U.S. Environmental Protection Agency

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

Volume 5: Rocker Timber Framing and Treating Plant Operable Unit

June 2011

Final

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

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

FINAL

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

Volume 5: Rocker Timber Framing and Treating Plant Operable Unit

Work Assignment No.: 337-FRFE-0822

June 2011

Prepared for:
U. S. ENVIRONMENTAL PROTECTION AGENCY
Region 8, Montana Office
Federal Building, Suite 3200
10 West 15th Street
Helena, Montana 59626

Prepared by:
CDM FEDERAL PROGRAMS CORPORATION
50 West 14th Street, Suite 200
Helena, Montana 59601

Contents

Tables

Figures

Acronyms

ARAR	Applicable or Relevant and Appropriate Requirements
BA&P	Butte, Anaconda, & Pacific
BSBC	Butte/Silver Bow County
CD	consent decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information System
CFR	Code of Federal Regulations
CGWA	controlled groundwater area
CTEC	Citizens Technical Environmental Committee
cy	cubic yard
DEQ	Montana Department of Environmental Quality
DNRC	Department of Natural Resources and Conservation
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FR	Federal Register
HHRA	human health risk assessment
IC	institutional control
LTMO	long-term monitoring optimization
MCL	maximum contaminant level
MBMG	Montana Bureau of Mines and Geology
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NCP	National Contingency Plan
NPL	National Priorities List
O&M	operations and maintenance
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
ppm	parts per million
RAO	Remedial Action Objectives
Rocker	Rocker Timber Framing and Treating Plant
ROD	Record of Decision
RPM	Remedial Program Manager
Site	Silver Bow Creek/Butte Area Superfund Site
SSTOU	Stream Side Tailings Operable Unit
TCLP	toxicity characteristic leaching procedure
µg/L	micrograms per liter

Section 1
Introduction

The U.S. Environmental Protection Agency (EPA) Region 8 has conducted a five-year review of the response actions implemented at the Silver Bow Creek/Butte Area Superfund Site (Site), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Information System (CERCLIS) ID: MTD980502777, in Silver Bow and Deer Lodge Counties, Montana. This review covers activities conducted from January 2005 through December 2009. This volume of the five-year review report focuses on the Rocker Timber Framing and Treating Plant (Rocker) Operable Unit (OU); separate volumes have been prepared for the other Silver Bow Creek/Butte Area Site OUs. This is the third five-year review for the Site and this is the second five-year review for the Rocker OU (OU07). The purpose of this volume of the five-year review report is to determine whether the remedy components in place at the Rocker OU are protective of human health and the environment. The methods, findings, and conclusions of this review are documented herein. In addition, this five-year review report identifies deficiencies found during the review, and identifies recommendations to address them. The Rocker OU is one of seven active remedial OUs comprising the Site.

This page left intentionally blank.

Section 2
Site Chronology

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

Table 2-1
Rocker OU Chronology of Events

Event	Operable Unit	Date
Placer gold discovered in Silver Bow Creek	All	1864
Large scale underground mining in Butte	03/08	1875 - 1955
Open pit mining at Berkeley Pit	03	1955 - 1982
Major smelting period in Butte	03/08	1879 - 1900
Rocker Timber Framing and Treatment Plant constructed	07	1909
Rocker Timber Framing and Treatment Plant closed	07	ca. 1957
Discovery of mining-related contamination along Silver Creek between Butte and Warm Springs, Montana	01	9/1/1979
Hazard Ranking System Package Completed	All	12/1/1982
Silver Bow Creek Site proposed to the National Priorities List (NPL)	All	12/30/1982
Silver Bow Creek Site (Original Portion) Phase 1 Remedial Investigation Final Report	All	01/1987
State of Montana directed cleanup of 1,000 cubic yards of contaminated soil at the Rocker OU	07	1989
Technical investigations at Rocker OU	07	1989 - 1995
Baseline Human Health Evaluation for the Rocker OU completed	07	2/13/1995
Remedial Investigation/Feasibility Studies completed	07	1995
Record of Decision (ROD) for Rocker OU	07	12/22/1995
Unilateral Administrative Order Rocker OU (Remedial Design/Remedial Action)	07	3/29/1996
Remedy implementation and completion	07	1997
Remedy Operations and Maintenance	07	1998 - present
Consent Decree for Rocker OU	07	11/07/2000
Supplemental treatments in support of Streamside Tailings OU construction activities	07	2001 - 2002
Initial Five-Year Review Silver Bow Creek/Butte Area Site	All	3/23/2000
Second Five-Year Review Silver Bow Creek/Butte Area Site	All	9/30/2005

This page left intentionally blank.

Section 3 Background

3.1 Location and Setting

The Rocker OU covers approximately 16 acres and is located to the south of U.S. Interstate 15/90 near Rocker, Montana, approximately three miles west of Butte, in Silver Bow County (Figure 3-1). The site is bounded on the north by Silver Bow Creek and on the south by railroad lines and sidings owned by the Butte, Anaconda, & Pacific (BA&P) Railway Company (formerly Rarus Railway). The BA&P Railway has two small storage sheds at the western end of the OU and a historic office building east of the repository remains on site. The small community of Fredericksburg lies to the south of the site, while the community of Rocker is just north of Silver Bow Creek. The eastern, western, and northern boundaries of the Rocker OU adjoin the Stream Side Tailings OU (SSTOU).

3.2 Physical Characteristics

Before the remedial action was implemented, the topography of the site was variable as a result of extensive fill that had been brought in to facilitate the industrial development of the site. Prior to development, Silver Bow Creek probably traversed the site just south of the creek's present location, with gently sloping stream terraces on either side. Fill for railroad corridors now form the southern boundary, while the eastern boundary is located along a historic stream diversion. In addition, the area where wood treating processes occurred was filled approximately 15 to 18 feet deep, probably with waste rock and cinders from the nearby mining operations. A small, poorly drained depression in the east central portion of the site was probably representative of the original land surface in this area.

Post remediation, a repository of treated materials was contoured to promote proper surface drainage, leaving a knoll approximately 15 feet high which was revegetated using drought-resistant grasses. The area of treated soils was fenced to limit access and trespassing. Riprap was installed along a portion of the north side of the excavation footprint to protect against erosion during flood events in Silver Bow Creek.

3.3 Land and Resource Use

The total population of Silver Bow County in 2000 was 34,606 of which the large majority resides in the city of Butte. The approximate population of Rocker is 200. Most of Silver Bow County is forest and range land. The community of Rocker is zoned by Silver Bow County for residential, commercial, and agricultural land uses. The Rocker OU land use is limited currently to industrial and railroad uses with some recreational use on the Greenway trail along Silver Bow Creek.

Property within and near the Rocker OU is owned by ARCO, Rarus Railroad, Butte-Silver Bow County, and various private and corporate entities. The three pieces of property constituting the Rocker repository are owned by ARCO and Rarus Railroad.

These are currently zoned for commercial/industrial purposes and institutional controls (ICs) exclude residential development. Land use restrictions are in place to prevent interference with or adverse affects to the integrity or protectiveness of the remedial measures implemented pursuant to the consent decree (CD). These restrictions exclude use of any portion of the OU for residential purposes and ban the use of groundwater.

Recent changes in land use in the vicinity include the construction of a trail for recreational use adjacent to Silver Bow Creek passing by the Rocker OU. Such a trail could make access to the site easier.

3.4 History of Contamination

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, 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.

Arsenic contamination of the soils and groundwater at the Rocker site is the primary contaminant of concern. Arsenic trioxide used in the treatment process at the Rocker OU was obtained from the Anaconda Smelter. Since its solubility in water is low, the arsenic trioxide was dissolved into a heated, and very high pH (13.4) solution of caustic soda and water. The resultant mixture, containing about 6% dissolved arsenic as arsenic (III), was used to treat wood timbers in a retort. Environmental contamination at the Rocker OU from the arsenical wood treating compounds is significant as a result of incidental spills of arsenic trioxide powder and of the saturated arsenic solution, onsite disposal of debris from the retort, and treatment solution that dripped or washed off the treated timbers while they dried or awaited shipment. Contamination was found in the surface soils and at depth as well as in the groundwater. Arsenic and metals contamination from mine waste was also present at various locations at the Rocker OU.

3.5 Regulatory History Summary

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

A Record of Decision (ROD) for the Rocker OU was signed in December 1995 (EPA 1995). EPA initially ordered the implementation of the ROD via a section 106 unilateral administrative order. In November 2000, EPA and Atlantic Richfield entered into a CD for implementation of the Rocker OU ROD.

3.6 Basis for Taking Action

In the 1995 ROD, EPA concluded that contaminated soils and groundwater at the Rocker site may pose an imminent and substantial endangerment to workers, trespassers, and future potential residents at or near the Rocker site. This conclusion provided the rationale for requiring response actions at the Rocker OU.

For surface soils, greater than 95 percent of the cancer and non-cancer risk was due to the presence of arsenic. No other contaminant (including other metals, creosote, and PAHs) was determined to pose a cancer or non-cancer risk outside of EPA's acceptable risk range. For groundwater, arsenic contributed over 99 percent of the future potential cancer risk of consuming groundwater from the shallow, intermediate, and deep alluvial groundwater systems. No other contaminant detected at the Rocker OU groundwater posed an unacceptable excess cancer risk.

Ecological risk near the Rocker OU was evaluated as part of the larger Streamside Tailings OU. The 1995 Rocker OU ROD states that “there is no evidence to indicate that groundwater and/or soils from the Rocker OU are contributing arsenic or PAH concentrations to the streambed sediments or surface water in Silver Bow Creek.”

This page left intentionally blank.

