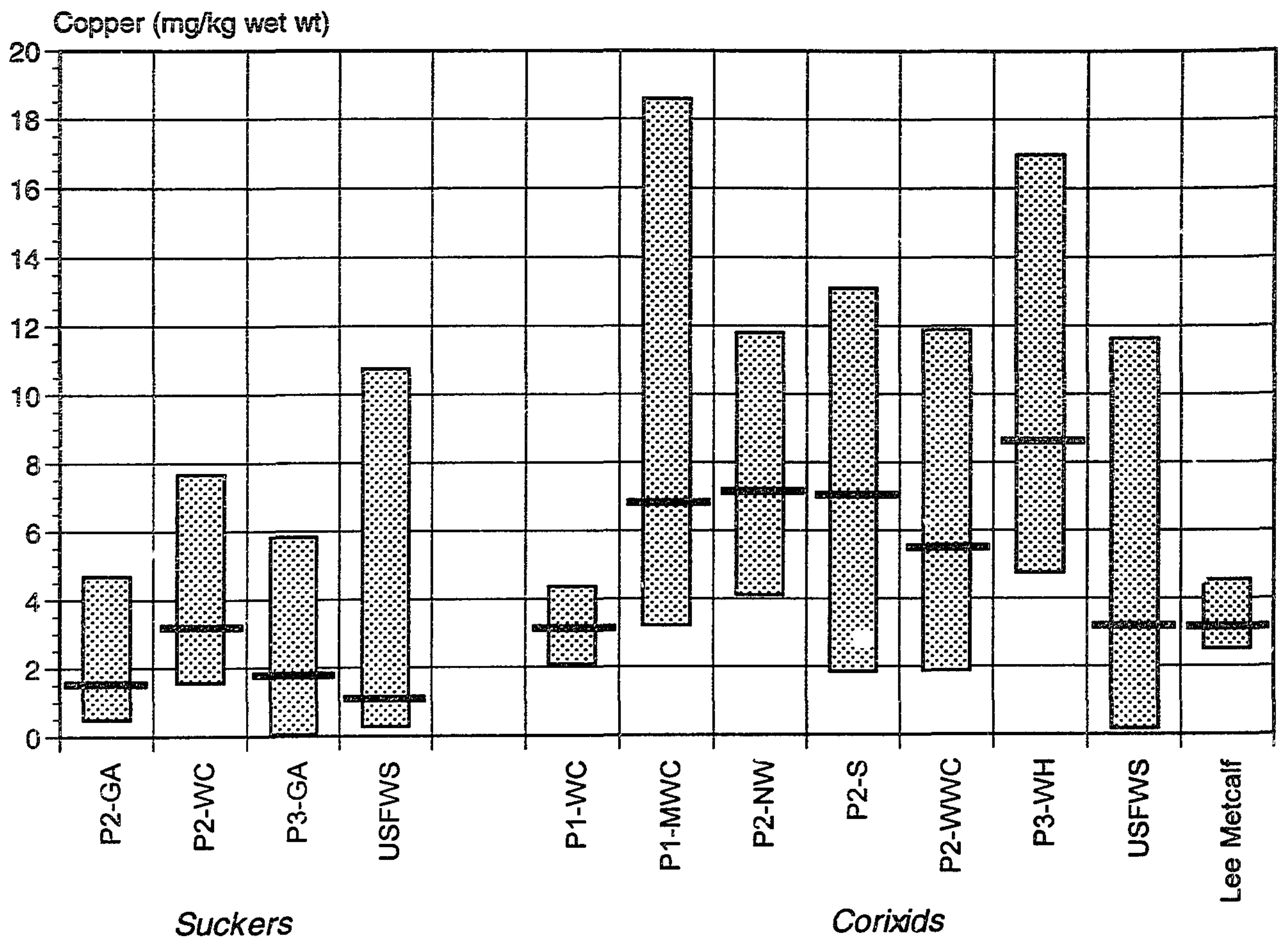


Figure 5BM. Warm Springs Ponds 1997 Biomonitoring Sampling Locations.

Excerpted from ENSR/R2 1998.



Note: Each bar represents the range of measured values, while the geometric mean is represented by the line on each bar.

Figure 6BM. Range of tissue copper residues in benchmark species from WSP sites and USFWS reference sites.

Excerpted from ENSR/R2 1998.

7.3.7 Soil-cement Toe Drains

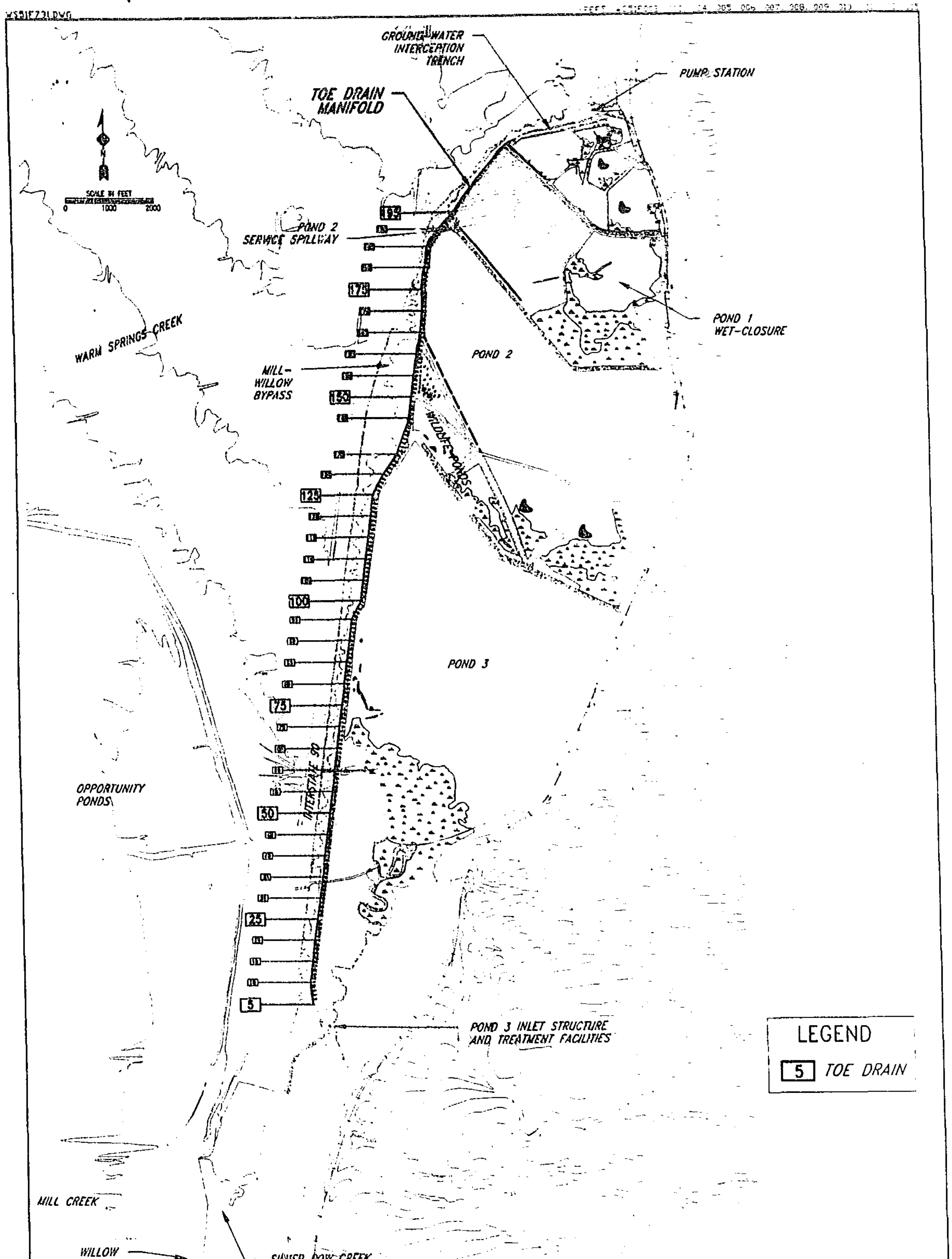
Dike slopes adjacent to the Mill-Willow bypass were faced with soil-cement for erosion protection. Perforated pipe drains were installed, prior to placement of the soil-cement, to relieve seepage pressures that might otherwise build up behind the soil-cement armor. Nearly 200 outlet pipes convey the seepage flow through the armor to the bypass side of the dikes.

Figure 7 illustrates the location of toe drains. Toe drains installed along the Pond 3 dike (Nos. 5-164) drain into the bypass channel. Toe drains installed along the Pond 2 dike (Nos. 165-193) drain into a collection manifold, which conveys the collected seepage water to the ground water interception trench.

EPA's administrative order for the active area required manifolding of all toe drains. However, during construction (reconstruction and armoring of the dikes), a decision was made by EPA, in consultation with DEQ, against manifolding toe drains 5 through 164. The decision followed a recommendation by the design engineers and EPA's construction oversight engineers. Their recommendation was based on an expectation of minimal additional loading into the bypass and the concern that a manifold collecting low-flowing and imtermittently-flowing drains would freeze in winter, thus leading to dike instability. Additionally, EPA considered that the costs associated with manifolding the upgradient toe drains would add approximately $880,000 to construction costs.

Some of the unmanifolded toe drains along Pond 3 flow year round; some flow intermittently; and some do not flow. Several flowing drains that are considered to be representative are sampled annually or semi-annually. Flow data and concentrations of selected constituents are shown in Table 12. Flows generally range from about 5 to 10 gallons per minute. While not considered to be out of compliance with respect to performance standards, some of the unmanifolded flowing toe drains discharge into the bypass concentrations of dissolved regulated constituents above performance standards (greater than MCLs). For example, note in the following tables (13 and 14) that arsenic concentrations being discharged from Drain No. 87 averaged 0.072 mg/l, but at a flow rate of about 5.4 gallons per minute. These data warrant continued monitoring and evaluation, as the potential exists for increases in seepage rates or increases in concentrations of regulated constituents.[2]

[2]Given that water from the manifolded toe drains discharges into the interception trench, and this water contains elevated concentrations of metals and arsenic, should the pump-back system be discontinued, initial monitoring frequency may have to be increased immediately following pump shut-down.



WARM SPRINGS PONDS

SOIL CEMENT
TOE DRAINS

FIGURE 7

TABLE 12: SOIL CEMENT TOE DRAIN WATER QUALITY SUMMARY (JULY 1991-SEPTEMBER 1996)

Constituent	Overall Average	Sample Date							
		7/91	5/92	6/93	10/93	5/94	10/94	10/95	9/96
Flow (gpm)	7.61	6.08	5.26	10.55	9.84	7.80	8.10	6.66	6.02
pH (standard units)	—	7.7	7.5	7.6	7.4	7.9	7.8	7.8	—
Arsenic (mg/L)	0.042	0.025	0.018	0.034	0.046	0.040	0.053	0.051	0.071
Cadmium (mg/L)	0.0001	0.0003	0.0001	0.0001	0.0001	<0.0001	0.0001	<0.0001	<0.0001
Calcium (mg/L)	76.2	—	—	86.6	80.6	78.7	79.3	79.0	52.8
Copper (mg/L)	0.004	0.007	0.005	0.007	0.003	0.003	0.008	<0.002	<0.003
Iron (mg/L)	0.039	0.043	0.023	0.058	0.030	0.026	0.069	0.030	0.036
Lead (mg/L)	0.0008	—	0.0006	0.0010	—	—	—	—	—
Magnesium (mg/L)	20.1	—	—	23.8	23.1	21.1	19.3	19.2	13.8
Manganese (mg/L)	0.443	—	—	0.426	0.496	0.355	0.353	0.499	0.530
Mercury (mg/L)	<0.0002	—	<0.0002	<0.0002	—	—	—	—	—
Zinc (mg/L)	0.011	0.006	0.008	0.006	0.012	<0.005	0.042	<0.009	<0.015

Notes:

(1) Values are flow weighted averages of toe drains 67, 84, 87, 90, 91, 99, 104, 152, 157, 160, 161.
(2) Metals averages are reported as total recoverable except for 10/95 and 9/96 averages are reported as dissolved.

excerpted from ESA, 1997

Table 13

WSP TOE DRAINS

Parameter*	Date	Toe Drain Number 67	84	87	90	91	99	104	152	157	160	161	P2TD	MH-4
Avg:		12.38	2.61	2.06	2.36	2.57	2.26	1.53	1.71	1.24	1.46	1.46	4.42	3.55
Redox (mV)	6/93	218	207	215	200	210	238	210	191	191	232	192		
	10/93	225	200	190	160	212	295	201	191	216	226	245		
	5/94	173	144	224	123	153	149	221	186	193	226	87		
	10/94	237	-18	91	8	110	103	164	131	-104	-30			
	10/95	167	-16	36	-11	70	101	86	52	85	28	73	-220	61
	9/96		-20	35	-64	-19	81	84	-39	120	69	111		
	10/97	262.00	0	171	0	121	149	198	-23	203	196	146		
Min:		167	-20	35	-64	-19	81	84	-39	-104	-30	73	-220	61
Max:		262	207	224	200	212	295	221	191	216	232	245	-220	61
Avg:		214	71	137	59	122	159	166	98	129	135	142	-220	61
Arsenic	7/91				0.008			0.029						
	5/92		0.026	0.021		0.012	0.026		0.013	0.021		0.022		
	6/93	0.019	0.064	0.034	0.026	0.015	0.040	0.033	0.020	0.036	0.039	0.047		
	10/93	0.024	0.157	0.056	0.023	0.029	0.048	0.052	0.022	0.045	0.046	0.046		
	5/94	0.020	0.187	0.040	0.016	0.027	0.042	0.040	0.021	0.032	0.039	0.037		
	10/94	0.024	0.161	0.060	0.027	0.047	0.054	0.048	0.032	0.051	0.043			
	10/95	0.020	0.135	0.092	0.030	0.052	0.050	0.048	0.023	0.039	0.041	0.045	0.004	0.027
	9/96		0.155	0.154	0.054	0.075	0.067	0.053	0.038	0.064	0.057	0.066		
	10/97	0.017	0.090	0.118	0.050	0.060	0.060	0.045	0.032	0.048	0.047	0.053		
Min:		0.017	0.026	0.021	0.008	0.012	0.026	0.029	0.013	0.021	0.039	0.022	0.004	0.027
Max:		0.024	0.187	0.154	0.054	0.075	0.067	0.053	0.038	0.064	0.057	0.066	0.004	0.027
Avg:		0.021	0.122	0.072	0.029	0.040	0.048	0.044	0.025	0.042	0.045	0.045	0.004	0.027
Cadmium	7/91				0.0002			0.0003						
	5/92		0.0002	0.0002		0.0001	<0.0001		0.0001	0.0003		0.0002		
	6/93	0.0004	<0.0001	<0.0001	0.0017	<0.0001	<0.0001	0.0009	<0.0001	<0.0001	<0.0001	<0.0001		
	10/93	0.0001	<0.0001	<0.0001	0.0004	<0.0001	0.0003	0.0002	<0.0001	<0.0001	<0.0001	0.0001		
	5/94	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0001	0.0001		
	10/94	0.0001	0.0001	<0.0001	<0.0001	0.0002	<0.0001	0.0003	<0.0001	<0.0001	0.0001			
	10/95	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0001	0.0002	0.0002	0.0001	0.0005
	9/96		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
	10/97	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
Min:		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0005

File: Sbrown2; Sheet: TOE DRAINS; Date: 5/12/98

Table 13 (cont)

WSP TOE DRAINS

Parameter*	Date	Toe Drain Number												
		67	84	87	90	91	99	104	152	157	160	161	P2TD	MH-4
Max:		0.0004	0.0002	0.0002	0.0017	0.0002	0.0003	0.0009	0.0002	0.0003	0.0002	0.0002	0.0001	0.0005
Avg:		0.0002	<0.0001	<0.0001	0.0003	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0001	0.0001	0.0005
Copper	7/91				0.009			0.007						
	5/92		0.005	0.018		<0.004	0.004		0.006	0.007		0.008		
	6/93	0.008	0.004	0.011	0.034	0.004	0.003	0.005	0.004	0.006	0.010	0.009		
	10/93	0.005	0.001	0.002	0.002	0.001	0.001	0.008	0.004	0.002	0.002	0.003		
	5/94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005		
	10/94		<0.006	<0.006	<0.006	<0.006	<0.006	0.034	0.012	<0.006	0.006			
	10/95	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	9/96		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003		
	10/97	0.008	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.004	<0.003		
Min:		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Max:		0.008	0.005	0.018	0.034	0.004	0.004	0.034	0.012	0.007	0.010	0.009	<0.002	<0.002
Avg:		<0.005	<0.006	<0.006	0.007	<0.006	<0.006	0.008	<0.006	<0.006	<0.006	<0.006	<0.002	<0.002
Iron	7/91				0.040			0.044						
	5/92		0.023	0.031		0.019	0.024		0.052	0.022		0.011		
	6/93	0.052	0.052	<0.014	1.580	0.014	<0.014	<0.014	0.047	<0.014	0.154	<0.014		
	10/93	<0.014	0.091	<0.014	0.242	<0.014	0.024	0.018	0.036	0.030	0.042	0.030		
	5/94	0.017	0.068	0.034	0.057	0.028	0.017	0.023	0.046	0.017	0.023	0.017		
	10/94	0.022	0.142	<0.012	0.122	0.024	<0.012	<0.012	<0.012	0.365	0.022			
	10/95	<0.014	0.171	<0.014	0.120	0.027	<0.014	<0.014	0.120	<0.014	0.028	0.021	4.30	0.407
	9/96		0.118	0.025	0.074	0.025	0.019	0.012	0.105	0.025	0.050	0.031		
	10/97	<0.024	<0.024	<0.024	0.041	<0.024	<0.024	<0.024	0.199	<0.024	<0.024	<0.024		
Min:		<0.014	0.023	<0.012	0.040	<0.014	<0.012	<0.012	<0.012	<0.014	0.022	<0.014	4.30	0.407
Max:		0.052	0.171	0.034	1.580	0.028	0.024	0.044	0.199	0.365	0.154	0.031	4.30	0.407
Avg:		<0.024	0.085	<0.024	0.285	<0.024	<0.024	<0.024	0.076	0.061	0.047	<0.024	4.30	0.407
Lead	5/92		0.001									<0.001		
	6/93	0.003	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.002	0.001	0.002	<0.001		
Min:		0.003	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.002	0.001	0.002	<0.001		
Max:		0.003	0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.002	0.001	0.002	<0.001		
Avg:		0.003	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.002	0.001	0.002	<0.001		

File: Sbrown2; Sheet: TOE DRAINS; Date: 5/12/98

Table 13 (cont)

WSP TOE DRAINS

Parameter*	Date	Toe Drain Number												
		67	84	87	90	91	99	104	152	157	160	161	F2TD	MH-4
Mercury	5/92		<0.0002									<0.0002		
	6/93	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		
Min:		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		
Max:		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		
Avg:		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		
Zinc	7/91				0.008			0.006						
	5/92		0.010	0.009		0.007	0.007		0.009	0.010		0.007		
	6/93	0.024	0.010	0.007	0.197	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006		
	10/93	0.018	<0.009	0.009	<0.009	0.009	<0.009	0.019	0.024	0.019	<0.009	0.009		
	5/94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
	10/94	<0.02	0.060	<0.02	0.020	0.130	<0.02	<0.02	<0.02	0.030	<0.02			
	10/95	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	0.079	0.077
	9/96		<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015		
	10/97	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009		
Min:		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.079	0.077
Max:		0.024	0.060	0.009	0.197	0.130	0.007	0.019	0.024	0.030	<0.02	0.009	0.079	0.077
Avg:		0.011	<0.015	<0.015	0.031	0.021	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.079	0.077
Manganese	6/93	0.005	0.463	0.430	2.430	0.092	0.123	0.161	0.612	0.227	0.742	0.805		
	10/93	0.006	0.533	0.478	0.218	0.106	0.126	0.167	0.578	0.353	1.30	1.08		
	5/94	<0.004	0.457	0.448	0.135	0.101	0.133	0.139	0.512	0.178	0.673	0.799		
	10/94	<0.005	0.482	0.451	0.177	0.100	0.111	0.125	0.610	0.447	1.140			
	10/95	0.013	0.600	0.508	0.203	0.118	0.128	0.157	0.541	0.373	1.98	1.58	2.61	0.736
	9/96		0.687	0.563	0.233	0.130	0.124	0.146	0.531	0.352	1.75	1.39		
	10/97	<0.004	0.785	0.554	0.238	0.141	0.139	0.166	0.591	0.378	1.61	1.35		
Min:		<0.004	0.457	0.430	0.135	0.092	0.111	0.125	0.512	0.178	0.673	0.799	2.61	0.736
Max:		0.024	0.785	0.563	2.430	0.141	0.139	0.167	0.612	0.447	1.980	1.580	2.61	0.736
Avg:		0.005	0.572	0.490	0.519	0.113	0.126	0.152	0.568	0.330	1.314	1.167	2.61	0.736

File: Sbrown2; Sheet: TOE DRAINS; Date: 5/12/98

Table 13 (cont)

WSP TOE DRAINS

Parameter*	Date	67	84	87	90	91	99	104	152	157	160	161	P2TD	MH-4
		Toe Drain Number												
Calcium	6/93	338	66.4	64.1	97.4	47.4	47.3	49.4	56.6	50.3	69.6	65.6		
	10/93	316	69.4	64.3	63.9	51.2	47.5	53.3	52.7	56.2	57.0	55.6		
	5/94	266	61.0	64.7	59.3	51.2	52.8	54.5		62.2	57.1	57.8		
	10/94	287		61.4	61.9	48.0	44.7	51.2	56.7	54.8	48.2			
	10/95	314	62.8	58.3	57.7	50.3	47.5	49.9	62.5	59.2	56.0	51.2	106	59.9
	9/96		64.7	56.9	62.4	52.2	44.3	45.9	52.0	51.7	50.9	47.3		
	10/97	234	66.9	55.2	60.0	52.8	45.9	49.2	59.6	56.9	56.9	52.6		
Min:		234	61.0	55.2	57.7	47.4	44.3	45.9	52.0	50.3	48.2	47.3	106	59.9
Max:		338	69.4	64.7	97.4	52.8	52.8	54.5	62.5	62.2	69.6	65.6	106	59.9
Avg:		293	65.2	60.7	66.1	50.4	47.1	50.5	56.7	55.9	56.5	55.0	106	59.9
Magnesium	6/93	121	15.6	12.7	18.6	12.4	12.0	9.63	13.9	10.9	19.0	16.6		
	10/93	104	17.9		15.3	14.0	12.0	10.5	13.2	13.0	16.0	15.4		
	5/94	83.6	14.8	14.2	15.0	13.7	13.6	10.9		14.5	15.2	15.3		
	10/94	79.8	14.2	12.8	14.3	12.4	11.3	10.5	13.2	12.6	12.1			
	10/95	71.8	16.5	14.9	16.8	13.8	11.9	11.0	15.4	13.4	13.3	12.7	13.6	12.5
	9/96		17.3	14.6	19.3	14.4	12.0	10.8	13.1	12.1	12.8	11.9		
	10/97	59.3	18.1	15	19.9	14.8	13.4	12.5	17.3	14.4	14.9	13.6		
Min:		59	14.2	12.7	14.3	12.4	11.3	9.6	13.1	10.9	12.1	11.9	14	12.5
Max:		338	18.1	15.0	19.9	14.8	13.6	12.5	17.3	14.5	19.0	16.6	14	12.5
Avg:		87	16.3	14.0	17.0	13.6	12.3	10.8	14.4	13.0	14.8	14.3	14	12.5

* All metals analyses are reported in mg/L as Total Recoverable except for 10/95 are reported as Dissolved.
1/2 of the Detection Level was used when calculating averages.

Table 13 (cont)

WSP TOE DRAINS

Parameter*	Date	Toe Drain Number												
		67	84	87	90	91	99	104	152	157	160	161	P2TD	MH-4
pH	7/91			7.7	7.8	7.7		7.8	7.7			7.7		
(standard units)	5/92		7.4	7.1	7.4	7.4	7.6	7.8	7.6	7.6		7.9		
	6/93	7.5	7.6	7.7	7.4	7.6	8.2	8.0	7.5	7.5	7.6	7.6		
	10/93	7.4	7.3	7.6	7.5	7.6	8.0	7.8	7.0	7.1	7.4	7.1		
	5/94	7.7	7.9	8.0	7.9	8.1	8.3	8.3	8.0	7.7	7.5	7.9		
	10/94	7.5	7.7	7.7	7.6	8.0	8.1	8.1	7.7	7.7	7.9			
	10/95	7.7	7.7	7.9	7.8	7.9	8.2	8.2	7.8	7.0	7.9	7.9	7.4	7.7
	9/96		7.8	7.8	7.7	7.8	8.1	8.1	7.7	7.6	7.8	7.8		
	10/97	7.3	7.5	7.3	7.3	7.4	7.4	7.4	7.8	7.3	7.3	7.3		
Min:		7.3	7.3	7.1	7.3	7.4	7.4	7.4	7.0	7.0	7.3	7.1	7.4	7.7
Max:		7.7	7.9	8.0	7.9	8.1	8.3	8.3	8.0	7.7	7.9	7.9	7.4	7.7
Avg:		7.5	7.6	7.7	7.6	7.7	8.0	7.9	7.6	7.4	7.6	7.6	7.4	7.7
Conductivity	7/91			470	466	416		240	365			393		
(umhos/cm)	5/92		490	470	580	450	405	400	470	420		460		
	6/93	2195	550	508	537	441	432	445	481	414	557	546		
	10/93	2242	584	499	475	472	439	452	515	458	529	473		
	5/94	1697	467	479	480	414	430	411	460	452	465	454		
	10/94	1657	493	477	567	418	402	401	421	429	418			
	10/95	1931	512	484	526	426	402	432	982	1119	874	897	703	1104
	9/96		589	525	628	490	434	430	462	451	463	448		
	10/97	1598	605	521	611	497	461	475	546	505	512	473		
Min:		1598	467	470	466	414	402	240	365	414	418	393	703	1104
Max:		2242	605	525	628	497	461	475	982	1119	874	897	703	1104
Avg:		1887	536	493	541	447	426	410	522	531	545	518	703	1104
Dissolved	6/93	7.40	1.80	0.90	2.60	1.10	1.60	1.20	0.90	1.40	0.60	0.40		
Oxygen (ppm)	10/93	5.87	1.80	0.77	0.92	0.54	0.97	0.75	0.60	0.40	0.45	0.65		
	5/94	9.00	1.10	0.90	3.13	0.70	0.58	1.23	1.02	0.48	0.93	0.59		
	10/94	6.62	0.84	0.67	1.41	0.63	0.52	0.58	0.52	0.54	0.30			
	10/95	6.20	0.86	0.62	1.27	0.55	1.11	0.42	0.48	0.35	0.28	0.36	4.42	3.55
	9/96		1.40	1.54	0.68	0.95	1.56	0.94	0.85	0.61	0.46	0.57		
	10/97	39.20	10.50	9.00	6.50	13.50	9.50	5.60	7.60	4.90	7.20	6.20		
Min:		5.87	0.84	0.62	0.68	0.54	0.52	0.42	0.48	0.35	0.28	0.36	4.42	3.55
Max:		39.20	10.50	9.00	6.50	13.50	9.50	5.60	7.60	4.90	7.20	6.20	4.42	3.55

File: Sbrown2; Sheet: TOE DRAINS; Date: 5/12/98

Table 13 (cont)

WSP TOE DRAINS

Parameter*	Date	Toe Drain Number: 67	84	87	90	91	99	104	152	157	160	161	P2TD	MH-4
Flow Rate	7/91			1.70	0.90	8.20		4.10	7.20			14.40		
(gpm)	5/92		1.40	1.60	1.10	15.90	10.60	1.90	5.20	2.00	5.00	7.90		
	6/93	0.14	3.88	7.15	1.68	19.79	13.29	8.40	7.48	19.74	18.18	16.35		
	10/93	0.07	3.55	7.18	1.74	18.63	13.74	10.75	9.01	16.61	10.44	16.48		
	5/94	0.06	2.95	6.43	1.33	16.47	11.49	10.71	4.89	7.91	10.71	12.80		
	10/94	0.07	3.33	6.94	1.39	17.49	12.67	10.56	6.12	10.64	8.26	11.67		
	10/95	0.03	2.41	5.64	1.04	15.31	10.91	9.99	5.86	10.16	3.75	8.12		
	9/96	0.00	1.45	4.65	1.05	14.17	9.48	7.84	6.59	7.04	4.70	9.23		
	10/97	0.03	2.25	7.50	1.10	15.00	15.00	10.00	7.39	8.81	3.99	4.55		
Min:		0.00	1.40	1.60	0.90	8.20	9.48	1.90	4.89	2.00	3.75	4.55		
Max:		0.14	3.88	7.50	1.74	19.79	15.00	10.75	9.01	19.74	18.18	16.48		
Avg:		0.06	2.65	5.42	1.26	15.66	12.15	8.25	6.64	10.36	8.13	11.28		
Temperature	7/91			11.7	11.1	11.0		10.4	15.6			14.8		
(°C)	5/92		6.6	7.7	7.1	9.3	7.9	8.3	9.5	10.1		8.6		
	6/93	10.1	9.4	8.9	8.8	11.3	8.1	7.7	11.5	11.9	13.1	10.5		
	10/93	9.0	12.2	12.0	13.3	12.5	12.8	12.6	11.5	12.8	12.4	12.9		
	5/94	9.9	6.7	7.2	5.5	7.1	6.8	6.7	9.7	8.9	9.0	8.9		
	10/94	11.6	14.3	13.2	15.3	14.4	14.4	14.4	15.1	15.2	14.9			
	10/95	6.6	12.5	11.9	12.9	12.5	12.6	12.4	10.8	11.7	11.8	12.3	4.7	8.5
	9/96		13.8	13.5	16.0	15.5	13.7	13.1	15.9	16.6	16.7	16.4		
	10/97	9.2	13.1	12.5	14.7	13.9	13.6	12.9	13.1	13.6	13.7	13.8		
Min:		6.6	6.6	7.2	5.5	7.1	6.8	6.7	9.5	8.9	9.0	8.6	4.7	8.5
Max:		11.6	14.3	13.5	16.0	15.5	14.4	14.4	15.9	16.6	16.7	16.4	4.7	8.5
Avg:		9.4	11.1	11.0	11.6	11.9	11.2	10.9	12.5	12.6	13.1	12.3	4.7	8.5

File: Sbrown2; Sheet: TOE DRAINS; Date: 5/12/98

Table 14
Warm Springs Ponds Toe Drain
Flow Summary

Toe Drain Number	Flow Rate (gpm)											
	7/91	5/92	6/93	10/93	5/94	10/94	11/95	9/96	10/97	Min	Max	Avg
60.00							0.00	0.00	0.00	0.00	0.00	0.00
61.00				0.08	0.07		<0.01	0.00	0.00	0.00	0.08	0.04
62.00							0.00	0.00	0.00	0.00	0.00	0.00
63.00			0.13	0.10	0.05		0.00	0.00	0.00	0.00	0.13	0.05
64.00				0.64	0.88	0.13	0.00	0.00	0.00	0.00	0.88	0.28
65.00			0.12	0.11	0.14	0.1	0.00	0.00	0.00	0.00	0.14	0.07
66.00			0.07	0.12	0.12	0.13	0.03	0.00	0.00	0.00	0.13	0.07
67.00			0.14	0.07	0.06	0.07	0.03	0.00	0.03	0.00	0.14	0.06
68.00			0.022	0.02	0.02		<0.01	0.00	0.00	0.00	0.02	0.01
69.00			0.00				0.00	0.00	0.00	0.00	0.00	0.00
70.00			0.00	0.09	0.08	0.07	<0.01	0.00	<0.01	0.00	0.09	0.05
71.00			0.00	0.10	0.08	0.11	<0.01	0.00	0.05	0.00	0.11	0.06
72.00			0.42	0.27	0.27	0.12	0.00	0.00		0.00	0.42	0.18
73.00			0.00							0.00	0.00	0.00
74.00			0.00				0.00	0.00	0.00	0.00	0.00	0.00
75.00			0.85	0.70	0.87	0.55	0.10	0.00	0.34	0.00	0.87	0.49
76.00			1.11	1.01	1.1	0.91	0.59	0.16	1.07	0.16	1.11	0.85
77.00			2.56	2.07	1.94	1.85	0.93	0.00	0.94	0.00	2.56	1.47
78.00			0.00				0.00	0.00		0.00	0.00	0.00
79.00			0.00				0.00	0.00		0.00	0.00	0.00
80.00			1.26	1.28	1.31	1.24	0.60	0.30	0.78	0.30	1.31	0.97
81.00			0.00				0.00	0.00	0.00	0.00	0.00	0.00
82.00			0.00				0.00	0.00	0.00	0.00	0.00	0.00
83.00		1.0	3.88	3.37	2.99	3	2.16	1.13	2.57	1.00	3.88	2.51
84.00		1.4	3.88	3.55	2.95	3.33	2.41	1.45	2.25	1.40	3.88	2.65
85.00	0.5	1.6	5.50	6.70	5.11	5.75	4.24	2.99	4.50	0.50	6.70	4.10
86.00		0.0	0.34	3.26	0.27	0.26	0.20	0.15	<0.01	0.00	3.26	0.64
87.00	1.7	1.6	7.15	7.18	6.43	6.94	5.64	4.65	7.50	1.60	7.50	5.42
88.00	2.1	2.9	5.80	2.62	5.04	3.46	3.86	3.45	4.74	2.10	5.80	3.77
89.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
90.00	0.9	1.1	1.68	1.74	1.33	1.39	1.04	1.05	1.10	0.90	1.74	1.26

Table 14 (cont)
Warm Springs Ponds Toe Drain
Flow Summary

Toe Drain Number	Flow Rate (gpm)											
	7/91	5/92	6/93	10/93	5/94	10/94	11/95	9/96	10/97	Min	Max	Avg
91.00	8.2	15.9	19.79	18.63	16.47	17.49	15.31	14.17	15.00	8.20	19.79	15.66
92.00		10.0								10.00	10.00	10.00
93.00		5.0								5.00	5.00	5.00
94.00												
95.00		0.1								0.10	0.10	0.10
96.00	6.0	2.0								2.00	6.00	4.00
97.00	1.3	0.2	0.43	0.38	0.53	0.34	0.59	0.24	0.20	0.20	1.30	0.47
98.00	4.3	1.7	3.35	3.10	2.7	3.34	2.54	2.16	2.65	1.70	4.30	2.87
98.50	8.9	2.9	5.12	4.92	4.59	4.89	3.30	3.61	4.09	2.90	8.90	4.70
99.00		10.6	13.29	13.74	11.49	12.67	10.91	9.48	15.00	9.48	15.00	12.15
99.50		2.1	3.46	3.25	2.92	3.3	2.42		2.65	2.10	3.46	2.87
100.00		6.3	12.20	12.36	10.88	10.4	8.52	7.60	9.47	6.30	12.36	9.72
101.00		3.0								3.00	3.00	3.00
102.00	4.9	3.0	8.43	9.48	6.89	9.17	7.11	6.33	8.57	3.00	9.48	7.10
103.00	8.3	2.9	6.04	6.78	6.51	7.22	5.61	3.99	6.00	2.90	8.30	5.93
104.00	4.1	1.9	8.40	10.75	10.71	10.56	9.99	7.84	10.00	1.90	10.75	8.25
105.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
106.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
107.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
108.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
109.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
110.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
111.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
112.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
113.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
114.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
115.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
116.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
117.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
118.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
119.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
120.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00

Table 14 (cont)
Warm Springs Ponds Toe Drain
Flow Summary

Toe Drain Number	Flow Rate (gpm)										
	7/91	5/92	6/93	10/93	5/94	10/94	11/95	9/96	10/97	Min	Max	Avg
121.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
122.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
123.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
124.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
125.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
126.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
127.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
128.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
129.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
130.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
131.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
132.00		0.0	2.96	2.86			0.00	0.00	0.00	0.00	2.96	0.97
133.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
134.00		0.0					0.00	0.00	0.00	0.00	0.00	0.00
135.00		0.0	0.00							0.00	0.00	0.00
135.50							0.00	0.00	0.00	0.00	0.00	0.00
136.00		1.7	1.82				0.00	0.00	0.00	0.00	1.82	0.70
137.00	1.9			1.73	1.44		0.00	0.00	0.00	0.00	1.90	0.85
138.00		0.0					0.00	0.00		0.00	0.00	0.00
139.00							0.00	0.00		0.00	0.00	0.00
140.00												
141.00												
142.00		0.0	0.00							0.00	0.00	0.00
142.15							0.00	0.00	0.00	0.00	0.00	0.00
143.00		0.0	0.00							0.00	0.00	0.00
143.15							0.00	0.00	0.00	0.00	0.00	0.00
144.00		0.0	0.00				0.00	0.00	0.00	0.00	0.00	0.00
145.00		0.1	0.00				<0.01			0.00	0.10	0.05
146.00		0.0	0.00			0.58	<0.01	1.17	0.56	0.00	1.17	0.46
147.00		0.0	0.00			0.57				0.00	0.57	0.19
148.00	2.5	0.5		1.43		2.07	2.95		1.41	0.50	2.95	1.81
149.00		2.0					7.38	7.13	6.00	2.00	7.38	5.63
150.00		3.0	11.07			8.06				3.00	11.07	7.38

Table 14 (cont)
Warm Springs Ponds Toe Drain
Flow Summary

Toe Drain Number	Flow Rate (gpm)											
	7/91	5/92	6/93	10/93	5/94	10/94	11/95	9/96	10/97	Min	Max	Avg
151.00	9.5	6.3	7.09	8.35	0.3	5.73	6.35	4.74	6.43	0.30	9.50	6.09
152.00	7.2	5.2	7.48	9.01	4.89	6.12	5.86	6.59	7.39	4.89	9.01	6.64
153.00	9.8	4.0	5.31	7.35		3.8	3.47	3.14	7.02	3.14	9.80	5.49
154.00	10.5	3.5	6.05	7.21		5.5	1.52	3.95	7.61	1.52	10.50	5.73
155.00	6.2	4.6	7.58	7.77	4.4	6.04	4.39	4.64	5.89	4.39	7.77	5.72
156.00		0.0								0.00	0.00	0.00
157.00		2.0	19.74	16.61	7.91	10.64	10.16	7.04	8.81	2.00	19.74	10.36
158.00		3.0	2.10	2.20	1.59	1.29	0.64	1.10	0.81	0.64	3.00	1.59
159.00		3.0	5.14	5.32	3.28	3.05				3.00	5.32	3.96
160.00		5.0	18.18	10.44	10.71	8.2[illegible]	3.75	4.70	3.99	3.75	18.18	8.13
161.00	14.4	7.9	16.35	16.48	12.8	11.67	8.12	9.23	4.55	4.55	16.48	11.28
162.00		0.0								0.00	0.00	0.00
163.00		0.0								0.00	0.00	0.00
164.00	5.2	2.0	16.58				8.02	8.18	8.00	2.00	16.58	8.00
165.00	6.8	3.2	15.92				10.65	9.92	9.15	3.20	15.92	9.27
166.00	4.6	4.6	12.30				6.07	6.69	5.51	4.60	12.30	6.63
167.00	10.0	10.6	28.04				16.22	14.80	9.43	9.43	28.04	14.85
168.00	25.0	15.9	36.81				22.33	23.84	7.69	7.69	36.81	21.93
169.00		15.9	33.33				15.76	19.03	13.77	13.77	33.33	19.56
170.00	9.4	15.9	35.05				16.36	12.24	9.06	9.06	35.05	16.34
171.00		31.7					15.38	12.08	11.19	11.19	31.70	17.59
172.00	15.8	10.6	43.17				13.10	11.49	10.33	10.33	43.17	17.42
173.00		10.0								10.00	10.00	10.00
174.00	6.0	6.3	32.26				15.15	15.08	19.23	6.00	32.26	15.67
175.00		10.0								10.00	10.00	10.00
176.00		7.9	26.79							7.90	26.79	17.35
177.00	4.0	4.6	14.15					6.05	4.23	4.00	14.15	6.61
178.00		1.9	6.93				3.27	3.69	2.47	1.90	6.93	3.65
179.00	5.7	5.2	35.01				16.61	17.50	14.21	5.20	35.01	15.71
180.00	7.7	5.2	23.08				11.57	11.83	9.05	5.20	23.08	11.41

Table 14 (cont)
Warm Springs Ponds Toe Drain
Flow Summary

Toe Drain Number	Flow Rate (gpm)											
	7/91	5/92	6/93	10/93	5/94	10/94	11/95	9/96	10/97	Min	Max	Avg
181.00		1.1	2.19				1.58	1.48	1.17	1.10	2.19	1.50
182.00	6.3	4.0	13.83				8.79	8.51	6.88	4.00	13.83	8.05
183.00	7.3	7.9	21.20				12.83	12.10		7.30	21.20	12.27
184.00	10.1	6.3	21.74				11.17	9.72	5.76	5.76	21.74	10.80
185.00	14.6	10.6	26.91				18.07	19.78	17.09	10.60	26.91	17.84
186.00	7.4	7.9	26.31				13.88	14.93	11.24	7.40	26.31	13.61
187.00	13.6	10.6	23.42				16.17	15.35	19.65	10.60	23.42	16.47
188.00	3.3	1.7	12.95				9.40	7.62	7.65	1.70	12.95	7.10
189.00	0.9	2.1	6.64				1.56	1.91	1.19	0.90	6.64	2.38
190.00	15.6	4.6	28.79				5.23	4.31	2.39	2.39	28.79	10.15
191.00		0.0	27.55				0.00	0.39	0.00	0.00	27.55	5.59

7.3.8 Mill-Willow Bypass Water Quality Summary

Water quality samples have been collected routinely at three separate points along the bypass since July 1992. These locations are referred to as MWB-1, MWB-2, and MWB-3. The MWB-1 sample location is above the bypass and MWB-2 is just above the discharge from Pond 2. The MWB-3 sample location is a short distance below the Pond 2 discharge. Water quality samples collected at MWB-1 should be representative of local conditions in Mill Creek and Willow Creek watersheds, while water quality samples from MWB-2 and MWB-3 would reflect the influences of the bypass channel, including unmanifolded flowing toe drains, and Pond 2 effluent.

Arsenic concentrations through the bypass show similar trends to those observed in the pond system. Concentrations of total recoverable arsenic in Mill and Willow creeks (as measured at MWB-1) tend to increase during the summer months. This seasonal trend appears to be due to dissolved arsenic concentrations. The same summertime increases are also observed in Silver Bow Creek. In comparison, total recoverable and dissolved arsenic concentrations at MWB-1 and MWB-2 are greater than those measured at MWB-3, showing a possible positive effect of Pond 2 effluent on bypass arsenic concentrations.

Copper and zinc show similar trends in total recoverable concentrations through the bypass. Concentrations of copper and zinc are presented in Figure 8. Elevated concentrations of copper and zinc at MWB-3 occurred on several occasions during the monitoring periods. These periods, apparently caused by the influence of the Pond 2 effluent, coincide with the winter and spring periods previously described. Outside of these periods, the Pond 2 effluent generally has a minimal effect on the total recoverable concentrations of copper and zinc in the bypass.

The total recoverable copper and zinc concentrations shown in Figure 8 also illustrate an important phenomenon. The peaks in copper and zinc concentrations at MWB-3 are, for the most part, not present at MWB-1. This observation supports the belief that the winter and spring periods of high metals concentrations are related to upstream conditions in the Silver Bow Creek watershed.

Surveys indicate that the reconstructed Mill-Willow bypass channel provides spawning habitat for brown trout. The level of utilization observed during a 1994 survey indicated that substrate, hydraulic, and water quality conditions favor brown trout spawning in the reconstructed channel.

Results of sampling indicate that the bypass channel has been colonized by a diverse assemblage of aquatic invertebrates, including insects representing the orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). The most common groups of insects present, baetid mayflies, hydropsychid caddisflies, and midges, are considered to be rapid colonizers of new or recently disturbed stream habitats.

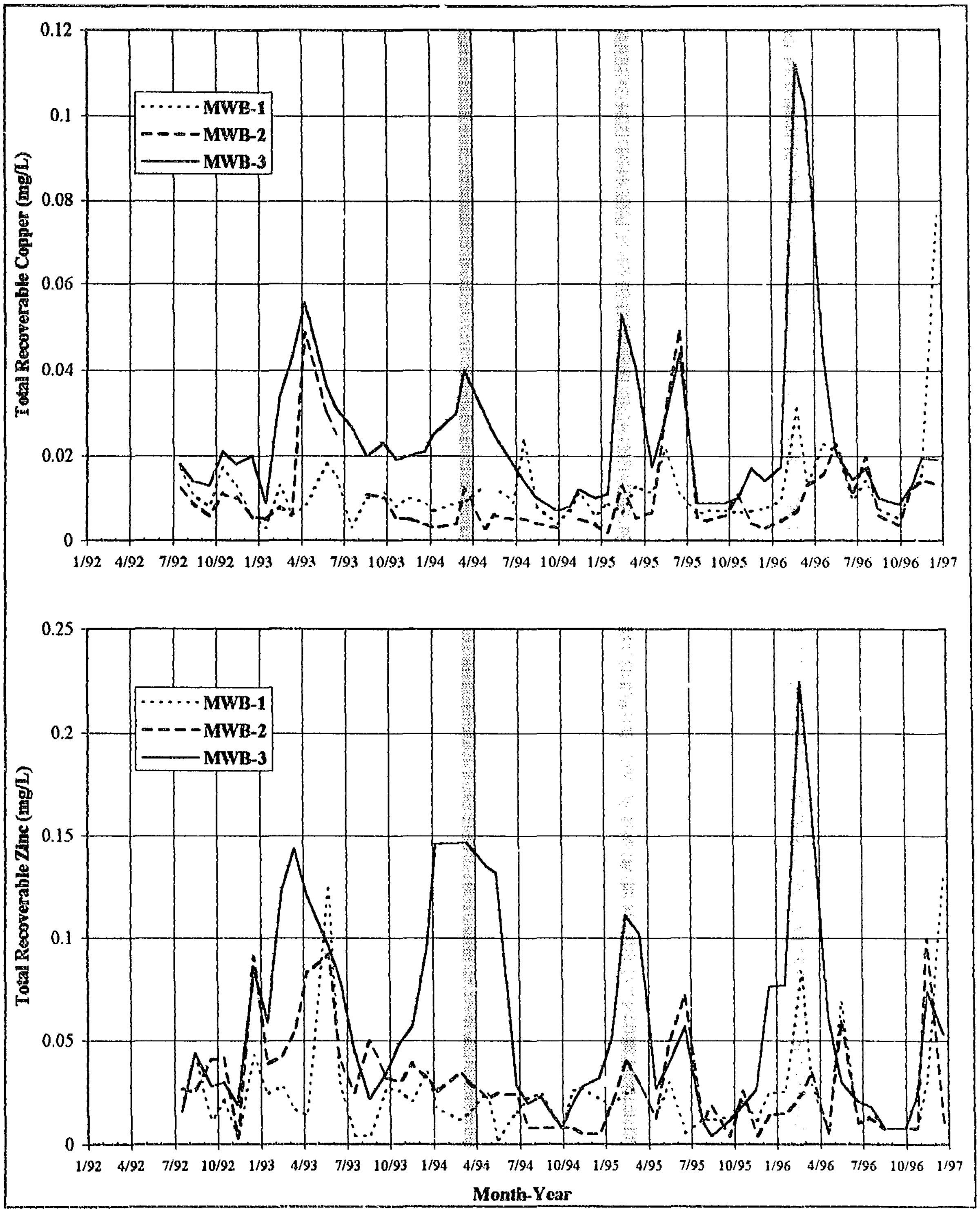


FIGURE 8. Total Recoverable Copper and Zinc Concentrations from MWB-1, MWB-2, and MWB-3.

7.3.9 Operation and Maintenance (O & M)

The administrative orders for both the active and inactive area remedial actions, issued by EPA in September 1991 and June 1993, respectively, required ARCO to prepare a detailed operation and maintenance plan prior to Certification of Completion of Initial Construction. By means of several actions carried out during the autumn of 1995, including construction completion inspections by EPA, construction completion reports by ARCO, a draft and final O & M plan, formal correspondence between EPA and ARCO, and a final construction completion meeting, requirements for Certification of Completion of Initial Construction were met. Thus, Phase I Operations and Maintenance of the Warm Springs Ponds facilities were initiated. (See attached correspondence and refer to Final Operations and Maintenance Plan of October 26, 1995.)

The Operations and Maintenance Plan comprehensively describes each aspect of the facility, including:

a. a general description of the overall system;
b. hydraulics;
c. water treatment;
d. pumpback system and controls;
e. monitoring systems;
f. dam safety requirements;
g. point source discharge requirements;
h. ground water requirements;
i. process controls;
j normal operating procedures;
k. operations during upsets;
l. laboratory testing and analytical procedures;
m. quality control;
n. reporting and record keeping;
o. inspections and maintenance guidelines;
p. emergency procedures;
q. site safety and health procedures;
r. staffing and management;
s. revisions and updates guidelines; and
t. seven separate appendices for references (includes Dam Safety Act and Regulations, Shakedown Plan, Standard Operating Procedures, etc.)

Four times each year, ARCO submits to EPA and DEQ a Quarterly Operations and Maintenance Report. These reports describe all activities conducted by ARCO over the preceding three months that pertain to daily, weekly and monthly operation and maintenance of the pond system.

For each reporting period, lime feed rates are summarized and compared with pH and inflow measurements. For example, during the period of April through June 1997, the automati88c feedback control was in use most of the time with a target pH of 9.4. Lime addition ranged from 12,500 to 80,800 pounds per day, with an average daily feed rate of 36,775 pounds. This was a period of high inflows (up to 278.3 million gallons per day at peak inflow) with very high concentrations of regulated constituents (total recoverable copper reached 0.992 mg/l on April 9 and averaged 0.348 mg/l through April).

Pool elevation changes for Pond 3 are also monitored and reported, as are the discharge rates for the two outlets that pass water from Pond 3 into Pond 2. All of this operational information, when compared to performance monitoring for the regulated constituents (also provided in detail in each quarterly report) facilitates a thorough understanding of pond system capabilities and enables operators to maximize treatment effectiveness.

In addition, each quarterly report describes maintenance activities that were carried out during the preceding three months. Referring to the O & M Quarterly Report for the period of July through September 1997, for example, routine as well as not-so-routine maintenance activities included the following actions:

a. emergency response procedures specified in the Dam Safety Emergency Action Plan for the Warm Springs Ponds were updated and redistributed;
b. cleanup activities were performed along the reconstructed bypass channel in response to EPA and MFWP inspection and recommendations;
c. riprap was placed along a short reach of the bypass and along the Pond 1/Pond 2 east dike for erosion protection;
d. topsoil was placed along the outside aspects of the Pond 2 and Pond 1 armored dikes, and bare spots on the dry-closure cell nearest the inlet to Pond 3 were treated with additional topsoil;
e. additional fencing was installed near the lime addition facility;
f. more trails were constructed and markers put in place; and
g. weed control activities continued.

These examples are fairly representative of the types of maintenance activities that are carried out in response to dam safety requirements, systems maintenance needs and general "housekeeping" responsibilities associated with this large, complex facility.

Altogether, requirements for operations and maintenance of the Warm Springs Ponds have thus far cost approximately $1.2 million per year (see Table 15 and Figure 9).

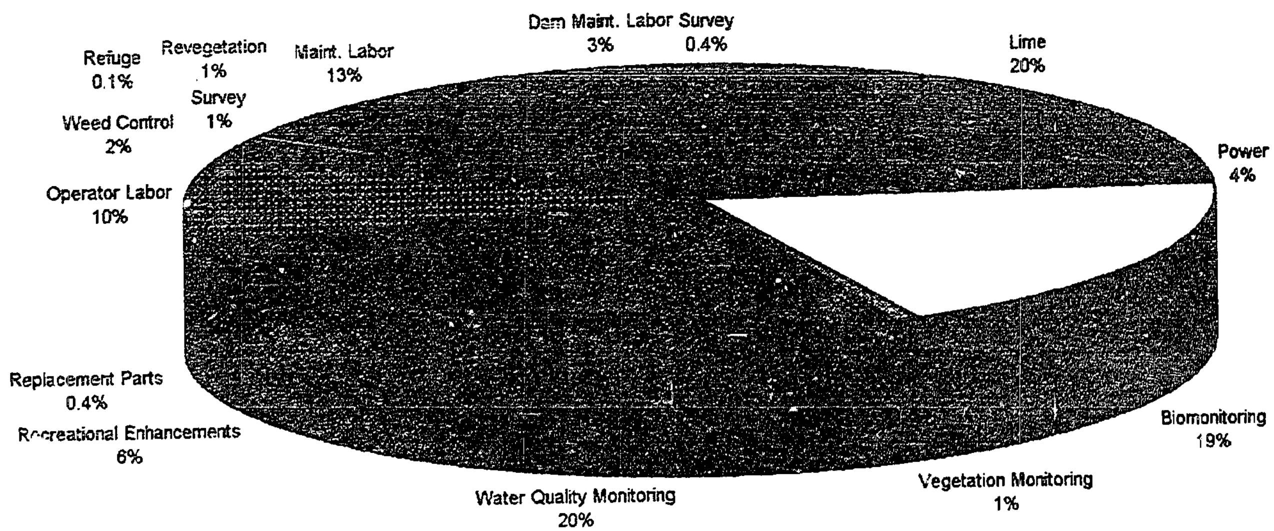
Warm Springs Ponds
1996 and 1997
Operations and Maintenance Cost

Table 15

Budget Category	1996 ($ in 000's)	1997 ($ in 000's)	Mean ($ in 000's)	Comments
Lime	$190	$319	$255	1997 was a high flow year.
Power	$43	$56	$50	1997 was a high flow year.
Monitoring				
Biomonitoring	$220	$267	$244	
Vegetation	$13	$4	$9	Program was discontinued in 1997.
Water Quality	$289	$227	$258	
Subtotal	**$522**	**$498**	**$510**	
Recreational Enhancements	$58	$94	$76	Does not include waterfowl enhancements or any activities performed by MFW&P.
O&M				
Replacement Parts	$9	$1	$5	
Operator Labor	$157	$96	$127	
Weed Control	$18	$29	$24	
Revegetation	$4	$21	$13	
Survey	$7	$8	$8	
Refuge	$1	$1	$1	
Maint. Labor	$165	$155	$160	
Subtotal	**$361**	**$311**	**$336**	
Dam Safety				
Labor	$18	$58	$38	
Survey	$5	$5	$5	
Subtotal	**$23**	**$63**	**$43**	
TOTAL	**$1,197**	**$1,341**	**$1,269**	

1) Costs do not include agency oversight charges.

Figure 9 – Warm Springs Ponds 1996/1997 Average O&M Cost



7.4 Conclusions and Recommendations Concerning Areas of Noncompliance

(a) Metals entering the pond system from Silver Bow Creek become associated with suspended particles through precipitation, co-precipitation, and adsorption. If the suspended particles are large enough, they will generally carry the metals to the pond sediments as they settle. Under most conditions, even smaller suspended particles would tend to agglomerate as they collide with each other, forming larger particles that settle. During some conditions, however, smaller particles may be inhibited from agglomerating and settling. The inability of these smaller particles (or colloids) to agglomerate and settle from the water column is believed to be the principal cause of periodic exceedences of surface water quality performance standards.

(b) During normal or low flow conditions, the dissolved fraction of metals generally dominates regulated constituent concentrations. The dissolved fractions of the metals are likely to be bound in dissolved complexes, which interferes with effective precipitation.

(c) Metals removal is controlled by precipitation and co-precipitation processes and adsorption to suspended particles. When biological activity increases during spring and summer months the amount of suspended organic material also increases. During these periods, adsorption to organic material is believed to enhance removal mechanisms for most metals.

(d) During late winter and spring periods, high loads of metals are transported to Warm Springs Ponds and are associated with, or in the form of, suspended colloidal particles. These events originate from the snow melt at low elevations on floodplain tailings along Silver Bow Creek. Transport of metals during these periods is believed to be dominated by adsorption to colloidal clay particles. These colloidal particles are difficult to settle. Thus, adsorbed metals may be transported through the system without sufficient removal to meet surface water quality performance standards during these periods. For various reasons, copper is most troublesome during these periods.

(e) The physical mechanisms that are believed to reintroduce sediments to the water column in Pond 3 and Pond 2 include high inflows, thermal turnover, and high wind events. Although the mixing of the pond water column appears to be aided by these events, they probably do not cause enough disturbance and resuspension of pond bottom sediments by themselves to affect water quality as measured at the Pond 2 outlet.

(f) Additional data collected during supplemental investigations include: (i) data collected from the sediment trap investigation, (ii) analysis of aluminum, iron, manganese, silica, and total organic carbon (TOC) during routine monitoring, and (iii) the use of a smaller filter pore size (0.1μm) during dissolved sample preparation.

Exhibit 5 of the 1990 Administrative Order for Remedial Design and Remedial Action (EPA Docket No. CERCLA-VIII-91-25) defines upset conditions:

> "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with effluent limitations because of factors beyond the reasonable control of

Settling Respondent. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with effluent limitations, if the requirements of paragraph 2 of this section are met. See "Upset" definition at I.A.6.

Conditions necessary for a demonstration of upset. To establish the affirmative defense of upset, Respondent shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

a. An upset occurred and that Respondent can identify the cause(s) of the upset;
b. The facility was at the time being properly operated;
c. Respondent submitted notice of the upset as required under Part II.H., Twenty-four Hour Notice of Noncompliance Reporting; and,
d. Respondent complied with any remedial measures required under Part III.D., Duty to Mitigate.

Burden of Proof. In any proceeding, the party seeking to establish the occurrence of an upset has the burden of proof.

It is the goal of [this section] of this Exhibit [Exhibit 5] to reduce to zero the frequency of exceedences of discharge limits due to upset conditions.

Exhibit 5 also defines ARCO's (Settling Respondent, or Respondent) duty to comply with all performance standards.

Duty to Comply. Respondent must comply with all conditions of this Unilateral Administrative Order, including Exhibit 5. Any noncompliance constitutes a violation of the Unilateral Administrative Order and is grounds for enforcement action. Settling Respondent shall give the Director advance notice if any planned changes at the facility or of an activity which may result in noncompliance.

EPA thoroughly evaluates all circumstances relating to each exceedence of performance standards. As has been demonstrated, copper and arsenic performance standards are exceeded roughly one-fourth of the time, zinc standards are exceeded roughly five to ten percent of the time, and all other performance standards are exceeded less than five percent of the time or have not been exceeded in five years. ARCO has demonstrated that these exceedences of performance standards in the past, including exceedences of copper and arsenic standards, were not due to operational error; were not due to lack of preventive maintenance; were not due to improperly designed or inadequate treatment facilities; were not due to lack of preventive maintenance; and were not due to careless or improper operation of the Warm Springs Ponds treatment system. Through extensive monitoring, testing and observation, ARCO has demonstrated that the causes of past exceedences of performance standards for water quality are well understood. Thus, EPA has concluded that past exceedences of standards are unintentional and beyond the system capabilities of this technology or any other known technology that could be operated effectively at this scale. Past exceedences of standards are deemed to be due to factors beyond the ARCO's operational control of the Warm Springs Ponds.

On the other hand, given the number and frequency of exceedences of performance standards observed in each previous spring runoff, specifically for total recoverable copper and total recoverable arsenic, EPA does not deem these episodes to be upsets. By definition and by law--the Federal Clean Water Act and Montana Water Quality Standards--an upset is an exceptional incident. While previous exceedences of standards were unavoidable consequences of remedial action construction within the pond system or uncontrollable events occurring along Silver Bow Creek above the ponds, which created conditions beyond the treatment capabilities of the system, the exceedences of performance standards are not, in this case, exceptional occurrences.

The cause of these non-compliance events remains the high level of input from the upstream operable units, such as the Streamside Tailings operable unit and the Butte Priority Soils operable unit. Control of these sources will likely lead to more frequent or total compliance with the discharge standards at the Ponds. Therefore, this report recommends continued progress in the implementation of the Streamside Tailings OU remedy and selection and implementation of the Lower Area One ERA and the Butte Priority Soils OU ROD. Over time, the careful implementation of these actions, combined with the continued operation and maintenance of the Warm Springs Ponds system, will ensure even better compliance with discharge performance standards.

8.0 Evaluations and Statements of Protectiveness

The EPA's Office of Solid Waste and Emergency Response at Washington, D.C., has issued three separate directives concerning the necessity for and conduct of five year reviews following the implementation of a Superfund remedy. These three directives, which are also referred to as guidance documents, were issued in May 1991, July 1994, and December 1995. (See references to the directives and discussion in Section 1.0.) In accordance with these directives the five year review report for the Warm Springs Ponds, having confirmed that the response actions were carried out as required by their respective decision documents and design plans, is next required to evaluate whether the response actions implemented remain protective of public health and the environment.

Previous sections of this report identify performance standards and requirements for the response actions (Section 6.0), describe the responses implemented toward satisfying standards and requirements (Section 7.1), and discuss results of performance monitoring for dam safety and stability (Section 7.3.1). It has been demonstrated in this five year review that compliance has been successfully achieved in nearly all areas for which standards apply (Section 7.0). In the area of surface water quality performance monitoring, however, while overall compliance has been impressive, less than consistent compliance has been demonstrated for arsenic, copper and zinc concentrations in the outflow.

Although compliance with water quality performance standards has not been consistently achieved, it is not accurate to conclude that the remedies therefore fail to be protective of the environment. The remainder of this evaluation examines the level of protectiveness afforded aquatic receptors, despite less than consistent compliance with performance standards.

An extensive amount of data has been analyzed by EPA in the conduct of this five year review and the Clark Fork River ecological risk assessment. These data support the following general conclusions regarding environmental hazards confronting fish, aquatic invertebrates and algae living in Silver Bow Creek immediately below the ponds:

(a) copper in its dissolved state dominates the hazards predicted when aquatic organisms are exposed to metals-enriched water;

(b) periodic pulses of elevated dissolved copper present the greatest potential for acute lethality; however, bypass reconstruction, improvements to the lime addition facility and enlargement of Ponds 3 and 2 (including wet closures) have greatly reduced–possibly eliminated–acute lethality; and

(c) long term exposure to metals concentrations present in the aquatic environment immediately below the ponds, since remedy construction was completed, appears to result in a low level of chronic stress to fish, aquatic invertebrates and possibly algae.

The rationale for these general assertions and a discussion of studies in support of them are presented below, in Section 8.2.

8.1 Evaluation of Protectiveness: Dam Safety

An evaluation of protectiveness arising from the response actions implemented at the Warm Springs Ponds must consider first and foremost public health and safety.

As early as 1988, the State of Montana warned that the Warm Springs Ponds dams were, in their condition at that time, highly susceptible to failure in the event of an earthquake or flood of moderate or greater proportions. In developing remedial objectives for the ponds, the State's first objective was to protect against dam failure. The EPA concurred with the State (see State's Proposed Plan for the Warm Springs Ponds, October 1989) and upon assuming primary responsibility for the ponds in 1990 the EPA carried forward that urgency into the Records of Decision and implementation of the three separate response actions.

Clearly, dam safety considerations dominated the remedial design process. And, the majority of construction costs (approaching $48 million) were, by a huge margin, related to raising, strengthening and armoring the dams, constructing safe inlet and outlet structures and providing for the safe passage of flood flows around the dams. The most urgent aspects of construction for meeting dam safety requirements were carried out as quickly as was possible. By the end of the second year of construction, 1991, the dams were safe against a maximum credible earthquake and against floods up to 70,000 cfs (one-half the probable maximum flood), as required by State of Montana dam safety regulations.

8.1.1 Statement of Protectiveness for Dam Safety, Flood Routing and Flood Plain Management

A dam system which was highly susceptible to failure and, in the event of failure, could have resulted in grave consequences for people living in the Deer Lodge valley has been reconstructed. Dams, inlet and outlet structures, and flood control features constituted the majority of Superfund response actions for the Warm Springs Ponds. The threat to rural valley residents and the city of Deer Lodge no longer exists and EPA deems these aspects of the remedy to be fully protective of human health and safety.

8.2 Evaluation of Protectiveness: Water Quality

The water quality performance standards for all regulated constituents in ground water are being met consistently at the inactive area operable unit compliance point. The construction and operation of a ground water interception trench and pump-back system along the lower (northern) aspect of the pond system, which recycles seepage and toe drain outfall, prevent migration of ground water into the surface water or alluvium immediately below.

The water quality performance standards for most of the regulated constituents in surface water are also being met. Cadmium, iron, lead, mercury and total suspended solids concentrations in water leaving the pond system consistently (98 percent or more of measurements) meet their respective standards. Also, pH of the water leaving the ponds rarely exceeds the performance standard. In every instance when the pH standard has been exceeded, the exceedence is slight and the cause can be traced back to high biological (algal) activity during warm summer months, which further enhances metals removal.

Performance standards for arsenic, copper and zinc in surface water have not been met consistently. The exceedences of standards for arsenic have been shown to occur almost exclusively during the summer months, when algal production within the pond system is greatest and there is an accompanying rise in the pH of pond water. At the higher pH values commonly measured during summer months (pH 9.2 to pH 9.8), particularly in Pond 2, there is a tendency for dissolved arsenic concentrations to increase slightly as water moves through the system.

The exceedences of standards for copper and zinc, on the other hand, rarely if ever occur during the warm summer months. Their exceedences have been shown to be associated nearly exclusively with two phenomena.

The first phenomenon which has been shown to cause high concentrations of copper and zinc to leave the pond system arose from events associated with remedy construction. Specifically, the intentional and necessary inundation of previously exposed tailings deposits in Pond 2 (wet closures) mobilized large volumes of metals and temporarily overloaded the capacity of Pond 2 to treat the metals before being discharged. With construction finished, this phenomenon is not expected to occur again.

The second phenomenon known to cause high concentrations of metals to leave the pond system arises from conditions in Silver Bow Creek, usually in late winter or spring. Ice breakup along the banks of the creek and higher than normal runoff flows, acting singly or in combination, have caused extraordinary suspended sediment loading into Pond 3. During such events, the very fine fraction of the suspended sediment load does not settle out as readily as would occur under normal or moderately high runoff conditions. Retention time is greatly reduced by the increased volume of water entering the system. This phenomenon will continue to occur until sources of metals-laden fine sediments from Silver Bow Creek are significantly reduced. The State of Montana, which has responsibility for the Silver Bow Creek cleanup, expects that the cleanup will require approximately 10 to 12 years beyond 1999. Full implementation of this cleanup, along with other upstream cleanups, will likely result in full or nearly complete compliance.

But, an important question arises: Are exceedences of performance standards for arsenic, copper and zinc a demonstration that the water leaving the pond system is not protective of either human health or aquatic life? There are many lines of evidence to consider in answering this question. EPA has examined and reexamined pertinent lines of evidence, both in the preparation of this review and in the conduct of the human health and ecological risk assessments for the upper Clark Fork River.

8.2.1 Arsenic, Acute Effects

With regard to arsenic, the final daily and monthly performance standards for total arsenic in surface water being discharged from the pond system, as well as in ground water that may emanate from the ponds and enter into the bypass or river below, as defined by Exhibit 5 of the 1991 Administrative Order, are 0.020 mg/l. Although the State of Montana has, since the 1991 order, revised its human health-based standard for arsenic in drinking water (now 0.018 mg/l), the two standards are virtually indistinguishable from one another in terms of the minimal risk posed to human health.

According to 40 CFR Section 300.430(f)(1)(ii)(E)(1), federal or state requirements that are promulgated or modified after a record of decision has been issued must be attained only when it can be determined to be applicable, or relevant and appropriate, and necessary to ensure that the remedy remains protective of human health and the environment. In this instance, because the difference in numbers is so small, EPA believes that a modification is unnecessary and the standards for total arsenic in surface and ground water, as identified in Exhibit 5, remain protective.

However, concentrations of total arsenic leaving the ponds each late summer have been slightly above the human health risk-based criterion for drinking water. When this occurs, concentrations are generally only slightly above 20 ug/l. Each late summer, both dissolved and total recoverable arsenic typically average about 15-25 ug/l, with periodic spikes of up to 35 ug/l.

At these concentrations, arsenic is not toxic to aquatic life. The national water quality criteria for dissolved inorganic arsenic are as follows: Arsenic should not exceed 360 ug/l more than once in every three years and should not exceed a four-day average of 190 ug/l in any three-year span. The Clark Fork River ecological risk assessment (EPA, 1999) reports both acute and chronic toxicity reference values (TRVs) for rainbow trout fry (the most sensitive life stage of trout). The LC0 (no lethality observed in 96-hour toxicity tests) for dissolved total arsenic is 6,670 ug/l and the IC20 (inhibition concentration at which 20 percent of test fish exhibited a measurable effect on growth or body mass over several weeks) is 2,953 ug/l.

If river or alluvial water immediately below the ponds were consumed directly by humans for domestic purposes, prior to being diluted by tributaries or lacking natural attenuation of arsenic underground, then arsenic concentrations, particularly during summer months, might exceed human health standards. Currently, neither domestic municipal water users withdraw water directly from the uppermost reach of the river or its alluvium. An enforceable ban on construction of shallow wells in the Ponds area is in effect. The Montana Department of Natural Resources and Conservation (DNRC) established a controlled groundwater area for both the active and inactive areas, extending down-gradient to Morrell Road, approximately one-quarter mile below the wet closures.

8.2.2 Copper and Zinc, Acute Effects

Copper and zinc concentrations being discharged from the pond system do not exceed human health-based protective levels. They have, however, exceeded the nationally-derived criteria for protection of aquatic organisms (ambient water quality criteria). Another look at Figures Cu-2 and Zn-2, which compare influent and effluent dissolved copper and zinc concentrations with nationally-derived criteria, shows that over the period of record for this review dissolved copper and zinc generally fall below their respective criteria.

Three spikes of dissolved copper (in 1992, 1993 and 1996) are noteworthy: The 1992 and 1993 spikes correspond with the intentional inundation of exposed tailings deposits (Pond 2 and wet closures) and the 1996 spike corresponds with ice scouring and abnormally high overland runoff along Silver Bow Creek.

Dissolved zinc concentrations consistently fall below the nationally-derived criterion. During the period of record for this review, zinc has twice exceeded the criterion by a small margin.

New questions arise: Were the three spikes of copper observed in 1992, 1993 and 1996 near or above levels considered protective of aquatic organisms? If the spikes did exceed protective levels, were the effects likely to have been lethal to some percentage of a population, or were the effects likely to have been more subtle, such as reducing growth of individual members of a population? If so, how significantly? And, if the three spikes can be considered representative of what might be anticipated in future years, until sources of metals along Silver Bow Creek are cleaned up and the remedy undergoes natural healing, what is the prognosis for aquatic receptors living below the Warm Springs Ponds over the next 15 to 20 years?

Several studies have been conducted in recent years yielding results which enable us to answer these questions: to evaluate the effects of copper and greatly facilitate an evaluation of protectiveness.

The U. S. Geological Survey conducts water quality, bed sediment and biological sampling throughout the Clark Fork Basin. At least 15 continuous records sampling and gaging stations are maintained along Silver Bow Creek and the main stem river. One such station on lower Silver Bow Creek is located approximately 500 feet downstream from the confluence of the Mill-Willow bypass with discharge flows from Pond 2. This station, Silver Bow Creek at Warm Springs Ponds, was constructed at its present location in early 1993, just after completion of the bypass expedited response action and about three years prior to remedial action construction completion. Prior to 1993, this station was located about one-quarter mile downstream; however, the portion of stream on which it was located was relocated and reconstructed as part of the overall remedy.

A comparison of recorded data for the new and old locations indicates that water quality at the new station is generally better than water quality at the old location. This observation is consistent with EPA's expectations: three response actions have been completed and the old location was situated within a severely contaminated reach. Three successive years of water quality data gathered and analyzed by USGS, from the present location, show that the mean dissolved copper concentration was 15 ug/l; the median concentration was 12 ug/l; the minimum was 6 ug/l; the maximum was 40 ug/l; and 95 percent of the values were less than 32 ug/l. The maximum recorded dissolved copper concentration (40 ug/l) occurred during the spring 1996 pulse (U.S. Geological Survey, 1998).

Two EPA scientists, Parrish and Rodriguez (1986), conducted a series of experiments in May and June of 1985, using a mobile laboratory that was set up along the Clark Fork River near Deer Lodge. They exposed rainbow trout green eggs, eyed eggs and fingerlings to diluted and undiluted river water, using flow-through chambers. During the period of their experiments, copper concentrations in the river water were generally between 15 ug/l and 40 ug/l, with an average of 28 ug/l. Zinc concentrations were generally between 10 ug/l and 50 ug/l, with an average of 34 ug/l. Rain storms occurred during the latter half of the experimental period, resulting in sharp, but brief spikes of copper and zinc in the river as high as 150 ug/l to 160 ug/l.

Eggs were exposed for 30 days. The green eggs developed into eyed eggs; the eyed eggs developed into swim-up fry. The fingerlings were exposed for 13 days. All three life stages were subjected to undiluted and diluted river water. Mortality and body weight of fry and fingerlings were observed and recorded.

Following the experiments and data evaluation, the researchers concluded that Clark Fork River water, at the concentrations encountered during spring runoff of 1985, did not produce significant mortality in any of the three life stages exposed; hatch success of the green eggs did not correlate with either lower or higher concentrations of river water; and there was no observed effect on the weight of the hatched fry. Reexamination of their data during the Clark Fork ecological risk assessment, however, indicates that mortality among fingerlings appeared to be slightly higher (20 percent mortality) when exposed to undiluted river water. Mortality among fingerlings exposed to diluted river water was observed to be from zero to 15 percent, but higher concentrations of diluted river water did not produce greater mortality.