Section 4
Remedial Actions

Summaries of the remedial action objectives, performance standards, remedial actions selected, their implementation, and operations and maintenance (O&M) activities for the Rocker OUs as described in the *Record of Decision, Rocker Timber Framing and Treatment Plant Operable Unit, Silver Bow Creek Butte Area NPL Site, Butte, Montana* are presented below (EPA 1995).

4.1 Remedial Action Objectives

EPA and the State's overall remedial action objectives for the Rocker OU were (and still are) to reduce the current and potential human exposure to contaminated soil and groundwater. Consistent with this overall objective, the Rocker remedy was developed to meet the specific remedial action objectives listed below.

4.1.1 Groundwater

The Remedial Action Objectives (RAOs) for groundwater, as stated in the ROD, are as follows:

- Attain groundwater standards (applicable or relevant and appropriate requirements [ARARs]) or other risk-based levels for inorganic (primarily arsenic) and organic contaminants of concern for groundwater underlying and adjacent to the site, and protect human health during and after cleanup. The State ARAR for arsenic in groundwater (at the time the ROD was prepared) was 18 micrograms per liter (µg/L). Owing to the nature of the groundwater contamination, the aquifers of preferred use, and the quality/quantity of water available from water producing zones with the Rocker site, this RAO is especially important in order to prevent further contamination of the two lower aquifers.

  The State groundwater standard is also applicable to the shallow aquifer, which is classified as a potential domestic water supply by the State. The shallow alluvial aquifer yields significantly less water than other water bearing zones, is generally not developed as a water resource in this area and has a lower quality than the deeper water sources. Therefore, reducing contaminant concentrations in the arsenic plume and the shallow alluvial aquifer to regulatory standards is considered a secondary objective.

- Prevent release of contaminated groundwater to Silver Bow Creek that would result in a violation of surface water ARARs or other risk based contaminant levels.

- Prevent degradation of groundwater underlying and adjacent to the site.

- Prevent migration of contaminated site groundwater from areas where levels exceed groundwater standards into regions where levels are within groundwater standards.

4.1.2 Soils

The RAOs for soils, as stated in the ROD, are as follows:

- Prevent human exposure to inorganic (primarily arsenic) and organic contaminants in soils which exceed risk-based or other relevant levels. Based on the Rocker baseline human health evaluation (CH_2M-Hill 1995) for the occupational and trespasser exposure scenarios, the EPA, in consultation with the State has determined that soils exceeding the risk-based soil concentration of 380 mg/kg arsenic (which represents a one in 10,000 excess cancer risk to workers or trespassers) should be remediated to break this potential pathway.

- Prevent migration of contaminants from soils to underlying and adjacent offsite groundwater, such that it would fail to comply with groundwater ARARs or other risk-based levels.

4.2 Performance Standards

The performance standard for soils and groundwater, as stated in the ROD, are as follows:

- For groundwater, clean up levels are based on the state's standards for Class I and Class II groundwater, which for arsenic is 18 µg/L.

- Excavation of soils exceeding 1,000 mg/kg arsenic to a depth of 18 inches (outside of areas remediated during the SSTOU remedy, including the rail lines, or the Rocker "source material" excavation), followed by replacement with a similar volume of uncontaminated soils suitable as a plant growth medium, followed by revegetation. Excavated materials will be disaggregated, treated with iron, and returned to an onsite repository above the water table in areas where groundwater has been treated with iron.

- Cover surface soils where arsenic concentrations exceed 380 mg/kg (outside of areas remediated during the SSTOU remedy, including the rail lines), with a minimum of 18 inches of uncontaminated soils suitable as a plant growth medium, followed by revegetation.

- Excavated soils will be tested on a routine basis, acceptable to the Agencies, to document that excavation and treatment will decrease arsenic mobility to levels below 5 milligrams per liter (mg/L) arsenic, using EPA's toxicity characteristic leaching procedure (TCLP).

- Groundwater in all aquifers must meet the 18 µg/L arsenic standard and all other standards for site constituents at appropriate points of compliance determined by the Agencies during remedial design.

- A sampling and analysis program was conducted during remedial design to provide better definition of "source materials" requiring excavation and treatment. Following the sampling and analysis program, excavation and treatment of "source materials", expected to continue releasing high concentrations of arsenic to groundwater, was accomplished. For areas where "source materials" were excavated, groundwater was treated with iron and iron/arsenic concentrations were monitored so that iron concentrations can be maintained at optimum levels to attenuate arsenic in groundwater.

- In the event that groundwater or surface water monitoring outside of the current area of arsenic groundwater contamination (above 18 µg/L) reveals that the arsenic plume has advanced laterally or with depth, the Agencies will evaluate, select, and determine what appropriate plume containment measures must be implemented.

4.3 Major Components of the Selected Remedy

The remedy for the Rocker OU is summarized as follows:

- Excavate and treat contaminated soils above 1,000 mg/kg arsenic.

- Dispose of treated soils in an on-site repository.

- Cover arsenic-contaminated soils ranging from 380 to 1,000 mg/kg remaining on site with 18 inches of clean soil and revegetate.

- Treat contaminated groundwater and rely on natural attenuation to achieve cleanup standards.

- Construct an expanded capacity water supply system for the community.

- Monitor and demonstrate that the requirements of the ROD have been met. Return the groundwater resource to the community, and provide operation and maintenance of the repository and soil covers.

- Implement ICs to ensure non-residential use of the OU, and prevent domestic groundwater use until cleanup is achieved.

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

4.4 Remedy Implementation

Groundwater and soil treatment was initiated and completed in the period from April through October 1997. Soils contaminated with arsenic above 1,000 ppm were excavated to a depth of five feet below the seasonally low groundwater level and treated in a pug mill with iron sulfate and lime amendments. Soil samples were collected at 10,000 ton intervals and analyzed using TCLP methods to verify the effectiveness of the treatment process. After treatment, the average value of TCLP results for the entire project was below 0.30 mg/L leachable arsenic (well below the 5 mg/L requirement for a hazardous waste).

The remedy was implemented over a little more than two acres. The total amount of contaminated soils removed and treated (both above and below the groundwater table) was estimated at 48,000 cy. Final disposition of the treated soil materials was in an on-site repository.

The Rocker OU overlies three aquifers that are hydraulically connected to each other. Of the three, only the shallow alluvial aquifer was determined to be contaminated with arsenic. Neither the deep alluvial aquifer or the underlying Tertiary aquifer were found to be impacted by the arsenic contamination at the site. There were concerns about the hydraulic connections between the contaminated shallow alluvial aquifer and the underlying aquifers, and about potential migration of the contamination into the deeper aquifer systems.

Groundwater contaminated with arsenic above 1,000 µg/L was treated in open excavation trenches using iron sulfate, lime, and potassium permanganate amendments. Water samples were collected before and after treatment to verify the success of the operation.

The Montana Department of Natural Resources and Conservation (DNRC) instituted a groundwater control area (well ban) in 1997 to protect the aquifers from potential contamination (in addition to protecting people from drilling into and drinking contaminated groundwater). The ban restricted the development of new wells in the shallow alluvial, deep alluvial and tertiary sediment aquifers within a ¼ -mile radius of the Rocker site.

The ROD called for an alternate water supply for the Rocker community to ensure that further groundwater use did not occur. Concurrent with the cleanup at the Rocker site, approximately 2.5 miles of new water main was constructed from the existing Butte-Silver Bow County water supply line to the community of Rocker. A 300,000-gallon water supply reservoir was also constructed to provide constant flows during periods of peak water usage. Thus, the alternative water supply is in place and functioning.

The site is fenced so that access is controlled. Atlantic Richfield, the site owner, implemented deed restrictions on the property to prevent future uses inconsistent with the cleanup levels for soils at the site.

4.4.1 Implementation and Subsequent Changes to Remedy

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

4.5 Remedy Operations and Maintenance

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

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

More than 40 monitoring wells were installed during the remedial investigations at the Rocker OU (Figure 4-1). During remedy implementation, a total of seven wells were constructed within the remediation footprint as treated source materials were backfilled into excavated areas; thus, those wells (RH-60 through RH-66) were designated as interior "gravel wells" because their screened intervals were within the treated groundwater that was backfilled with clean gravel. The groundwater monitoring network also includes exterior and contingency (i.e., point-of-compliance) wells screened in each of the three aquifer zones. The current network monitoring groundwater quality consists of 34 wells with other site wells used to obtain water level information.

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

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

Section 5
Progress Since Last Review

This section discusses the performance of the remedies at the Rocker OU.

5.1 Previous Statement on Protectiveness

From the second five-year review in 2005, the following statement was made regarding the protectiveness of the Rocker remedy:

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

5.2 Previous Follow-Up Actions

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

The objectives of the supplemental treatment were to reduce arsenic concentrations at the interior well locations, determine groundwater flow characteristics (e.g., by conducting tracer tests), and to determine the effects of reagent delivery. In September 2001, alternating deliveries of potassium permanganate and ferrous sulfate were delivered into the gravel zone. Weekly sampling to assess the results of reagent delivery were conducted until February 2002; however, alteration of the groundwater flow patterns by SSTOU remedial activities made drawing conclusions about treatment effectiveness difficult. A follow-on treatment was conducted in the latter part of 2002 with more stable groundwater conditions. The results in both series of tests indicated temporary reductions in arsenic concentrations of more than 50 percent in wells RH-62 and RH-65.

As summarized in Table 5-1, quarterly monitoring activities are the only significant activity conducted at the site since the previous five-year review in 2005. Annual qualitative monitoring inspections and evaluations of general site conditions have also been conducted at the site. No additional remedy adjustments (e.g., chemical dosing) have occurred.

Table 5-1
Actions Taken Since the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-Up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
Rebound of arsenic concentrations below repository is greater than expected.	Atlantic Richfield will continue quarterly groundwater sampling and O&M activities so that any changes in site conditions will be detected.	Atlantic Richfield	Ongoing	Quarterly sampling has continued through this five-year review report period. Data are evaluated in Section 6.	Ongoing
Rebound of arsenic concentrations below repository is greater than expected.	EPA to evaluate the protectiveness and continuation of the 1/4-mile radius well ban.	EPA	May 2011. See report in Appendix D.	EPA will require action described in report.	Ongoing

Section 6
Five-Year Review Evaluation

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

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

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

The schedule for review extended through March 2011.

6.1 Community Notification and Involvement

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

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

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

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

6.2 Local Interviews

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

6.3 Document Review

A summary list of decision and data documents reviewed in preparation for the Rocker OU five-year review includes:

- February 1995. Baseline Human Health Evaluation for the Rocker Timber Framing and Treating Plant Operable Unit, Silver Bow Creek/Butte Area (Original Portion) Superfund Site, Rocker, Montana (CH_2M-Hill 1995).
- December 1995. Record of Decision, Rocker Timber Framing and Treatment Plant Operable Unit, Silver Bow Creek Butte Area NPL Site, Butte, Montana (EPA 1995).
- July 2000. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, Operations and Maintenance Plan (ARCO 2000).
- September 2005. Second Five-Year Review Report for Silver Bow Creek/Butte Area Superfund Site (EPA 2005).
- April 2006. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2005 Annual Monitoring Report (ARCO 2006).
- April 2007. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2006 Annual Monitoring Report (ARCO 2007).
- April 2008. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2007 Annual Monitoring Report (ARCO 2008).
- April 2009. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2008 Annual Monitoring Report (ARCO 2009).
- May 2009. Monitoring Report for 2008 Streamside Tailings Operable Unit Silver Bow Creek/Butte Area NPL Site (Bighorn Environmental 2009).
- April 2010. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2009 Annual Monitoring Report (ARCO 2010).
- December 2010. Draft Rocker Timber Framing and Treatment Plant OU Controlled Groundwater Area Evaluation. (MBMG 2010).

6.4 Data Review

6.4.1 Groundwater Monitoring

The purpose of the groundwater monitoring program is to evaluate treatment results, track groundwater quality trends, and to monitor potential plume migration laterally and vertically. Also included is compliance monitoring at specified groundwater contingency wells and long-term trend analysis for the five-year review reports.

Interior, exterior, and contingency monitoring wells at the OU are defined in the consent decree work plan and included in the O&M Plan (ARCO 2000). The monitoring wells being sampled fall into three groups, based upon their relation to the existing groundwater arsenic plume. A summary of the O&M wells sampled for groundwater quality is provided in Table 6-1. The wells are shown on Figure 4-1.

Table 6-1
Wells Sampled for Groundwater Quality at the Rocker OU

Shallow Alluvial Wells (17 total)	Interior	RH-60, RH-61, RH-62, RH-63, RH-64, RH-65, RH-66
	Exterior	RH-5, RH-7, RH-15, RH-17, RH-19, RH-41, RH-44, RH-47
	Contingency	RH-52R
	O&M Plan Appendix A**	RH-75
Deep Alluvial Wells (8 total)	Exterior	RH-14R, RH-16, RH-18, RH-20
	Contingency	RH-12R, RH-51, RH-76
	O&M Plan Appendix A**	RH-55
Tertiary Sediment Wells (9 total)	Exterior	RH-6, RH-43, RH-48
	Contingency	Ayers, Palmer, RH-36R, RH-46, RH-53, Town Pump 1

Interior and exterior monitoring well data are not used to initiate contingency remedy actions, but are used to:

- Supplement and support decisions made from the contingency well data
- Identify trends that may result in subsequent arsenic plume migration
- Assess the location of arsenic source materials that may release arsenic to groundwater

Table 6-2 provides annual mean arsenic concentrations from key wells sampled at the Rocker OU since the last five-year review.

Table 6-2
Mean Annual Arsenic Concentrations at Select Rocker OU Wells

		Mean Arsenic Concentration by Year (µg/L)											
Hydro-stratographic Unit	**Well**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Gravel	RH-60	110	155	313	277	315	245	252	299	1,141	537	516	520
	RH-62	4,280	6,991	9,900	9,390	11,685	9,735	10,845	11,283	10,951	7,655	7,460	7,250
Shallow	RH-17	76	119	151	94	38	39	29	32	36	53	53	55
	RH-44	553	403	395	258	244	175	196	163	135	213	254	328
	*RH-52R**	7	6	7	3	3	3	3	4	4	4	3	3
Deep	*RH-12R**	10	9	9	8	8	7	7	8	7	7	7	7
	RH-14R	1,225	1,700	1,910	1,807	2,014	1,768	1,660	1,658	1,338	1,195	1,067	1,023
	RH-18	11	12	12	11	11	11	11	11	11	11	10	10
	*RH-51**	7	8	7	6	7	6	6	6	6	6	5	5
	RH-55	--	--	--	10	10	12	13	15	14	13	13	13
	*RH-76**	--	--	--	5	5	4	4	4	4	4	4	4
Tertiary	*AYERS**	13	12	11	11	11	11	11	12	11	10	10	10
	*PALMER**	4	4	4	4	4	4	3	3	5	4	3	3
	RH-06	1,024	745	584	338	207	99	92	148	141	126	116	97
	*RH-36R**	12	11	12	9	10	10	10	9	10	9	9	10
	RH-43	13	12	11	9	8	9	9	9	10	9	8	9
	*RH-46**	11	10	10	9	7	9	9	9	9	9	8	8
	RH-48	141	151	93	54	27	24	22	20	15	15	13	12
	*RH-53**	11	13	11	12	14	11	12	13	13	12	11	12
	*TOWN PUMP**	11	11	11	11	12	11	12	12	12	11	11	11

Note: Asterisk and italics denote contingency well

Since the second five-year review, the water quality in the treatment zone appears to continue to be in equilibrium with the hydrology and geochemistry of the site. The equilibration following the 2001 and 2002 dosing events resulted in a rebound in arsenic concentrations above 10,000 µg/L in the gravel zone below the repository in the years immediately following these treatments. This continued into 2005 and 2006; however, since that time quarterly sample results have approached but not exceeded the 10,000 µg/L arsenic concentration in well RH-62. The source of the arsenic appears to be arsenic-containing groundwater immediately underlying the gravel (excavated zone). There is no evidence to suggest that the source of arsenic is the gravel zone itself or the stabilized soil mass overlying the gravel zone.

Groundwater data from the interior gravel zone, exterior, and contingency wells indicates minimal expansion of the arsenic plume since completion of the remedial action and since the last five year review. Of the 34 wells included in the monitoring program, only 4 wells exhibited increased arithmetic mean concentrations between 2005 to 2009 (RH-17, RH-36R, RH-44, and RH-60). Figure 6-1 shows the trends (using annual mean concentrations) in these four wells since the last five-year review. Of these wells, only RH-36R is a contingency well. Well RH-36R shows a change of only 1 µg/L during the review period.

Well RH-17 is a shallow exterior well located immediately north of the repository and is generally side-gradient to the overall east to west groundwater flow within the Rocker OU. During the review period, well RH-17 experienced a fairly wide range of quarterly arsenic concentrations (20 to 78 µg/L) and the average arsenic value in 2009 of 55 µg/L was approximately 20 µg/L higher than in 2005.

Well RH−60 is a gravel well at the east end of the repository. Viewing the time versus concentration graph for well RH−60, the increasing trend is a continuation of an apparent longer-term rebound of arsenic concentrations in this well since the original remedial action was completed. Due to well RH−60's location within the gravel zone, increasing arsenic concentrations do not necessarily indicate an expansion of plume boundaries.

Of possible significance is an increasing trend in shallow well RH−44 downgradient and west of the repository, and approximately 100 feet from Silver Bow Creek. (RH−44 is not a contingency well.) RH−44 quarterly arsenic concentrations since 1998 are shown on Figure 6−2, with the 2005−2009 review period highlighted. Average arsenic concentrations in well RH−44 steadily increased and doubled during the review period, from an average of 163 µg/L arsenic in 2005 to 328 µg/L arsenic in 2009 (Table 6−2). Figure 6-2 shows that post-remediation arsenic concentrations spiked to above 300 µg/L in 2003 and 2004, but then returned to lower levels. During this five-year review period, RH-44 arsenic concentrations are showing a steady increase without seasonally returning to lower concentrations. If this trend continues, it may be an indication of plume expansion in the shallow aquifer. Figure 6-3 shows the current potentiometric surface for the shallow aquifer. With groundwater approximately 1 foot below ground surface, it is likely this shallow groundwater is hydraulically connected to Silver Bow Creek. It should be determined if the plume is migrating and if this shallow groundwater is having (or has the potential to have) a detrimental impact on Silver Bow Creek.

During remediation of Silver Bow Creek, the reach adjacent to Rocker was lowered to prevent accumulation of sediments. The lowering of the stream channel may have impacted the potentiometric surface at the Rocker OU, and this may account for the increasing arsenic concentrations at RH-44.

The available SST OU water quality data were reviewed at stations in the vicinity of the Rocker OU to determine if the existing data were adequate to evaluate potential arsenic loading to Silver Bow Creek from the shallow groundwater. The nearest stations are SS-08A and SS-10A (Bighorn Environmental 2009). SS-08A is approximately ¼-mile upgradient of the Rocker OU repository and has arsenic concentrations of about 6 µg/L. SS-10A is about two miles downgradient of the Rocker OU and has similar arsenic concentrations to SS-08A (i.e., variable, but less than the 10 µg/L maximum contaminant level [MCL]). Station SS-10A is too far downstream to determine whether or not arsenic from the Rocker OU groundwater is impacting Silver Bow Creek locally in any significant way. The SS-10A data indicate that if there are any arsenic impacts in Silver Bow Creek immediately downstream of Rocker, they are being attenuated and/or diluted within two miles.