This study by Parrish and Rodriguez is relevant to the Warm Springs Ponds protectiveness evaluation partly because exposure duration extended beyond the normal 96-hour exposure duration of standard toxicity tests.

More recently, two other researchers, Bergman (1993, two studies) and Lipton etal. (1995), performed several series of toxicity tests on sensitive life stages of both rainbow and brown trout. Their studies also are relevant to this evaluation of protectiveness for the ponds.

Bergman (1993), attempting to zero in on the LC 50 of juvenile rainbow and brown trout, used a mixture of metals. (The LC 50 is the concentration of a chemical or mixture of chemicals at which 50 percent of the exposed test organisms die. In any series of tests designed to estimate the LC 50, however, lower levels of lethality such as the LC 10 can also be estimated.) Bergman selected the mixture and concentration of each metal to replicate conditions observed during a severe fish kill that occurred in the upper Clark Fork River in July of 1989.

Juvenile trout were exposed for 96 hours. Mixtures of cadmium, copper, lead and zinc ranged from a low of 0.3 times to a high of 5.0 times the initial concentration. The initial concentration of copper was 120 ug/l and zinc was 230 ug/l. Thus, copper concentrations in these laboratory toxicity tests were between 36 ug/l (0.3X) and 600 ug/l (5X), and zinc concentrations were between 69 ug/l (0.3X) and 1,150 ug/l (5X). Mortality was observed and recorded in each test at 12, 24, 36, 48, 72 and 96 hours. The hardness of the test water was 100 mg/l.

Bergman (1993) observed that the LC 50 for juvenile rainbows after 12 hours of exposure was 475 ug/l copper and 757 ug/l zinc. At 96 hours exposure, the LC 50 was 127 ug/l copper and 182 ug/l zinc. He estimated that about 80 percent of the lethal effect observed was due to copper toxicity; about 17 percent due to zinc; and the remainder due to cadmium. The LC 50 values for juvenile rainbow trout are tabulated below.

Chemical of Concern	**LC50 for Juvenile Rainbow Trout (ug/L) (Hardness = 100 mg/L)**		
	12hr	**48 hr**	**96 hr**
Copper	4.5	148	127
Zinc	757	240	182

Excerpted from Clark Fork River Ecological Risk Assessment (USEPA 1999)

Bergman (also in 1993) performed another series of laboratory toxicity tests in order to examine the effects of "pulsed" exposures of cadmium, copper, lead and zinc on trout fry. Pulses, or sudden increases of metals levels in the river, it was reasoned, may limit the survival or growth of very young trout. (It was reasonably well established that throughout the 1980s pulses of metals and sudden drops in pH in the upper river were associated with thunderstorms. The old Mill-Willow bypass channel, which became choked with tailings shortly after its construction in the 1960s, was believed to be the principal cause of severe metals pulses following thunderstorms. Several fish kills were observed in and below the old bypass following thunderstorms.)

Bergman exposed the trout fry to 8-hour pulses with varying concentrations of dissolved metals in the test water, at varying hardness values. In tests using water adjusted to between 100 mg/l and 200 mg/l hardness, Bergman observed no increase in mortality of test fry until metals concentrations reached levels where copper was about 480 ug/l. When he decreased hardness values to 50 mg/l, or when pH was adjusted downward to pH 4.5, increased mortality occurred for rainbow trout fry at a copper concentration of 120 ug/l.

Based on these observations, Bergman estimated that the no observed adverse effect level (NOAEL) for copper was between 121 ug/l and 285 ug/l, depending upon hardness, and the lowest observed adverse effect level (LOAEL) for copper was between 186 ug/l and 601 ug/l, again depending upon hardness. For zinc, he estimated a NOAEL range of 186 ug/l to 628 ug/l and a LOAEL range of 271 ug/l to 1,291 ug/l (both ranges are hardness dependent).

Lipton etal. (1995) also conducted a series of laboratory toxicity tests on sensitive life stages of rainbow and brown trout. They exposed both fry and juvenile rainbow and brown trout for 96 hours, and from these tests were derived the no observed effect concentration (NOEC), LC 10, LC 20 and LC 50. All tests were conducted in laboratory water with a hardness of 100 mg/l.

From Lipton's experiments, the no observed effects concentrations (NOEC) of copper over 96 hours were 45 ug/l for rainbow trout fry; 92 ug/l for rainbow trout juveniles; and 45 ug/l for both fry and juvenile brown trout. The corresponding no observed effects concentrations (NOEC) of zinc were 69 ug/l for rainbow trout fry; 147 ug/l for rainbow trout juveniles; and 69 ug/l for both fry and juvenile brown trout.

The LC 50 concentrations of copper over Lipton's 96-hour test were 61 ug/l for rainbow trout fry; 134 ug/l for rainbow trout juveniles; 65 ug/l for brown trout fry; and 82 ug/l to 87 ug/l for brown trout juveniles. The corresponding LC 50 concentrations of zinc were 96 ug/l for rainbow trout fry; 219 ug/l for rainbow trout juveniles; 102 ug/l for brown trout fry; and 130 ug/l to 138 ug/l for brown trout juveniles.

Species	**Age**	**Stock**	**Toxicity of Cu at 96 Hours (Hardness = 1[illegible] mg/L)**				**Toxicity of Zn at 96 Hours (Hardness = 100 mg/L)**			
			NOEC	**LC10**	**LC20**	**LC50**	**NOEC**	**LC10**	**LC20**	**LC50**
Rainbow	**Fry**	**Hatchery**	45	47	52	61	69	72	80	96
	Juvenile	**Hatchery**	92	--	94	134	147	--	152	219
Brown	**Fry**	**Hatchery**	45	41	49	65	69	63	76	102
	Juvenile	**Hatchery**	45	64	72	87	69	100	113	138
	Juvenile	**CFR**	45	55	65	82	69	87	102	130

Excerpted from Clark Fork River Ecological Risk Assessment (USEPA 1999)

A comparison of Bergman's and Lipton's LC 50 values for juvenile rainbow trout (127 ug/l and 134 ug/l) yields very consistent results. Lipton's experiments also show that, as expected, trout fry are considerably more sensitive to copper and zinc than juveniles. It follows that adults would be expected to be less sensitive than juveniles.

Toxicity tests such as those conducted by Bergman and Lipton are generally conducted using laboratory water, into which copper, zinc and other metals are dissolved. Hardness is usually maintained by addition of calcium carbonate, and in Bergman's and Lipton's tests hardness was maintained at 100 mg/l.

Yet another series of toxicity tests designed to estimate the LC 50 value for fish exposed to copper was conducted by ENSR (1995). In these toxicity tests, however, series of experiments were set up to zero in on the lethality of both laboratory water and actual site water. (Site water was taken from various locations along Silver Bow Creek, immediately below the Warm Springs Ponds, various locations along the Clark Fork River, and some tributaries.) Actual site water was used in these experiments because it is widely recognized that surface water from many streams contains naturally-occurring dissolved compounds which bind dissolved metal ions and render them less bioavailable to aquatic organisms. If such conditions exist in the upper Clark Fork River, it was reasoned, then concentrations of dissolved copper found to be acutely lethal in laboratory water might, in fact, not be lethal under natural stream conditions. Such an ameliorating effect on the toxicity of copper, as well as on some other metals, including zinc, has been demonstrated by several researchers.

ENSR's toxicity tests are particularly noteworthy because five separate rounds of tests were conducted using water taken from the Warm Springs Ponds outflow. ENSR captured water being discharged from the ponds in January, April, June and October of 1993, and September of 1994, then subjected rainbow trout fry, fathead minnow and Ceriodaphnia (a very small, metals-sensitive invertebrate) to standard 96-hour toxicity tests using water collected from the ponds' outflow. For rainbow trout fry, LC 50, LC 10 and NOEC values for dissolved copper were calculated and are summarized below. Measured hardness is also provided.

Results of toxicity tests on rainbow trout fry using water taken from the Pond 2 outfall.

Date	Hardness	LC50 (micrograms per liter)	LC10 (micrograms per liter)	NOEC (micrograms per liter)
Jan 93	164 mg/l	182	107	No results
Apr 93	118 mg/l	161	112	87
Jun 93	124 mg/l	296	204	175
Oct 93	134 mg/l	166	121	102
Sep 94	158 mg/l	205	124	76

from ENSR (1995)

ENSR conducted toxicity tests on rainbow trout fry using both Warm Springs Ponds discharge water and laboratory water. The laboratory water tests were conducted at varying hardness values, with some rounds designed to replicate as closely as possible the hardness values of the site water. ENSR's laboratory water test results are very similar to results obtained by Lipton (1995). For example, at a water hardness value of 110 mg/l, ENSR's tests yielded an LC 50 concentration (for dissolved copper) of 73 ug/l (compare to Lipton's 61 ug/l), an LC 10 concentration of 52 ug/l (compare to Lipton's 47 ug/l), and an estimated NOEC of 36 ug/l (compare to Lipton's 45 ug/l).

Having compared laboratory water test results of separate studies, EPA also compared ENSR's results using site water with Lipton's results using laboratory water. Both series of tests

3 increased substantially during late winter and spring runoff periods. This deliberate increase in liming during critical periods for aquatic organisms downstream has resulted in increased water hardness. Hardness values recorded for each of the past three years' runoff periods often exceed 200 mg/l and usually fall in the range of 190 mg/l to 210 mg/l. Whereas the LC 10 value for dissolved copper in laboratory water, involving trout fry, has been estimated to be about 45ug/l to 55 ug/l at a hardness value of 100 mg/l, the corresponding LC 10 value rises to about 90 ug/l or higher when hardness is about 200 mg/l.)

5. In acute toxicity tests involving copper in water taken from just below the Warm Springs Ponds (site water), it has been demonstrated by ENSR (1995) that copper's toxic effects on aquatic receptors, including trout fry, are considerably less than predicted from toxicity tests using laboratory water and otherwise equivalent concentrations of copper. Five separate rounds of 96-hour toxicity tests, involving trout fry and water taken from immediately below the ponds, yielded LC 10 values for dissolved copper from a low value of 107 ug/l to a high value of 204 ug/l. (EPA is not alarmed by the variability; such variability is the rule, not the exception, when biological testing is conducted.) The ameliorating effect on copper toxicity that is associated with site water, as compared to laboratory water, has been consistently demonstrated and cannot be ignored.

6. Fish, and for that matter all aquatic organisms, that inhabit the aquatic environment below the Warm Springs Ponds benefit from an abundance of food and organic matter (detritus), relatively constant flows, generally favorable water temperatures, and metals concentrations which are an order of magnitude less than in Silver Bow Creek above the ponds. Aquatic organisms inhabiting the stream below the ponds also benefit from the immediate dilution effect of Mill and Willow creeks. It is plausible that the combination of these favorable conditions would lessen, or mitigate any biological stress that might otherwise express itself. (EPA acknowledges that uptake of metals via dietary and sediment pathways must also be considered. In the Clark Fork River ecological risk assessment, these pathways were shown to be minimal.)

7. Since completion of remedial action construction, the highest concentration of dissolved copper recorded by the USGS at the continuous monitoring station located just below the Pond 2 outlet has been 40 ug/l. The mean concentration has been 15 ug/l and the median concentration has been 12 ug/l. Ninety-five percent of the dissolved copper values were less than 32 ug/l. These concentrations reflect a generally favorable aquatic environment below the ponds, but only so far downstream as the benefits from the ponds' cleanup have been able to overcome the deleterious effects of increasing copper levels in the main stem river from Galen to below Deer Lodge. The concentrations of dissolved copper within the first few miles of stream below the Warm Springs Ponds are consistently below the range of LC0 (no effects concentration) observed from several pertinent toxicity tests using site water (107 ug/l to 204 ug/l) and, with a single, short-lived exception (40 ug/l), below the much more conservative LC0 value derived by Erickson et al. (1999) of 37 ug/l.

8. The risk of acute metals-induced lethality for fish living in the first few miles of stream below the Warm Springs Ponds is deemed by EPA to be very low.

8.2.3 Chronic (Sub-lethal) Effects

Having evaluated the potential for mortality arising from acute exposures, it is necessary to evaluate whether or not more subtle effects may be present. Several separate feeding studies have been conducted in recent years, each attempting to examine mortality or reduced growth in fish that were fed invertebrates taken from Silver Bow Creek, the Warm Springs Ponds or upper Clark Fork River. (It is well established that body burdens of metals are elevated in aquatic invertebrates taken from these three sources.)

Woodward and others, in 1994 and 1995, conducted three separate feeding studies on young trout. The researchers concluded that the metal content of Clark Fork River invertebrates "is a plausible cause" of the decreased growth of young brown trout and rainbow trout, but they also noted that the reduced feed intake by test fish could account for the reduction in growth. Adverse effects on growth were reported in five of the six feeding studies examined. EPA considers this consistency of observed effect, across multiple studies, to be evidence which cannot be ignored.

Therefore, in its Clark Fork River ecological risk assessment, EPA (1999) examined the possibility that Clark Fork River fish may be smaller than fish of the same year class in nearby reference streams. Of the studies available and reviewed, there is insufficient evidence to conclude that fish in the Clark Fork River are smaller in body mass than fish of equivalent age in reference streams. In fact, the weight of evidence from studies that compared body mass of Clark Fork River fish to body mass of Rock Creek, Flint Creek, Little Blackfoot River and Big Hole River fish suggests that Clark Fork River fish are not smaller.

For many reasons conditions in the river immediately below the ponds are steadily improving, thus rendering effects on growth, if they exist at all, increasingly difficult to ascertain. While exposure to copper and other metals certainly occurs to this day, and there are ample indications of such exposure, the evidence for chronic impacts on fish is inconclusive. The recently-completed ecological risk assessment for the Clark Fork River (December, 1999) concludes as follows:

> "Taken together, the data above [studies examined in the risk assessment] are consistent with the hypothesis that copper (and possibly other metals) in the aquatic environment (surface water, diet) is (are) imposing an intermittent low-level chronic stress on trout and other fish. The most likely manifestation of this stress is decreased growth, but the magnitude of the effect cannot be stated with certainty, and data are not adequate to determine whether or not fish from the Clark Fork River are actually smaller than expected."

8.2.4 Aquatic Invertebrates

Population-level or community structure-level effects are more readily recognized and more easily measured in studies of aquatic invertebrates than they are in fish studies. Beginning in 1986 and continuing to the present, a long-term study of benthic invertebrates has been conducted along the entire Clark Fork River and some of its key tributaries. Each year, results of surveys are assembled for the purpose of evaluating biological integrity. Ten separate measures of macroinvertebrate structure and function are integrated by the principal researcher, McGuire, into an index of biological integrity. The ten measurement endpoints include density, taxa richness and richness of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT species richness), among others. Comparisons are made each year among results obtained from main stem river stations and tributaries which include Rock Creek and the Blackfoot and Little Blackfoot rivers.

Average benthic macroinvertebrate abundance, or density, is higher in most main stem river locations than in tributaries. This is an indication of the higher degree of nutrient enrichment that exists in the main stem. Density measurements do not tend to decrease with increasing metals concentrations in the water column, which may mean that metals stress on this measurement endpoint can be hidden behind, or overshadowed by the effect of nutrient enrichment, such as has been observed in the middle reaches of the main stem river.

But, measures of taxa richness and diversity show a clear and consistent reduction in the number and type of sensitive species present where copper levels in the water column are highest. McGuire has identified a few taxa which are considered to be particularly sensitive to metals. They include a caddisfly (Arctopsyche sp.) and two stoneflies (Claasinia sp. and Hesperoperla sp.). The upstream reaches of the main stem tend to have fewer individuals of these sensitive members (per unit area) than in reaches below the mouth of the Little Blackfoot River or in reference tributaries. In some portions of upstream reaches, usually far removed from the influence of small tributaries, McGuire has observed that these sensitive, often long-lived invertebrates are either absent from the main stem or found only rarely.

Results of all ten measures are integrated to produce an overall biointegrity index, with scores ranging from zero to 100 percent. A metals pollution subset of metrics includes density, EPT richness and a metals tolerance index. An organic pollution subset of metrics includes density, a biotic index and percent filter feeders. Careful interpretation of the metals and organic pollution subsets allows McGuire to distinguish between the effects arising from metals and effects arising from organic compounds.

McGuire's extensive survey, backed by thorough statistical analysis, demonstrates that metals in the upper river are responsible for observed alterations in the composition and population dynamics of the invertebrate community. Overall abundance is not affected, and organic pollution is as significant as, or at times and in certain reaches more significant than, metals pollution. Nevertheless, exposure to metals contributes to a decrease in the number of species present, an increase in the relative abundance of metals-tolerant species, and a marked decrease in, or absence of metals-sensitive species. These effects express themselves most readily in the middle to lower portions of the river within the Deer Lodge Valley.

These impacts to aquatic invertebrates are thought to be due to conditions within the bed sediments, banks and over bank areas of the upper river. Only one sampling station for invertebrate surveys is located between the Pond 2 outflow and the mouth of Warm Springs Creek. Much of the impact on invertebrates observed by McGuire occurs between Galen and Deer Lodge. Therefore, it would not be accurate to conclude that the observed impacts are wholly attributable to conditions from Silver Bow Creek and the Warm Springs Ponds. The multiple sources of metals and the variability of effect create considerable uncertainty over assigning blame to any one particular source. Probably all three sources are responsible: Silver Bow Creek, Warm Springs Ponds, and the upper reaches of the Clark Fork River. A few excerpts from McGuire's June 1998 report (for the 1996 survey) are noteworthy.

> "Since 1993 biological integrity has improved at seven stations in the upper basin. The greatest improvements in biointegrity occurred in Silver Bow Creek below the Warm Springs Ponds and in the Clark Fork River below Warm Springs Creek. Slight metals impacts were evident below the Warm Springs Ponds and at Deer Lodge. Nutrient and organic pollution appeared to be the principal causes of slight biological impairment in the remainder of the Clark Fork River."

Whereas conditions for the aquatic invertebrate community immediately below the ponds were severely to moderately impacted by metals prior to 1990, this reach is now characterized by McGuire as having benefitted significantly from Superfund cleanup efforts and only "slight metals impacts" were reported in 1996.

8.2.5 Algae

Population-level effects are also more readily measured and observed in the benthic algae. Long-term surveys have been conducted by Weber, with much the same study design as McGuire's invertebrate surveys. Algae, especially diatoms, are important indicators of water quality and general aquatic health because their environmental requirements are well understood, there are unique pollution tolerance indicators among certain species, and algae are very sensitive to physical and chemical factors in the water column and substrate.

Algae surveys conducted over the past 12 years show that the reach of stream immediately below the Warm Springs Ponds has improved markedly, particularly since 1990, when Superfund cleanup activities were initiated there. Weber reported in his May 1998 report (for 1996 data) as follows:

> "The three upper Silver Bow Creek sites: 1) above the Butte wastewater treatment plant (WWTP); 2) downstream of the WWTP and Colorado Tailings; and 3) above the Warm Springs Ponds at Opportunity all exhibited severe overall impairment of aquatic life and poor biological integrity in 1996. Elevated levels of sediment, heavy metals, biogenic wastes and

nutrients continue to seriously impact this reach. Only minor biological impairment was seen in Silver Bow Creek downstream of the Warm Springs Ponds, indicating much improved water quality."

"Biological integrity was only fair in the Clark Fork between Warm Springs Creek and the Little Blackfoot River, with moderate impairment indicated. Sediment was apparently the primary cause of the impairment, although sources of nutrients and metals are present in this reach."

"The Warm Springs Ponds serve to remove dissolved and sediment-born[e] heavy metals from upper Silver Bow Creek. Remediation efforts were undertaken in recent years by ARCO and the Superfund Program to improve the ponds' treatment efficiency and eliminate frequent bypasses of highly toxic water to the Clark Fork.....This improvement was evident in the biological integrity at station 4.5 [USGS station described earlier, located immediately below the Warm Springs Ponds outflow and also used by Weber for his survey], which was rated as good for three of the last four years. The Superfund remediation efforts likely contributed to the improved biological healt! .."

8.2.6 Statement of Protectiveness for Water Quality

The Warm Springs Ponds 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 Warm Springs Ponds 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 Warm Springs Ponds 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 Warm Springs Ponds and continuing for about 40 miles, any attempt to eliminate chronic threats that persist immediately below the ponds through modification of the Warm Springs Ponds system would produce virtually no change in protectiveness for the river in the Deer Lodge valley.

The Warm Springs Ponds 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 Warm Springs Ponds 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 Warm Springs Ponds 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.

Appendix A: Community Involvement Activities

Community Involvement Since the Record of Decision

The Warm Springs Ponds Superfund cleanup has always been an object of intense public interest. This interest did not fade with the 1990 ROD. Instead, interest became more focused, as EPA and ARCO began the Mill-Willow Bypass Expedited Response Action (ERA), and deferred a decision on Pond 1 (the inactive area) to a separate ROD. As a result of this interest, EPA approached community involvement differently than it or MDHES had in the RI/FS process for the first decision.

EPA recognized several disparate public views of the Ponds system: Some saw the Ponds as a necessary evil until upstream cleanup could be achieved; and others saw the Ponds as a successful wildlife attractant which brought fisher people, duck hunters, and other wildlife enthusiasts to the Anaconda-Deer Lodge area. Even those in the first category accepted that the Ponds had become a wildlife haven, but were concerned about the long term viability of the Ponds as a waste treatment unit. Others expressed concern that the Ponds acted as a storage system for water, and that losses to evaporation caused a lessening of water resources for downstream irrigators. However, EPA held numerous public meetings and gauged public sentiment to be that the Ponds needed to be strengthened and protected against earthquakes and floods, while retaining their nature as a wildlife area, and that the Mill-Willow Bypass cleanup was supported in concept. There were definitely reservations from various quarters about the long term plan for the Ponds, and yet these reservations conflicted with those who supported maintenance of the Ponds long into the future as wildlife habitat.

EPA followed the NCP for community involvement, but because of the high level of public interest, went far beyond minimum requirements, both pre- and post-ROD, in order to meaningfully involve the public in the decision making process. Using information gathered for the 1989 Revised Silver Bow Creek Community Relations Plan (prepared by the Montana Department of Health and Environmental Sciences), EPA held numerous public meetings, distributed written information when appropriate, held site tours, met with small groups as invited, and enlarged the attendance at and participation in design meetings.

The first five public meetings listed below were to keep the public informed and receive comment about the activities leading up to the Warm Springs Ponds Record of Decision (September 1990). That ROD deferred a decision on soil, tailings, and ground water below Pond 1. Therefore, in 1991 and early 1992 EPA held public meetings and hearings to inform the public and receive comment on plans to deal with that area and Pond 1, which had been administratively moved into a separate operable unit. EPA explained its action in the July 1991 Warm Springs Ponds Update, which was sent to EPA's Silver Bow Creek mailing list. Following meetings and two public hearings, EPA released a Record of Decision for the "Inactive Area" of the Warm Springs Ponds in June 1992. The agency conducted a tour of the Ponds for the media and interested public in September 1992.

Remedial action progressed at the Ponds. One area drew particular attention: a loop of

Silver Bow Creek below Pond 1 that had stream banks contaminated with copper, zinc, and other metals. While EPA believed it had fully involved interested groups and State agencies in the design process for this loop, at the point of approval the State Department of Fish Wildlife and Parks raised serious concerns with EPA's design, and enlisted environmental groups who had not been as intimately involved in the design process. As a result of discussions with all parties, EPA agreed to specific activities to encourage public involvement in the decision and design process (letter to National Wildlife Federation, June 1994). EPA involved the public in setting up the critical biological monitoring plan for the Ponds, data from which figure into this five year review.

EPA has followed guidance on involving the public in five year reviews by participating in a public meeting sponsored by the site Technical Assistance Grant recipient, CTEC, in September 1997. This meeting was reported in the Montana Standard, a daily newspaper of general distribution. Additionally, EPA published and sent to over 600 people a newsletter describing the five year review process and the public's opportunity for involvement. EPA plans to announce the completion of the review in the local media, place copies in all local information repositories, and hold a public meeting to describe its findings. A public comment period will ensue upon release of the final report. Any comments will be responded to individually versus in a responsiveness summary, and if any changes to EPA's recommendations result, EPA's final recommendations will be sent to the media and published in a newsletter and distributed to the same mailing list that received the initial newsletter. This planned course of action is based on suggestions received from the public.

Public Meetings and Announcements:

February 27, 1990	- Fairmont Hot Springs (Anaconda and Butte)
February 28, 1990	- St. Patrick Hospital, Missoula
May 22, 1990	- Anaconda Courthouse
May 24, 1990	- Deer Lodge Community Center
May 29, 1990	- St. Patrick Hospital, Missoula
June 13, 1990	- EPA releases proposed work plan for Mill-Willow Bypass; list of repositories given (EPA news release)
October ?, 1990	- Text for WSP ROD availability (display ad to newspapers)
October 1, 1990	- WSP ROD signed (EPA news release)
October 10, 1991	- Powell County Community Center, Deer Lodge
October 11, 1990	- WSP ROD to information repositories (letter to librarians)
July 1991	- SBC/BA Warm Springs Ponds Update-ESD (June 91)
September 27, 1991	-"Dear Friends" letter about workshop and public meetings
October 23, 1991	- St. Patrick Hospital, Missoula
October 24, 1991	- Copper Village Museum/Art Center, Anaconda
April ?, 1992	- PSA announcing April 27, 28 public hearings
April 27, 1992	- Copper Village Museum/Art Center, Anaconda
April 28, 1992	- St. Patrick Hospital, Missoula
August 4, 1992	- Original date of media/public tour of Ponds

August 21-27, 1992	- Notice of Availability Display Ad, ROD, Msla Independent
September 4, 1992	- Rescheduled Public tour of Warm Springs Ponds
December 29, 1993	- Meeting at Ponds construction trailer about lower MWB rechanneling
April 13, 1994	- WSP Briefing and Tour
June 7, 1994	- EPA letter to National Wildlife Federation and Stan Bradshaw, Trout Unlimited attorney
June 1994	- SBC/BA Warm Springs Ponds Fact Sheet (100% Design)
September 1994	- Summary-Long term Biological Monitoring Plan-WSP
September 29, 1994	- WSP Briefing-Biological Monitoring Plan
November 2, 1995	- Agenda for Construction Completion meeting to limited public representatives (Tourangeau and Blodgett)
November 16, 1995	- Initial Construction Completion Certification Meeting
August 1996	- Clark Fork Superfund Sites Master Plan - 1996 Update
September 11, 1997	-EPA participated in CTEC meeting re: WSP
December 1997	- Silver Bow Creek/Butte Area Five Year Review Newsletter

Sitewide Community Involvement

1. Public Information distributed via mailing lists:

Superfund Program Fact Sheet, Silver Bow Creek Site, November 1986

Superfund Program Fact Sheet, Silver Bow Creek Site, Butte Addition, June 1987

Update, Silver Bow Creek/Butte Site, July 1987

MDHES Solid & Hazardous Waste Bureau Fact Sheet, November 1987

Fact Sheet, Silver Bow Creek/Butte Site, May 1988

Project Summary, Butte Soils Screening Study, Silver Bow Creek/Butte Site, May 1988

Progress Report, Clark Fork Superfund Sites, May 1988

EPA/DHES Master Plan for Cleanup in the Clark Fork Basin, June 8, 1988

Progress, Silver Bow Creek Superfund Site Report, July 1988

Progress Report No. 2, Clark Fork Superfund Sites, August 1988

Superfund Program Fact Sheet, Silver Bow Creek/Butte Area Site, September 1988

Clark Fork Superfund Master Plan, USEPA and MDHES, October 1988

Clark Fork Superfund Sites Briefing Package, January 1989

Progress, Silver Bow Creek Superfund Site Report, April 1989 (Area One)

Progress, Silver Bow Creek Superfund Site Report, June 1989

Progress, Silver Bow Creek Superfund Site Report, September 1989

Warm Springs Ponds Proposed Plan, Silver Bow Creek Superfund Site Report, October 1989

Public Meeting on Warm Springs Ponds Feasibility Study and Proposed Plan, November 9, 1989

Progress, Clark Fork Basin Superfund Sites, May 1990

Fact Sheet, Superfund Program, Silver Bow Creek Site, Butte Area, May 1990 (Mine Flooding)

Fact Sheet, Superfund Program, Silver Bow Creek Site, Butte Area, May 1990 (Source Areas)
Media Information Packet, Clark Fork Basin Superfund, August 9, 1990
Clark Fork Superfund Sites Master Plan, November 1990 (updated from 1988)
The Butte and Silver Bow Creek Superfund Sites Master Plan: A Quick Guide (Undated)
Proposed Plan, Lower Area One Colorado Tailings, Butte Reduction Works, April 1991
Superfund Program, Priority Soils Operable Unit, Silver Bow Creek/Butte Area Site, May 1991
Silver Bow Creek/Butte Area Superfund Site, Warm Springs Ponds Update, July 1991
Progress, Streamside Tailings Superfund Report, August 1991
Superfund Program, Lower Area One Colorado Tailings, Butte Reduction Works, August 1991
Letter, "Dear Friends of the Clark Fork River," September 27, 1991
Superfund Program Fact Sheet, Priority Soils Operable Unit, SBC/BA, November 1991
SBC/BA Superfund Site, Warm Springs Ponds Inactive Area Proposed Plan, March 1992
Progress, Silver Bow Creek/Butte Area Site, Montana Pole Site, April 1992
Superfund Program, Priority Soils Operable Unit, SBC/BA Site, August 1992
Progress, Streamside Tailings Superfund Report, February 1993
An Update of Butte Mine Flooding RI/FS Activities, April 28, 1993 (Public Meeting Handouts)
SBC/BA Site, Mine Flooding Operable Unit Proposed Plan, January 1994
SBC/BA Priority Soils Operable Unit, Expedited Response Action Proposed Plan, March 1994
Superfund Questions and Answers, April 1994 (Handout)
SBC/BA Superfund Site, Warm Springs Ponds Fact Sheet, June 1994
Summary, Long-Term Biological Monitoring Plan, Warm Springs Ponds, September 1994
Superfund Remedy Summary, Mine Flooding Operable Unit, September 30, 1994
Progress, Streamside Tailings Superfund Report, December 1994
Butte/Walkerville, Montana, Superfund Progress, December 1994
Rocker Timber Framing and Treating Plan, SBC/BA, Superfund Site Report, Human Health Risk Assessment, March 1995
Progress, Streamside Tailings Superfund Report, March 1995
Lead Program Information Update,.SBC/BA, June 1995, Number 1
Proposed Plan: Streamside Tailings Operable Unit, June 1995
Proposed Plan: Rocker Timber Framing and Treating Plant Operable Unit, July 1995
Superfund Remedy Summary, Rocker Timber Framing and Treating Plant OU, January 1996
Record of Decision Summary: Streamside Tailings Operable Unit, January 1996
PITWatch 1996, Vol.1, No.1 (Berkeley Pit Public Education Committee)
Clark Fork Superfund Sites Master Plan, 1996 Update, August 1996
Butte and Walkerville, Montana, Superfund Progress, October 1996
Site Update, Closure of the Old Butte-Silver Bow Landfill and the Clark Tailings Area and Proposed Use of the Clark Tailings as a Disposal Site for Lower Area One Wastes, February 1997

PITWatch 1997, Vol.2, No.1 (Berkeley Pit Public Education Committee)
Information Summary Sheet, Missoula Gulch Stormwater Improvements, July 9, 1997
PITWatch 1997, Vol.2, No.2 (Berkeley Pit Public Education Committee)
Pilot Test on Silver Bow Creek (brochure), October 1997
Superfund Site Update, Rocker Timber Framing and Treating Plant OU, December 1997
PITWatch 1998, Vol.3, No.1 (Berkeley Pit Public Education Committee)
Silver Bow Creek/Butte Area NPL Site Five Year Review Newsletter, December 1997
Superfund Progress Report, Lower Area One Operable Unit, SBC/BA NPL Site, May 1998

<u>Public Meetings Held</u>:
August 1991 - Anaconda, Missoula, Butte - Streamside Tailings Draft AOC and Work Plan
August 13, 1991 - Public hearing in Ramsay on Streamside Tailings Work Plan and AOC
August 1991 - Site Tours for Local Media and Landowners
March 31, 1993 - Opportunity - ARCO's planned Demonstration Project II

<u>Public Meetings Attended</u>:
March 24, 1994 - CTEC monthly meeting, "Let's Talk About Superfund"
July 14, 1994 - CTEC monthly meeting, Property owner rights under Superfund
August 11, 1994 - CTEC monthly meeting, Lower Area One expedited response action
October 13, 1994 - CTEC monthly meeting, STARS
November 10, 1994 - CTEC monthly meeting, Mine Flooding ROD
May 11, 1995 - CTEC monthly meeting, Rocker Remedial Investigation
June 8, 1995 - CTEC monthly meeting, Streamside Tailings Proposed Plan
July 13, 1995 - CTEC monthly meeting, Rocker Proposed Plan and Butte Stormwater Runoff
August 10, 1995 - CTEC monthly meeting, Butte Stormwater runoff
September 14, 1995 - CTEC monthly meeting, Rocker Water and Sewer District
December 7, 1995 - CTEC monthly meeting, Streamside Tailings Record of Decision
March 14, 1996 - CTEC monthly meeting, Horseshoe Bend work plan
April 11, 1996 - CTEC monthly meeting, Streamside Tailings RD/RA work plan
June 13, 1996 - CETC monthly meeting, Lower Area One ERA progress report
August 8, 1996 - CTEC monthly meeting, Streamside Tailings design process and schedule
January 16, 1997 - CTEC monthly meeting, Butte Stormwater Runoff engineering design
March 13, 1997 - CTEC monthly meeting, Butte remediation activities, Streamside Tailings
July 10, 1997 - CTEC monthly meeting, Berkeley Pit cleanup technologies
August 14, 1997 - CTEC monthly meeting, Lower Area One Wetlands
September 11, 1997 - CTEC monthly meeting, Warm Springs Ponds performance
October 9, 1997 - CTEC monthly meeting, Sequencing of Superfund Cleanup from Butte to WSP

January 8, 1998 - CTEC monthly meeting, Ecological Significance of Wetlands

February 12, 1998 - CTEC monthly meeting, Berkeley Pit: Where is the Water Going?

March 12, 1998 - CTEC monthly meeting, Alice Dump reclamation plans

June 11, 1998 - CTEC monthly meeting, Berkeley Pit and Well H Update

APPENDIX B: REFERENCES

ARCO, 1991. Comprehensive RD/RA Work Plan, Silver Bow Creek/Butte Area NPL Site Warm Springs Ponds Operable Unit (Active Portion) Upper Clark Fork River Basin, Montana. Report prepared by ESA Consultants. December 1991.

ARCO, 1991. Monthly Water Quality and Discharge Monitoring Reports from December 1991 through December 1997.

ARCO, 1992. Wetlands Delineation and Wildlife Habitat Evaluation of the Warm Springs Ponds Operable Unit.

ARCO, 1993. Comprehensive RD/RA Work Plan and Preliminary Design Package Warm Springs Ponds Inactive Area Operable Unit (OU12) Silver Bow Creek/Butte Area NPL Site (Original Portion) Clark Fork Basin, Montana. Report prepared by ESA Consultants. July 1993

ARCO, 1994. Quarterly Operations and Maintenance (O & M) Reports from April 1, 1994 through March 31, 1997. Reports prepared by ESA Consultants.

ARCO, 1995. 1995 Biomonitoring Work Plan for the Warm Springs Ponds. Report Prepared by ENSR, Environmental Toxicology Services. February 1995.

ARCO, 1996. Clark Fork River Riparian Zone Inventory Final Report. November 1996. Report prepared by the University of Montana.

ARCO, 1996. 1995 Biomonitoring for the Warm Springs Ponds, Warm Springs, Montana Phase I (1995) Final Report. Report prepared by ENSR Environmental Toxicology Services. August 1996.

ARCO, 1996. Warm Springs Ponds 1996 Annual Inspection Report. November 1996. Report prepared by ESA Consultants.

ARCO, 1997. Warm Springs Ponds 1996 Biomonitoring and Analysis Report. Report Prepared by ENSR Environmental Toxicology Services. June 1997.

ARCO, 1997. Warm Springs Ponds Mill-Willow Bypass 1997 Biomonitoring Work Plan Addendum. Report prepared by ENSR, Environmental Toxicology Services. July 1997.

ARCO , 1997. Warm Springs Ponds Five-Year Review Report. Report prepared by ESA Consultants. April 1997.

1997.

ARCO , 1997. Warm Springs Ponds Five-Year Review Report. Report prepared by ESA Consultants. April 1997.

ARCO, 1997. Warm Springs Ponds 1997 Biomonitoring Work Plan Addendum. Report Prepared by ENSR, Environmental Toxicology Services. July 1997.

ARCO, 1998. Warm Springs Ponds Five-Year Review Report Addendum. Report prepared by ESA Consultants. February 1998.