A report by the Montana Bureau of Mines and Geology for DEQ (MBMG 2011, Appendix D) makes recommendations for changes in the monitoring program. This report recommends follow-up discussions with Atlantic Richfield on changes to the monitoring plan for this site.

6.4.2 Qualitative Monitoring Inspection

The qualitative monitoring inspection evaluates on an annual basis the following items at the Rocker OU:

- General site conditions
- Uniformity of vegetation cover
- Presence of bare areas
- Identification of noxious weed infestations
- Location of erosive areas
- Condition of ditches and riprap
- Damage due to trespassing
- Condition of fencing

- Suggested corrective actions

Qualitative monitoring inspections are usually conducted in August of each year. Overall, site vegetation conditions at the Rocker OU have remained stable during the review period. Vegetation cover has varied slightly from year to year, but no barren areas have developed. Usually, some spot spraying of weeds is required, particularly in the rip rap areas along the north edge of the site and along the fence perimeter. No signs of surface erosion or instability have been observed on the repository cap and drainage ditches show no sign of erosion, siltation, or failure. No evidence of trespassing has been noted.

6.5 Institutional Controls Review

6.5.1 Institutional Controls and Instruments

The ROD for the Rocker OU (EPA 1995) identifies ICs in Section 10 – The Selected Remedy. With respect to contaminated soils and near surface soils, the ROD states,

> *"Institutional controls and monitoring will maintain the soil cover and vegetative communities, and limit land uses that would jeopardize the integrity of the cover. Institutional controls will also designate the area for continued railroad/industrial use and specifically exclude residential development as a future use (consistent with County planning document)."*

With respect to the recognized health threat from the migration of arsenic into groundwater systems that were currently being used, or were thought could be used in the future, the ROD discussed the need for a well ban. The ROD stated,

> *"EPA believes that it is necessary to restrict shallow and deep groundwater development in order to prevent the spread of the existing arsenic plume into aquifers currently used at or near the OU. Therefore, during the term of the Rocker remedy, a groundwater well ban will be implemented for new wells within a one-quarter mile radius of the site in any of the designated three aquifer units."*

The ROD goes on to state that the well ban would be removed once sufficient evidence from the post remedial action monitoring demonstrates that the arsenic plume has been controlled sufficiently to abate the threat of exacerbating its migration. The implementation of ICs for the Rocker OU is discussed below and a summary is provided in Table 6-3.

6.5.2 Implementation

Information obtained from the CD, from a search of the county property records, and through interviews with the following individuals forms the basis of the discussion of IC implementation at the Rocker OU provided in this section.

- Daryl Reed. DEQ. December 22, 2009.

- Mike Bishop. EPA RPM. December 22, 2009.

- Rob Jordan. ARCO lands manager. December 29, 2009.

6.5.2.1 Access

Property within and near the Rocker OU is owned by ARCO and several private entities (Figure 6-4). The land parcels of concern are those associated with the repository, which contain the consolidated contaminated soils and the access point to the repository, as shown on the map. Property ownership for these parcels is listed below.

Parcel Number	Ownership
011971610148MINE	Rocker Holdings LLC
011972040220RARR	Rarus Railroad
011972149020RARR	Rarus Railroad
0119721201050000	ARCO Environmental Remediation
01119792149001BHRR	Butte/Silver Bow County (BSBC)

Rocker Holdings recently conveyed the southeast corner of parcel 011971610148MINE to ARCO (Jordan 2009) and, thus, no longer has property associated with the waste repository. However, it still has monitoring wells on its property on both sides of Silver Bow Creek (Figure 6-2).

6.5.2.2 Land and Water Use Restrictions

Groundwater Control Area

The DNRC established a controlled groundwater area (CGWA) that encompasses a ¼-mile radius from the approximate center of the Rocker OU (DNRC 2003). The following information was taken from DNRC's website.

> *The effective date of this CGWA is May 30, 1997. The reason for establishing this area is contamination of the groundwater in three aquifers:*
>
> *a. The Rocker Timber Framing Treatment Plant Operable Unit of the Silver Bow Creek-Butte Area Superfund Site,*
>
> *b. A small portion of the Streamside Tailings Operable Unit Superfund Site, and*
>
> *c. A 1/4-mile buffer zone radius around the contaminated groundwater area.*
>
> *This area is closed to all new appropriations of groundwater. This is not a permanent CGWA. During this closure, quarterly monitoring is being done to determine the effectiveness of remediation actions on the groundwater. The results of this monitoring are to be reported to DNRC. Once the determination is made that the Rocker plume has been effectively mitigated to halt the threat of further migration, the Butte-Silver Bow Health Department will re-petition DNRC to remove the CGWA designation.*

The CGWA remains in place and no petition has been submitted to DRNC to remove or reduce the size of the CGWA.

Table 6-3
Implementation and Effectiveness of Institutional Controls at Rocker Operable Unit

	Institutional Control and Instrument (as identified in the controlling documents)	Instrument Implementation and Use	Effectiveness of the Institutional Control in Supporting the Remedy
Controlling Document	ROD (1995)		
Responsible Entity	Atlantic Richfield		
Land and Water Use Restrictions	CGWA established by DNRC to implement a well ban for 3 aquifers	The DNRC implemented a CGWA for this site in 1997.	With the conversion of the Town Pump potable water source to the Rocker community water system, the implemented ICs will be effectively implemented using the CGWA designation.
	County zoning to restrict residential development via a master plan.	Property within the OU is zoned for non-residential use. This land is within the 100 year floodplain of Silver Bow Creek. As such, building and other restrictions on land use are controlled by floodway-related ARARs. According to the county's zoning map, this area has been proposed as "river corridor."	This IC has been effectively implemented using several instruments.
	Written private land-owner agreements to abide by provisions of the ROD and protect remedy.	These are applicable to private property (non-ARCO and county property). ARCO has written agreements with the other property owners to abide by the provisions in the CD. (Jordan 2009)	This IC is implemented and effective.
	Add Fencing	ARCO installed and maintained.	This IC is implemented and effective.

This page left intentionally blank.

In the draft five-year review report for the Rocker OU, two existing domestic wells were identified as both in use and at or exceeding the 10 µg/L human health standard. EPA worked with the MBMG to look more closely at groundwater data for the Rocker site. That report is attached as Appendix D.

The report indicates that the Ayers domestic well is likely to be outside the influence of the Rocker site contamination plume. Data from that well indicate that it is in a decreasing trend and has not exceeded the human health standard in the last several months. Accordingly, monitoring should continue for this well, but a replacement water supply is not recommended.

The report indicates several concerns with the Town Pump well. Tests done by the MBMG indicate prolonged use of the well could enlarge the existing plume and otherwise adversely affect remediation of the site. Use of the Town Pump well for domestic purposes could lead to exceedances of the human health-based standard. Accordingly, action to prevent domestic/public use of this well and to prevent extensive pumping is needed to ensure protectiveness at this site.

Finally, the report also notes that some changes to the CGWA boundaries and DNRC ruling may be advisable. EPA will continue to examine this issue in consultation with DEQ.

Zoning

The pieces of property constituting the Rocker OU are currently zoned for commercial/industrial purposes and not residential. No additional instrument is needed for this IC.

Remedy Protection Agreements

The ROD states that ARCO must obtain agreements from the land owners that are enforceable by ARCO and the United States to abide by the obligations and restrictions established in the CD or are necessary to implement, ensure non-interference with, or ensure protectiveness of the remedial measures to be performed at the site. According to the ARCO lands manager, ARCO has obtained these agreements.

6.5.2.3 Cooperation and Funding

The RPM for the Rocker OU has indicated that ARCO has fully cooperated with the provisions identified in the CD regarding cooperation in funding community water supplies and ensuring access by DEQ and EPA (Bishop 2009).

6.5.3 Effectiveness

With the exception of the "deed restrictions", all of the ICs identified in the CD have been implemented for the Rocker OU. With the conversion of the Town Pump potable water source to the Rocker community water system, the implemented ICs will be effective at protecting the selected remedy for the OU. However, as noted above, more IC work regarding the Town Pump well should be done to ensure long-term protectiveness.

6.6 Site Inspection

EPA and DEQ project managers and their contractors attended a site inspection of the Rocker OU on October 7, 2009. Site photos can be found in Appendix A. During this site inspection, monitoring wells were examined for security and integrity, and the site conditions observed.

The site inspection determined that nine wells were in need of repair. Wells RH-17, RH-37, RH-26, RH-8, RH-16, RH-15, RH-60, RH-52R, and RH-19 showed evidence of frost heaving (the interior PVC pipe had pushed above the outer casing) and the wells could no longer be capped and locked. Atlantic Richfield has since made necessary repairs to these wells. Other minor issues during the site inspection included:

- Fencing, along the north and west sides of the repository area, was in marginal condition and falling down in places.
- The gate on the west side of the site was not secured.
- Vehicle tracks on the repository cap were greater than six inches deep in places; these tracks could eventually develop into erosional rills and compromise cap integrity.

Atlantic Richfield has since made the necessary repairs at the site.

While the site inspection identified several minor issues, all of these issues should have been identified and corrected as part of the annual qualitative inspection of general site conditions conducted each August as part of O&M activities. It is recommended that EPA and state project managers re-evaluate the annual qualitative inspections and participate in these annual inspections in the future.

It was also noted that the recreational greenway trail adjacent to the reconstructed Silver Bow Creek channel had been constructed to the edge of the Rocker OU. A new bridge had been installed across Silver Bow Creek with the intent that the trail would continue along the south bank of Silver Bow Creek, along the toe of the Rocker repository. This is a land use change in that the likelihood of trespass will increase because the site is easily accessible to the public. Thus it will be important that the site access restrictions (e.g., fencing and gates) be maintained to make trespass less likely.

Section 7
Technical Assessment

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

Remedial Action Performance

No. EPA must address the Town Pump well use, as discussed earlier. EPA must require additional monitoring of Silver Bow Creek to ensure that the Rocker site is not causing violations of standards in surface water.

Arsenic concentrations in the most contaminated wells in the tertiary and deep aquifers dropped by 35 percent and 38 percent, respectively, since 2006. Because EPA projected moderate difficulty in meeting the ARARs in a limited part of the groundwater system (i.e., the shallow alluvium), the RAOs were prioritized according to the actual or potential use of these groundwater zones. The prime objective is to prevent pollution from reaching the high quality lower aquifers which are currently used (tertiary groundwater system) and that have the potential to be used (deep alluvium). Monitoring to date has documented the effectiveness of the remedy in meeting this prime objective. Institutional controls prevent exposure pathways in the shallow groundwater. The soils component of the remedy continues to perform as designed.

Remedy O&M

Monitoring of the plume continues on a quarterly basis, and repository cap and other site maintenance actions are implemented, as necessary, on an annual basis. Costs for system operation and O&M have been within an acceptable range. However, it is recommended that the monitoring network undergo long-term monitoring optimization (see Appendix D).

Early Indicators of Potential Issues

EPA will continue to examine whether additional work is needed to address non-compliance with performance standards in the shallow, deep, or tertiary aquifers. EPA will consider the petition for a waiver of standards in certain aquifers, in accordance with the CD. Atlantic Richfield submitted a petition for standard waiver in 2007 that has not yet been reviewed by the Agencies. Finally, EPA will continue to examine the existing institutional controls relevant to these aquifers.

The reason for the increasing arsenic concentrations in shallow well RH-44 should be investigated and the potential for shallow groundwater to impact water quality in Silver Bow Creek should be considered. Well RH-44 is located less than 100 feet from Silver Bow Creek and, with a depth to water of only about 1 foot below ground surface, interactions between groundwater and surface water may allow arsenic from the Rocker OU to enter Silver Bow Creek. As there are no other shallow alluvial wells downgradient of RH-44, this increasing trend may indicate that the down-gradient portion of the arsenic plume could parallel Silver Bow Creek for some distance or discharge to Silver Bow Creek near RH-44. Surface water quality data are available from station SS-10A about 2 miles downstream. Arsenic concentrations are below the MCL at this location, but the station is too far downstream from the Rocker OU to conclude there is no impact above standards. Groundwater sampling from temporary or permanent wells and surface water sampling from temporary sampling stations in that area could evaluate the current or potential contribution, if any, of arsenic contamination to Silver Bow Creek from shallow groundwater.

Implementation of Institutional Controls

The DNRC implemented institutional controls on groundwater wells for three aquifers, eliminating a potential pathway for arsenic contaminated water in the shallow alluvial aquifer to enter both the deep alluvial and tertiary aquifers through well installation. This ban also controls the exposure pathway for humans from the contaminated groundwater in the shallow alluvial aquifer. The Town Pump well needs additional consideration and action to prevent unhealthy use and plume migration.

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

Changes in Standards and To Be Considereds

No. Since implementation of the remedy at the Rocker OU, a revised drinking water standard for arsenic has been promulgated. The Arsenic Rule was published in the Federal Register (FR) on January 22, 2001 (66 FR 6976). This changed the arsenic MCL of 50 µg/L to 10 µg/L, with this new standard becoming enforceable on January 23, 2006. The state adopted this standard in 2008. Because the revised arsenic standard is based on protection of human health, the revised arsenic MCL is being applied prospectively at all Superfund sites. The National Contingency Plan (NCP) states that ARARs are frozen at the time of the ROD, unless new, post-ROD standards are "necessary to ensure that the remedy is protective of human health and the environment". (40 Code of Federal Regulations [CFR] Section 430(f)(1)(ii)(B)(1)). The NCP also states that new standards can be adopted for a remedy using an Explanation of Significant Differences, rather than a ROD modification (40 CFR Section 300.435(c)(2) and accompanying preamble language at 55 FR 8772). Therefore, it is recommended that EPA issue an Explanation of Significant Differences (ESD) that adopts the new arsenic standard for the entire Rocker OU.

Currently, the shallow groundwater system in the area of the Rocker OU is not used as a drinking water source, but may be in the future. The lower arsenic standard should be applied as the cleanup standard for the Rocker OU, replacing the prior standard of 18 µg/L. If the new standard is applied to the Rocker OU, this will significantly affect the interpretation of the arsenic results in the contingency wells. Based on data during the review period, 5 of the 10 contingency wells (Ayers, RH-

36R, RH-46, RH-53, and Town Pump) have had or currently have a quarterly arsenic concentration equal to or above 10 µg/L arsenic.

Changes in Exposure Pathways

As long as exposure pathways have been broken and remain incomplete, the remedy should remain protective. Risks are manageable with maintenance of site access restrictions (e.g., fencing, locked gates, keeping the area unattractive for trespassing). Whether or not arsenic in shallow groundwater is impacting or has the potential to impact Silver Bow Creek is a data gap to be filled. The MBMG is studying the groundwater migration and the arsenic plume in greater detail to examine this issue.

Changes in Toxicity and Other Contaminant Characteristics

Minor changes in toxicity values for human health (i.e., oral cancer slope factor for arsenic or PAH's) would not alter the conclusions of the human health risk assessment (HHRA) or result in a change to the protectiveness of the remedy.

Changes in Risk Assessment Methods

No information gathered during the risk assessment review changes the human health based standards in the ROD.

Expected Progress Towards Meeting RAOs

Although the arsenic concentrations in the shallow aquifer and gravel zone beneath the repository have rebounded to a greater extent than originally anticipated, the concentrations are, on the whole, significantly reduced compared to pre-remediation results. The highest levels of arsenic in groundwater generally coincide with the location of past operations at the site and the arsenic plume has not expanded beyond the site's contingency wells. Any expansion of the arsenic plume will be detected under the current monitoring program. ICs prevent exposures to contaminated groundwater. However, the remedy is still considered to have a moderate uncertainty when considering the potential time-frame to achieve the arsenic cleanup standard of 18 µg/L (as designated in the ROD) or any revised standard.

7.3 Question C: Has any Other Information Come to Light that Could Call Into Question the Protectiveness Of The Remedy?

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

This page left intentionally blank.

Section 8
Issues

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

Table 8-1
Rocker OU Issues Summary

Issue No.	Issue	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1	Rebounds of arsenic concentrations below the repository are greater than expected in groundwater.	No	Yes
2	Atlantic Richfield submitted a technical impracticability evaluation for a waiver of the arsenic standard in groundwater in 2007.	No	No
3	The Town Pump well exceeds the recently-promulgated 10 µg/L drinking water standard for arsenic. While the facility has switched to the community alternative water supply, there is no requirement for the facility to stay on the alternative water supply.	Yes	Yes
4	Increasing arsenic concentrations in shallow well RH-44 adjacent to Silver Bow Creek may indicate groundwater impacts to surface water. This is a data gap.	Yes	Yes
5	The ¼-mile radius controlled groundwater area may be overly restrictive.	No	No
6	The monitoring plan is not ideal for the current phase of the remedy.	No	No
7	The new arsenic standard of 10 µg/L is not in a decision document	No	No

This page left intentionally blank.

Section 9
Recommendations and Follow-Up Actions

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

Table 9-1
Recommendations and Follow Up Actions

Issue	Recommendations and Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date
1,2	Evaluate whether additional treatment or a TI waiver is needed. Review the TI waiver petition submitted in 2007.	Atlantic Richfield/EPA/ DEQ	EPA/DEQ	September 30, 2012
3	Follow up to ensure Town Pump continues to use the community water supply and not groundwater	EPA/DEQ	EPA/DEQ	December 31, 2011
4	Evaluate the current or potential contribution, if any, of arsenic contamination to Silver Bow Creek from shallow groundwater.	Atlantic Richfield	EPA/DEQ	September, 30, 2011
5	Evaluate the protectiveness and continuation of the ¼-mile radius well ban.	EPA/DEQ/ BSB	EPA	September, 30, 2011
6	Update the monitoring plan to optimize groundwater sampling.	EPA/DEQ	EPA/DEQ	September, 30, 2011
7	Write a decision document to update the arsenic standard.	EPA/DEQ	EPA/DEQ	September 30, 2012

This page left intentionally blank.

Section 10
Protectiveness Statements

The remedy at OU7 is not protective because the Town Pump well exceeds the arsenic MCL of 10 µg/L and was being used for drinking water. Additionally, prolonged use of this well could enlarge the existing plume and otherwise adversely affect remediation of the site. Action to prevent domestic/public use of this well and to prevent extensive pumping is needed to ensure protectiveness.

Further, it is unknown whether site contaminants are reaching Silver Bow Creek.

Other aspects of the remedy currently protect human health and the environment because land use controls are in place to prevent residential development on the OU and a ban on well use within the Rocker OU is still in place. The DNRC instituted a CGWA for the Rocker area and the Rocker residents were provided with an alternate community water system. Existing wells within the CGWA can still be utilized, however well owners have been notified of the potential risks. RAOs were prioritized according to actual or potential use of these groundwater zones. Progress is taking place in lowering the arsenic concentrations in the high quality lower aquifers which are currently used (tertiary groundwater system) and that have the potential to be used (deep alluvium). A TI waiver is under consideration. Ongoing monitoring, continued implementation of institutional controls, controlling site access, and O&M activities are required to ensure long-term protectiveness.