ARCO, 1998. Clark Fork River Riparian Zone Inventory Addendum. January 1998. Report prepared by the University of Montana.

ARCO, 1999. Mill-Willow Bypass, Montana Biomonitoring Report 1997 - 1998. Report Prepared by R2 Resource Consultants.

ARCO, 1999. Warm Springs Ponds 1997 Biomonitoring and Analysis Results Final Report. Report prepared by ENSR, Environmental Toxicology Services. April 1999.

Bergman H. 1993. Influence of Acclimation/Adaptation on Toxicity: Differential Tolerance and Resistance of Brown and Rainbow Trout to Water-borne Metal Concentrations Typical of the Clark Fork River. In: Lipton et al. 1995a. Aquatic Resources Injury Assessment Report, Upper Clark Fork River Basin. Report Prepared for State of Montana, Natural Resource Damage Litigation Program by RCG/Hagler Bailly, Boulder CO. January 1995. Appendix C.

Bergman H. 1993. Acute Toxicity in Pulse Events: Relative Sensitivity of Brown and Rainbow Trout to Pulses of Metals Typical of the Clark Fork River. In: Lipton et al. 1995. Aquatic Resources Injury Assessment Report, Upper Clark For River Basin.

ENSR, 1995. Development of Site-Specific Water Quality Criteria for Copper in the Upper Clark Fork River. Phase I and II Program Testing Results. Final Report. ENSR Consulting and Engineering, Fort Collins, CO. Document #0480-228.3.95. March 1995

ENSR, 1999. Full data set for all Clark Fork River site water and laboratory water toxicity testing performed by ENSR Consulting and Engineering, Fort Collins, CO. Data disk provided to USEPA on 2/25/99..

Lipton J, Beltman D, Bergman H, Chapman D, Hillman T, Kerr M, Moore J, Woodward D, 1995. Aquatic Resources Injury Assessment Report, Upper Clark Fork River Basin. Report prepared for State of Montana, Natural Resource Damage Litigation Program by RCG/Hagler Bailly, Boulder CO. January 1995.

McGuire DL, Ingman GL, 1996. Clark Fork River Macroinvertebrate Community Biointegrity: 1994 Assessment. Report prepared by McGuire Consulting, Espanola NM, for Montana Department of Environmental Quality. April 1994.

McGuire DL, 1998. Clark Fork River Macroinvertebrate Community Biointegrity: 1996 Assessment. Report prepared by McGuire Consulting, Espanola NM, for Montana Department of Environmental Quality. February 1998.

McGuire DL, 1998. Comments on the Clark Fork River Sediment/Benthic Macroinvertebrate Assessment (ENSR 1996). Memo from Dan McGuire to Kevin Kirley, Montana DEQ. Dated July 22, 1998.

MDHES, 1989. Warm Springs Ponds Proposed Plan, Silver Bow Creek Superfund Site.

University of Montana, 1994. Determination of Functionally Effective Wetland Area With Threatened/Endangered Species Inventory. Prepared by Riparian and Wetland Research Program, School of Forestry, University of Montana, Missoula Montana 59812. Prepared for ARCO.

USEPA, 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. U.S. Environmental Protection Agency, Office of Research and Development. January 1985. NTIS Document Number PB85-227049.

USEPA, 1990. Record of Decision: Silver Bow Creek/Butte Area NPL Site Warm Springs Ponds Operable Unit Upper Clark Fork River Basin, Montana. September 1990.

USEPA, 1990. Consent Decree, Montana Docket Number CERCLA-VIII-90-15 Silver Bow Creek/Butte Area (Original Portion) Warm Springs Ponds Operable Unit: Mill-Willow Bypass Expedited Response (Removal). June 30, 1990.

USEPA, 1991. Explanation of Significant Differences (ESD) for Warm Springs Ponds Record of Decision. June 1991.

USEPA, 1991. Explanation of Significant Differences (ESD) for Warm Springs Ponds Record of Decision. September 1991.

USEPA, 1991. Consent Decree First Amendment to Montana Docket Number CERCLA VIII-90-15. Silver Bow Creek/Butte Area (Original Portion) Warm Springs Ponds Operable Unit: Mill-Willow Bypass Expedited Response (Removal). January 25, 1991.

USEPA, 1991. Consent Decree Second Amendment to Montana Docket Number

CERCLA-VIII-90-15. Silver Bow Creek/Butte Area (Original Portion) Warm Springs Ponds Operable Unit: Mill-Willow Bypass Expedited Response (Removal) June 12, 1991.

USEPA, 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, 1992. Final Technical Memorandum: Removal of Tailings, Associated Soils and Pond Bottom Sediments, Pond 1 Area and Below. March 1992.

USEPA,1992. Record Of Decision: Silver Bow Creek/Butte Area NPL Site Warm Springs Ponds Inactive Area Operable Unit, Clark Fork River Basin, Montana. June 30,1992.

USEPA, 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, 1993. Correspondence from D. Scott Brown, Remedial Project Manager, to Jack A Majerison, Construction Manager, September 13, 1993. Completion of Initial Construction Inspection and Meeting for the Warm Springs Ponds Active Area (OU 4), Silver Bow Creek/Butte Area Superfund Site.

USEPA, 1993. Correspondence from D. Scott Brown, Remedial Project Manager, to Jack A. Marjerison, Construction Manager, October 5, 1993. Pre-certification Completion of Initial Construction Inspection and Meeting for the Warm Springs Ponds Active Area (OU 4), Silver Bow Creek/Butte Area Superfund Site.

USEPA, 1994. Correspondence from D. Scott Brown, Remedial Project Manager, to Sam Stephenson, Construction Supervisor, May 18, 1994. Approval of ARCO's Final Design Plans and Specifications for Remedial Action Construction; Silver Bow Creek/Butte Area Superfund Site, Warm Springs Ponds Inactive Area Operable Unit (OU 12).

USEPA, 1994. Memorandum from D. Scott Brown, Remedial Project Manager, to Kathy Chiotti, Environmental Protection Specialist, June 14, 1994. Completion of Remedial Action Construction for the Warm Springs Ponds Active Area (OU 4) Tied to the Inactive Area, Silver Bow Creek/Butte Area Superfund Site.

USEPA, 1995. Correspondence from D. Scott Brown, Remedial Project Manager, to Jack A. Majerison, Construction Manager, September 29, 1995. Final Initial Construction Completion for the Warm Springs Ponds Inactive Area Operable Unit (OU 12), Silver Bow Creek/Butte Area Superfund Site, Clark Fork River Basin, Montana.

USEPA,1995. Construction Inspection Summary Report Warm Springs Ponds Inactive Area Remedial Action Construction. Report prepared by Huntingdon Engineering and Environment for CH2M and EPA. January 1995.

USFWS,1998. Aquatic Macroinvertebrate Diversity and Biomass as Potential Indices of Environmental Contamination at National Wildlife Refuges in Montana. Authored by Donald Palawski, John Malloy, Shannon Heath, Bill Olsen, Eric Gilbert.

USGS, 1994. Water Quality, Bed-Sediment, and Biological Data (October 1992 through September 1993) and Statistical Summaries of Water Quality Data (March 1985 through September 1993) for Streams in the Upper Clark Fork Basin, Montana. U.S. Geological Survey, Open File Report 94-375

USGS, 1995. Water-Quality, Bed-Sediment, and Biological Data (October 1993 through September 1994) and Statistical Summaries of Water-Quality Data for Streams in the Upper Clark Fork Basin, Montana. U.S. Geological Survey, Open File Report 95-429.

USGS, 1996. Water-Quality, Bed-Sediment, and Biological Data (October 1994 through September 1995) and Statistical Summaries of Water-Quality Data for Streams in the Upper Clark Fork Basin, Montana. U.S. Geological Survey, Open File Report 96-432.

USGS, 1997. Water-Quality, Bed-Sediment, and Biological Data (October 1995 through September 1996) and Statistical Summaries of Water-Quality Data for Streams in the Upper Clark Fork River Basin, Montana. U.S. Geological Survey, Open File Report 97-552.

WBE, Incorporated, 1997. Progress Report from Bill Bluck, Engineer and Subcontractor for CH2M Hill, Contractor, (ARCS) for U.S.EPA, to D. Scott Brown, Remedial Project Manager, February 18, 1997. Routine Inspection and Report of Operation and Maintenance Activities at the Warm Springs Ponds.

Weber EE, 1991. An Assessment of Water Quality in the Clark Fork River and its Major Tributaries, Based on the Structure and Composition of Summer Algae Associations In the Periphyton Community: prepared for Montana Department of Environmental Quality.

Weber EE, 1997. Clark Fork Basin Periphyton Monitoring: An Assessment of Biological Integrity and Impairment Based on Algae Associations During August 1995. State of Montana Water Quality Division.

Woodward DF, Brumbaugh WG, DeLonay AJ, Little EE, Smith CE, 1994. Effects on Rainbow Trout Fry of a Metals-contaminated Diet of Benthic Invertebrates from the Clark Fork River, Montana. Transact. Am. Fish. Soc. 123:51-62

Woodward DF, Farag AM, Bergman HL, DeLonay AJ, Little EE, Smith CE and Barrows FT, 1995. Metals-Contaminated Benthic Invertebrates in the Clark Fork River, Montana: Effects on Age-0 Brown Trout and Rainbow Trout. Can. J. Fish. Aquat. Sci. 53:1994-2004.

Woodward DF, Bergman HL, McDonald LL, Farag AM, 1995. Evaluation of the Chronic Toxicity of Clark Fork River Invertebrates to Rainbow Trout (Oncorhyncus mykiss) When Administered by the Diet. In: Expert Opinions Regarding Injuries to Aquatic Sources, Clark Fork River Basin, MT. Report prepared by Hagler Bailly Consulting, Inc., Boulder, CO, for State of Montana Natural Resource Damage Litigation Program. October 18, 1995. Appendix B.

APPENDIX C

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8

IN THE MATTER OF:

SILVER BOW CREEK/
BUTTE AREA (ORIGINAL
PORTION) SUPERFUND SITE;
WARM SPRINGS PONDS ACTIVE AREA
OPERABLE UNIT:
SITE NO. 22.
OPERABLE UNIT NO. 4.

ATLANTIC RICHFIELD COMPANY,
and/or ATLANTIC RICHFIELD COMPANY,
INCORPORATED,
RESPONDENT.

PROCEEDING UNDER SECTION 106(a)
OF THE COMPREHENSIVE ENVIRONMENTAL
RESPONSE, COMPENSATION, AND
LIABILITY ACT, AS AMENDED,
42 U.S.C. § 9606(a).

EPA Docket No.
CERCLA-VIII-91-25

ADMINISTRATIVE ORDER
FOR REMEDIAL DESIGN/REMEDIAL ACTION

TABLE OF CONTENTS

EXHIBIT 4

PERFORMANCE STANDARDS
FOR THE WARM SPRINGS PONDS ACTIVE AREA REMEDIATION
SILVER BOW CREEK/BUTTE AREA (ORIGINAL PORTION) SUPERFUND SITE

The following list of performance standards is based on the list of Applicable or Relevant and Appropriate Requirements (ARARs) for the September, 1990 Warm Springs Ponds operable unit Record of Decision (U.S. EPA), and modifications to that list made in the June, 1991 Explanation of Significant Differences (U.S. EPA), including the errata sheet attached to the Explanation of Significant Differences. It is also based on the risk assessment documents for the Warm Springs Ponds operable unit and related documents, and subsequent evaluation of data generated during performance of the Mill-Willow Bypass removal action.

I. Contaminant Specific Performance Standards

A. Air Standards

1. **Lead** - No person shall cause or contribute to concentrations of lead in the ambient air which exceed **1.5 micrograms per cubic meter (ug/m3) of air, measured over a 90 day average,** in accordance with the substantive standards of ARM § 16.8.815.

   POINT OF COMPLIANCE: Within the confines of the Warm Springs Ponds operable unit, where human exposure is probable.

   TIME OF COMPLIANCE: During the implementation of the remedial action, and at the conclusion of the remedial action and thereafter. Compliance shall be measured in accordance with the methods described in 40 CFR Part 50, and corresponding State law provisions.

2. **Particulate matter that is 10 microns in diameter or smaller (PM-10)** - No person shall cause or contribute to concentrations of PM-10 in the ambient air which exceed:

- 150 micrograms per cubic meter of air, 24 hour average, no more than one expected exceedence per calendar year;

- 50 micrograms per cubic meter of air, annual average, in accordance with the substantive standards of ARM § 16.8.821.

POINT OF COMPLIANCE: Within the confines of the Warm Springs Ponds operable unit, where human exposure is probable.

TIME OF COMPLIANCE: During the implementation of the remedial action, and at the conclusion of the remedial action and thereafter. Compliance shall be measured in accordance with the methods described in 40 CFR Part 50, and corresponding State law provisions.

3. **Airborne Particulate Matter - Construction activities must not be undertaken unless reasonable precautions are taken to control emissions of airborne particulate matter**, in accordance with ARM § 16.8.1401(4).

POINT OF COMPLIANCE: At the construction activity.

TIME OF COMPLIANCE: During the implementation of the remedial action. Compliance shall be measured in accordance with the methods described in 40 CFR Part 50, and corresponding State law provisions.

4. **Opacity - Emissions of airborne particulate matter from any stationary source shall not exhibit any opacity of 20 percent or greater averaged over six consecutive minutes**, in accordance with the substantive standards of ARM § 16.8.1401(4).

POINT OF COMPLIANCE: At the source of emission.

TIME OF COMPLIANCE: During the implementation of the remedial action. Compliance shall be measured in accordance with the methods described in 40 CFR Part 50, and corresponding State law provisions.

ADMINISTRATIVE RECORD SDC

5. **Road Dust Suppression - Persons who perform construction activity must employ measures to control road dust**, in accordance with the substantive standards of ARM § 16.8.1401(3).

   POINT OF COMPLIANCE: At the construction activity.

   TIME OF COMPLIANCE: During the implementation of the remedial action.

6. **Settled Particulate Matter - No person shall cause or contribute to concentrations of particulate matter in the ambient air such that the mass of settled particulate matter exceeds 10 grams per square meter, 30 day average**, in accordance with the substantive standards of ARM § 16.8.818

   POINT OF COMPLIANCE: Within the confines of the Warm Springs Ponds operable unit, where human exposure is probable.

   TIME OF COMPLIANCE: During implementation of the remedial action, and at the conclusion and thereafter.

7. **General air pollution - Generators of air pollution must achieve and maintain such levels of air quality as will protect human health and safety, to the greatest extent practicable**, in accordance with the substantive standards of MCA § 75-2-102.

   POINT OF COMPLIANCE: Within the confines of the Warm Springs Ponds operable unit, where human exposure is probable.

   TIME OF COMPLIANCE: During implementation of the remedial action, and at the conclusion and thereafter. Compliance with the numeric standards listed will achieve compliance with this standard.

8. **Occupational Health and Safety Standards - No worker shall be exposed to:**

Arsenic	0.5 milligrams per cubic meter (mg/m3)
Inorganic Arsenic	10.0 ug/m3
Copper	1.0 mg/m3
Lead	0.15 mg/m3
Manganese	5.0 mg/m3
Selenium compounds	0.2 mg/m3
Silver	0.01 mg/m3
Cadmium Dust	0.2 mg/m3, 8 hour time weighted average
Mercury	0.1 mg/m3 acceptable ceiling
Silica-crystalline quartz	250 millions of particulates per cubic foot of air
Inert or nuisance dust	15 mppcf 5.0 mg/m3
Total Dust	50 mppcf 15.0 mg/m3

COMPLIANCE: The Respondent is required to comply with the Occupational Health and Safety Act, 29 U.S.C. §§ 651 - 678, and regulations promulgated at 29 CFR §§ 1910.1000, 1910.1018(c), and 1910.1025(c); and the Occupational Health Act of Montana, MCA §§ 50-70-113 and ARM § 16.42.102. Compliance with these acts and regulations, including the contaminant specific parameters identified above, will be accomplished in part through the submittal of a Site Health and Safety Plan, and compliance with that plan.

B. Ground Water Standards

1. **Contamination of ground water is prohibited. Ground Water wells must be constructed and maintained so as to prevent waste, contamination, or pollution of ground water**, in accordance with the described substantive standards of MCA § 85-2-505. **Activities cannot result in the degradation of ground water**, in accordance with ARM §§ 16.20.1011, .1003, .203, .204, .206, .207, and .1002.

   POINT OF COMPLIANCE: At the location of any ground water well located at Warm Springs Ponds operable unit.

   TIME OF COMPLIANCE: During construction or maintenance of any ground water well, both during implementation of the remedial action and upon completion of the remedial action.

C. <u>Surface Water Standards for Point Source Discharges from Ponds 2 and 3 and for Receiving Waters.</u>

1. **Numeric limitations for point source discharges, other than emergency spillway discharges or bypass events, are (all values expressed a milligrams per liter):**

	Acute	Chronic
Arsenic	0.02	0.02
Cadmium	0.0039	0.0011
Copper	0.018	0.012
Iron	-	1.0
Lead	0.082	0.0032
Mercury	0.0002	0.0002
Selenium	0.26	0.035
Silver	0.00[illegible]1	0.00012
Zinc	0.12	0.11
pH	Range between 6.5 and 9.5.	

These standards are set in accordance with ARM §§ 16.20.604, 16.20.622(2) and 16.20.618(2), and the ARAR waiver provisions of section 121(d)(4)(A) and (C) of CERCLA, 42 U.S.C. § 9621(d)(4)(A) and (C). Monitoring of point source discharges must be in compliance with 40 CFR § 122.44(i) and 40 CFR Part 136, and best management practices for operation of the Pond Treatment system must be in compliance with 40 CFR § 440.148.

POINT OF COMPLIANCE: At the point of discharge. No mixing zone will be applied to measure compliance with these requirements.

TIME OF COMPLIANCE: Upon completion of the remedial action and thereafter.

Until five years after the completion of initial construction action, interim numeric limits must be complied with by the Respondent. Interim limits, final limits, time periods for compliance, compliance monitoring requirements, and other details concerning point source discharges at the Pond Treatment system are contained in Exhibit 5 of the Unilateral Administrative Order issued to the Respondent, Detailed Performance Standards for the Point Source Discharges for the Pond Treatment System (hereinafter, Exhibit 5). Requirements and standards contained in that document must also be complied with by the Respondent.

In addition, the pollution sources from the Warm Springs Ponds Active Area, including the point source discharges, may not degrade existing high quality water. Compliance with the standards identified above will likely achieve compliance with this requirement.

These standards are set in accordance with MCA § 75-5-303 and ARM §§ 16.20.604, 16.20.622(2), 16.20.618(2), and 16.20.702.

POINT OF COMPLIANCE: Within the receiving stream.

TIME OF COMPLIANCE: Upon completion of the remedial action and thereafter.

2. **Numeric limitations for the receiving water of the point source discharges.**

Induced variation in pH	Induced variation of pH within the range of 6.5 to 9.5 must be less than 0.5 pH unit. Natural pH outside this a range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0;
Dissolved Oxygen	Must not be reduced below 7.0 mg/l;
Turbidity	No more than 5 nephelometric turbidity units above naturally occurring turbidity, except, with prior approval of EPA, for short-term construction or hydraulicprojects, or game fish population restoration;
Temperature	A 1 degree F maximum increase above naturally occurring water temperature is allowed within the range of 32 degrees F to 66 degrees F; and no discharge can cause the water temperature to exceed 67 degrees F, if the naturally occurring range is 66 degrees F to 66.5 degrees F; and the maximum allowable increase in water temperature is 0.5 degrees F, where the naturally occurringwater temperature is 66.5 F or greater. A 2 degree F per hour decrease below naturally occurring water temperature is allowed when the water temperature is above 55 degrees F; and a 2 degree F maximum decrease below naturally occurring water temperature is allowed within the range of 55 degrees F to 32 degrees F;

Color	True color must not be increased more than 5 units above naturally occurring color in the receiving stream.

No increases are allowed above naturally occurring concentration of sediment, settleable solids, oils, or floating solids in the receiving waters which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, or other wildlife.

These standards are set in accordance with ARM §§ 16.20.622(2) and 16.20.618(2).

POINT OF COMPLIANCE: Within the receiving stream.

TIME OF COMPLIANCE: Upon completion of the remedial action and thereafter. In the interim time period, these parameters should be monitored as appropriate.

D. Contaminated Soils and Mining Waste

Contaminated soils and other mining waste found within the Warm Springs Ponds active area will be remediated through excavation and dry closure, capping, or flooding. All such material which meets or exceeds the following criteria shall be addressed through the Warm Springs Pond active area remediation, in a manner consistent with the ROD and ESD and as approved by EPA.

Color shall be used as the primary criteria. Discolored materials shall be remediated. Discolored materials are readily identified visually by discoloration compared to the natural color of adjacent materials.

Texture shall be used as a secondary criterion for remediation. Soils or waste materials which are fine grained shall be remediated. Fine grained materials can be distinguished from coarse grained materials by identifying coarse sand, gravel, or cobbles (Refer to section 2.1 of the Mill-willow Bypass Removal Work Plan).

Following remediation of the above identified materials, the contaminant concentrations of soils and waste material remaining unremediated are expected to exhibit the range of concentrations shown in the attached table. If this range is not exhibited, remediation shall continue until the range is exhibited, in a manner to be approved by EPA.

II. Location Specific Performance Standards

A. Floodplain and Floodway Management Act Standards

1. Structures such as parks and wildlife management areas are permitted within floodplains, in accordance with the substantive provisions of MCA § 76-5-402.

2. Water conservation projects, flood control projects, conservation and wildlife protection projects, streamflow stabilization projects, and pollutant abatement projects are permitted in floodplains and floodways. These may include dikes, embankments, impounding reservoirs, and other watercourse improvements, in accordance with the substantive provisions of MCA §§ 76-5-1101 and 1102, and ARM § 36.15.801.

3. Flood control works are permitted in the floodplain and floodway, if they are protective to the 100 year flood frequency flow, in accordance with the substantive provisions of ARM § 36.15.606.

4. Construction and remediation activities must minimize potential harm to the floodplain and improve natural and beneficial values of the floodplain, in accordance with the substantive provisions of 40 CFR § 6.302(b) and Executive Order No. 11,988.

5. The Pond 2 and 3 facilities must be designed, constructed, operated, and maintained to avoid washout to the 100 year floodplain, in accordance with ARM § 16.44.702, as that section incorporates 40 CFR § 264.18(a) and (b).

B. Natural Streambed and Land Preservation Act Standards

1. Soil erosion and sedimentation to Montana rivers must be kept to a minimum, in accordance with MCA § 75-7-102.

C. Historic Preservation Standards

1. The Rainbow Bridge within Pond 2 is eligible for inclusion of the Register of Historic Places. The bridge must be photographed and recorded, according to the substantive regulations governing preservation of historic places. Additional measures may be identified during remedial design for compliance with this standard, in accordance with the substantive provisions of 40 CFR § 6.301(b) and 36 CFR Part 800.

2. If significant scientific, prehistorical, historic, or archaeologic data is found at the Warm Springs Ponds active area, it must be preserved in an appropriate manner, in

ADMINISTRATIVE RECORD SRC

accordance with the substantive provisions of 40 CFR § 6.301(c).

D. Wetlands Protection Standards

1. An inventory of wetlands at the Warm Springs Ponds active area as they existed prior to any cleanup activities must be compiled and approved. Activities must be conducted so as to avoid or minimize destruction of wetlands. If destruction is not avoidable, wetlands must be replaced and/or restored to ensure that no net loss of wetlands will occur as a result of the cleanup activities (past and present) at the Warm Springs Ponds active area, in accordance with the substantive provisions of 40 CFR § 6.302(a) and 40 CFR Part 6, Appendix A and Executive Order No. 11,990.

It is the current belief of EPA and the consulting agencies that previous cleanup of the Mill Willow Bypass and other areas of the Warm Springs Ponds active area has and will continue to have adverse impacts on wetland habitats. Therefore, all efforts and reconstruction, reclamation, restoration, or other similar activities planned by the Respondent must be done as part of the remedial action implementation process, to ensure compliance with this standard.

E. Endangered Species Protection Standards

1 Bald eagles and peregrine falcons have been identified as users of the Warm Springs Ponds active area. Appropriate mitigative measures during construction activities must be followed, and additional biological surveys or other studies may be required, in accordance with the substantive provisions of the Endangered Species Act, 16 U.S.C. § 1531 et seq., and 50 CFR Parts 17 and 402, and 40 CFR § 6.302(h).

III. Action Specific Performance Standards

A. Reconstruction/Reclamation/Restoration of the Mill-Willow Bypass

The Warm Springs Ponds active area remediation involves and has involved the excavation and reconstruction, reclamation, and/or restoration of the Mill-Willow Bypass. The Mill-Willow Bypass from the southern boundary of the Bypass to the end of Pond 2 is addressed in this action. In addition to the contaminant specific and location specific standards identified above, further cleanup work in the Bypass and any following reconstruction, restoration, and/or reclamation work must comply with the following requirements:

1. Substantive provisions of the dredge and fill requirements must be met, in accordance with 40 CFR Parts 230 and 231 and 33 CFR Parts 323 and 330.

2. Reclaimed drainages must be designed to emphasize channel and floodplain dimensions that will blend with the undisturbed drainage above and below the area to be reclaimed. The channel must be restored to its natural habitat or characteristic pattern with a geomorphically acceptable gradient. The drainage must safely pass through a 24-hour precipitation event with a 100-year recurrence interval. Reclamation must provide for long-term stability of the landscape, establishment or restoration of the stream to include a diversity of aquatic habitats (generally a series of riffles and pools), and restoration enhancements, or maintenance of natural riparian vegetation, in accordance with the substantive provisions of ARM § 26.4.634.

3. Temporary diversion structures at the Bypass or on Silver Bow Creek or nearby creeks must be constructed to safely pass the peak run-off from a precipitation event with a 10-year, 24-hour recurrence interval. Channel lining must be designed using standard engineering practices such as riprap, to safely pass designed velocity. Free board must be no less than 0.3 feet, all in accordance with the substantive provisions of ARM § 26.4.636.

4. Reclamation and revegetation requirements described below in Section III.B. must be met.

As noted above, reconstruction, reclamation, and restoration measures are required for the Bypass area pursuant to this administrative order, in part to ensure compliance with the standards regrading no net loss of wetlands at the Warm Springs Ponds active area.

<u>B. General Reclamation and Revegetation Standards</u>

The Warm Springs Ponds active area remediation involves and has involved excavation of contaminated areas, dry capping of contaminated areas, and the creation and maintenance of disposal areas within the Pond 3 berms. All of these areas must be reclaimed and revegetated. For those activities, the following standards apply:

1. The disposal unit and other reclaimed areas must be covered with clean soil and revegetated in an appropriate manner, consistent with the Timber Butte removal action and work plan, in accordance with the substantive provisions of 30 CFR § 816.111.

2. Revegetation of any excavated, capped in place area, disposal area, or other land area disturbed or addressed by this action must comply with the substantive standards of ARM §§ 26.4.501, .501(a), .505, .520, .631, .633, .638, .644, .703, .711, .713, .714, .716, .718, .719, .721, .724, .726, .728, .730, .751, and .761, and MCA §§ 82-4-231 and -233.

C. The Dry Disposal Areas within Pond 3 Standards.

The Warm Springs Ponds active area remediation involves and has involved the creation and maintenance of dry disposal areas within the Pond 3 berms. The construction and maintenance of these areas must comply with the following standards:

1. All waste within the disposal areas must be drained of free liquids, and stabilized appropriately, in accordance with the substantive provisions of 40 CFR § 264.228(a), which is incorporated by reference into ARM § 16.44.702.

2. Closure of the disposal areas must be done in such a manner as to minimize the need for further maintenance and to control, minimize, or eliminate, to the extent necessary to protect public health and the environment, post-closure escape of hazardous substances, hazardous constituents, leachate, contaminated run-off or hazardous substance decomposition products to the ground water or surface waters or to the atmosphere, all in accordance with the substantive provisions of 40 CFR § 264.111, which is incorporated by reference into ARM § 16.44.702. This standard does not require an impermeable cap or liners

3. Disposal facility covers for each unit must function with minimum maintenance, promote drainage, and minimize erosion or abrasion of the final cover, and accommodate settling and subsidence, in accordance with 40 CFR § 264.228(a)(2)(iii)(B), (C), and (D), which is incorporated by reference into ARM § 16.44.702.

4. The Respondent must submit to the local land use or zoning authority a survey plat indicating the location and dimensions of waste disposed of in each unit. Additionally, the Respondent must record a deed restriction, in accordance with State law, that will in perpetuity notify potential purchasers that the property has been used for waste disposal and that its use is restricted, in accordance with the substantive provisions of 40 CFR §§ 264.116 and .119, which is incorporated by reference into ARM § 16.44.702.

5. The Respondent's waste can be disposed of on its own property, but the disposal areas must not create a nuisance or a public hazard. Additionally, the waste must be

disposed of outside of the 100 year flood plain, must be disposed of in a manner which prevents pollution of the ground or surface water, must contain adequate drainage structures, and must prevent run-off from entering disposal areas; and waste must be transported to the disposal areas in such a manner as to prevent its discharge, dumping, spillage, or leaking, in accordance with the substantive provisions of ARM §§ 16.14.505 and .523, and MCA § 75-10-214.

D. Berm Strengthening Standards

Many of the berms within the Warm Springs Ponds active area will be or have been remediated by strengthening the berms against floods or earthquakes. The berm strengthening actions must comply with the following standards:

1. The dams and reservoirs which store water must do so in a secure, thorough, and substantial and safe manner, in accordance with the substantive provisions of MCA §§ 85-15-207 and 208.

2. All high hazard dams and berms must comply with the criteria given in ARM § 36.14.501, including compliance with the Maximum Credible Earthquake standards.

3. All high hazard dams must be able to safely pass the flood calculated from the inflow design flood, to the extent of safely managing the 0.5 Probable Maximum Flood, in accordance with the substantive provisions of ARM § 36.14.502.

E. Standards Associated with Continued Operation of Ponds 2 and 3

Under this interim remedial action at the Warm Springs Ponds active area, Ponds 2 and 3 will be left in place, and will continue to function as treatment and storage ponds for hazardous substances. This continued operation must comply with the following standards:

1. The structural integrity of the Ponds must comply with the substantive provisions of 40 CFR§ 264.221(f), (g), (h) and 40 CFR § 264.226, which are incorporated by reference into ARM §§ 16.44.701 - .703. This includes protection against overtopping and continued regular inspection and maintenance.

2. Discharges from the Ponds must be monitored in compliance with ARM § 16.20.1321(12)(f) and 40 CFR § 122.44(i), which incorporates by reference 40 CFR Part 136. Full monitoring requirements for point source discharges from the Ponds Treatment System are described in Exhibit 5.

3. The Ponds must be operated with the substantive standards describing Best Management Practices found in ARM § 16.20.1310(15)(a) and 40 CFR § 125.102.

4. The Ponds must be operated to prevent pollution of surface waters above the numeric standards identified above, in accordance with the substantive standards of ARM §§ 16.20.633, and MCA §§ 75-5-605 and 75-6-112(2).

F. Ground Water Monitoring Standards

The Warm Springs Ponds active area remediation will involve ground water monitoring from existing wells if possible. Such activities must comply with the following standards:

1. Standards established in 40 CFR § 264.97, which is incorporated by reference into ARM § 16.44.702, must be complied with. Only contaminants for ground water identified in the September 1990 ROD must be monitored.

IV. Other Laws

In addition to the environmental or siting standards identified above, the State of Montana has identified a list of other State laws which should be complied with during the conduct of site remediation and maintenance activities. These are:

A. Occupational Health and Safety, and Community and Worker Right to Know Laws

1. Noise levels for protection of on-site workers must be met, as described in ARM § 16.42.101.

2. The Occupational Health and Safety Act, 20 U.S.C. §§ 651 - 678, and implementing regulations must be complied with. Particularly, 29 CFR Part 1926 and 29 CFR §§ 1910.120 and .132 must be complied with. As noted earlier, the Respondent is required to submit and follow and site specific Health and Safety Plan for conduct of activities at the Warm Springs Ponds active area.

3. To the extent it is applicable, substantive provisions of the Montana Safety Act, MCA § 50-71-201 must be complied with.

4. To the extent applicable, the Employee and Community Hazardous Chemical Information Act must be complied with, in accordance with the substantive provisions of MCA §§ 50-78--202, -203, -204, and -305.

B. Ground Water Well Drilling and Monitoring

1. If ground water wells are determined to be necessary, well drillers must be licensed and registered as stated in ARM §§ 36.21.402, .403, .405, .406, .411, .701, and .703.

2. Ground water wells must be logged and reported to the Department of Natural Resources Conversation, as stated in MCA § 85-2-516.

C. Water use rights

1. To the extent applicable, any remedial activities at the Warm Springs Ponds active area must comply with the substantive provisions of MCA §§ 85-2-301, -306, -311, and -402, and MCA §§ 75-7-104 and 87-5-506, and implementing regulations found at ARM §§ 36.16.104 - .106, and 26.4.648. Appropriate notice to the Department of Natural Resources should be given.

ADMINISTRATIVE RECORD

APPENDIX D
EXHIBIT 5

Detailed Performance Standards for Point Source Discharges from Ponds 2 and 3

I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. Definitions.

1. The "30-day (and monthly) average," is the arithmetic average of all composite samples collected during a consecutive 30-day period or calendar month, whichever is applicable. The calendar month shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms.

2. "Daily Maximum" ("Daily Max.") is the maximum value allowable in any single composite sample.

3. "Composite samples" shall be flow proportioned. The composite sample shall, as a minimum, contain at least four (4) samples collected over the compositing period. Unless otherwise specified, the time between the collection of the first sample and the last sample shall not be less than six (6) hours nor more than 24 hours. Acceptable methods for preparation of composite samples are as follows:

   a. Constant time interval between samples, sample volume proportional to flow rate at time of sampling;

   b. Constant time interval between samples, sample volume proportional to total flow (volume) since last sample. For the first sample, the flow rate at the time the sample was collected may be used. When substantial diurnal flow variations do not occur, simple time-composite sampling are allowed;

   c. Constant sample volume, time interval between samples proportional to flow (i.e., sample taken every "X" gallons of flow); and,

   d. Continuous collection of sample, with sample collection rate proportional to flow rate.

4. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

5. An "instantaneous" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement.

6. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with effluent limitations because of factors beyond the reasonable control of Settling Respondent. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

7. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility. The intentional release of treated water from the Pond 3 controlled discharge or emergency spillway structures shall not be a Bypass.

8. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

9. "Completion of Initial Construction" means the completion of the initial on-site physical actions required for the construction of the lime treatment system, the flooding or dry closure of contaminated areas in and around Pond 2, and the reconstruction, reclamation, and restoration of the excavated portions of the Mill-Willow Bypass, as described in the Work Plan and the Final Design Report. Completion of Construction does not include activities required under Sections X and XII of the Unilateral Administrative Order, or activities occurring during the shakedown period of operation of the Pond system.

B. <u>Description of Discharge Points</u>

The authorization to discharge is limited to those outfalls specifically designated below as discharge locations. Flows which bypass the Pond System during abnormally high flow periods (flows in excess of approximately 3,300 cfs) are not regulated by these conditions. Discharges at any location not authorized herein are a violation and could subject the Respondent to penalties. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge within a reasonable time from first learning of an unauthorized discharge could subject the Respondent to criminal penalties.

Outfall Serial Number	Description of Discharge
002	Pond 2 controlled discharge to the Mill-Willow Bypass.
003	Pond 3 controlled discharge to the Mill-Willow Bypass.
004	Pond 2 Emergency Spillway discharge.
005	Pond 3 Emergency Spillway discharge.
006	Drains from the North-South Dike adjacent to the Mill-Willow Bypass.

C. Discharge Conditions

1. Discharge 002 - Pond 2 Controlled Discharge

a. Tier I Interim Standards. The following limitations are effective immediately upon the effective date of the Unilateral Administrative Order, which this document is an attachment to. These limitations will remain in effect until four years after the effective date of the Unilateral Administrative Order.