This page left intentionally blank.

Section 11
Next Review

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

This page left intentionally blank.

Section 12
References

AERL 2000. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, Streamside Tailings Operable Unit Construction – Treating Sampling and Analysis Plan. Found in Appendix G of the Consent Decree for the Rocker Operable Unit. July.

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

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

ARCO 2000. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, Operations and Maintenance Plan. Prepared by ARCO Environmental Remediation, LLC. July 7.

ARCO 2006. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2005 Annual Monitoring Report. Prepared by the Atlantic Richfield Company. April.

ARCO 2007. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2006 Annual Monitoring Report. Prepared by the Atlantic Richfield Company. April.

ARCO 2008. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2007 Annual Monitoring Report. Prepared by the Atlantic Richfield Company. April.

ARCO 2009. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2008 Annual Monitoring Report. Prepared by the Atlantic Richfield Company. April.

ARCO 2010. Silver Bow Creek/Butte Area NPL Site, Rocker Timber Framing and Treating Plant Operable Unit, 2009 Annual Monitoring Report. Prepared by the Atlantic Richfield Company. April.

Bighorn Environmental et al. 2009. Monitoring Report for 2008. Streamside Tailings Operable Unit Silver Bow Creek/Butte Area NPL Site. Prepared for the Montana Department of Environmental Quality, Montana Department of Justice, and U.S. Environmental Protection Agency. May.

Bishop 2009. Interview with Mike Bishop, Remedial Project Manager for the Rocker Operable unit.

CH2M-Hill 1995. Baseline Human Health Evaluation for the Rocker Timber Framing and Treating Plant Operable Unit, Silver Bow Creek/Butte Area (Original Portion) Superfund Site, Rocker, Montana. Prepared for EPA by CH2M-Hill, Inc. February 13.

DEQ 2010. Public Water Supply System Reports, PWSID: MT0003746. Website accessed June 22, 2010. http://www.deq.mt.gov/wqinfo/pws/reports.mcpx.

DNRC 2003. Montana's Basin Closures and Controlled Groundwater Areas. Prepared by the Montana Water Resources Division, Water Rights Bureau, Helena. December.

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

EPA 2000a. Consent Decree for the Rocker Operable Unit. Civil Action No. 89-39-BU-PGH. November 7.

EPA 2000b. Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups. EPA 540-F-00-005, OSWER 9355.0-74FS-P. September 2000.

EPA 2005. Second Five-Year Review Report for Silver Bow Creek/Butte Area Superfund Site (EPA 2005). Prepared by U.S. Environmental Protection Agency, Montana Office. September 30.

Jordan 2009. Interview with Rob Jordan, ARCO Lands Manager, December 29, 2009.

MBMG 2010. Draft Rocker Timber Framing and Treatment Plant OU Controlled Groundwater Area Evaluation. Prepared by MBMG for DEQ. December.

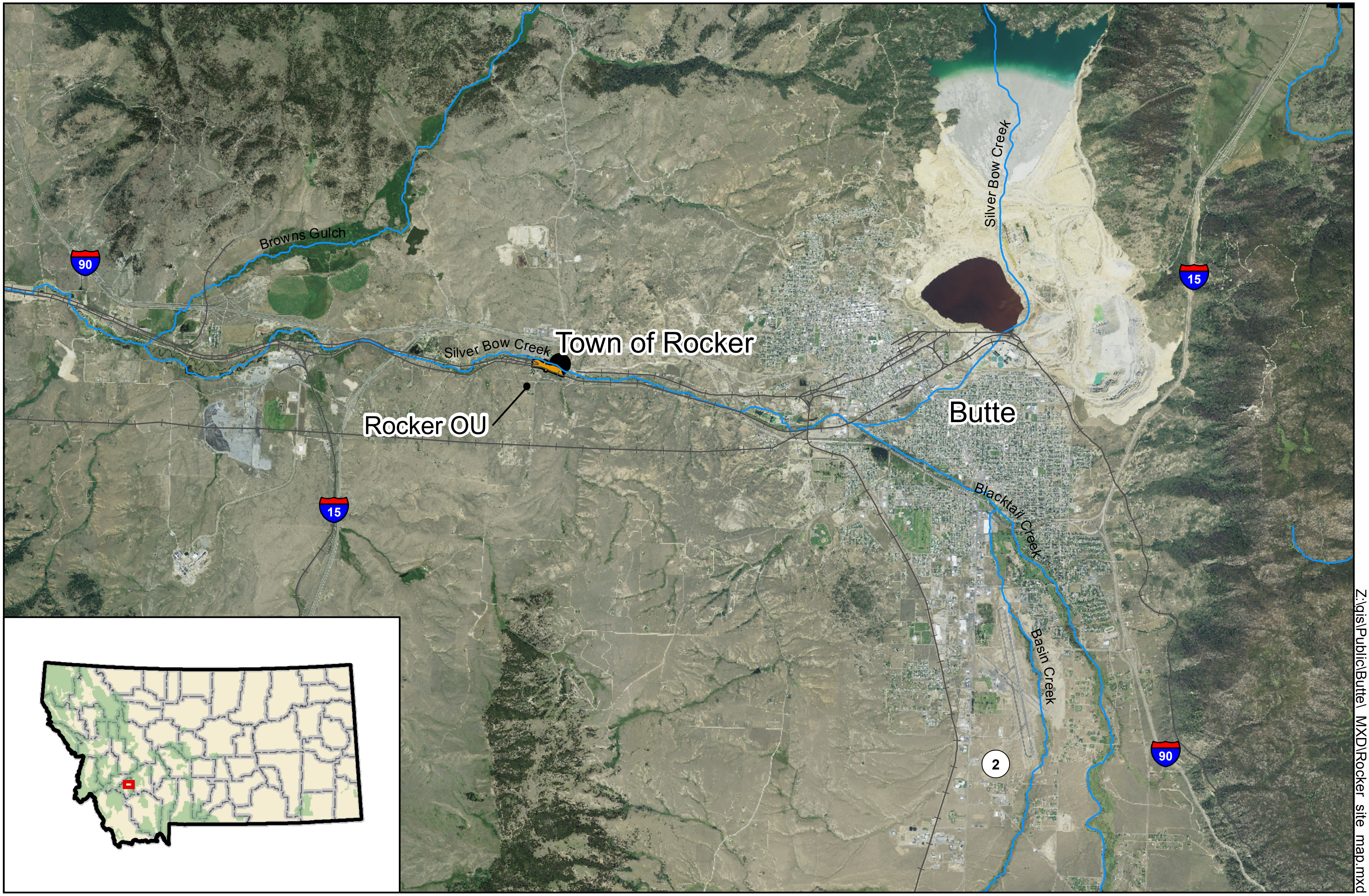


Figure 3-1
Rocker OU Location Map

Silver Bow Creek/Butte Area Five Year Review
Rocker Operable Unit

0 0.5 1 2 3 4 Miles

N

CDM

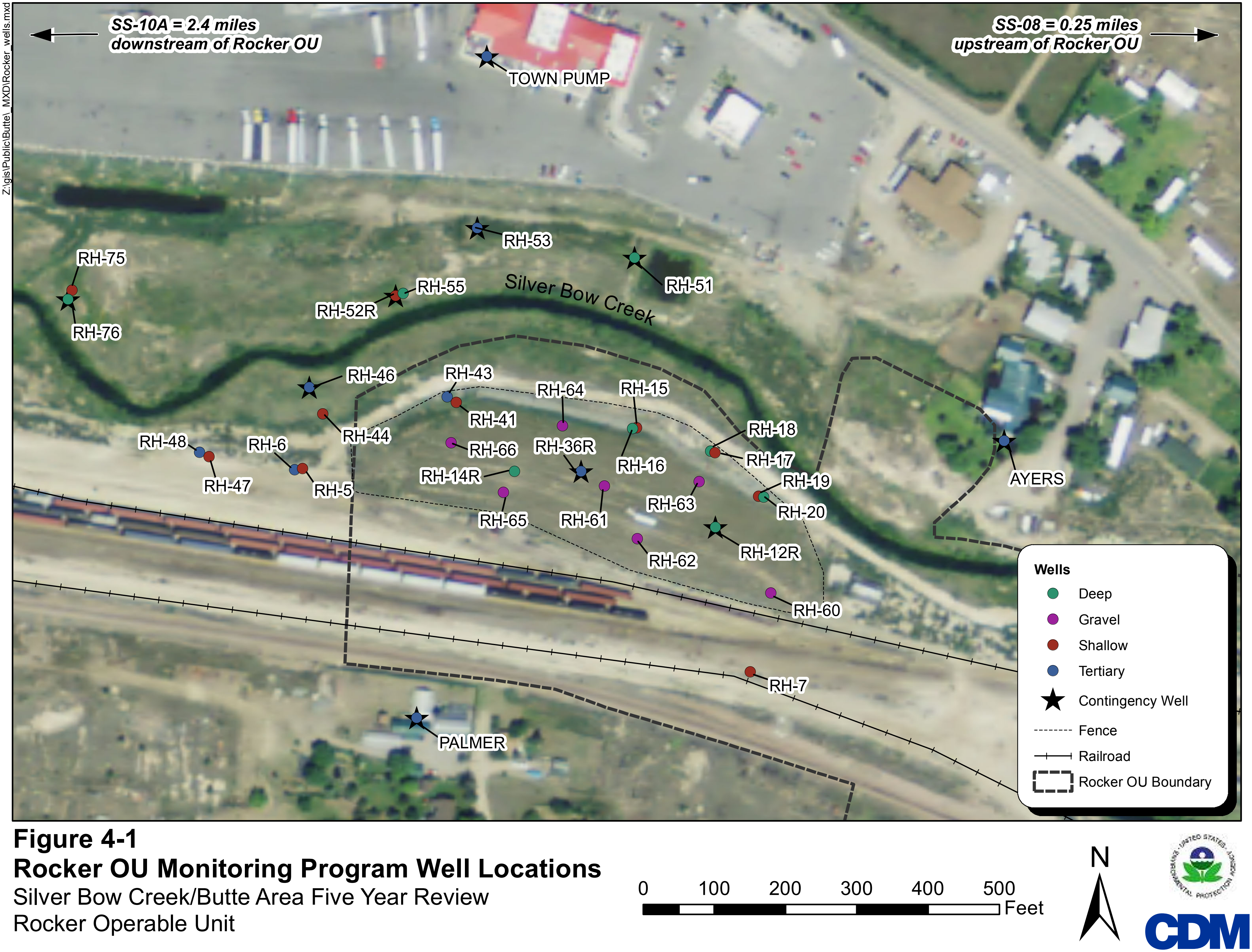
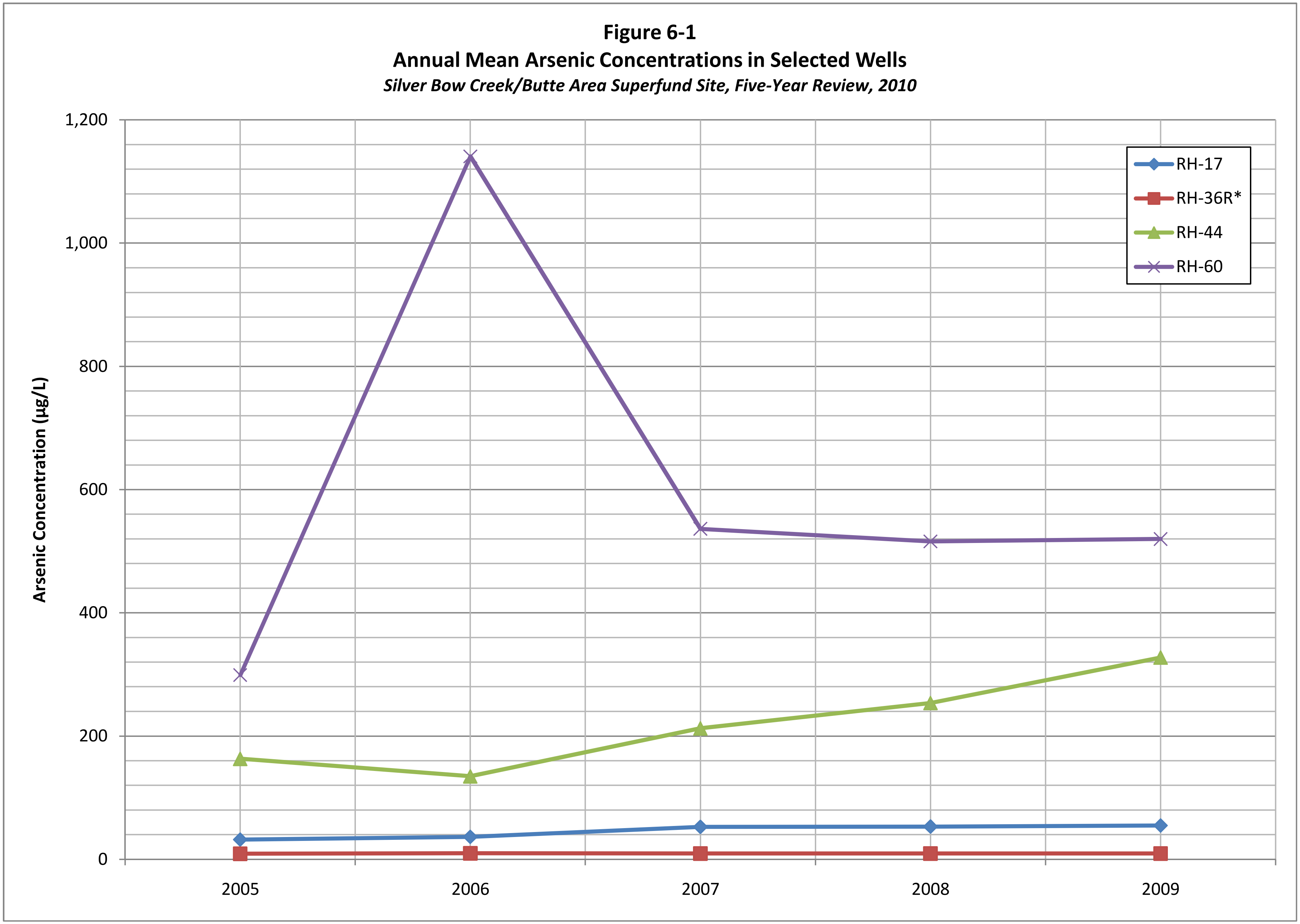
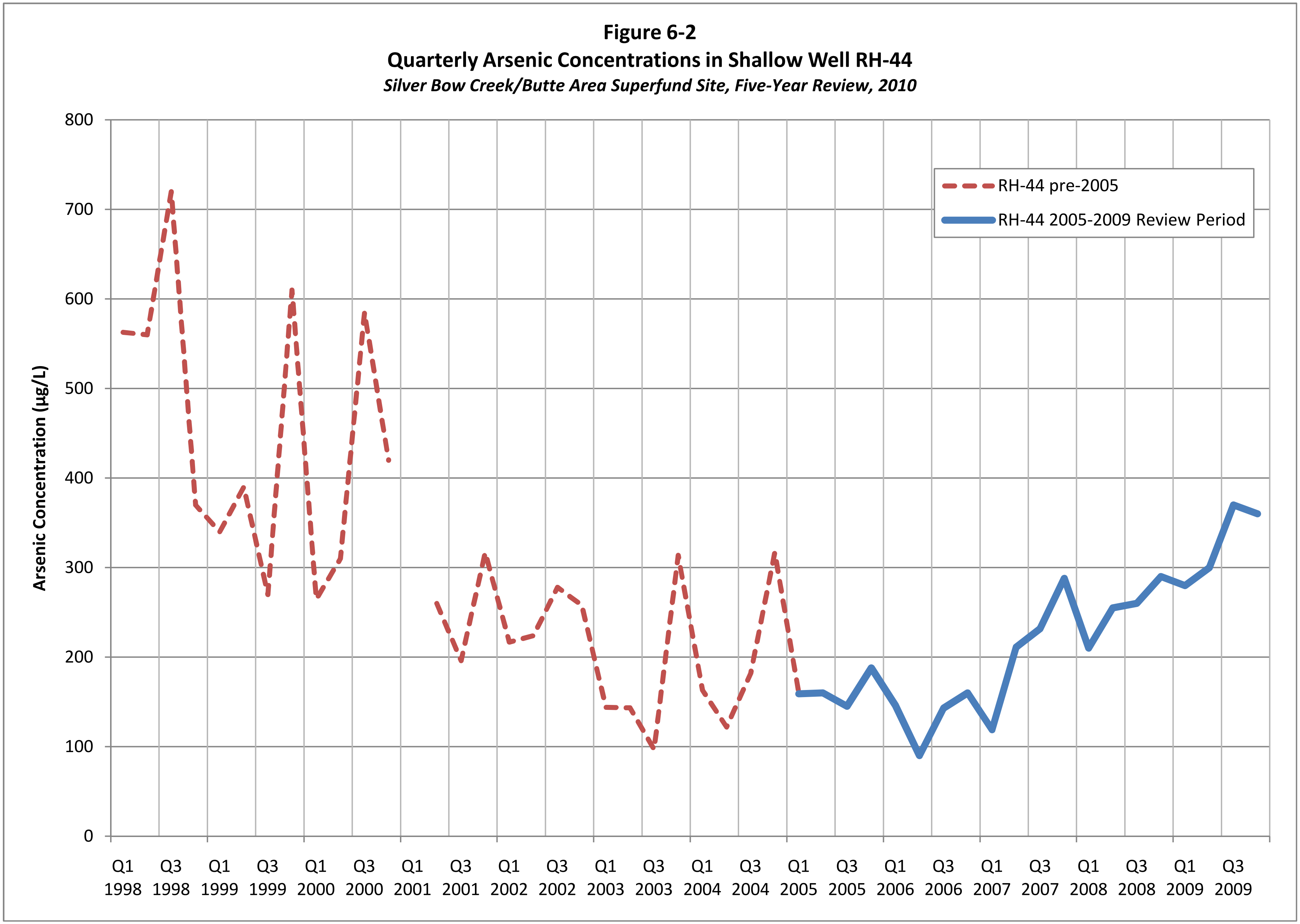


Figure 4-1
Rocker OU Monitoring Program Well Locations
Silver Bow Creek/Butte Area Five Year Review
Rocker Operable Unit



CDM

Q:\Silver Bow Creek 5-Yr Review\Prelim Draft Report\Rocker\Derek's Revised Draft\rocker_well_graphs_rv2.xls Fig 6-1



CDM

Q:\Silver Bow Creek 5-Yr Review\Draft Final Report\Rocker\rocker_well_graphs_rv2.xls Fig 6-2