Parameter	Daily Max.(mg/l)*	Monthly Avg.(mg/l)*
Arsenic (Total)	0.05	0.02
Cadmium	0.01	0.0062
Copper	0.09	0.035
Iron	2.2	1.5
Lead	0.1	0.1
Mercury	0.001	0.0002
Zinc	0.3	0.16
TSS	45.0	45.0
pH	6.5-9.5 Units	

* With the exception of arsenic, copper, iron, mercury, TSS and pH, these limitations are based on the Acute Ambient Water Quality Criteria assuming a hardness of 150 mg/l. Adjustment factors for hardness contained in the "Quality Criteria For Water 1986" also known as the "Gold Book" will be applied to limitations for cadmium, lead and zinc. Hardness shall be measured in the discharge and adjustments to the limitations calculated for each composite sample with measured hardness greater than 150 mg/l.

b. Tier II Interim Standards. Four years after the effective date of the Unilateral Administrative Order, the following limitations shall become effective:

Parameter	Daily Max.(mg/l)*	Monthly Avg.(mg/l)*
Arsenic (Total)	0.02	0.02
Cadmium	0.0039	0.0039
Copper	0.035	0.018
Iron	1.5	1.5
Lead	0.082	0.082
Mercury	0.0002	0.0002
Zinc	0.12	0.12
TSS	45.0	45.0
pH	6.5-9.5 Units	

* With the exception of arsenic, copper, iron, mercury, TSS and pH, these limitations are based on the Acute Ambient Water Quality Criteria assuming a hardness of 100 mg/l. Hardness shall be measured in the discharge and limitations adjusted for each sample with hardness greater than 100 mg/l. The monthly average copper limitation also may be adjusted for measured hardness. These limitations will remain in effect until six years after the effective date of the Unilateral Administrative Order.

c. <u>Final Standards.</u> The following limitations shall become effective six years after the effective date of the Unilateral Administrative Order.

Parameter	Daily Max.(mg/l)*	Monthly Avg.(mg/l)*
Arsenic (Total)	0.02	0.02
Cadmium	0.0039	0.0011
Copper	0.018	0.012
Iron	1.5	1.0
Lead	0.082	0.0032
Mercury	0.0002	0.0002
Selenium+	0.26	^.035
Silver+	0.0041	0.00012
Zinc	0.12	0.11
TSS	45.0	30.0
pH	6.5-9.5 Units	

+ At the conclusion of four years after the effective date of the Unilateral Administrative Order, EPA will reevaluate the frequency of monitoring and the necessity of retaining the numeric limitations for silver and selenium. If changes are appropriate, EPA may modify Exhibit 5and the Unilateral Administrative Order.

* These limitations are the Chronic and Acute Ambient Water Quality Criteria assuming a hardness of 100 mg/l. Adjustments to the limitations based on measured hardness at the discharge shall be made for cadmium, copper, lead, silver (except no adjustment is allowed in the monthly average limitation for silver) and zinc.

2. Discharge 003 - Pond 3 Controlled Discharge

a. Tier I Interim Standards. The following discharge limitations are effective upon the effective date of the Unilateral Administrative Order:

Parameters	Daily Max.(mg/l)*	Monthly Avg.(mg/l)*
Arsenic (Total)	0.05	0.02
Cadmium	0.01	0.0062
Copper	0.09	0.035
Iron	2.2	—
Lead	0.1	0.1
Mercury	0.001	0.0002
Zinc	0.3	0.16
TSS	45.0	45.0
pH	6.5-9.5 Units	

* See footnotes in I.C.1. These discharge limitations assume a hardness of 150 mg/l. Adjustments to the limitations shall be made, based on measured hardness at the discharge, for those samples with hardness greater than 150 mg/l.

These limitations will apply until four years after the effective date of the Unilateral Administrative Order. Monthly average limits shall not apply until EPA certifies the completion of construction for the Pond upgrade requirements.

b. Tier II Interim Standards. Four years after the effective date of the Unilateral Administrative Order, the following limitations shall become effective:

Parameters	Daily Max.(mg/l)*	Monthly Avg.(mg/l)*
Arsenic (Total)	0.02	0.02
Cadmium	0.0059	0.00592
Copper	0.053	0.027
Iron	2.2	2.2
Lead	0.123	0.123
Mercury	0.0002	0.0002
Zinc	0.18	0.18
TSS	45.0	45.0
pH	6.5-9.5 Units	

* See footnote at I.C.1. For cadmium, copper, iron and zinc, these limitations are 150 percent of the associated discharge limitations for Pond 2. For those parameters for which the limitations are based on an assumed hardness of 100 mg/l, adjustments can be made to the limitations according to the measured hardness of the discharge. The adjusted limitation shall be 150 percent of the appropriate Acute Ambient Water Quality Criteria at the measured hardness. These limitations will apply until six years from the effective date of the Unilateral Administrative Order.

c. Final Standards. The following discharge limitations shall become effective six years after the effective date of the Unilateral Administrative Order:

Parameter	Daily Max.(mg/l)*	Monthly Avg.(mg/l)*
Arsenic (Total)	0.02	0.02
Cadmium	0.0039	0.0011
Copper	0.018	0.012
Iron	1.5	1.0
Lead	0.082	0.0032
Mercury	0.0002	0.0002
Selenium+	0.26	0.035
Silver+	0.0041	0.00012
Zinc	0.12	0.11
TSS	45.0	30.0
pH	6.5-9.5 Units	

+ At the conclusion of four years after the effective date of the Unilateral Administrative Order, EPA will reevaluate the frequency of monitoring, as described in this Exhibit, and the necessity of retaining the numeric limitations for silver and selenium. If changes are appropriate, EPA may modify Exhibit 5 and the Unilateral Administrative Order.

* These limitations are based on Acute and Chronic Ambient Water Quality Criteria and assume a hardness of 100 mg/l. Adjustments to the limitations based on measured hardness at the discharge shall be made for cadmium, copper, lead, silver (except no adjustment is allowed in the monthly average limitation for silver) and zinc.

3. Discharges 004 and 005 - Emergency Spillway Discharges from Ponds 2 and 3.

Discharges from the Emergency Spillways in Pond 2 and Pond 3 may occur at any time that the water level in the respective pond rises above the elevation of the spillway. The quality of these discharges will not be regulated. Monitoring and reporting of spillway discharge is required as specified below in sections II, III and IV.

Respondent shall not use discharges 004 and 005 solely to avoid compliance with the discharge limitations applied to discharges 002 and 003.

4. Discharge 006 - Toe Drains from the North-South Dike adjacent to the Mill-Willow Bypass.

There shall be no discharge from the toe drains to the Mill-Willow Bypass effective one year after the effective date of the Unilateral Administrative Order. Flows from the drains shall be collected and returned to the Pond system for treatment.

D. Monitoring Requirements

As a minimum, within 45 days of the effective date of the of the Unilateral Administrative Order, the following constituents shall be monitored at the frequency and with the type of measurement indicated; samples or measurements shall be representative of the volume and nature of the monitored discharge. All monitoring and sampling shall use EPA total recoverable methods.

1. <u>Discharge 002</u> - Pond 2 Controlled Discharge

Parameter	Frequency	Sample Type
Arsenic (Total)	Twice per week	Composite
Cadmium	"	"
Copper	"	"
Iron	"	"
Lead	"	"
Mercury	"	"
Selenium	Once per month	"
Silver	"	"
Zinc	Twice per week	"
Total Flow, mgd (a),(b)	"	"
Hardness	"	"
pH, Units	"	"
Temperature, °C	"	"
Total Suspended Solids	"	"
Volatile Suspended Solids	"	"
Turbidity	"	"
Specific Conductance	"	"
Alkalinity	"	"
Sulfate	"	"
NO_3+NO_2-N	Twice per month	composite
NH_3-N	"	"
TKN	"	"
Total Phosphorous	"	"
Dissolved Ortho-P	"	"

(a) Flow measurements of effluent volume shall be made in such a manner that the Respondent can affirmatively demonstrate that representative values are being obtained.

(b) If the rate of discharge is controlled, the rate and duration of discharge shall be reported.

2. Discharge 003 - Pond 3 Discharge

Measurements shall be made prior to discharge from Pond 3 discharge (even if discharge is not occurring), and during any discharge period. Each sample for laboratory analysis shall be taken in the immediate vicinity of the discharge structure.

Parameter	Frequency	Sample Type
Arsenic	Prior to discharge and twice per week during discharge	Grab
Cadmium	“	Composite
Copper	“	”
Iron	“	”
Lead	“	”
Mercury	“	”
Selenium	Once per month	“
Silver	“	”
Zinc	Twice per week	“
Total Flow, mgd (a),(b)	“	”
Hardness	“	”
pH, Units	“	”
Temperature, °C	“	”
Total Suspended Solids	“	”
Volatile Suspended Solids	“	”
Turbidity	“	”
Specific Conductance	“	”
Alkalinity	“	”
Sulfate	“	”
NO_3/NO_2-N	Twice per month	composite
NH_3-N	“	”
TKN	“	”
Total Phosphorous	“	”
Dissolved Ortho-P	“	”

(a) Total flow during each discharge event will be calculated from Pond 3 operating records.

(b) The rate and duration of discharge shall be reported.

3. Discharges 004 and 005 - Pond 2 and 3 Emergency Spillway Discharges.

Effluent Characteristic	Frequency	Sample Type
Total Flow	Continuous	Depth recorder at Weir

Total flow during each discharge event will be calculated from Pond 3 operating records.

4. Additional Monitoring - The inlet to Pond 3 prior to the addition of treating chemicals shall be monitored as indicated. Monitoring shall begin one year after the effective date of the Unilateral Administrative Order.

Parameter	Frequency	Sample Type
Arsenic (Total)	Twice per week	Composite
Cadmium	"	"
Copper	"	"
Iron	"	"
Lead	"	"
Mercury	"	"
Selenium	Once per month	"
Silver	"	"
Zinc	Twice per week	"
Total Flow, mgd	"	"
Hardness	"	"
pH, Units	"	"
Temperature, °C	"	"
Total Suspended Solids	"	"
Volatile Suspended Solids	"	"
Turbidity	"	"
Specific Conductance	"	"
Alkalinity	"	"
Sulfate	"	"
NO_3/NO_2-N	Twice per month	composite
NH_3-N	"	"
TKN	"	"
Total Phosphorous	"	"
Dissolved Ortho-P	"	"

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling. Samples taken in compliance with the monitoring requirements established under Part I shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge. Sampling shall use the EPA total recoverable method.

B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this Exhibit.

C. Reporting of Monitoring Results. Effluent monitoring results obtained during the previous month shall be summarized for each month and reported on a Discharge Monitoring Report Form (EPA No. 3320-1) or equivalent approved form, postmarked no later than the 28th day of the month following the completed reporting period. Monitoring data shall also be reported in the Clark Fork Data Management electronic format. Legible copies of these, and all other reports required herein, shall be signed and certified in accordance with the Signatory Requirements (see Part IV), and submitted to the Director, Montana EPA Office and the Director, State Water Quality Bureau at the following addresses (collectively referred to as the Directors):

original to:

United States Environmental Protection Agency
Region 8, Montana Office
301 South Park, Drawer 10096
Helena, MT 59626

Attention: D. Scott Brown
Remedial Project Manager

copy to:

Montana Department Of Health and
Environmental Sciences
Water Quality Bureau
Cogswell Building
Helena, MT 59620

Attention: Fred Shewman

D. Compliance Schedules. Any progress report, compliance report, or noncompliance report on achieving interim and final requirements contained in any Compliance Schedule of this document shall be submitted no later than 14 days following each schedule date.

E. Additional Monitoring. If Respondent monitors any pollutant more frequently than required by this Exhibit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated.

F. Report Contents. Reports of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements;

2. The initials or name(s) of the individual(s) who performed the sampling or measurements;

3. The date(s) analyses were performed;

4. The time analyses was initiated;

5. The initials or name(s) of individual(s) who performed the analyses;

6. References and written procedures, when available, for the analytical techniques or methods used; and,

7. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine these results.

G. Retention of Records. Respondent shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, and copies of all reports required by this Exhibit, for a period of at least ten years from the date of the sample, measurement or report. This period may be extended by request of the Directors at any time. Data collected on site, copies of Discharge Monitoring Reports, and a copy of this Exhibit must be maintained on site during the duration of activity at the site.

H. Twenty-four Hour Notice of Noncompliance Reporting.

1. Respondent shall report any noncompliance which may seriously endanger health or the environment as soon as possible, but no later than twenty-four (24) hours from the time the Respondent first became aware of the circumstances. The report shall be made to the EPA, Region 8, Montana Office at 406 449-5414 and the State of Montana at 406 444-6911.

2. The following occurrences of noncompliance shall be reported by telephone to the EPA, Region VIII, Montana Office at 406 449-5414 and the State of Montana at 406 444-2406 by the first workday (8:00 a.m. - 4:30 p.m. Mountain Time) following the day Respondent became aware of the circumstances:

   a. Any unanticipated bypass which exceeds any effluent limitation in this Exhibit; or

   b. Any upset which exceeds any effluent limitation in this Exhibit.

3. Any violation of a maximum daily discharge limitation for any of the pollutants listed in this Exhibit is to be reported within 24 hours.

4. A written submission of II.H.1. and 2. violations shall also be provided within five days of the time that Respondent becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

   d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

5. The EPA Montana Office Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the EPA Montana Office, Helena, Montana, by phone, 449-5414.

6. Reports shall be submitted to the addresses in Part II.C., Reporting of Monitoring Results.

I. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for Part II.C. are submitted. The reports shall contain the information listed in Part II, H, 2 and 4.

J. Inspection and Entry. In additions to the requirements of the Unilateral Administrative Order, Respondent shall allow the Directors, or an authorized representative, including representatives of the State of Montana, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the Respondent's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Exhibit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Exhibit; and,

4. Sample or monitor at reasonable times, for the purpose of assuring compliance or as otherwise authorized by this Exhibit, any substances or parameters at any location.

K. Other Requirements

EPA and the Montana Water Quality Bureau shall be notified as specified above if Respondent proposes to utilize the Pond 3 discharge in lieu of discharging to Pond 2.

III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. Respondent must comply with all conditions of this Unilateral Administrative Order, including Exhibit 5. Any noncompliance constitutes a violation of the Unilateral Administrative Order and is grounds for enforcement action. Settling Respondent shall give the Director advance notice of any planned changes at the facility or of an activity which may result in noncompliance.

B. Penalties for Violations of Discharge Conditions. Except for Part III.G., Upset Conditions, nothing in this Exhibit shall be construed to relieve Respondent of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense in an enforcement action that it would have been necessary to halt or reduce the activity in order to maintain compliance with the conditions of the Unilateral Administrative Order, including this Exhibit.

D. Duty to Mitigate. Settling Respondent shall take all reasonable steps to minimize or prevent any discharge in violation of this Exhibit.

E. Proper Operation and Maintenance. Respondent shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the conditions of this Unilateral Administrative Order, including the Exhibit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed only when the operation is necessary to achieve compliance with the conditions of the Unilateral Administrative Order including the Exhibit.

F. Removed Substances. Collected screening, grit, solids, sludges, or other pollutants removed in the course of treatment shall be buried or disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard.

G. Upset Conditions.

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with effluent limitations, if the requirements of paragraph 2. of this section are met. See "Upset" definition at I.A.6.

2. Conditions necessary for a demonstration of upset. To establish the affirmative defense of upset, Respondent shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that Respondent can identify the cause(s) of the upset;

   b. The facility was at the time being properly operated;

   c. Respondent submitted notice of the upset as required under Part II.H., Twenty-four Hour Notice of Noncompliance Reporting; and,

   d. Respondent complied with any remedial measures required under Part III.D., Duty to Mitigate.

3. Burden of proof. In any proceeding, the party seeking to establish the occurrence of an upset has the burden of proof.

4. It is the goal of Section III.G. of this Exhibit (Upset Conditions) to reduce to zero the frequency of exceedances of discharge limits due to upset conditions.

H. The five year periodic review process, described in Unilateral Administrative Order, shall begin four (4) years after the effective date of the Unilateral Administrative Order and shall be concluded no later than five (5) years after the effective date of the Unilateral Administrative Order. The five year periodic review process shall involve public comment, as described in applicable EPA guidance and the NCP.

IV. GENERAL REQUIREMENTS

A. <u>Signatory Requirements</u>. All reports or information submitted to the Directors shall be signed and certified.

1. All reports required by this Exhibit shall be signed by a duly authorized representative of Settling Respondent. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Director, and,

   b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

2. Changes to authorization. If an authorization under paragraph IV.A.1. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph IV.A.1. must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

3. Certification. Any person signing a document under this section shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

B. <u>Availability of Reports</u>. Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this Exhibit shall be available for public inspection at the offices of the State Water Quality Bureau and the EPA Montana Office Director. As required by law, monitoring data shall not be considered confidential.

ADMINISTRATIVE RECORD SBC

APPENDIX E

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8

IN THE MATTER OF:

SILVER BOW CREEK/
BUTTE AREA (ORIGINAL
PORTION) SUPERFUND SITE;
WARM SPRINGS PONDS INACTIVE AREA
OPERABLE UNIT:
SITE NO. 22.
OPERABLE UNIT NO. 12.

ATLANTIC RICHFIELD COMPANY,
and/or ATLANTIC RICHFIELD COMPANY,
INCORPORATED,
RESPONDENT.

PROCEEDING UNDER SECTION 106(a)
OF THE COMPREHENSIVE ENVIRONMENTAL
RESPONSE, COMPENSATION, AND
LIABILITY ACT, AS AMENDED,
42 U.S.C. § 9606 (a).

EPA Docket No.
CERCLA-VIII-93-23

ADMINISTRATIVE ORDER
FOR REMEDIAL DESIGN/REMEDIAL ACTION

TABLE OF CONTENTS

EXHIBIT 4

APPLICABLE OR RELEVANT AND APPROPRIATE
REQUIREMENTS, STANDARDS, CONTROLS, CRITERIA, OR LIMITATIONS
AND OTHER PERFORMANCE STANDARDS
FOR THE
WARM SPRINGS PONDS INACTIVE AREA OPERABLE UNIT
SILVER BOW CREEK/BUTTE AREA (ORIGINAL PORTION) SUPERFUND SITE
CLARK FORK RIVER BASIN, MONTANA

Section 121(d) of CERCLA, 42 U.S.C. Section 9621(d), certain provisions of the current National Contingency Plan (the NCP), 40 CFR Part 300 (1990), and guidance and policy issued by the Environmental Protection Agency (EPA) require that remedial actions taken pursuant to Superfund authority shall require compliance with substantive provisions of applicable or relevant and appropriate standards, requirements, criteria, or limitations from State environmental and facility siting laws, and from federal environmental laws (commonly referred to as ARARs) at the completion of the remedial action, and/or during the implementation of the remedial action, unless a waiver is granted. ARARs are the first type of performance standard applicable to Superfund cleanups.

Each ARAR or group of related ARARs is identified by a specific statutory or regulatory citation, and a compliance description which addresses how and when compliance with the ARAR will be measured (some ARARs will govern the conduct of the implementation of the remedial action, some will govern the measure of success of the remedial action, and some will do both). Contaminant specific ARARs are followed by a description of the point of compliance, which describes where compliance with the ARAR will be measured.

Only substantive portions of the listed requirements are ARARs. Administrative and procedural requirements are not ARARs, and need not be attained during or after site cleanups. Administrative and procedural requirements are those which involve consultation, issuance of permits, documentation, reporting, recordkeeping, and enforcement. The CERCLA program has its own set of administrative procedures which assure proper implementation of CERCLA. The application of additional or conflicting administrative or procedure requirements could result in delay and confusion. The only exception to this involves the application of State of Montana water use law to activities contemplated at the site. Because the substantive provisions of those laws are closely tied to procedural rights, EPA has recommended that the potentially responsible party, ARCO, apply for any necessary water right permit or otherwise comply with State water right law, where water rights are implicated by the cleanup activities contemplated by this ROD. This is a narrow exception to the general principle described above, and EPA has reserved its right to review this decision if significant delay is caused by separate water rights proceedings.

Beside ARARs, performance standard can consist of standards determined by EPA to be necessary for ensuring the protection of human health and the environment. Soils standards and the hydraulic gradient standard identified below are examples of these types of standards.

Also listed are non-environmental State laws, which the State of Montana has identified as potentially applicable to this action.

CERCLA authorized actions which are conducted on-site are exempt from permit requirements, pursuant to section 121(e) of CERCLA, 42 U.S.C. § 9621(e). This exemption applies to all activities contemplated by this Record of Decision. However, as noted in the paragraph above, EPA has recommended to the potentially responsible party that a narrow exception to this rule be observed for water rights issues.

The scope of this Interim Record of Decision

EPA guidance establishes that interim actions, such as removal actions or interim remedial actions, need not meet all ARARs potentially implicated at an operable unit. Rather, removals or interim actions must comply with ARARs which address the specific scope of the removal or interim action.

The Warm Springs Ponds Inactive Area Remedial Action is an interim action, in that it will be reviewed after implementation of upstream cleanup activities and cleanup activities at the Ponds. Nevertheless, the action is meant to be a permanent action which addresses site conditions comprehensively. Accordingly, all of the ARARs listed here are within the scope of this interim action.

Final action levels in soils and contaminated materials for protection of human health and the environment for the various contaminants found at the Warm Springs Ponds Inactive Area are not identified in this Record of Decision. Ongoing risk assessment work at other operable units within the Clark Fork Basin and ecological monitoring required under this action will determine those action levels. Compliance with any final action level is expected to be achieved with this cleanup. This issue will be reviewed before a final cleanup is selected or declared for the entire Warm Springs Ponds area.

1. **CONTAMINANT SPECIFIC ARARS AND PERFORMANCE STANDARDS**

I. Groundwater

A. Maximum Contaminant Levels and non-zero Maximum Contaminant Limit Goals for contaminants of concern at the site, promulgated pursuant to the Safe Drinking Water Act, 42 U.S.C. §§ 300f et seq. and the Montana Public Water Supplies Act, MCA §§ 75-6-100 et seq. Regulations establishing specific limits are found at 40 CFR §§ 141.11 - .16 and ARM §§ 16.20.203 - .205, .1002, .1003, and .1011. These standards in part are also required by the Resource Conversation and Recovery Act, 42 U.S.C. §§ 6901 et seq. and 40 CFR § 264.94, and corresponding State of Montana statutes and regulations.

Specific levels are:

Arsenic	0.050 milligrams per liter (mg/l)
Cadmium	0.010 mg/l
Chromium	0.050 mg/l
Lead	0.050 mg/l
Mercury	0.002 mg/l
Nitrate (as N)	10.000 mg/l

Both the time and point of compliance with these standards is influenced by the presence of the temporary pumpback system. While the interception trench and pumpback system is operating, the standards must be met immediately north of the ground water interception trench. Immediately prior to shutting down the interception trench and pumpback system, and thereafter, these standards must be met immediately south of the ground water interception trench. See also related standards regarding implementation of the interception trench and pumpback system and shut off of the interception trench and pumpback system. Completion of Remedial Action Completion can be certified for this Performance Standard upon a demonstration of consistent compliance with ground water standards immediately south of the ground water interception trench for a period of twenty four months.

B. Hydraulic Gradient Performance

A controlled hydraulic gradient shall be maintained by means of grading along and within the western portion of Pond 1 and a ground water interception trench and pump-back system immediately south of the proposed Pond 1 berm extension. This controlled hydraulic gradient shall be constructed and operated such that all ground water flow in the affected aquifer or aquifers is toward the interception trench, from all directions. ARCO shall use best efforts to ensure that all of the necessary components of the controlled hydraulic gradient are monitored to demonstrate their effectiveness. Further, ARCO shall use best efforts to ensure that the hydraulic gradient standard is a temporary standard. It is intended to temporarily supplement, not supplant, metals immobilization by means of chemical fixation and wet and dry closures.

The controlled hydraulic gradient performance standard is applicable during implementation of remedial action, and shall become effective immediately upon completion of construction of the interception trench and pump-back system, and continue so long as the interception trench and pumpback system are operating. The interception trench and pumpback system shall not be terminated until ARCO demonstrates and EPA determines that (a) ground water performance standards identified above have been consistently complied with for a period of at least 24 months at a point or points immediately south of the interception trench, and (b) flow of ground water from the operable unit, after the pump back system is discontinued, will not adversely affect surface water in the lower bypass or the Clark Fork River.

Compliance with this Performance Standard shall be determined based upon monitoring of water levels in: (a) piezometers to be constructed both north and south of the interception trench and along the Pond 1 berm, (b) the ground water interception trench itself, and (3) the lower bypass channel.

Compliance with the standards identified in I.A. and I.B. will also achieve compliance with the State of Montana non-degradation standard for ground water, ARM § 16.20.1011.

C. Ground water well construction criteria.

Additional contamination of ground water through construction of ground water wells is prohibited. Ground water wells must be constructed and maintained so as to prevent waste, contamination, or pollution of ground water. Activities cannot result in the degradation of ground water, in accordance with ARM §§ 16.20.203, .204, .206, .207, .1002, .1003, and .1011. To the extent these regulation identify numeric limits for contaminants in the ground water other than those substances which are listed in Section I.A. above, numeric limits for other substances are not Performance Standards for the WSPIA remedy.

This performance standard must be met during construction or maintenance of any ground water well, both during implementation of the remedial action and upon completion of remedial action.

II. Surface Water

A. Ambient Standards

State of Montana surface water quality standards and federal water quality criteria, or appropriate replacement values for those standards and criteria which are waived, must be met for in-stream ambient water at or near the site (that is, water within the reconstructed Lower Bypass, and the water entering the Clark Fork River). These standards are enacted pursuant to the section 304 of the Clean Water Act, 42 U.S.C. § 1314 and the "Gold Book" (aka Water Quality Criteria for Water, 1986); and the Montana Water Quality Act, MCA §§ 75-5-101 et seq. and ARM §§ 16.20.618(2) and 16.20.622(2) (the Clark Fork River is class C-2 River and the Mill and Willow rivers are class B-1 rivers - see ARM §§ 16.20.604, .618, and .622).

Specific limits are:

	Acute	Chronic
Arsenic (III)	0.36 mg/l	0.19 mg/l
Arsenic (V)	0.85 mg/l	0.048 mg/l
Arsenic (Total)	-	0.02 mg/l*
Cadmium	0.0039 mg/l**	0.0011 mg/l**
Copper	0.018 mg/l**	0.012 mg/l**
Iron	-	1.0 mg/l
Lead	0.082 mg/l**	0.0032 mg/l**
Mercury	-	0.2 ug/l*
Zinc	0.12 mg/l**	0.11 mg/l**

* indicates that the standard is a replacement standard for a standard which is waived, pursuant to section 121(d)(4)(A) and (C) of CERCLA. See Warm Springs Ponds Active Area Record of Decision (EPA, 1990).
** indicates that the value is based on an assumed hardness of 100 mg/l. If average hardness can be demonstrated to occur at different levels at monitoring points or at the compliance point, the standards will be adjusted appropriately.

Dissolved Oxygen - Dissolved oxygen concentration may not be reduced below 7.0 mg/l.

pH - Induced variation of pH within the range of 6.5 to 9.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

Turbidity - The maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units except for short-term construction or hydraulic projects, game fish population restoration, as allowed in ARM s§ 16.20.633.

Temperature - A 1 degree F maximum increase above naturally occurring water temperature is allowed within the range of 32 degrees to 66 degrees F; within the naturally occurring range of 66 degrees F to 66.5 degrees F, no discharge is allowed which will cause the water temperature to exceed 67 degrees F; and where the naturally occurring water temperature is 66.5 degrees F or greater, the maximum allowable increase in water temperature is 0.5 degrees F. A 2 degree F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55 degrees F, and a 2 degree F maximum decrease below naturally occurring water temperature is allowed within the range of 55 degrees F to 32 degrees F.

Sediment, etc. - No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, or other wildlife.

Color - True color must not be increased more than 5 units above naturally occurring color.

These standards must be met at the point of compliance, which will be within the reconstructed bypass channel immediately upstream of the confluence with Warm Springs Creek. This point will be further defined in design documents developed for implementation of the Warm Springs Ponds Inactive Area remedy. These standards must be met at the conclusion of the remedial action implementation, or at the conclusion of the Active Area remediation including the shakedown period, whichever comes later.

Appropriate in-stream monitoring must be implemented to measure in-stream values, if such monitoring is not already implemented as part of the Active Area remediation or the Clark Fork Basin monitoring effort.

If exceedences of the in-stream standards can be demonstrated by the potentially responsible party to be caused by conditions which are unrelated to the Warm Springs Ponds Active and Inactive Area operable units and unrelated to the operation of the Warm Springs Ponds Inactive and Active Area operable units or the Warm Springs Ponds treatment system, these ARARs and Performance Standards will not be considered to be violated.

Compliance with these standards will constitute compliance with the State of Montana's non-degradation standards, promulgated pursuant to the Montana Water Quality Act, MCA § 75-5-303, and ARM § 16.20.702.

III. Air Standards

Standards related to air pollution are promulgated pursuant to the Clean Air Act, 42 U.S.C. §§ 7401 et seq. and the Clean Air Act of Montana, MCA §§ 75-2-102 et seq.. Specific standards are identified below.

A. ARM § 16.8.1401(2), (3), and (4). Airborne particulate matter. There shall be no production, handling, transportation, or storage of any material, use of any street road or parking lot, or operation of a construction site or demolition project unless precautions are taken to control emissions of airborne particles. Emissions shall not exhibit an opacity exceeding 20% or greater averaged over 6 consecutive minutes. This provision must be complied with at the site during remedial action implementation activities, at the construction activity.

B. ARM § 16.8.1404(2). Visible Air Contaminants. Emissions into the outdoor atmosphere shall not exhibit an opacity of 20% or greater averaged over 6 consecutive minutes. This provision must be complied with at the site during remedial action implementation activities, at the source of the emission.

C. ARM § 16.8.1427. Nuisance or odor bearing gases. Certain gases (excluding diesel gases from vehicles), vapors, and dusts must be controlled such that no public nuisance is caused. This provision must be complied with at the site during remedial action implementation activities, within the confines of the Site. Compliance with this provision at the site will assure that no public nuisance occurs.

D. ARM § 26.4.761. Fugitive dust control. Practicable fugitive dust control measures must be planned, through description of appropriate measures in design documents subject to EPA approval, and implemented during excavation activities. This provision must be complied with at the site during remedial action implementation activities, at the source of the emission.

E. ARM § 16.8.815. Lead. The concentration of lead in ambient air shall not exceed a 90 day average of 1.5 micrograms per cubic meter of air. This provision must be complied with at the conclusion of the remedial action implementation.

F. ARM § 16.8.818. Settled particulate. Settled particulate shall not exceed a 30 day average of 10 grams per square meter. This provision must be complied with at the conclusion of the remedial action implementation, measured within the confines of the Site.

G. ARM § 16.8.821. PM-10. The concentration of PM-10 in ambient air shall not exceed a 24 hour average of 150 micrograms per cubic meter of air and an annual average of 50 micrograms per cubic meter of air. This provision must be complied with at the conclusion of the remedial action implementation, measured within the confines of the Site.

IV. Soils and Contaminated Material and Mining Waste

Contaminated soils and other mining waste found within the Warm Springs Ponds Inactive Area will be remediated through excavation, dry closure and capping, or wet closure and flooding, as described in the ROD text. All such material which meets or exceeds the following criteria shall be addressed through the Warm Springs Pond Inactive area remediation, in a manner consistent with the Warm Springs Ponds Inactive Area ROD and as approved by EPA.

Color shall be used as the primary criteria. Discolored materials shall be remediated. Discolored materials are readily identified visually by discoloration compared to the natural color of adjacent materials.

Texture shall be used as a secondary criterion for remediation. Soils or waste materials which are fine grained shall be remediated. Fine grained materials can be distinguished from coarse grained materials by identifying coarse sand, gravel, or cobbles (Refer to section 2.1 of the Mill-willow Bypass Removal Work Plan).

Following remediation of the above identified materials, the contaminant concentrations of soils and waste material remaining unremediated are expected to exhibit the range of concentrations shown in the table addressing this issue in the Record of Decision. If this range is not exhibited, remediation shall continue until the range is exhibited, in a manner to be approved by EPA. These standards are further clarified and explained in the Record of Decision.

2. **LOCATION SPECIFIC ARARS AND PERFORMANCE STANDARDS**

I. Floodplain and Floodway Management Act Standards

A. Structures such as parks and wildlife management areas are permitted within floodplains, in accordance with the substantive provisions of MCA § 76-5-402.

B. Flood control works are permitted in the floodplain and floodway, if they are protective to the 100 year flood frequency flow, in accordance with the substantive provisions of ARM § 36.15.606.

C. Construction and remediation activities must minimize potential harm to the floodplain and improve natural and beneficial values of the floodplain, in accordance with the substantive provisions of 40 CFR § 6.302(b) and Executive Order No. 11,988.

D. The Pond 1 and Area Below Pond 1 facilities must be designed, constructed, operated, and maintained to avoid washout to the 100 year floodplain, in accordance with ARM § 16.44.702, as that section incorporates 40 CFR § 264.18(a) and (b).

II. Natural Streambed and Land Preservation Act Standards

A. Soil erosion and sedimentation to Montana rivers must be kept to a minimum, in accordance with MCA §§ 75-7-102, -104, -105, and -111, and ARM § 36.2.404. This ARAR is particularly important during construction activities, and must be met through adequate design and implementation practices.

III. Historic Preservation Standards

A. Identified or eligible cultural resources shall be identified and the impact of the Warm Springs Ponds Inactive Area remediation on those resources must be avoided or mitigated. Performance Standards for notification and documentation of cultural and historic resources are those procedures established by the Programmatic Agreement, in accordance with the substantive provisions of 40 CFR § 6.301(b) and 36 CFR Part 800.

B. If significant scientific, prehistorical, historic, or archaeologic data is found at the Warm Springs Ponds Inactive area, it must be preserved in an appropriate manner, in accordance with the substantive provisions of 40 CFR § 6.301(c).

IV. Wetlands Protection Standards

An inventory of wetlands at the Warm Springs Ponds Inactive area as they existed prior to any cleanup activities must be compiled and approved. Activities must be conducted so as to avoid or minimize destruction of wetlands. If destruction is not avoidable, wetlands must be replaced and/or restored to ensure that no net loss of wetlands will occur as a result of . the cleanup activities (past and present) at the Warm Springs Ponds Inactive area, in accordance with the substantive provisions of 40 CFR § 6.302(a) and 40 CFR Part 6, Appendix A . . and Executive Order No. 11,990.

It is the current belief of EPA and the consulting agencies that previous cleanup of the Mill Willow Bypass and other areas of the Warm Springs Ponds active area has and will continue to have adverse impacts on wetland habitats. Therefore, all efforts and reconstruction, reclamation, restoration, or other similar activities planned by the Respondent must be done as part of the remedial action implementation process, to ensure compliance with this standard.

V. Endangered Species Protection Standards

Bald eagles and peregrine falcons have been identified as users of the Warm Springs Ponds Inactive Area. Appropriate mitigative measures during construction activities must be followed, and additional biological surveys or other studies may be required. in accordance with the substantive provisions of the Endangered Species Act, 16 U.S.C. § 1531 <u>et . seq.</u>, and 50 CFR Parts 17 and 402, and 40 CFR § 6.302(h).

VI. Fish and Wildlife Coordination

In accordance with the Fish and Wildlife Coordination Act, 16 U.S.C. § 1531 <u>et seq.</u>, and 40 CFR § 6.302(g), remediation activities at the Warm Springs Ponds Inactive Area shall provide adequate protection of fish and wildlife resources. This requirement must be met during implementation of the remedial activities and at the conclusion of the remedial action activities. EPA will consult with the U.S. Fish and Wildlife Service and the State of Montana Department of Fish, Wildlife and Parks to ensure that design plan and remedial activities comply with this ARAR.

VII. Waste Disposal Siting Restrictions

Relevant and appropriate RCRA siting requirements, found at ARM § 16.44.702, which incorporates by reference 40 CFR § 264.18(a) and (b), prohibit disposal of wastes within 200 feet of a fault, and impose certain conditions on waste disposed of within a flood plain. Relevant and appropriate solid waste siting requirements, found at ARM §§ 16.14.505 and .523, prohibit disposal of solid waste within the 100 year flood plain. Because the berming and other remedial activities will ensure that the Pond 1 area and the wetlands closure area below Pond 1 will be outside of a re-engineered flood plain, these ARARs are satisfied through implementation of the Record of Decision activities, and through appropriate design, construction, operation, and maintenance of the remediated area. If it is determined that the remediated areas are within the flood plain, EPA invokes an ARAR waiver pursuant to section 121(d)(4)(A) of CERCLA, 42 U.S.C. § 9621(d)(4)(A) which applies to ARM § 16.14.505(c).

3. <u>ACTION SPECIFIC ARARS AND PERFORMANCE STANDARDS</u>

The Warm Springs Ponds Inactive Area remedy requires the excavation and reconstruction, reclamation, and restoration Lower Bypass Channel which includes creation of a connector stream in the lowermost portion of the Bypass channel, creation of wet closure cells which will function as wetlands within Pond 1 and below Pond 1, creation of a dry closure cell for dry portion of Pond 1, strengthening of existing Pond berms and construction of a new berm, development of a ground water intercept system at the boundary of the area below Pond 1, and implementation of necessary surface water monitoring. Following are ARARs and Performance Standards for these aspects of the remedial action.

I. Reconstruction/Reclamation/Restoration of the Lower Bypass Channel

The Warm Springs Ponds Inactive Area remediation involves and has involved the excavation and reconstruction, reclamation, and/or restoration of the Mill-Willow Bypass from the Pond 2 discharge point to the current northern end of the Mill Willow Bypass (the Mill-Willow Bypass from the southern boundary of the Bypass to the end of Pond 2 is addressed in the Warm Springs Ponds Active Area action). In addition to the contaminant specific and location specific standards identified above, further cleanup work in the Bypass and any following reconstruction, restoration, and/or reclamation work must comply with the following requirements:

A. Substantive provisions of the dredge and fill requirements must be met, in accordance with 40 CFR Parts 230 and 231 and 33 CFR Parts 323 and 330.

B Reclaimed drainages must be designed to emphasize channel and floodplain dimensions that will blend with the undisturbed drainage above and below the area to be reclaimed. The channel must be restored to a more natural habitat or characteristic pattern with a geomorphically acceptable gradient. Reclamation must provide for long-term stability of the landscape, establishment or restoration of the stream to include a diversity of aquatic habitats (generally a series of riffles and pools), and restoration enhancements, or maintenance of natural riparian vegetation, in accordance with the substantive provisions of ARM § 26.4.634.

C. Temporary diversion structures at the Bypass or nearby creeks must be constructed to safely pass the peak run-off from a precipitation event with a 10-year, 24-hour recurrence interval. Channel lining must be designed using standard engineering practices such as riprap, to safely pass designed velocity. Free board must be no less than 0.3 feet, all in accordance with the substantive provisions of ARM § 26.4.636.

D. Reclamation and revegetation requirements described below in Section III. must be met.

As noted above, reconstruction, reclamation, and restoration measures are required for the Lower Bypass area pursuant to this action, in part to ensure compliance with the standards regrading no net loss of wetlands at the Warm Springs Ponds area.

II. General Reclamation and Revegetation Standards

The Warm Springs Ponds Inactive Area remediation requires excavation of contaminated areas at the existing Lower Bypass channel and possibly in the area below Pond 1, and the consolidation and dry capping of contaminated areas, which will result in the creation and maintenance of a disposal area within the Pond 1 berm. All of these areas must be reclaimed and revegetated. For those activities, the following standards apply:

A. The disposal unit and other reclaimed areas must be covered with clean soil and revegetated in an appropriate manner, consistent with the Timber Butte removal action and work plan, in accordance with the substantive provisions of 30 CFR § 816.111.

B. Revegetation of any excavated, capped in place area, disposal area, or other land area disturbed or addressed by this action must comply with the substantive standards of

ARM §§ 26.4.501(3)(a), .501(A)(1)(a), .520(4), .631, .638, .640(1), .644(1), and .761, and MCA §§ 82-4-231 and -233.

III. Dry Disposal Area within Pond 1 Standards.

The Warm Springs Ponds Inactive Area remediation requires the creation and maintenance of a dry disposal area within the Pond 1 berm. The construction and maintenance of these areas must comply with the following standards:

A. All waste placed within the disposal areas must be drained of free liquids, and stabilized appropriately, in accordance with the substantive provisions of 40 CFR § 264.228(a)(2)(i), which is incorporated by reference into ARM § 16.44.702.

B. Closure of the disposal areas must be done in such a manner as to minimize the need for further maintenance and to control, minimize, or eliminate, to the extent necessary to protect public health and the environment, post-closure escape of hazardous substances, hazardous constituents, leachate, contaminated run-off or hazardous substance decomposition . . . products to the ground water or surface waters or to the atmosphere, all in accordance with the substantive provisions of 40 CFR § 264.111, which is incorporated by reference into . . ARM § 16.44.702. This standard does not require an impermeable cap or liners.

C. Disposal facility covers for the unit must function with minimum maintenance, promote drainage, and minimize erosion or abrasion of the final cover, and accommodate settling and subsidence, in accordance with 40 CFR § 264.228(a)(2)(iii)(B), (C), and (D), and 40 CFR § 264.251(c),(d), and (f) which are incorporated by reference into ARM § 16.44.702.

D. The Respondent must submit to the local land use or zoning authority a survey plat indicating the location and dimensions of waste disposed of in each unit. Additionally, the Respondent must record a deed restriction, in accordance with State law, that will in perpetuity notify potential purchasers that the property has been used for waste disposal and that its use is restricted, in accordance with the substantive provisions of 40 CFR §§ 264.116 and .119, which is incorporated by reference into ARM § 16.44.702.

E. The disposal area must be constructed in such a manner so as to comply with the general handling, storage, and disposal requirements of 40 CFR §§ 257.3-1(a), 257.3-2, 257.3-3, and 257.3-4, which are incorporated by reference into ARM § 16.44.702..

F. The Respondent's waste can be disposed of on its own property, but the disposal areas must not create a nuisance or a public hazard. Additionally, the waste must be disposed of outside of the 100 year flood plain, must be disposed of in a manner which prevents pollution of the ground or surface water, must contain adequate drainage structures, and must prevent run-off from entering disposal areas; and waste must be transported to the disposal areas in such a manner as to prevent its discharge, dumping, spillage, or leaking, in accordance with . the substantive provisions of ARM §§ 16.14.505 and .523, and MCA § 75-10-214.

IV. Wet closure cell standards

A. The wet closure cells must be designed and operated so as to comply with the structural integrity requirements of 40 CFR § 264.221(g), which are incorporated by reference into ARM § 16.44.702.

B. The Respondent must submit to the local land use or zoning authority a survey plat indicating the location and dimensions of waste disposed of in each unit. Additionally, the Respondent must record a deed restriction, in accordance with State law, that will in perpetuity notify potential purchasers that the property has been used for waste disposal and that its use is restricted, in accordance with the substantive provisions of 40 CFR §§ 264.116 and .119, which is incorporated by reference into ARM § 16.44.702.

C. The disposal area must be constructed in such a manner so as to comply with the general handling, storage, and disposal requirements of 40 CFR §§ 257.3-1(a), 257.3-2, 257.3-3, and 257.3-4.

D. The Respondent's waste can be disposed of on its own property, but the disposal areas must not create a nuisance or a public hazard. Additionally, the waste must be disposed of outside of the 100 year flood plain, must be disposed of in a manner which prevents pollution of the ground or surface water, must contain adequate drainage structures, and must prevent run-off from entering disposal areas; and waste must be transported to the disposal areas in such a manner as to prevent its discharge, dumping, spillage, or leaking, in accordance with the substantive provisions of ARM §§ 16.14.505 and .523, and MCA § 75-10-214.

V. Berm Strengthening Standards

The berms within the Warm Springs Ponds Inactive Area will be remediated by strengthening the berms against floods or earthquakes. The berm strengthening actions must comply with the following standards:

A The North South berm adjacent to Pond 1 and the new berm extension

1. The berm, which is a high hazard dams and berm, must comply with the criteria given in ARM § 36.14.501, including compliance with the Maximum Credible Earthquake standards.

2. The berm, which is a high hazard dam, must be able to safely pass the flood calculated from the inflow design flood, to the extent of safely managing the 0.5 Probable Maximum Flood, in accordance with the substantive provisions of ARM § 36.14.502. The reconstructed Mill Willow Bypass nest to this berm must be designed to meet this standard as well.

B. The Existing Pond 1 Berm

1. The berm must store water in a secure, thorough, and substantial and safe manner, in accordance with the substantive provisions of MCA §§ 85-15-207 and 208.

2. The berm, which is a high hazard dams and berm, must comply with the criteria given in ARM § 36.14.501, including compliance with the Maximum Credible Earthquake standards.

VI. Ground Water Monitoring Standards

The Warm Springs Ponds Inactive Area remediation requires the monitoring of ground water at and around the ground water interception trench, to ensure compliance with the ground water standards described in the Contaminant Specific ARARs and Performance Standards Section. Such activities must comply with the following standards:

A. Standards established in 40 CFR § 264.97, which is incorporated by reference into ARM § 16.44.702, must be complied with. Only contaminants for ground water identified in this ROD must be monitored.

VII. Surface Water Monitoring and Collection Standards

Ambient surface water standards are required to be met by this remedial action, in the manner described above. Adequate surface water monitoring, to the extent such monitoring does not exist as part of the Active Area monitoring program or the Clark Fork Basin monitoring program, must be implemented to measure compliance with those standards.

To the extent that the toe drains create point source discharges, some of those discharges will be collected and pump backed into the Active Area for appropriate treatment, in compliance with water quality discharge standards identified in the original Warm Springs Ponds ROD and ESD. Some discharges will not be collected. These discharges either do not violate point source discharge standards or their collection and treatment is waived, pursuant to section 121(d)(4)(C) of CERCLA.

4. OTHER LAWS

In addition to the environmental or siting standards identified above, the State of Montana has identified a list of other State laws which should be complied with during the conduct of site remediation and maintenance activities. These are:

I. To the extent applicable, noise levels for protection of on-site workers must be met, as described in ARM § 16.42.101.

II. The Occupational Health and Safety Act, 20 U.S.C. §§ 651 - 678, and implementing regulations must be complied with. Particularly, 29 CFR Part 1926 and 29 CFR §§ 1910.120 and .132 must be complied with. The Respondent is required to submit and follow a site specific Health and Safety Plan for conduct of activities at the Warm Springs Ponds Inactive Area.

III. To the extent it is applicable, substantive provisions of the Montana Safety Act, MCA § 50-71-201 must be complied with.

IV. To the extent applicable, the Employee and Community Hazardous Chemical Information Act must be complied with, in accordance with the substantive provisions of MCA §§ 50-78--202, -203, -204, and -305.

<u>Ground Water Well Drilling and Monitoring</u>

V. If ground water wells are determined to be necessary, well drillers must be licensed and registered as stated in ARM §§ 36.21.402, .403, .405, .406, .411, .701, and .703.

VI. Ground water wells must be logged and reported to the Department of Natural Resources Conversation, as stated in MCA § 85-2-516.

<u>Water use rights</u>

VII. To the extent applicable, any remedial activities at the Warm Springs Ponds active area must comply with the substantive provisions of MCA §§ 85-2-301, -306, -311, and -402, and MCA §§ 75-7-104 and 87-5-506, and implementing regulations found at ARM §§ 36.16.104 - .106, and 26.4.648.

APPENDIX F

WARM SPRINGS PONDS

Silver Bow Creek/Butte Area Superfund Site
Upper Clark Fork River Basin

Key Dates and Milestones for Superfund Activities

1985 - 1989	Montana Department of Health and Environmental Sciences (now MDEQ) conducted remedial investigations of Silver Bow Creek and Warm Springs Ponds.
July 1989	Massive fish kill in upper Clark Fork River, caused by storm runoff from bare tailings deposits within the Mill-Willow bypass.
March 1990	ARCO agreed to request by EPA to conduct a non-time critical removal action for the Mill-Willow bypass.
July 1990	Administrative Order on Consent signed. ARCO began removal action immediately, under EPA's oversight.
Sept. 1990	EPA issued Record of Decision for Warm Springs Ponds cleanup, following extensive public review. Cleanup decision was highly controversial.
Oct. 1990	ARCO completed major portion of Mill-Willow bypass in one field season. Nearly 1 million cubic yards of tailings and fill were excavated from the active channel.
June 1991	EPA modified Record of Decision. Active Area (Ponds 3 and 2, and bypass) was separated from Inactive Area (Pond 1 and area below). Focused feasibility study began for Inactive Area, in response to public concern over remedy decision made in 1990.
Oct. 1991	EPA issued Unilateral Administrative Order for cleanup of Active Area. Bypass removal work was completed in the second field season.
Spring 1992	ARCO began remedy construction on dams and new treatment facility, with EPA oversight. Bypass channel was constructed with meanders and alternating deep pools and riffles for trout habitat. Twenty four waterfowl ponds were added.
June 1992	EPA issued second Record of Decision (Inactive Area.)
Field Season	Remedy construction continued for Active Area. New Treatment facility was in operation by end of 1992. Dams were raised and strengthened, ponds were enlarged, wet closures were created, new inlet and outlet structures were constructed.

July 1993	EPA issued Unilateral Administrative Order for Inactive Area. ARCO began construction immediately.
1994	Remedy construction proceeded in both the active and inactive areas. EPA began pre-final construction inspections in fall 1994.
1995	Inspections completed. System shakedown and operations and maintenance began. Minor construction modifications were carried out. Ecological (biological) monitoring initiated.

Cost of Construction: $45 million

The Warm Springs Ponds may be the world's largest water treatment system. It is an alkaline precipitation system that employs large amounts of lime to raise the pH, plus volume and area to provide retention time. Within the first five years of operation of the new treatment facility, performance standards were met about 95 percent of the time. "Gold Book" criteria for copper were met about 90 percent of the time. Upsets occur during spring runoff, when metals entering the ponds from Silver Bow Creek exceed the system's capability for precipitating metals.

APPENDIX G

SILVER BOW CREEK/BUTTE AREA NPL SITE
FIVE YEAR REVIEW
NEWSLETTER

DECEMBER 1997 · U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 8 · MONTANA OFFICE

Introduction

EPA is conducting a five year review of the Silver Bow Creek/Butte Area (SBC/BA) Superfund site. The document will be available for public review and comment in early 1998. The purpose of this newsletter is to summarize the five year review process and the opportunities for public involvement.

Background

According to the National Contingency Plan (NCP), EPA's regulations that implement the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund), "if a remedial action is selected that results in...contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, (EPA) shall review such action no less often than every five years after initiation of the selected remedial action." NCP Subpart E, Section 300.430 (f)(4)(ii).

Although we have referred to the review being conducted by EPA as the Warm Springs Ponds five year review, EPA guidance requires that: "Sites subject to five year reviews with multiple remedies or operable units should conduct a five year review for the **entire site**, and not separate five year reviews for each remedy or operable unit...(EPA) should cover each operable unit...as appropriate to its progress in remediation...the five year review, however, is triggered by the first operable unit giving rise to a five year review." OSWER Directive 9355.7-02A Thus, SBC/BA five year reviews will be done for the entire site, and will be triggered by the start of remedial action at the Ponds, or in five year increments from 1992.

Because the Ponds are only one of several operable units of the SBC/BA site, they cannot be reviewed in isolation. The Silver Bow Creek/Butte Area Superfund site has eight remedial operable units, including Mine Flooding (Berkeley Pit), Priority Soils, Non-Priority Soils, Rocker Timber Framing and Treatment Plant, Streamside Tailings, the Warm Springs Ponds Active and Inactive Areas (two administratively separate units), and the Active Mining area. The SBC/BA site has also been the subject of ten removal actions or operable units, notably timber Butte, the Mill-Willow Bypass, Lower Area One, Butte Soils, and Travona/West Camp Mine Water. The Warm Springs Ponds function as a settling and treatment facility for the wastes which continue to migrate downstream in Silver Bow Creek from the Butte Area, Rocker, and Streamside Tailings.

In 1992, ARCO, the potentially responsible party at the Warm Springs Ponds operable units of the Silver Bow Creek/Butte Area site, began remedial action construction of the active area of the ponds, including Ponds 2 and 3. Thus, in 1997, EPA is required to evaluate the effectiveness of the selected remedy for this operable unit as a part of the entire SBC/BA site. As explained above, EPA will combine the five year evaluations for both the active and inactive areas, as well as the other remedial and major removal operable units, in this review.

Why the Ponds First?

The Ponds were among the first Superfund operable units in the Clark Fork Basin to be addressed by cleanup activities because it was necessary to: upgrade the retaining berms to withstand earthquakes and floods; eliminate tailings from the Mill-Willow Bypass to prevent additional fish kills; and to upgrade their ongoing treatment function for Silver Bow Creek water. During the five year review, the Ponds must be addressed in context of the other operable units, and EPA must determine if selected response actions remain protective of human health and the environment not only for the Ponds, but for the entire site.

We recognize that cleanup activities are not complete at Lower Area One or at the Butte Priority Soils and Mine Flooding, that Streamside Tailings remediation is yet to begin in full force, and that Rocker is just being completed. The need for upstream work is more apparent than ever as the review progresses, because much of the Warm Springs Ponds operable units' objectives were predicated upon upstream cleanup and subsequent reduction in contaminants flowing to the ponds.

Components of Five Year Reviews

A five year review may vary in extent according to EPA guidance, but the basic purpose is to evaluate whether the response action remains protective of human health and the environment. The components of the SBC/BA five year review include the following information as outlined, which incorporates the requirements of a five year review. The report will look at these issues in detail for the Warm Springs Ponds area, and in a more limited fashion for the other, incomplete operable units.

---

1. Introduction (requirements, objectives, purpose)

2. Site Background
   - 2.1 Site Description and History (chronology and regulatory history)
   - 2.2 Remedial Objectives
   - 2.3 Summary of Remedies

3.0 ARARs Review (changes to any applicable, relevant and appropriate requirements (ARARs) since the RODs)

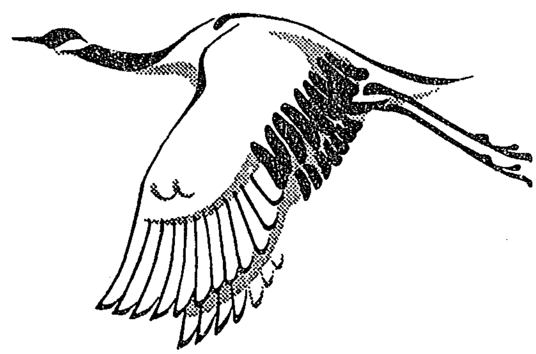
4.0 Summary of Site Visits
   - 4.1 Summary of Current Conditions
   - 4.2 State/Local Input/Concerns

5.0 Areas of Compliance and Non-Compliance
   - 5.1 Description of Ongoing Operations and Maintenance
   - 5.2 Monitoring Summary
   - 5.3 Explanation of Non-Compliance

6.0 Recommendations
   - 6.1 Rationale for Observational Approach
   - 6.2 Recommendations for Improved Performance

7.0 Statements of Protectiveness

8.0 Schedule for Next Five Year Review



Public Participation in the Five Year Review

While EPA guidance does not prescribe extensive public involvement activities for a five year review, it does indicate that EPA " will inform the public when it determines that...a five year review is appropriate, describe the planned scope...and describe actions taken based on any review." OSWER Directive 9355.7-02 EPA will also make the review report available to the public. Finally, but perhaps most importantly, EPA should "consult with the community in developing a communication strategy." Ibid.

For the past five years, EPA has, in conjunction with the Montana Department of Environmental Quality and ARCO, held annual sessions and site tours, open to the public, to review the data generated for Warm Springs Ponds. At these sessions, all parties understood that a five year review for the Ponds would be necessary. In addition, EPA set a five year shakedown period for the Ponds, which officially ended October 25, 1997.

Also, at a public meeting of the Citizens Technical Environmental Committee (CTEC) on September 11, 1997, EPA presented information about the scope of the five year review. CTEC solicited comment with a comment sheet. This information was reported in the Montana Standard, a local newspaper of general circulation.

EPA's Communication Strategy

Based on requests from the public, and our understanding of the public's information needs for the Silver Bow Creek/Butte Area site, EPA determined the public needed more information about the five year review. Thus, EPA's newsletter attempts to increase awareness about and understanding of the SBC/BA five year review for those who were not in attendance at the CTEC meeting or the annual sessions. We encourage readers to call or write us with questions or concerns about EPA's outlined review (above). When the five year review is complete, the resulting report will be placed in all information repositories for the Clark Fork Basin Superfund sites (see back page for locations). Copies will also be available upon request from EPA.

Public Comment Period

EPA plans to hold a public comment period on the final review report. During the comment period, we will hold public meetings in at least Opportunity and Bonner. Resulting public comment on the report and EPA's recommendations will be evaluated by EPA. Where appropriate, comments may influence the recommended actions. If so, this information will be placed in the administrative record, and EPA's final recommendations will be noticed in the media and through a newsletter to the mailing list.

Involvement of EPA Personnel

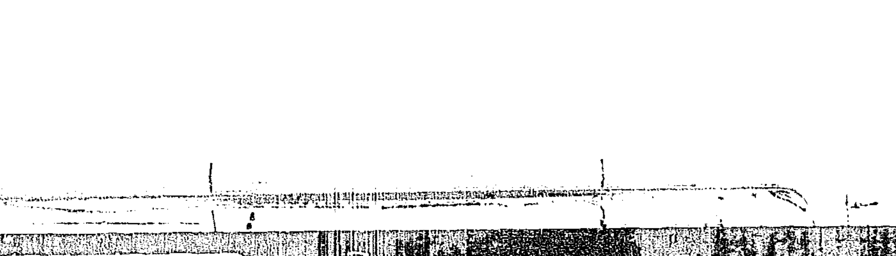
The Warm Springs Ponds are the focus of this five year review of the SBC/BA site for several reasons. The Ponds prompted the review because remedial action construction began there first. In addition, the Ponds are a complex set of operable units where essentially the remedy construction is complete and the public has shown intense interest in the Ponds' performance. Thus, the Ponds will get the most thorough review of the SBC/BA site's operable units. Still, all but three of the EPA Montana Office's remedial project managers will participate in producing the final five year review for their respective operable units. The personnel and their responsibilities are listed below.

Ron Bertram - Priority Soils, Lower Area One
Mike Bishop - Rocker
Scott Brown - Warm Springs Ponds
Russ Forba - Mine Flooding
Rosemary Rowe/Mike Bishop - Streamside Tailings
Sara Weinstock - Priority Soils and Removals

Pam Hillery, Community Involvement Coordinator, and Bob Fox, Superfund Branch Chief, will also participate in the five year review process. For questions about the process, please contact Pam Hillery at EPA (phone (406) 441-1150 ext. 246, E-mail: hillery.pam@epamail.epa.gov, and address: 301 S. Park, Drawer 10096, Helena, MT 59626). Copies of the five year review process guidance are available upon request.

Housekeeping

If you received this newsletter in the mail, you are on one of EPA's operable unit/site mailing lists. We try to keep them current, so we ask you to contact EPA at the above address (or phone/E-mail) and tell us if you wish to remain on the list. If we don't hear from you by March 1, 1998, we will remove your name from all our site lists. (If you just responded to a similar request on the Anaconda/East Helena proposed plans, you can ignore this request.)



Information Repositories

EPA will place the final five year review report for Silver Bow Creek/Butte Area in all information repositories for the Clark Fork Basin. These are:

Montana Tech Library
West Park, Butte

EPA Butte Office
Courthouse, Butte

Hearst Free Library
3rd and Main, Anaconda

Mansfield Library
UM, Missoula

Grant-Kohrs Ranch NHS Office
Deer Lodge

Powell County Public Library
Deer Lodge

Missoula Public Library
East Front, Missoula

EPA Montana Office
Federal Building, Helena

In addition, three citizens groups hold Technical Assistance Grants (TAGs) for sites in the Clark Fork Basin. Also, an environmental group is active on river issues. These groups will receive copies of the report, and have technical advisors who can help review the information for the general public. These groups are:

Citizens Technical Environmental Committee (CTEC)
Butte (TAG for Silver Bow Creek/Butte Area and Montana Pole)
(406) 723-6247

Milltown Technical Assistance Committee (MTAC)/Upper Clark Fork Technical Assistance Committee (UpTAC)
Missoula/Deer Lodge (TAG for the Milltown Reservoir site and Clark Fork River OU,
P.O. Box 9086, Missoula 59807 or
P.O. Box 26, Deer Lodge 59722

Arrowhead
Anaconda (TAG for the Anaconda Smelter site)
(406) 563-5538

Clark Fork-Pend Oreille Coalition
Missoula (active on all aspects of Clark Fork River drainage water quality)
(406) 542-0539

U.S. Environmental Protection Agency
301 S. Park, Drawer 10096
Helena, Montana 59626-0096

Printed on Recycled (20% Post-Consumer) Paper

APPENDIX H

ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711
Telephone 406 563 5211
Facsimile 406 563 8269

5.05.08.01
Warm Springs Ponds
Water Quality Monitoring

ENVIRONMENTAL PROTECTION AGENCY
FEB 2 ? 1997
MONTANA OFFICE

Following receipt of comments, transmit proposal and comments to Geoff Smith, CFC; also MTAC, CTEC and Powell County

February 19, 1997

Copies, together with CH2M Hill's comments, to: ← Sent 3-13-97
John Lambing, USGS
Gary Ingman, MDEQ
Abe Horpestad, MDEQ
Neil Marsh, MDEQ

Mr. Scott Brown
U.S. EPA Region VIII
Montana Office
301 South Park, Drawer 10096
Helena, MT 59626

Subj: Proposed Modifications to the Warm Springs Monitoring Program

COPY

Dear Scott:

Enclosed please find the proposed modifications to the monitoring program for the Warm Springs Ponds *Active and Inactive Area.* Key points are highlighted below:

- Aluminum, manganese, silica, and TOC are proposed to be added to the SS-1, SS-3E, and SS-5 composite analyses for 1997. These constituents were suggested by Bill Bluck because of their importance in colloidal and sedimentation processes. It is recommended that these analytes be reviewed at the end of the shakedown period.

- Metals and silica will continue to be analyzed for total recoverable and dissolved fractions (0.45μm filtered).

- As discussed at the November meeting, it is proposed that 0.1 μm filtering and analysis be added to the 1997 Spring monitoring program for TOC, aluminum, copper, iron, maganese, silica, and zinc in SS-1, SS-3E, and SS-5 composite samples. This focused monitoring will be to provide further evaluation of the potential effects of colloidal materials on the Warm Springs Ponds performance.

- It was also discussed at the November meeting to split the monitoring program into periods of "routine" sampling and "upset" sampling. It is proposed that the difference between "routine" and "upset" sampling be distinguished by flow or turbidity values at SS-1 and turbidity at SS-3E and SS-5.

  SS-1 — Flows greater than 45 mgd (70 cfs) and turbidity values greater than 10 NTU should be considered upset conditions.

  SS-3E — Turbidity values greater than 10 NTU at SS-3E should be considered upset conditions.

  SS-5 — Turbidity values greater than 6 NTU should be considered upset conditions.

5050801

446789

Routine or upset sampling conditions should be determined separately for each station. For example, if upset conditions are only being observed at SS-1, routine sampling continues at all other stations.

- It is proposed that during periods of extremely high influent concentrations (typically occurring at SS-1 with turbidity values > 30 NTU), daily sampling and analysis be performed at SS-1.
- It is recommended that daily sampling and analysis be performed at SS-4 and SS-5 when considering use of Pond 3 bypass spillway.

ARCO would like to initiate the proposed modifications to the Warm Springs Ponds Monitoring Plan on March 1, 1997. Please call (406) 563-5211 ext. 414 with any questions, comments or concerns. Thank you for your consideration of these proposed monitoring modifications.

Sincerely,

Robin J. Bullock
Sr. Environmental Manager

RJB:tjb

cc: Sandy Stash
Pam Sbar
Bart Richardson
Barry Duff
Bill Duffy/PMHS
Bill Kelly/ESA
John Clark/ISI
Jim Kambich/MSE-HKM
Kevin Kissell/MSE-HKM
Roger Gordon/MSE-HKM
Bill Bluck

file: 71.01.110.1
71.01.80
Chronological

g:\usr\traci\sif\wsp\wq-mntr.doc

SURFACE WATER QUALITY MONITORING

	COMPOSITE SAMPLES									GRAB SAMPLES								
	SS-1			SS-3E			SS-5			SS-2			SS-4			SS-3W		
Parameter	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets
LABORATORY																		
General:																		
Alkalinity, Total as $CaCO_3$	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk				2 /wk	2 /mo	2 /wk	2 /wk		
Calcium, Dissolved	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk				2 /wk	2 /mo	2 /wk	2 /wk		
Magnesium, Dissolved	2 /wk			2 /wk			2 /wk						2 /wk			2 /wk		
Hardness, as $CaCO_3$	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk				2 /wk	2 /mo	2 /wk	2 /wk		
Silica, as SiO_2		1 /wk	2 /wk		1 /wk	2 /wk		1 /wk	2 /wk									
Sulfate	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk				2 /wk			2 /wk		
Turbidity	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk				2 /wk			2 /wk		
Total Suspended Solids	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk	2 /wk	2 /mo	2 /wk				2 /wk			2 /wk		
Volatile Suspended Solids	2 /wk			2 /wk			2 /wk						2 /wk			2 /wk		
Total Organic Carbon (TOC)		1 /wk	2 /wk		1 /wk	2 /wk		1 /wk	2 /wk									
Nutrients:																		
Ammonia, as N	2 /mo	2 /mo	2 /mo	2 /mo			2 /mo	2 /mo	2 /mo				2 /mo			2 /mo		
Nitrate/Nitrite, as N	2 /mo	2 /mo	2 /mo	2 /mo			2 /mo	2 /mo	2 /mo				2 /mo			2 /mo		
TKN, as N	2 /mo	2 /mo	2 /mo	2 /mo			2 /mo	2 /mo	2 /mo				2 /mo			2 /mo		
Ortho-Phosphate, as P	2 /mo	2 /mo	2 /mo	2 /mo			2 /mo	2 /mo	2 /mo				2 /mo			2 /mo		
Total Phosphorus, as P	2 /mo	2 /mo	2 /mo	2 /mo			2 /mo	2 /mo	2 /mo				2 /mo			2 /mo		
Metals:																		
Aluminum		1 /wk	2 /wk		1 /wk	2 /wk		1 /wk	2 /wk									
Arsenic	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk				2 /wk	2 /mo	2 /wk	2 /wk		
Cadmium	2 /wk			2 /wk			2 /wk						2 /wk			2 /wk		
Copper	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk				2 /wk	2 /mo	2 /wk	2 /wk		
Iron	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk				2 /wk	2 /mo	2 /wk	2 /wk		
Lead	2 /wk	2 /mo	2 /wk	2 /wk			2 /wk	2 /mo	2 /wk				2 /wk			2 /wk		
Manganese		1 /wk	2 /wk		1 /wk	2 /wk		1 /wk	2 /wk									
Mercury	2 /wk	2 /mo	2 /wk	2 /wk			2 /wk	2 /mo	2 /wk				2 /wk			2 /wk		
Selenium	2 /mo			2 /mo			2 /mo						2 /mo			2 /mo		
Silver	2 /mo			2 /mo			2 /mo						2 /mo			2 /mo		
Zinc	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk	2 /wk	1 /wk	2 /wk				2 /wk	2 /mo	2 /wk	2 /wk		
FIELD																		
Conductivity	2 /wk	1 /day	1 /day	2 /wk	1 /day	1 /day	1 /day	1 /day	1 /day				2 /wk	2 /mo	2 /wk	2 /wk		
Dissolved Oxygen								1 /day	1 /day									
Flow	1 /day	1 /day	1 /day				1 /day	1 /day	1 /day				1 /day	2 /mo	2 /wk			
pH	1 /day	1 /day	1 /day	1 /day	1 /day	1 /day	1 /day	1 /day	1 /day	1 /day			1 /day	2 /mo	2 /wk	1 /day		
Turbidity	2 /wk	1 /day	1 /day	2 /wk	1 /day	1 /day	2 /wk	1 /day	1 /day									
Water Level				1 /day	1 /day	1 /day	1 /day	1 /day	1 /day									
Water Temperature	1 /day	1 /day	1 /day	1 /day	1 /day	1 /day	1 /day	1 /day	1 /day				1 /day	2 /mo	2 /wk	1 /day		
Color	1 /day			1 /day			1 /day						1 /day			1 /day		

Notes:

1. Shaded cells are analyses presently required by UAO.

SURFACE WATER QUALITY MONITORING (continued)

Parameter	GRAB SAMPLES											
	EWC			WWC			MWB-1			MWB-2 & MWB-3		
	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets
LABORATORY												
General:												
Alkalinity, Total as $CaCO_3$	1 /wk			1 /wk								
Calcium, Dissolved	1 /wk			1 /wk								
Magnesium, Dissolved	1 /wk			1 /wk								
Hardness, as $CaCO_3$	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
Silica, as SiO_2												
Sulfate	1 /wk			1 /wk								
Turbidity	1 /wk			1 /wk								
Total Suspended Solids	1 /wk			1 /wk								
Volatile Suspended Solids	1 /wk			1 /wk								
Total Organic Carbon (TOC)												
Nutrients:												
Ammonia, as N												
Nitrate/Nitrite, as N												
TKN, as N												
Ortho-Phosphate, as P												
Total Phosphorus, as P												
Metals:												
Aluminum												
Arsenic	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
Cadmium	1 /wk			1 /wk			1 /mo			1 /mo		
Copper	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
Iron	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /mo			1 /mo		
Lead	1 /wk			1 /wk			1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
Manganese												
Mercury	1 /wk			1 /wk			1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
Selenium							1 /mo			1 /mo		
Silver							1 /mo			1 /mo		
Zinc	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
FIELD												
Conductivity	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
Dissolved Oxygen							1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
Flow							1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
pH	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
Turbidity		1 /wk	1 /wk		1 /wk	1 /wk	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo	1 /mo
Water Level												
Water Temperature	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk		1 /mo	1 /mo		1 /mo	1 /mo
Color							1 /mo			1 /mo		

SURFACE WATER QUALITY MONITORING (continued)

	INACTIVE AREA GRAB SAMPLES														
	MWC & SWC			Pond 1 WC			IA-1			IA-2			IA-3		
Parameter	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets	current	proposed routine	proposed upsets
LABORATORY															
General:															
Alkalinity, Total as $CaCO_3$							1 /wk			1 /wk			1 /wk		
Calcium, Dissolved							1 /wk			/wk			1 /wk		
Magnesium, Dissolved							1 /wk			1 /wk			1 /wk		
Hardness, as $CaCO_3$							1 /wk	1 /wk	1 /wk	1 /wk	2 /mo	2 /mo	1 /wk	2 /mo	2 /mo
Silica, as SiO_2															
Sulfate							1 /wk			1 /wk			1 /wk		
Turbidity							1 /wk			1 /wk			1 /wk		
Total Suspended Solids							1 /wk			1 /wk			1 /wk		
Volatile Suspended Solids							1 /wk			1 /wk			1 /wk		
Total Organic Carbon (TOC)															
Nutrients:															
Ammonia, as N															
Nitrate/Nitrite, as N															
TKN, as N															
Ortho-Phosphate, as P															
Total Phosphorus, as P															
Metals:															
Aluminum															
Arsenic							1 /wk	1 /wk	1 /wk	1 /wk	2 /mo	2 /mo	1 /wk	2 /mo	2 /mo
Cadmium							1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk
Copper							1 /wk	1 /wk	1 /wk	1 /wk	2 /mo	2 /mo	1 /wk	2 /mo	2 /mo
Iron							1 /wk	1 /wk	1 /wk	1 /wk	2 /mo	2 /mo	1 /wk	2 /mo	2 /mo
Lead							1 /wk			1 /wk			1 /wk		
Manganese															
Mercury							1 /wk			1 /wk			1 /wk		
Selenium															
Silver															
Zinc							1 /wk	1 /wk	1 /wk	1 /wk	2 /mo	2 /mo	1 /wk	2 /mo	2 /mo
FIELD															
Conductivity	2 /wk	1 /wk	1 /wk	2 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk
Dissolved Oxygen															
Flow															
pH	1 /day	1 /wk	1 /wk	1 /day	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /day	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk
Turbidity															
Water Level				1 /day	1 /wk	1 /wk									
Water Temperature	1 /day	1 /wk	1 /wk	1 /day	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk	1 /day	1 /wk	1 /wk	1 /wk	1 /wk	1 /wk
Color															

SURFACE WATER QUALITY MONITORING (continued)

Parameter	CONTINUOUS ELECTRONIC MONITORING													
	SS-1		SS-2		SS-3E		SS-4		SS-5		EWC & WWC		Pond 3 Total	
	current	proposed	current	proposed	current	proposed	current	proposed	current	proposed	current	proposed	current	proposed
Field														
Air Temperature									X	X				
Conductivity					X	X			X	X				
Dissolved Oxygen									X					
Flow	X	(X)					X	X	X	X	X	X	X	X
Precipitation									X					
pH	X	X	X	X	X	X			X	X				
Relative Humidity									X					
Solar									X					
Turbidity	X	(X)			X	(X)			X	(X)				
Water Level					X	X			X	X				
Water Temperature					X	X			X	X				
Wind Direction					X	X			X	X				
Wind Speed					X	X			X	X				
Color														

Notes:
1. Monitoring stations that are circled could be used to determine "routine" and "upset" conditions.

APPENDIX I: CORRESPONDENCE

MEMORANDUM

TO: Scott Brown/EPA 8MO

FROM: Bill Bluck/WBEI/HLN

DATE: February 18, 1997

SUBJECT: Progress Report - Warm Springs Ponds

I made a field trip to Warm Springs Ponds on February 4, 1997 to meet with Bart Richardson, ARCO Construction Supervisor, and inspect the recently completed riprap maintenance work on Pond 3 dike. As you recall, during the annual inspection conducted last fall, several important pond components that ARCO committed to repair were identified. Virtually all of the dike maintenance required associated with Ponds 1 and 2 were completed prior to the onset of winter. Primary efforts at these facilities consisted of regrading the dike crown at Pond 1 and adding riprap to selected areas of the western edge of Pond 2 dike. These efforts were successfully completed prior to winter shutdown. Other repair items noted in the fall inspection that were not completed prior to winter shutdown included a) repair of the riprap to a major reach on the west side of Pond 3; b) reseeding the portion of the north face of Pond 3 dam where the buried seepage interception drains had been installed in the Fall of 1995; c) revegetating the lower bypass pursuant to preliminary plans developed by R_2 Consultants last fall; and d) adding additional woody vegetation to selected areas in the Upper Mill-Willow Bypass between the inlet and Pond 3 discharge that suffered bank erosion during high flow events last spring.

A site tour was conducted with Bart and the following were noted and discussed.

1) Pond 3 dike riprap repair was completed the previous week. Work was conducted by Jordan Construction with onsite supervision by ESA/ARCO staff including Roger Hall and Duane Logan. Work was conducted along a nominal 2600-foot length of the west dike. Prior to the riprap being added, a base course of graded Type A borrow material was placed on the dike face and bucket compacted to a Procter density greater than 90%. Over 3000 cubic yards of Type A material from two borrow sources were utilized. Riprap from the Crackerville area was then bucket placed over the Type A material blanket. Over 2000 cubic yards of plus 6-inch riprap (estimated D_{50} of 10-inches) was utilized. Selected construction photos provided by ARCO are enclosed.

2) The Type A material was obtained from two borrow area; one source just north of the principal dry closure within Pond 3, and the other in the very upper end of the Mill-Willow bypass. Two additional small ponds had subsequently been created as part of the borrow from the upper bypass and a stockpile of excess Type A material had been left nearby. I discussed with Bart the importance of minimizing ongoing disturbance in this area as well as maintaining the enhanced habitat in the

bypass. I strongly suggested recontouring the stockpile and revegetation of this area as quickly as possible.

3) On our way down the Pond 3 dike, Bart indicated they were planning on planting additional vegetation in the Mill-Willow Bypass this coming spring. I reminded him of the impact of large (tall) vegetation on the hydraulic capacity of the channel and suggested they focus on stunted willows and other low profile woody vegetation. He will keep that in mind and advise EPA well in advance of any actions taken here. I also discussed with him the importance of maintenance and inspection of the toe drains so that they flow unimpeded during all conditions (this included the manifolded as well as unmanifolded flowing drains).

4) He indicated Western Reclamation was scheduled to hydroseed the portion of the north face of Pond 3 dam that was noted that fall. This was tentatively scheduled for March. I again reminded him to keep EPA advised well in advance of the work.

5) As regards the lower bypass, Bart indicated that Steve Clayton, University of Montana, will be engaged to provide guidance on the forthcoming vegetative maintenance enhancements scheduled later this spring. He indicated Mike Ramey (R_2 Consultants) may also be involved. I again asked that he keep EPA well informed of forthcoming construction schedules since this was again of very keen interest to EPA.

6) Other outstanding issues were also discussed with Bart. I mentioned that the survey cross sections on the Mill-Willow Bypass between Pond 3 and Pond 2 discharges had never been provided to EPA (promised by ARCO in September 1996). As such, final decisions by EPA and others regarding channel modifications in that reach could not yet be made. I also asked him the status of the pond system water sampling modifications that were discussed last November with ARCO and ESA. It is important that these be reviewed by EPA and be in place for any upset (runoff) events that could occur anytime now. Bart was unaware of these issues and advised me that a new ARCO representative named Barry Duff was just assuming ARCO site management from Robin Bullock. Since the planned tour with DNRC was scheduled later in the week, it was arranged to conduct that tour with Barry and discuss all of the above issues with him as well.

7) A site tour with two representatives of the Montana DNRC Dam Safety Program was conducted on February 6, 1997. We were accompanied by John Clark and Barry Duff. All of the issues noted above were discussed with Barry during or after the tour and he should be well aware of the importance of the follow-up necessary with EPA as a result of those discussions.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8, MONTANA OFFICE
FEDERAL BUILDING, 301 S. PARK, DRAWER 10096
HELENA, MONTANA 59626-0096

Ref: 8MO

September 29, 1995

Mr. Jack A. Marjerison
Construction Manager
ARCO
307 E. Park, Suite 401
Anaconda, MT 59711

Re: Final initial construction completion for the Warm Springs Ponds Inactive Area Operable Unit (OU 12), Silver Bow Creek/Butte Area Superfund Site, Clark Fork River Basin, Montana

Dear Jack:

This letter is intended to document the EPA's Final Initial Construction Inspection for the Warm Springs Ponds Inactive Area Operable Unit (OU 12). It is also intended to serve as a bridge between remedial action construction completion for the inactive area and remedial action construction completion for the active area (Operable Unit 4).

First, however, the EPA would like to commend you and Mr. Sam Stephenson, as well as other ARCO officials and contractors, for completing construction within the Warm Springs Ponds inactive area nearly a year ahead of schedule and at a cost less than originally estimated, without compromising the integrity of the remedy or the safety of site workers. We commend ARCO as well for numerous upgrades, over and above the preliminary design specifications, which were incorporated during construction, and for the extraordinary measures taken throughout construction to control and reduce sediment releases.

The Administrative Order for Remedial Design and Remedial Action, Warm Springs Ponds Inactive Area (Operable Unit 12), became effective on July 19, 1993. This order specifies that upon completion of construction, ARCO shall hold a precertification completion conference with the EPA and MDHES, at which time a prefinal inspection will be conducted to assure compliance with project plans and specifications and consistency with the Record of Decision. That conference and inspection requirement was partially met on December 21, 1994.

On December 21, 1994, Willard Bluck of CH2M Hill and I met with Sam Stephenson of ARCO and Duane Logan of ESA Consultants at the Warm Springs Ponds. We reviewed approved construction plans and specifications for work that was conducted over the few previous weeks. It is important to note here, for EPA's purposes

and ARCO's alike, that the EPA provided extensive oversight throughout remedial design and remedial action construction. Thus, the processes of certification and inspection were ongoing over the entire course of design and construction.

As a rule, Mr. Bluck, Scott Calvin of Huntingdon Consulting Engineers and Scientists, or I personally observed and oversaw construction activities at least once or twice each week. Neil Marsh and James Ford of the Montana Department of Health and Environmental Sciences (more recently, Department of Environmental Quality) accompanied the EPA on several of these oversight visits and inspections. Additionally, ARCO's construction supervisor, Sam Stephenson, and I conferred by telephone often. These telephone conferences were conducted sometimes several times each week to assure that construction progress was closely monitored, potential problems averted, or design changes thoroughly discussed. Generally, design change requests were found to be reasonable, and in many instances the modifications were an improvement or upgrade.

Following our review of plans and specifications on December 21, the prefinal inspection of the inactive area began. That inspection resulted in the following observations:

1. All major components of the remedy were constructed according to requirements and design specifications.

   a. Phase I construction activities, primarily tailings removal and placement in Pond 1, sediment controls for continued bypass restoration work, bypass and floodway grading, toe drain manifold construction (partial), and excavation of- the Pond 2 toe ditch, were completed in accordance with requirements and design specifications.

   b. Phase II construction activities, primarily construction of the relocated lower bypass channel and additional tailings removal and sediment controls, were completed in accordance with requirements and design specifications.

   c. Phase III construction activities, primarily rough grading of unfinished portions of the bypass channel and dry-closure and contouring of most of the exposed tailings of Pond 1, were completed in accordance with requirements and design specifications.

   d. Phase IV construction activities, primarily stabilization of the Pond 1 dam near the old Silver Bow Creek channel, flood extension dike and wing construction, armoring of the Pond 1 dike and part of the flood extension dike, extension of the toe drain manifold, east hills runoff controls construction,

construction of berms for wet-closure cells, upgrading of hydraulic structures and construction of new hydraulic structures, construction of a ground water interception trench and pump facility and pipeline, removal of selected tailings deposits below Pond 1, construction of outlet structure for toe ditch below Pond 2, application of limestone and completion of dryclosure cap over exposed tailings and consolidated spoils in the western portion of Pond 1, and installation of ground water monitoring system of wells and piezometers, were completed in accordance with requirements and design specifications.

2. Although major construction activities were complete, as noted, a checklist of unfinished items was developed. These "loose ends" included:

a. The toe drain manifold plug near the Pond 2 outlet structure remained in place. Its removal was not planned until after system start up, which was scheduled for early January 1995.

b. The water seeping into the toe ditch below the Pond 2 berm was being pumped back into Pond 2. After system start up, the seepage water will flow by gravity in the opposite direction and enter the manifold collection system.

c. Several areas, such as portions of the Pond 1 dry-closure, portions of the bypass channel or floodway, much of the eastern strip of land along the buried pipeline, borrow areas and other disturbed ground, will be mulched and seeded, then fertilized, when weather permits.

d. A few small areas of exposed tailings, such as along the toe of the Pond 2 berm (inactive area) and near the dry closure areas of Pond 3 (active area), should be consolidated and capped.

Approximately one month later, on January 25, 1995, shortly after system start up, a second inspection and meeting were conducted at the Warm Springs Ponds inactive area. At my request, and as a follow up of the December inspection and meeting, Mr. Bluck and Mr. Calvin met Mr. Stephenson and Mr. Bill Leady of ESA at the ponds. Once more, each phase of construction was reviewed in detail. All major construction items were determined to be complete and in accordance with requirements and design specifications.

A report was prepared by Mr. Calvin and Mr. Bluck, entitled "Construction Inspection Summary Report, Warm Springs Ponds

Inactive Area, Remedial Action Construction, January 1995." Although you and I have discussed the report and you were given a copy of it in April, another copy of the inspection summary report is enclosed with this letter. It is a comprehensive report of construction oversight activities and I urge everyone who is interested in comprehending the full extent of this construction project to read the inspection report.

On April 12, 1995, Mr. Bill Olsen of the U.S. Fish and Wildlife Service accompanied Mr. Bluck and me to the Warm-Springs Ponds for the final initial construction completion inspection and meeting, pursuant to requirements of the Administrative Order for Remedial Design and Remedial Action (refer to Page 14). You demonstrated to us that most of the "loose ends" identified earlier (see checklist above) had been, or were at that time being rectified. An exception was the flow of seepage water in the toe ditch below Pond 2; it was still being pumped into Pond 2.

You informed us, on April 12, that the seepage water being collected in the toe ditch was still being pumped into Pond 2 because ESA and ARCO had discovered a problem with the gradient in the southwest portion of Pond 1, adjacent to the outfall from Pond 2. Until ARCO and the EPA had an opportunity to examine the situation more completely, you recommended that the flow of seepage water in the toe ditch should continue to be reversed. We agreed.

Several times throughout the summer, you and I discussed the "incomplete gradient," as I envisage it, and agreed that water quality samples should be taken. Samples were taken, I understand from piezometer number 14, and analytical results indicate that ground water escaping to the bypass meets performance standards f or both surface and ground water. The water quality samples, I understand, were taken after the pumps f or the toe ditch were shut down and seepage water was flowing by gravity toward the manifold collection system.

Fluctuations in the level of seepage water flowing in the toe ditch apparently affect the gradient. Therefore, I agree with your recommendation of September 27 to expand the water quality sampling program to include samples from piezometer number 12, as well as number 14.

While I am concerned over this development, and it is one that we must continue to monitor closely, it does not affect the EPA'S acceptance and approval of ARCO's remedial action construction for the Warm Springs Ponds Inactive Area. The EPA hereby acknowledges its acceptance and approval of the work completed, and I consider the problem noted as a matter that can be resolved through operation and maintenance of the remedy.

I also noted early in my letter that I would bridge the gap between remedial action construction completion f or the inactive area operable unit (OU 12) and active area operable unit (OU 4). As the EPA and ARCO agreed in 1993, construction work associated with the active area remedy, specifically rough grading and final reconstruction and reclamation of a portion of the bypass channel adjacent to the wildlife ponds and Pond 2, would not be 'completed until the inactive area remedy construction work had progressed to the point where a substantial volume of fill material and overburden could be excavated from the active area, transported to the inactive area, and utilized as berm reinforcement fill and a cap for dry-closures.

For the record, this agreement was reached in order to avoid double handling of large amounts of fill and overburden. Thus, one major component of the active area remedy was delayed until the inactive area remedy was nearly complete. The remaining component--channel reconstruction and reclamation-- was completed in 1994 in accordance with requirements and design specifications. Therefore, the EPA hereby acknowledges its acceptance and approval of remedial action construction within the active area operable unit (OU 4).

It is noteworthy that severe thunderstorms of June 1995 and the accompanying floods damaged much of the reach of bypass that was most recently reconstructed and reclaimed. Throughout the summer and until August 28, when you and I, accompanied by state officials, conducted the last comprehensive assessment of flood damage, I was reluctant to close out this construction completion report. However, after discussing the issues with several people, including our attorney, Henry Elsen, I concluded that these events did not constitute a failure of the remedy. Rather, events such as these are a matter of operation and maintenance.

It is also noteworthy that my letter of October 5, 1993, regarding initial construction completion for the active area, referred to the need to flood the two wet closure cells within Pond 2. For the record, I note that they have filled with water; the eastern cell became fully inundated during this past spring and summer.

Mr. Elsen and I have reviewed the administrative orders for remedial design and remedial action, for both operable units (OU 4 and OU 12), and we conclude that the initial construction completion requirements are satisfied. We respectfully request ARCO to submit to the EPA, within 15 days of receipt of this letter, the initial construction report and certification of construction completion for the inactive area operable unit (OU 12). The November 17, 1993, initial construction completion report and as-built drawings for the active area operable unit (OU 4) stand as submitted; however, I recommend that you should include in your cover letter for the inactive area report a statement regarding the active area bypass construction work and wet - closures.

Closely following our receipt of the initial construction completion report, I would like to arrange a meeting involving ARCO, the state, EPA, and a few interested individuals. The principal purposes of the meeting would be to (a) review all of the components of both remedy construction projects, as well as the bypass removal action, (b) review the operations and maintenance plan and schedule, and (c) discuss the ongoing shakedown period and biomonitoring requirements. Please consider some possible dates for such a meeting and a preferred location.

Please contact Mr. Elsen or me if there is a question or concern.

Sincerely,

D.Scott Brown,
Remedial Project Manager

Enclosure: January 1995 Inspection Summary Report
cc: Wm. Yellowtail, Administrator, Region VIII
John Wardell, Director, Montana Office
Bob Fox, Branch Chief, 8M0
Henry Elsen, Asst. Regional Counsel
Pam Hillery, 8M0
Neil Marsh, MDEQ
W. Bluck, WBEI
Bill Olsen, USFWS
Scott Colvin, Maxim Techn., Inc.
Roger Hail, ESA Consultants
Sam Stephenson, ARCO
Glenn Phillips, MDFWP
Kathy Chiotti, 8M0

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8, MONTANA OFFICE
FEDERAL BUILDING, 301 S. PARK, DRAWER 10096
HELENA, MONTANA 59626-0096

June 14, 1994

Ref: 8MO

MEMORANDUM

SUBJECT: Silver Bow Creek/Butte Area Superfund Site, Warm Springs Ponds Active Area (OU 4); completion of remedial action construction tied to the inactive area.

FROM: D. Scott Brown, Remedial Project

TO: Kathy Chiotti, Environmental Protection Specialist

With the exception of two tasks, remedial action construction activities f or the Warm Springs Po ds Active Area (OU 4) were completed by ARCO in September 1993. The two unfinished tasks- - inundation of two wet closure cells in Pond 2 and final reclamation of the middle bypass channel- -were set aside until construction work could be undertaken in the inactive area (OU 12).

This delay was allowed primarily because several hundred thousand cubic yards of earth scheduled for excavation from the middle bypass channel (active area) is suitable fill material for raising and strengthening the berms of Pond 1 (inactive area). This action allowed ARCO to save perhaps as much as $1.5 million; however, it was no less protective of the environment, as all tailings and contaminated soils were removed from the affected portion of the bypass channel in 1990 and 1991.

The EPA, in consultation with the State, recently approved ARCO's design plans for the fourth and final phase of construction in the inactive area. Actual construction will begin during the week of June 20-24, and is expected to be completed by the end of this year or early next year, depending upon the severity of the autumn and winter. During this construction period, the two unfinished tasks associated with the active area (OU 4) will also be completed.

Thus, I expect to conduct the final remedial action construction completion inspections for both the active and inactive areas simultaneously next spring. Attached are two letters sent to ARCO last year regarding an initial construction inspection and meeting. Please note that the tasks completed at that time for the active area constitute the majority of construction actions necessary for completion of the remedy. The expenses incurred at that time by ARCO for the active area were approximately $24 million.

cc: Bob Fox
Don Pizzini
Pam Hillery
Henry Elsen
Bill Bluck
Jack Marjerison
Neil Marsh
Glenn Phillips

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8, MONTANA OFFICE
FEDERAL BUILDING, 301 S. PARK, DRAWER 10096
HELENA, MONTANA 59626-0096

Ref: 8MO

September 13, 1993

Mr. Jack A. Marjerison
Construction Manager
Atlantic Richfield Company
307 East Park, Suite 401
Anaconda, MT 59711

Dear Jack:

I want to confirm our plans for the Completion of Initial Construction Inspection and Meeting, which we agreed would be conducted on September 20, 1993, at the Warm Springs Ponds Active Area.

I have asked several people to accompany the EPA for this important inspection of the treatment works, closure areas, berms, inflow and outflow structures, and completed portions of the reconstructed bypass. Neil Marsh, Mike Oelrich, Glenn Phillips and Wayne Hadley have indicated that they will represent the state. The EPA will be represented by Don Pizzini, Bill Bluck of CH2M Hill, and myself.

While we cannot inspect the wet-closure cells in Pond 2 or the portion of the bypass from the S-curve of the Pond 3 berm to the Pond 2 outflow until they are completed and functional, we would like to examine these components of the remedy and discuss their completion.

We plan to depart Helena at 8:00 a.m. and expect to arrive about 9:00 a.m. at the Warm Springs store. We would like to begin the inspection at the Pond 2 berm, which is of particular interest to Mr. Oelrich. Once we have completed the inspection of features that Mr. Oelrich feels have a bearing on dam safety, he would like to return to Helena.

Please call me if you have a question or concern.

Sincerely,

D. Scott Brown,
Remedial Project
Manager

cc: Don Pizzini

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8, MONTANA OFFICE
FEDERAL BUILDING, 301 S. PARK, DRAWER 10096
HELENA, MONTANA 59626-0096

Ref: 8MO

October 5, 1993

Jack A. Marjerison
ARCO
307 East Park Ave.
Suite 400
Anaconda, MT 59711

Dear Jack:

Thank you for making the arrangements that enabled the EPA to conduct its Precertification Complet'on of Initial Construction Inspection and Meeting for the Warm Springs Ponds active area last week, September 20.

Bob Fox and I were accompanied by Bill Bluck of CH2M Hill, Neil Marsh of MDHES Glenn Phillips and Wayne Hadley of MDFWP, Mike Oelrich of MDRNC, and Bill Olsen of USFWS.

We inspected first the east side of the Pond 2 berm, where earlier in 1993 (January and February) excessive pore pressure was noted by ARCO and its consultant, ESA, and a cluster of piezometers was installed. We discussed the problem of the unexpectedly high increase in head, the revised stability calculations by ESA, and the improvements made for better drainage and reinforcement of the berm's downstream toe. Both CH2M Hill and Mr. Oelrich, the latter representing the state's dam safety inspection section, assured the EPA that proper corrective measures were carried out.

We also discussed the important implications of this problem on construction plans for the inactive area.

We moved on to inspect the Pond 2 outflow structure. Mr. Oelrich noted that the structure is rather constricted and may be vulnerable to ice jamming; however, the emergency spillway is very well situated to accommodate outflows under such conditions. He recommended daily monitoring of the outflow structure when the potential for ice jamming is great and careful inspection of the emergency spillway's integrity during and after any event that results in spills.

We inspected the water quality and meteorological data collection building near the Pond 2 outflow structure, which has been inspected several times in the recent past. Other than the problems ARCO has experienced with debris being introduced at the intake tube for 24-hour composite sampling, the EPA and state Water Quality Bureau believe that this system provides excellent data. We may wish to collect grab samples again in 1994, as in 1993, as spring conditions come into play.

It was pointed out by ESA that some computer connections among the water quality parameter and weather monitoring buildings (Pond 2 outflow, Pond 3 berm above the weir structure, and pH building below the inlet, and their connections with the main treatment control building) still have not been completed. I would like to be informed when those connections are completed. I foresee the possibility of a procedure being established for notifying the EPA under certain conditions. For example, high wind followed by noticeable resuspension of pond bottom sediments is a likely condition that will be more readily detected and monitored, as compared to current conditions. The EPA and Water Quality Bureau are very interested in the earliest possible notification, should these or similar events occur.

We inspected the weir, the channel leading into Pond 2, and the Pond 2 wet-closure berms with their five outlet structures. In light of the conclusions of the limnological studies, which were discussed on September 21, our concerns are heightened that the wet-closure cells are not completely inundated. A separate letter is forthcoming in respect to this issue. One important afterthought: It is fortunate that we agreed to treat the exposed tailings with a lime slurry.

Our inspection of the Pond 3 berm (both its north-south and east-west aspects) initiated a discussion with Mr. Oelrich concerning the noticeable degree of erosion along the upstream portion. Either wave action or ice scouring seems to be the cause, although both mechanisms may be responsible. Mr. Oelrich recommended a gentler slope or beach, along the interface of the pond bottom and berm. Mr. Stephenson stated that the water level in Pond 3 would be raised slightly in early winter (8-10 inches), then lowered again to "anchor things in place". Clearly, this is an operations and maintenance issue, and its monitoring should be noted in periodic progress reports by ARCO, as well as in the five-year reviews.

At the Pond 3 bypass spillway, which was used on a few occasions earlier this year, we noted no problems. We want to be informed of any release at least 5 days in advance.

Mr. Oelrich noted also that the debris racks constructed for each outflow structure in Pond 3 should be inspected frequently and cleaned when necessary.

We inspected the inlet structures, main Treatment Control Building and lime silos. We commend ARCO for this new, automated lime treatment facility. It is a significant investment in improving the ponds' treatment capabilities.

As we discussed the automated system, and once more the incomplete interconnections between the main control computer and three monitoring buildings, it was again apparent that some guidelines or procedures ought to be written. These will ensure early notification (to the EPA) and prompt corrective actions.

Time did not permit us to inspect the reconstructed bypass, although the EPA and state have conducted several inspections of the upper bypass over the past 16 months. We feel that communication between ARCO's consultant, R-2, and the state's consultant, Interfluve, has been very effective. The reconstructed channel, pair ponds, and revegetation efforts appear to be a very successful reclamation and restoration project. Our inspection of the two dry closure areas within Pond 3 showed the cap and vegetation to be secure and no problems were observed along the edges. These areas should be inspected periodically.

Some questions were raised by state officials concerning the rip-rap along the inlet channel; however, I have been assured by CH2M Hill and the MDNRC that the rip-rap meets required criteria.

In closing, the EPA is satisfied that the components of the remedy discussed in this letter have been constructed according to requirements and specifications set forth in the September 1990 Record of Decision, as modified by the Explanation of Significant Differences and Errata Sheets, the Unilateral Administrative Order for the Warm Springs Ponds Active Area, and design reports for this operable unit.

I wish to make it clear that until the wet-closure cells are filled and maintained, and until the bypass reconstruction is extended down to the Pond 2 outflow, these components of the remedy are incomplete. These actions must be implemented as soon as possible. Because there is a need for reviews of the Active Area remedy no less than every five years, all components of the remedy will be reviewed again at the appropriate time.

The EPA commends ARCO and its contractors for the remedial action undertaken at the Warm Springs Pond active area and for the improvement that this remedy has already produced for the Clark Fork River. As the shakedown period and biomonitoring continue we are all very hopeful that the improvements meet or surpass our expectations.

As I discussed with you the day following the inspection, ARCO's reply should be sent within 10 days of this inspection report. Because we have reported no deficiency, per se, rather some unfinished business that will require additional time- - and not unexpectedly- - your reply is not required to provide the EPA with any specific information or corrective action. Your reply should comply with all other aspects of paragraph 41 of the Unilateral Administrative Order. If any portion of the remedy actually constructed differs from final design plans approved by the EPA, include in your reply the revisions as built. Together with this letter, your reply will constitute the Certification of Completion of Initial Construction for this operable unit.

Please call me if you have a question or concern.

Sincerely,

D. Scott Brown
Remedial Project Manager

cc: Don Pizzini
Bob Fox
Henry Elsen
Pam Hillery
Neil Marsh
Glenn Phillips, FWP
Wayne Hadley, FWP
Mike Oelrich, DNRC
Bill Olsen, FWS
Don Palawski, FWS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8, MONTANA OFFICE
FEDERAL BUILDING, 301 S. PARK, DRAWER 10096
HELENA, MONTANA 59626-0096

Ref: 8MO

May 18, 1994

Mr. Sam Stephenson
Construction Supervisor
ARCO
307 E. Park Street, Suite 400
Anaconda, MT 59711

Subject: Approval of ARCO's final design plans and specifications for remedial action construction; Silver Bow Creek/Butte Area Superfund Site, Warm Springs Ponds Inactive Area Operable Unit (OU 12).

Dear Sam:

The EPA has reviewed and hereby approves, with conditions, the final design plans and specifications submitted by ARCO for Phase IV remedial action construction at the Warm Springs Ponds Inactive Area Operable Unit (CU 12). You are authorized to begin construction immediately on this last phase of work for the pond system with the following conditions.

1. Delete from Appendix B, Performance Standards Report, the last sentence of ARCO's response concerning time of compliance for ground water performance standards (bottom of page B-3 and top of page B-4; "The.. .through. . .UAO.") and the last two sentences of paragraph 2 of ARCO's response concerning time of compliance for surface water performance standards (middle of page B-7; "Exceedances.. .through... UAO."). Please provide a red-line version of these pages, showing the deletions.

2. Revegetation plans for reclaiming the unfinished portion of the bypass channel, from approximately Station 166+00 to Station 211+53, may require some modifications following final grading. We have discussed the need for returning some portion of the flow of Mill and Willow creeks into the bypass as soon as possible in 1994. Placement of bank erosion control fabric, if necessary, and revegetation plans will be refined as construction proceeds.

3. The comments enclosed, which were prepared by CH2M Hill in consultation with other reviewers, offer several important suggestions for assuring that adequate communication takes place with the construction contractor.

Printed on Recycled Paper

ADMINISTRATIVE RECORD SBC

Other comments require clarification concerning specific aspects of the plans and drawings, which I suggest can be resolved by red-line additions to the plans and a letter to me indicating the changes have been considered.

Additionally, CH2M Hill offers several recommendations concerning construction methods and materials that you may wish to discuss further with Bill Bluck.

The plans and specifications are complete; however, I will point out that the discussion concerning wetlands and their relative value has not been completely reviewed by the U.S. Fish and Wildlife Service. As you will recall, we had not received a copy of the Autumn 1993 wetlands evaluation report until quite recently. I await comments from Don Palawski and Bill Olsen, and therefore may follow this approval letter with additional comments concerning the wetlands evaluation. I do not expect those comments to have an important bearing on construction activities.

Please contact me if you have a question or concern.

Sincerely,

D. Scott Brown
Rem dial Project Manager

Enclosure: Comments by CH2M Hill

cc: John Wardell
Kathy Chiotti
Don Pizzini
Bob Fox
Henry Elsen
Pam Hillery
Neil Marsh/Jim Ford/Jim Madden
Bill Bluck
Glenn Phillips
Don Palawski/Bill Olsen
Tricia Jones, CH2M Hill

CH2M HILL

Engineers
Planners
Economists
Scientists

Memorandum

To: Scott Brown/ EPA 8MO

From: Bill Bluck/ CH2M HILL

Date: May 9, 1994

Subject: Review Comments- Warm Springs Ponds Inactive Area Phase IV Design Documents

---

Per the EPA's request., CH2M HILL staff has completed the technical review of the Phase IV design package which consisted of 1) The Draft Final Design Report (DFDR) including Appendix D (bound separately), 2) The Draft Phase IV Scope of Work/ Technical Specifications, 3) The Draft Phase IV Construction Quality Assurance Plan Update, and 4) Phase IV Construction Drawings (82 Sheets). The documents were dated March 11, 1994 and were prepared by ESA Consultants for ARCO. Reviewers included:

- o Bill Bluck- Project Manager, for overall content
- o John Lincoln- Sr. Civil Engineer, for civil and mechanical content
- o Jim Schneider- Sr. Geotechnical Engineer- for geotechnical content

GENERAL COMMENT

The design documents are well thought out, complementary to the previous phases of design for the Inactive Area, and consistent with the Phase IV design presentation given by ARCO/ ESA in Fort Collins in January, 1994. The ground water modelling memorandum, submitted and reviewed earlier, has been appropriately revised and incorporated as an appendix to the DFDR, and forms the basis for design of the ground water controls for the Inactive Area. Our review has found no major technical flaws in the Phase IV design submittals. The Phase IV designs submitted are consistent with the preliminary and other Phase I, II and III final design documents submitted earlier to EPA by ARCO/ ESA.

Helena Office
Power Block Building, Level Four, Suite 614
Sixth and Last Chance Gulch, Helena, Montana 59601
406.442.4116
Fax 406.449.3668

SPECIFIC COMMENTS

The following specific comments are offered to clarify certain aspects of the documents or to suggest other designs or improvements that may be beneficial to the project.

DRAFT FINAL DESIGN REPORT

1) **Page 8, Section 2.1, third full paragraph.** This section outlines a number of measures to preserve and protect functional wetlands in the project area, including limiting construction activities to the immediate vicinity of required work. It is suggested that these areas be clearly delineated on the drawings and the requirements to protect them must be specified.

2) **Page 20, Section 4.5, second and third full paragraphs (and Drawings, Sheets 3-4 and 3-16).** Corrugated metal pipe (CMP) is not the best material for use in a long design life pipeline through a dam. CMP generally has a design life (depending on corrosivity of the soils) of 15 to 30 years. A longer life product, such as reinforced concrete pipe is suggested for this application. In fact, in the case of the 66-inch pipelines, the concept of using a piped outlet for the 0.5 PMF flows should be re-examined, given the possibility of plugging with the debris associated with such a major flood event. An overflow spillway, armored with soil cement similar to the spillway in Pond 2, may be more appropriate for these major flow events.

3) **Page 26, Section 4.81, Table 2 and Last Paragraph.** The settlement estimates shown are only estimates. Please clarify in the text what the consequences may be and response actions planned if post-construction settlement exceeds the estimates shown.

4) **Appendix C, Design Memo C1, Page 6, Table 3.** Why was the end-of-construction condition not assessed for the flood extension dike?

5) **Appendix C, Design Memo C1, Page 6, second paragraph.** In reality, several of the analyses only meet the criteria, but do not exceed them.

DRAFT PHASE IV CONSTRUCTION QUALITY ASSURANCE PLAN UPDATE

6) **General Comment.** ARCO should specify in this document the number, type, qualifications, and anticipated schedule for the inspectors to be used during Phase IV construction.

ADMINISTRATIVE RECORD SBC 1232

DRAWINGS

7) **Sheets 1-4, 3-1, 3-2, 3-3, and 3-6.** The plan views of the various portions of the work should have areas of existing functional wetlands delineated. These areas should be called out for protection by the Contractor during construction. See comment #1.

8) **Sheets 3-2 and 3-6.** The dikes for the Wet Closure cells should be constructed with curves at the corners of the dikes, rather than the angle points as shown. The plans should include curve data for these curves based upon the types of anticipated maintenance vehicles (generally 20 to 30 feet inside radius, depending on type of vehicle).

9) **Sheet 3-3.** The note near the lower right hand corner concerning bedding of the manifold pipe should be more specific. The note should reference the details for this bedding shown on Sheets 3-10 and 4-7.

10) **Sheet 3-14** <u>Typical Section, Toe Berm, Stations 40 to 44</u>

This section shows rockfill placed directly on a relatively lightweight geotextile (type "G3" specified in Section 02710).

a) This coarse rockfill may puncture the geotextile. A cushioning layer should be provided.

b) The stability analysis (Appendix C, Memo C2, Figure 10) assumes efficient drainage through the geotextile blanket and fill material. What if this does not occur due to blinding from fines from the existing dike fill? Please explain.

11) **Sheets 4-1 through 4-6 and Sheet C-2.** The maintenance concept for the pumpback pipeline should be reconsidered The use of a pig for maintenance of a pressure line that is pumping essentially clean water is an unusual application. Pigs are more normally used in petroleum pipelines to clean the lines and to ensure separation of products, or in pipelines carrying large loads of grit or grease that may become deposited in the lines (such as sewage sludge lines). Use of 30-inch steel pipe and then transitioning to a 32-inch HDPE pipe after a sharp radius appears to be an inappropriate configuration to use a pig. Also,if a pig is to be used, a pig catcher should be incorporated into the design somewhere near the end of the pipeline before it discharges to Pond 2. We suggest it may be more appropriate to use pressure manholes at periodic intervals (approximately every 1/2 mile) for the rare occasions when maintenance is required inside the pipeline and abandon the concept of a pig system.

ADMINISTRATIVE RECORD SRC

12) Sheet 4-1, Station 1+00 and Sheet 4-4, Station 42+80. The pipeline should have valved drains located near these locations to drain the low points in the pipeline, when required for maintenance/inspection.

13) Sheet 4-7. The intake piping to the pump station may receive sufficient flow velocities to warrant the use of thrust blocking at the angle points or thrust restraints on the flexible couplings. The design calculations for this piping should be checked to assure that the flexible couplings will not suffer separation under the thrusts involved.

14) Sheets 4-7, (or Specification Section 02225). Details of the thrust blocking noted for the 90_degree radius should be provided, either on the Drawings or in the Specifications.

15) Sheet C-1. It is suggested that the outlet structures for all of the wet closure cells should be equipped with trash racks (similar to the Pond 1 outlet) to avoid debris plugging in the outlet structures or outlet pipes. In addition, at least one concrete seepage collar or filter diaphragm should be provided around the HDPE outlet pipes in the berms downstream from the outlet structures. Even at the low heads available, erosion of backfill material around these pipelines is possible due to their flexibility and surface smoothness.

16) Sheet C-2. Consideration should be given to the use of butterfly or plug valves as isolation valves on each of the pump discharge lines, rather than knife gate valves. The butterfly or plug valves provide more flexibility in operations since they can be used to throttle flows, if necessary, to achieve flow balancing.

17) Sheet C-2. The suction vessels for the pumps <u>must</u> be equipped with vents to allow introduction of air in this application; otherwise the suction head required for proper pump operation may not be available under all conditions of flow. In addition, without adequate venting, transients in the intake piping could cause severe operational problems.

<u>SPECIFICATIONS</u>

18) Section 02110. This section must include a prohibition against clearing and grubbing in areas of high quality wetlands as noted in comments #1 and 7.

19) Section 02220, Paragraph 3.02B. The material to be used to replace over-excavated material should be stated within this section of the specifications.

20) Section 02620, Paragraph 2.01C. This paragraph is inconsistent with the Drawings. The specifications call out 3"X1" corrugations for CMP over 36" in diameter, while the Drawings (Sheet 3-16) call out 5"X1" corrugations for the 66" CMP. Also note previous comment # 2.

21) Section 09900, Paragraphs 4.01 and 4.02. The paint thickness should be called out on the basis of Minimum Dry Film Thickness (MDFT), rather than wet film thickness. There is no convenient method for confirming conformance with the specifications using wet film thickness, whereas a simple hand-held gauge can be used to confirm dry film thickness.

22) Section 09925. This section should include a coating for submerged metal surfaces. A coal-tar epoxy with an epoxy primer is normally used in these applications. In addition, a repair procedure for the coal tar epoxy coating (following welding if the initial coating is shop applied) should be specified.

23) Section 11240, Paragraph 2.01. The Net Positive Suction Head (NPSH) requirements for the pumpback pumps at the critical flow parameters should be specified since the design calculations show that there is little safety factor for NPSH included in the design.

Please call if you have any questions.

APPENDIX J

October 25, 1997 - December 31, 1999

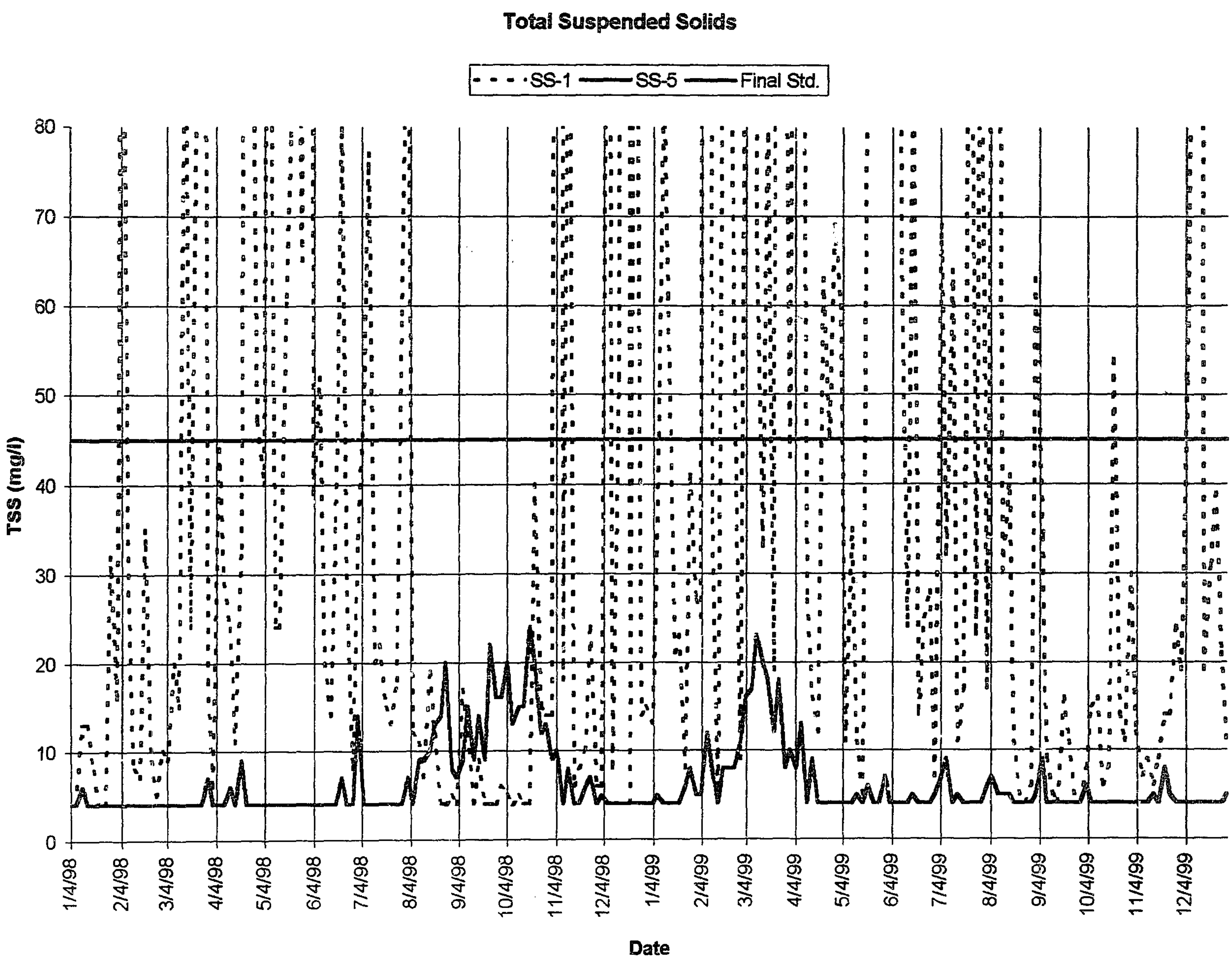
DAILY FINAL STANDARD EXCEEDENCE SUMMARY

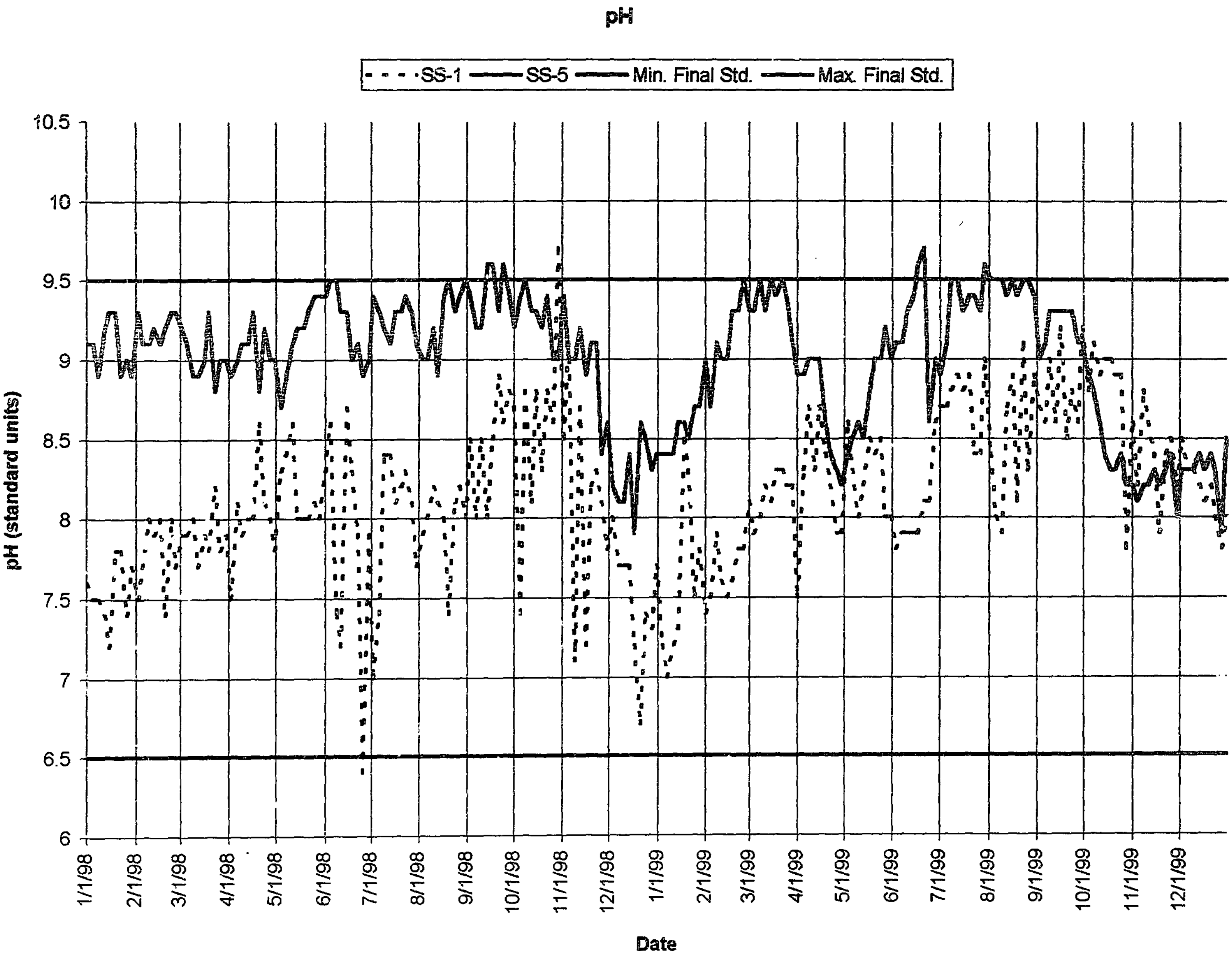
Constituent	No. of Measurements	No. of Exceedences	% of Exceedences
TSS	228	0	<1
pH	277	6	3
Arsenic	228	81	36
Cadmium	228	0	<1
Copper	228	7	3
Iron	228	0	<1
Lead	228	0	<1
Mercury	228	2	1
Zinc	228	0	<1

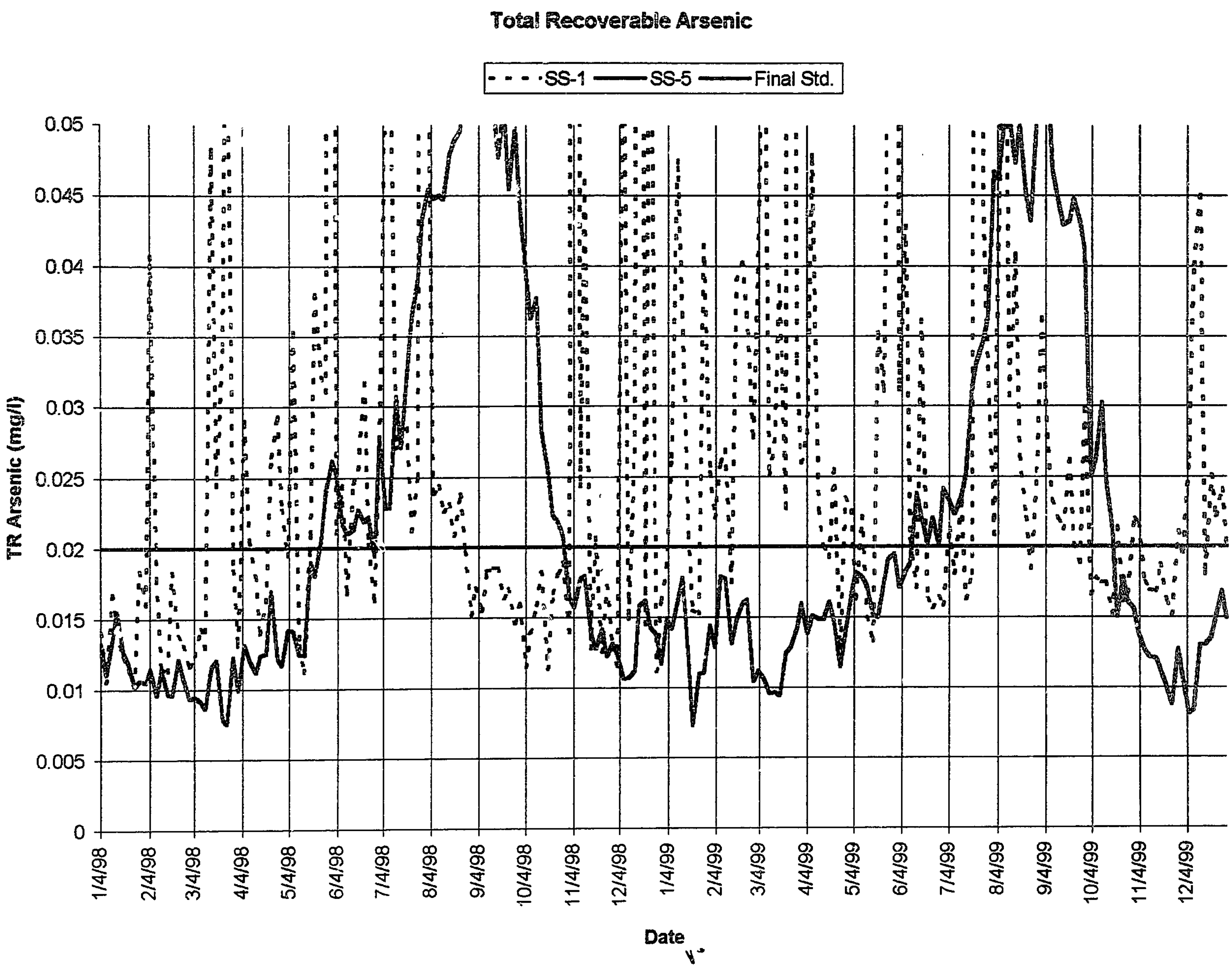
MONTHLY AVERAGE FINAL STANDARD EXCEEDENCE SUMMARY

Constituent	No. of Measurements	No. of Exceedences	% of Exceedences
TSS	27	0	<1
Arsenic	27	10	37
Cadmium	27	0	<1
Copper	27	0	<1
Iron	27	0	<1
Lead	27	0	<1
Mercury	27	0	<1
Zinc	27	0	<1

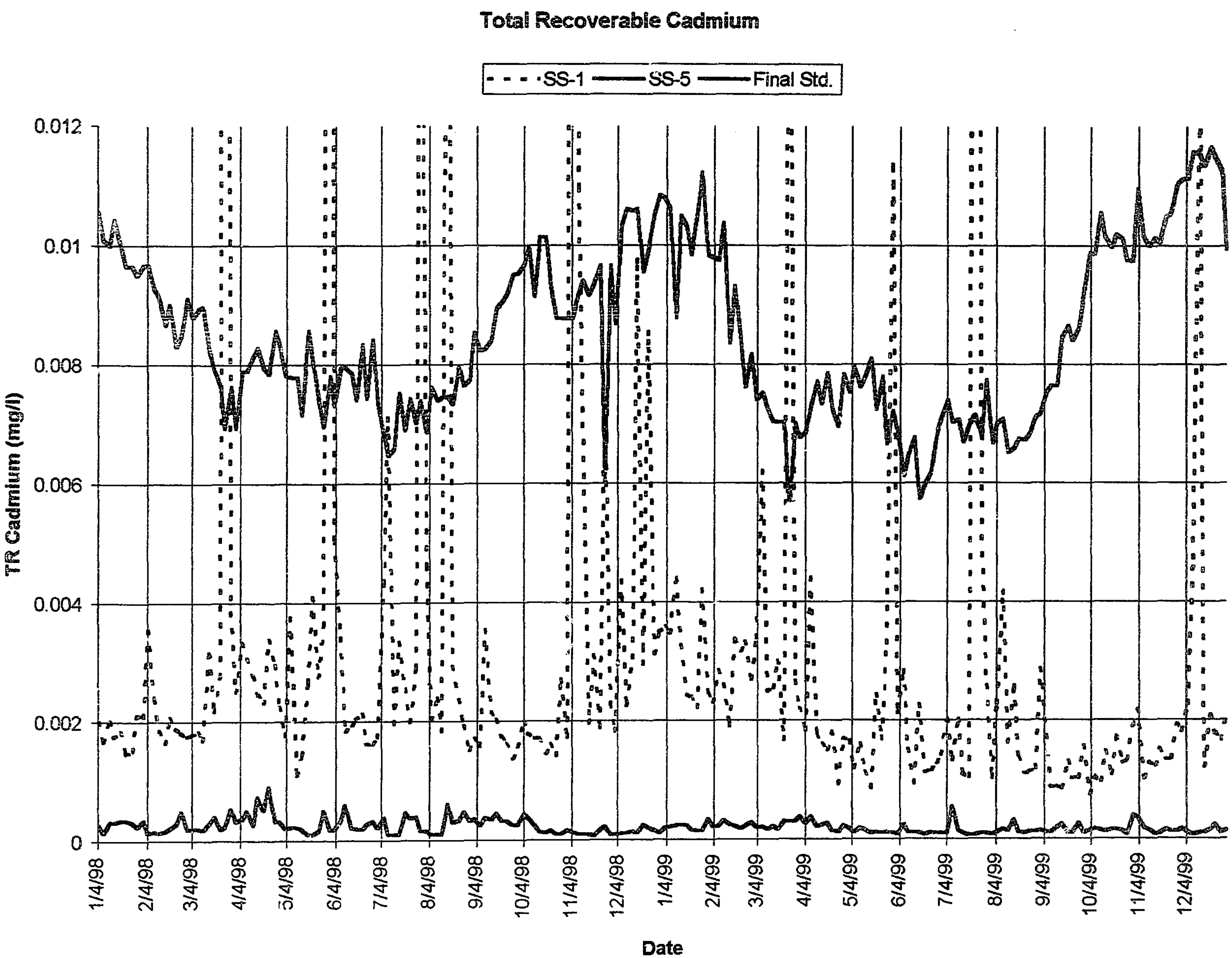
Metals are total recoverable analyses. Mercury is as total.

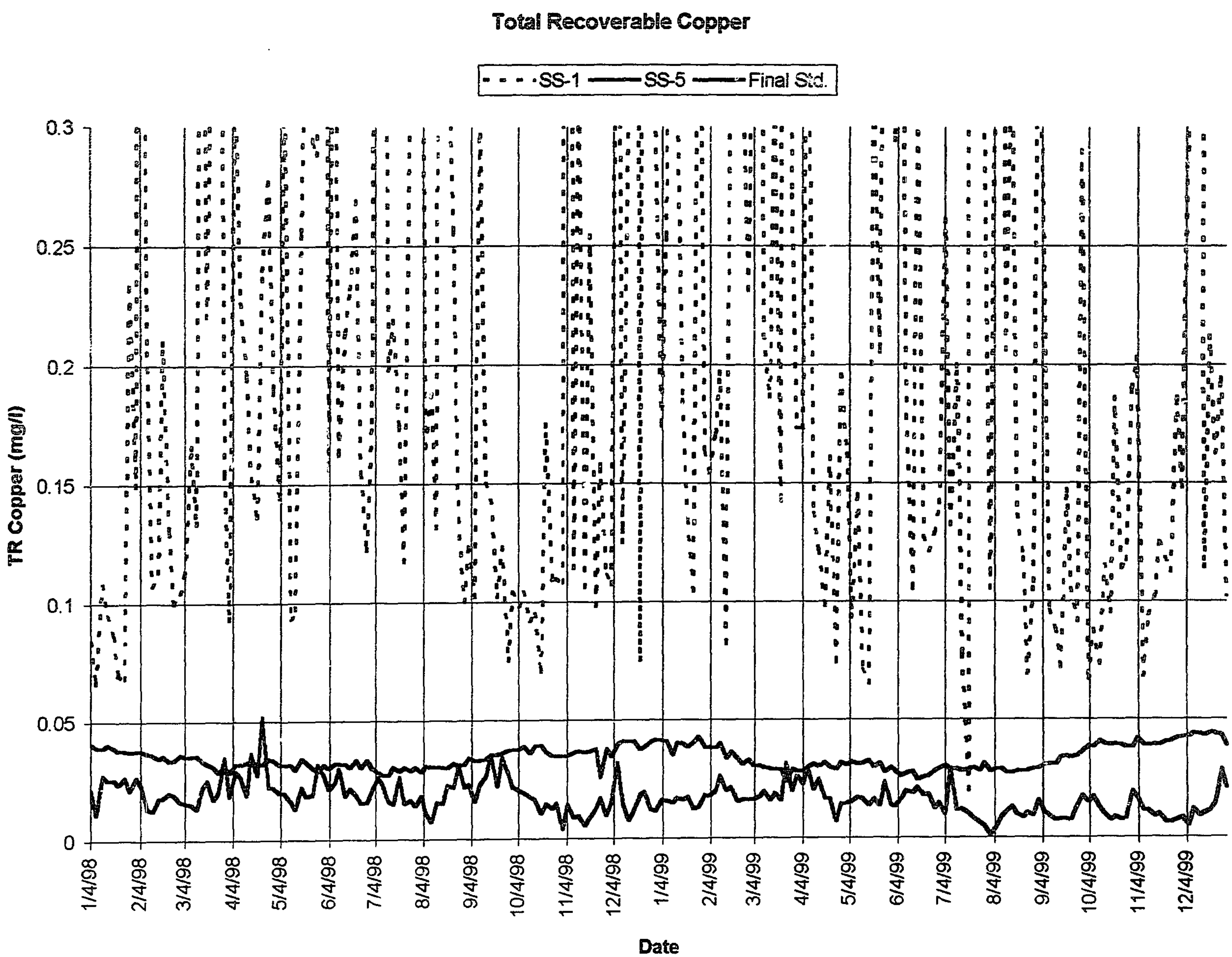

Total Suspended Solids
SS-1
SS-5
Final Std.
TSS (mg/l)
80
70
60
50
40
30
20
10
0
1/4/98
2/4/98
3/4/98
4/4/98
5/4/98
6/4/98
7/4/98
8/4/98
9/4/98
10/4/98
11/4/98
12/4/98
1/4/99
2/4/99
3/4/99
4/4/99
5/4/99
6/4/99
7/4/99
8/4/99
9/4/99
10/4/99
11/4/99
12/4/99
Date


pH
SS-1
SS-5
Min. Final Std.
Max. Final Std.
pH (standard units)
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
1/1/98
2/1/98
3/1/98
4/1/98
5/1/98
6/1/98
7/1/98
8/1/98
9/1/98
10/1/98
11/1/98
12/1/98
1/1/99
2/1/99
3/1/99
4/1/99
5/1/99
6/1/99
7/1/99
8/1/99
9/1/99
10/1/99
11/1/99
12/1/99
Date



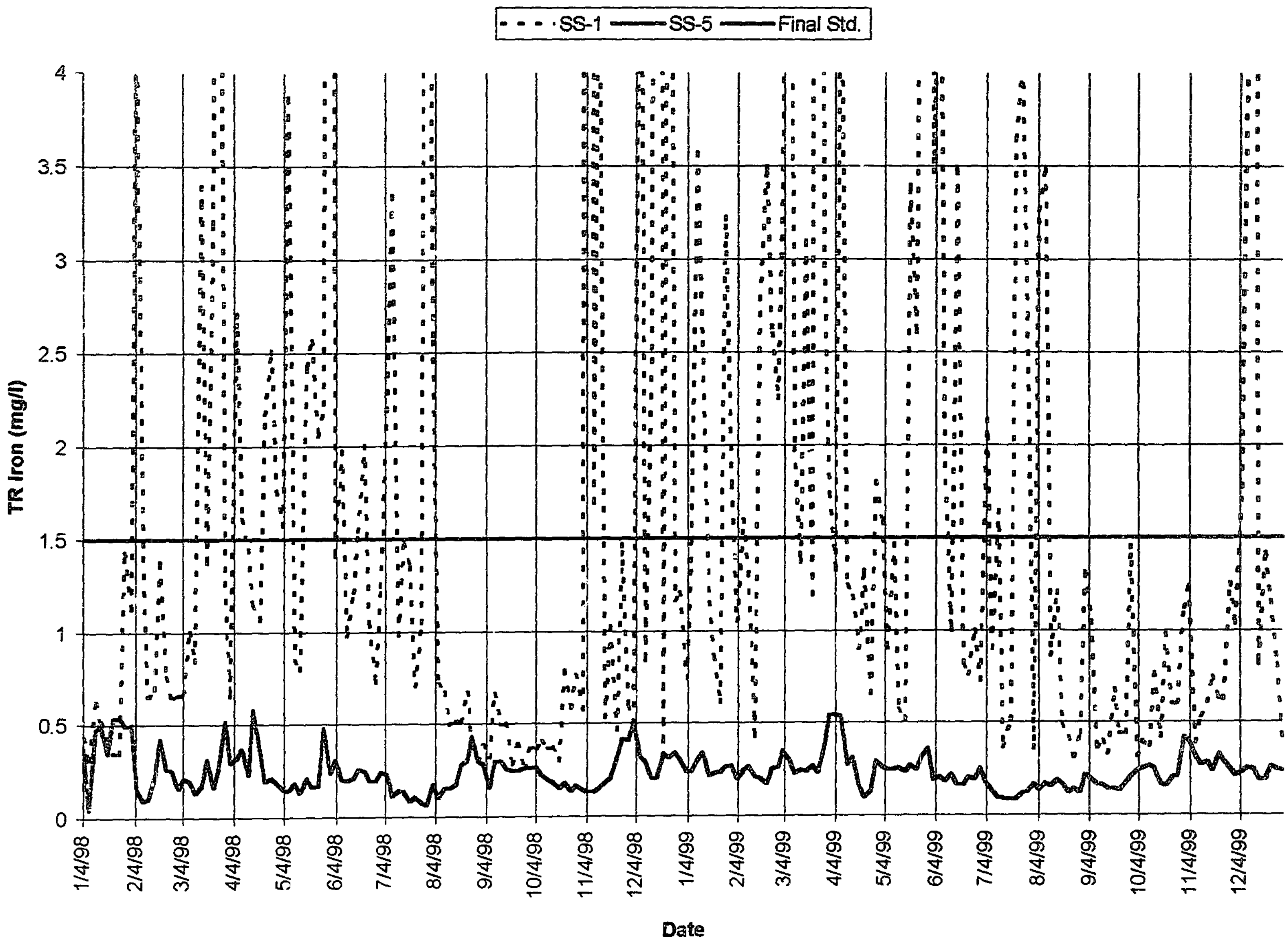
Total Recoverable Arsenic
SS-1
SS-5
Final Std.
TR Arsenic (mg/l)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1/4/98
2/4/98
3/4/98
4/4/98
5/4/98
6/4/98
7/4/98
8/4/98
9/4/98
10/4/98
11/4/98
12/4/98
1/4/99
2/4/99
3/4/99
4/4/99
5/4/99
6/4/99
7/4/99
8/4/99
9/4/99
10/4/99
11/4/99
12/4/99
Date


Total Recoverable Cadmium
SS-1
SS-5
Final Std.
TR Cadmium (mg/l)
0.012
0.01
0.008
0.006
0.004
0.002
0
1/4/98
2/4/98
3/4/98
4/4/98
5/4/98
6/4/98
7/4/98
8/4/98
9/4/98
10/4/98
11/4/98
12/4/98
1/4/99
2/4/99
3/4/99
4/4/99
5/4/99
6/4/99
7/4/99
8/4/99
9/4/99
10/4/99
11/4/99
12/4/99
Date

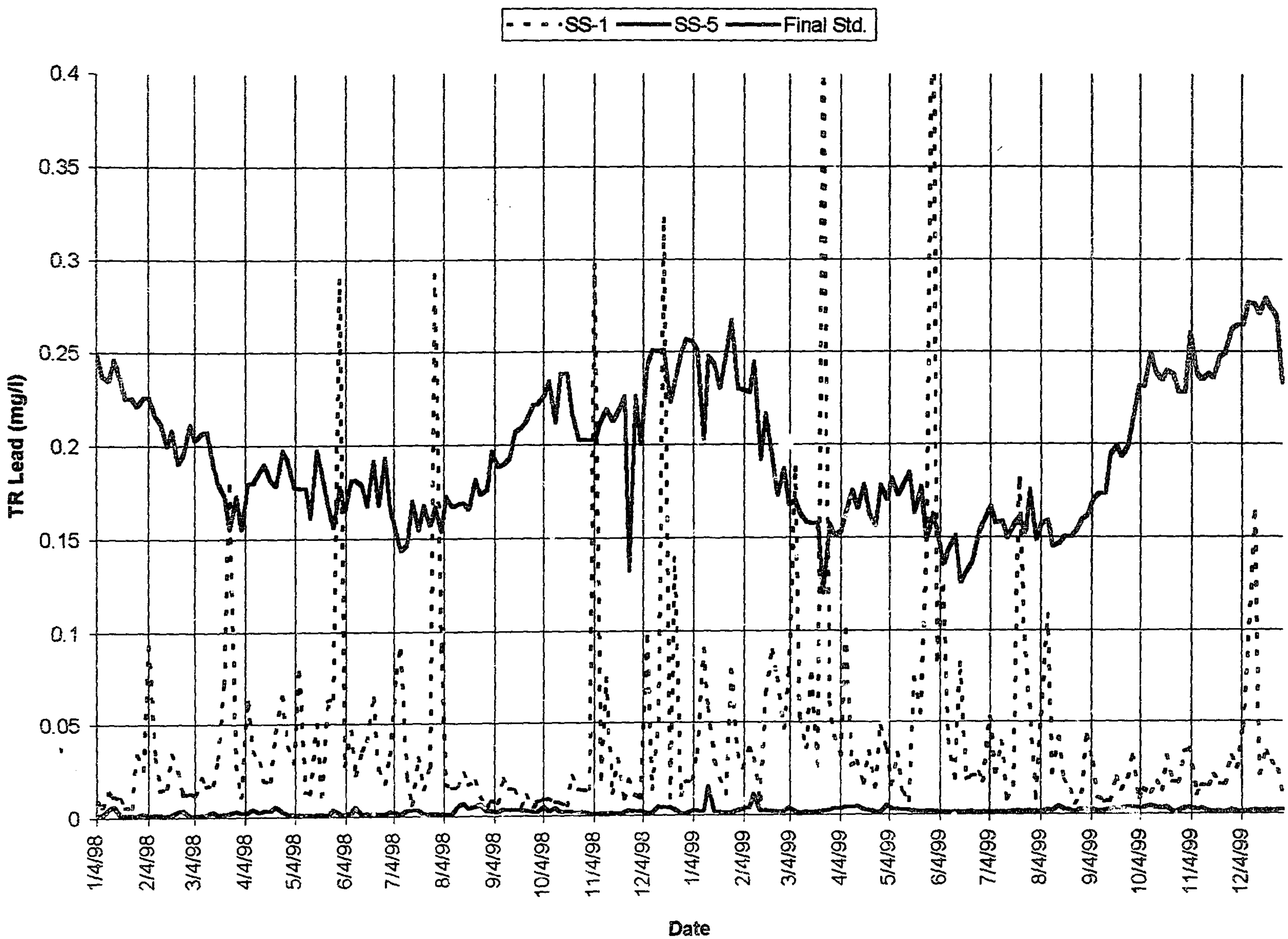


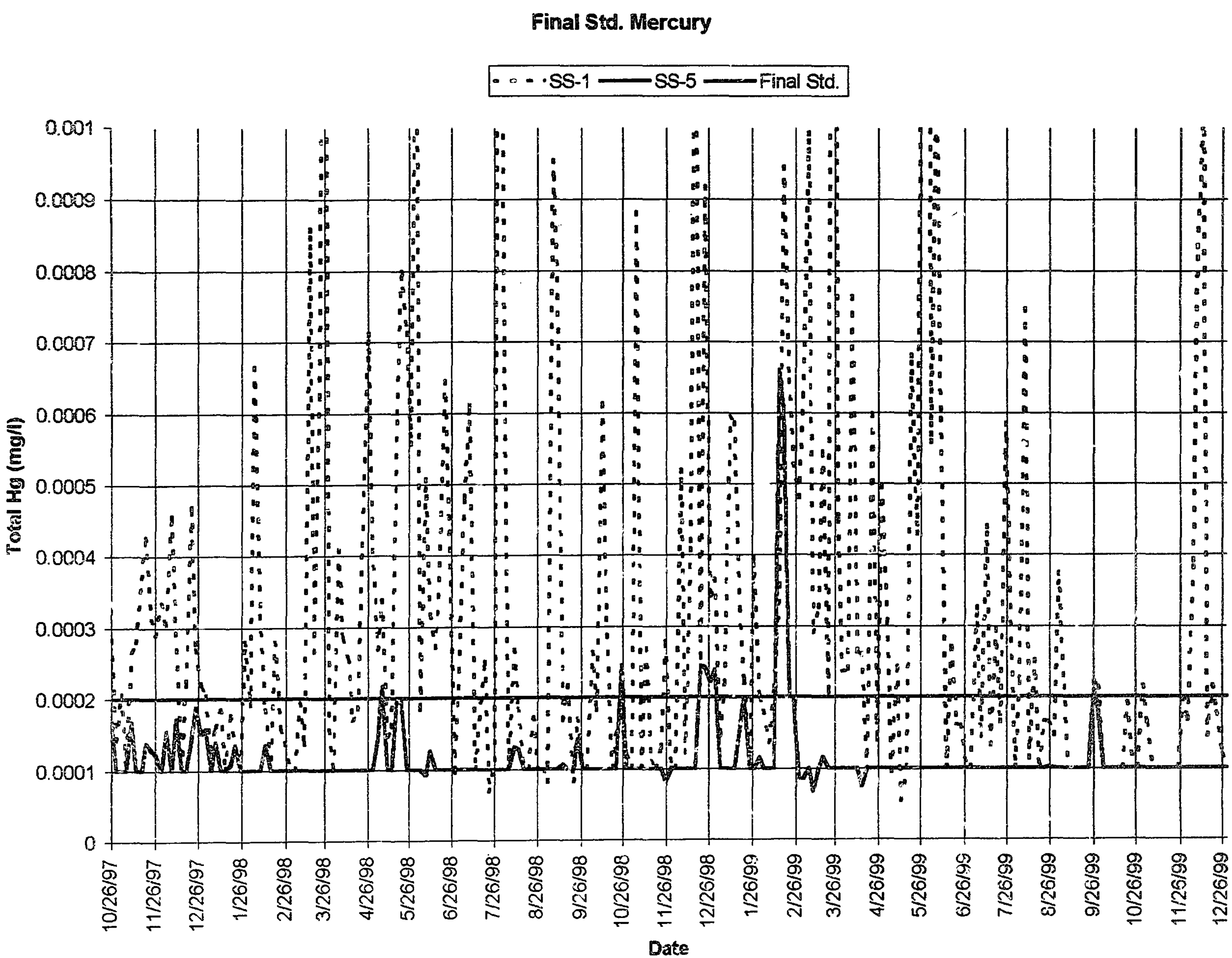
Total Recoverable Copper
SS-1
SS-5
Final Std.
TR Copper (mg/l)
0
0.05
0.1
0.15
0.2
0.25
0.3
1/4/98
2/4/98
3/4/98
4/4/98
5/4/98
6/4/98
7/4/98
8/4/98
9/4/98
10/4/98
11/4/98
12/4/98
1/4/99
2/4/99
3/4/99
4/4/99
5/4/99
6/4/99
7/4/99
8/4/99
9/4/99
10/4/99
11/4/99
12/4/99
Date

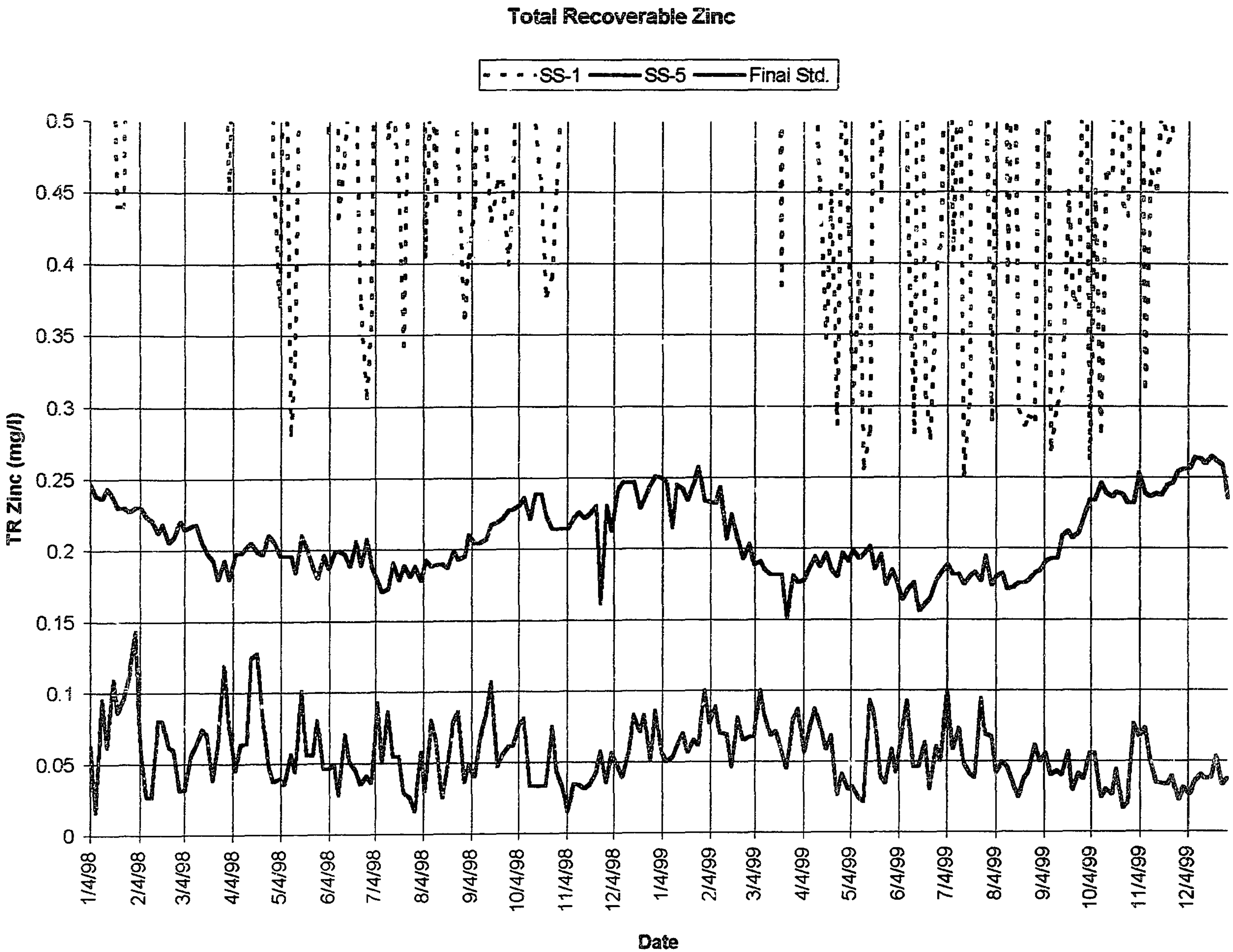
Total Recoverable Iron



Total Recoverable Lead




Final Std. Mercury
SS-1
SS-5
Final Std.
Total Hg (mg/l)
0.001
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
10/26/97
11/26/97
12/26/97
1/26/98
2/26/98
3/26/98
4/26/98
5/26/98
6/26/98
7/26/98
8/26/98
9/26/98
10/26/98
11/26/98
12/26/98
1/26/99
2/26/99
3/26/99
4/26/99
5/26/99
6/26/99
7/26/99
8/26/99
9/26/99
10/26/99
11/26/99
12/26/99
Date


Total Recoverable Zinc
SS-1
SS-5
Final Std.
TR Zinc (mg/l)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1/4/98
2/4/98
3/4/98
4/4/98
5/4/98
6/4/98
7/4/98
8/4/98
9/4/98
10/4/98
11/4/98
12/4/98
1/4/99
2/4/99
3/4/99
4/4/99
5/4/99
6/4/99
7/4/99
8/4/99
9/4/99
10/4/99
11/4/99
12/4/99
Date