\\hlnsvr01\gis\Public\Butte_MXD\Rocker_Potentiometric_Shallow.mxd

Figure 6-3

Rocker OU Shallow Aquifer Potentiometric Surface

Silver Bow Creek/Butte Area Five Year Review

Rocker Operable Unit

0 50 100 200 300 400 500 Feet

N

CDM

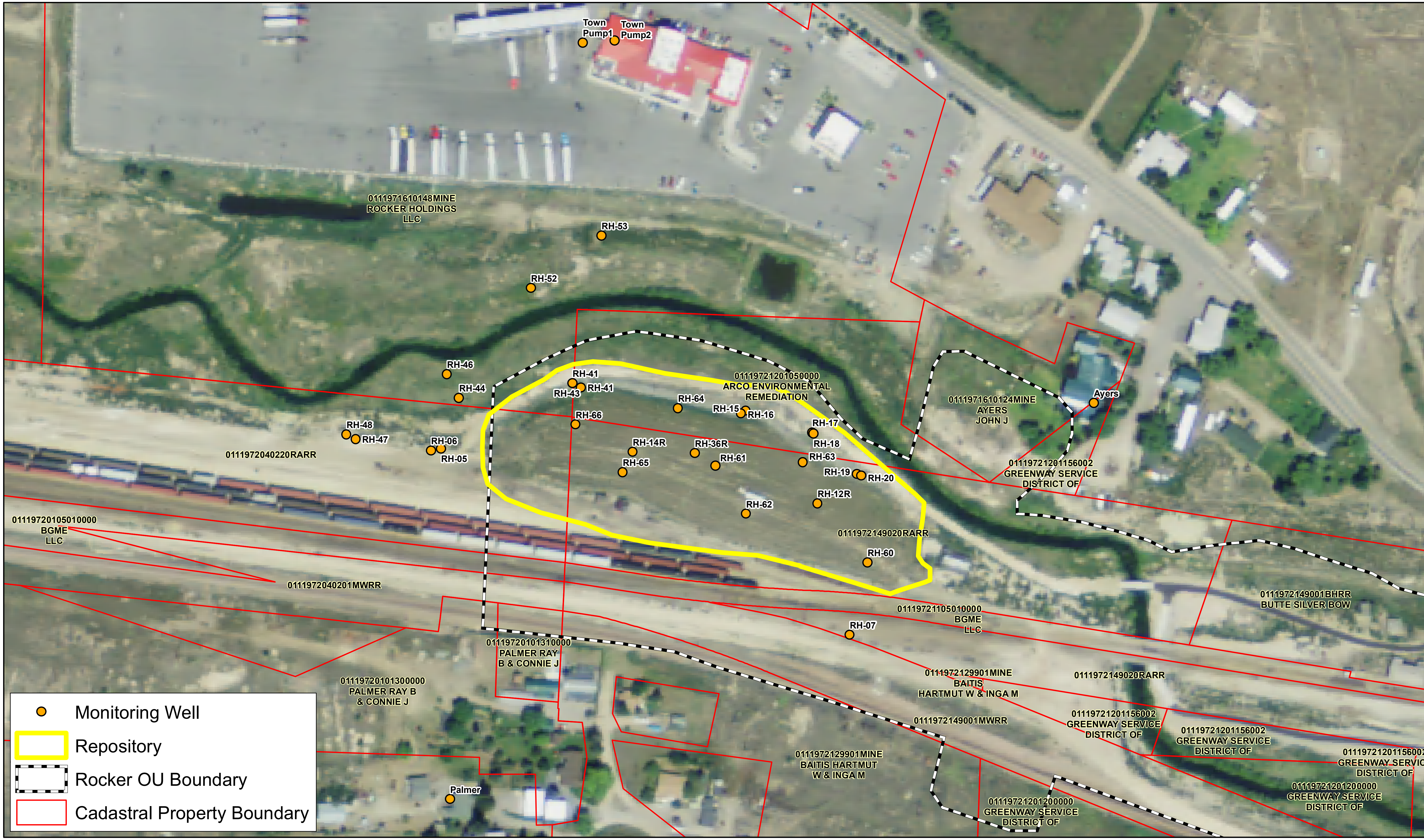


Figure 6-4
Property Ownership within and near Rocker Operable Unit
Silver Bow Creek/Butte Area Five Year Review
Rocker Operable Unit

0 75 150 300 450 600 Feet

N

Q:\Silver Bow Creek 5-Yr Review\Institutional Controls\IC Documents\Rocker\Rocker_OU_ownership.mxd

Appendix A

Site Inspection Photographs

Photographs Taken During Site Inspection: October 7, 2009

Photo 1. New recreational trail (Greenway Trail) along Silver Bow Creek near the Rocker OU

Photo 2. New bridge across Silver Bow Creek near Rocker OU. Trail will eventually pass at the toe of the repository.

Photographs Taken During Site Inspection: October 7, 2009

Photo 3. Silver Bow Creek Greenway trail (looking east)

Photo 4. Monitoring wells with evidence of frost heaving. Town pump visible in background.

Photo 5. Damaged fencing along edge of repository. Rip rap visible in foreground.

Photo 6. Damaged gate and well with frost heaving.

Photo 7. Empty tanks (used for previous groundwater dosing)

Photo 8. Array of injection wells remaining from groundwater dosing.

Photo 9. Tire ruts from repeated driving on repository cap.

Photo 10. Tire ruts on repository cap.

Appendix B

Town Pump Public Water Supply Data

Public Water Supply System

Montana Department of Environmental Quality
Data Source: Public Water Supply Section

Return to PWS Query
Return to PWS Reports

PWSID: **MT0003746 Name: TOWN PUMP NO 5600 ROCKER**

City: ROCKER **County:** SILVERBOW **Tot Pop:**2,000

Pri Src: GW **Class:** NC **Last Snty Srv Dt:** 01/14/2003 **Activity Status:** A

Type	Conn's	In Srvc Dts	Eff Begin Dt	Avg Daily Cnt	Type
CM	1	1/1-12/31	07/18/1994	2,000	T

Administrative Contact	**Financial Contact**	**Owner**
HOVIS, ROGER	HOVIS, ROGER	ROCKER HOLDINGS LLC

Facilities and Entry Points

Status: A 10/03/2000 **Fac ID** DS001 DISTRIBUTION SYSTEM **Src:** GW
Lat/Long Dec: **DMS:**

Smp Pt ID	Status	Description
SP001	A 10/03/2000	SP FOR DS

Status: A 01/14/2003 **Fac ID** PC001 PRESSURE CONTROL ASSEMBLY **Src:** GW
Lat/Long Dec: **DMS:**

Status: A 01/14/2003 **Fac ID** TP001 TP FOR WELLS **Src:** GW
Lat/Long Dec: **DMS:**
TP Units: S460

Smp Pt ID	Status	Description
EP502	A 10/03/2000	EP FOR WELL 1 TP

Status: A 10/03/2000 **Fac ID** WL002 WELL 1 **Src:** GW
Lat/Long Dec: **DMS:**

Status: A 01/14/2003 **Fac ID** WL003 WELL 2 **Src:** GW
Lat/Long Dec: **DMS:**

Sample Schedules/Monitoring Requirements

Fac ID: DS001 **Fac Name:** DISTRIBUTION SYSTEM **Status:** A **Src:**GW

Smp Pt I	Active	Smp Pt Descriptio
SP001	A	SP FOR DS

Group	Name	Schd Beg Dat	Seas Coll Pe	Requiremen
3100	COLIFORM (TCR)	07/01/2008	1/1-12/31	2 RT MN

Fac ID: TP001 **Fac Name:** TP FOR WELLS **Status :** A **Src :** GW

Smp Pt I	Active	Smp Pt Descriptio
EP502	A	EP FOR WELL 1 TP

Group	Name	Schd Beg Dat	Init MP Be	Seas Coll Pe	Requiremen
NITR	CDS NITRATE NITRITE	01/01/2000	01/01/2000	1/1-12/31	1 RT YR

PWSID: **MT0003746 Name: TOWN PUMP NO 5600 ROCKER** **(continued)**

Bacti Results

FROM 01/01/1992 TO 06/22/2010

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc		Fec/EC Result
05/03/2010	1005009-001A	RT		3014	E. COLI	A		-
05/03/2010	1005009-001A	RT		3100	COLIFORM (TCR)	A	-	
05/03/2010	1005009-002A	RT		3100	COLIFORM (TCR)	A	-	
05/03/2010	1005009-002A	RT		3014	E. COLI	A		-
04/06/2010	1004009-003A	RT		3100	COLIFORM (TCR)	A	-	
04/06/2010	1004009-003A	RT		3014	E. COLI	A		-
04/06/2010	1004009-004A	RT		3014	E. COLI	A		-
04/06/2010	1004009-004A	RT		3100	COLIFORM (TCR)	A	-	
03/02/2010	1003012-004A	RT		3100	COLIFORM (TCR)	A	-	
03/02/2010	1003012-004A	RT		3014	E. COLI	A		-
03/02/2010	1003012-005A	RT		3100	COLIFORM (TCR)	A	-	
03/02/2010	1003012-005A	RT		3014	E. COLI	A		-
02/03/2010	1002010-003A	RT		3014	E. COLI	A		-
02/03/2010	1002010-003A	RT		3100	COLIFORM (TCR)	A	-	
02/03/2010	1002010-004A	RT		3014	E. COLI	A		-
02/03/2010	1002010-004A	RT		3100	COLIFORM (TCR)	A	-	
01/07/2010	1001014-003A	RT		3014	E. COLI	A		-
01/07/2010	1001014-003A	RT		3100	COLIFORM (TCR)	A	-	
01/07/2010	1001014-004A	RT		3014	E. COLI	A		-
01/07/2010	1001014-004A	RT		3100	COLIFORM (TCR)	A	-	
12/03/2009	0912002-006A	RT		3100	COLIFORM (TCR)	A	-	
12/03/2009	0912002-006A	RT		3014	E. COLI	A		-
12/03/2009	0912002-007A	RT		3100	COLIFORM (TCR)	A	-	
12/03/2009	0912002-007A	RT		3014	E. COLI	A		-
11/03/2009	0911007-004A	RT		3014	E. COLI	A		-
11/03/2009	0911007-004A	RT		3100	COLIFORM (TCR)	A	-	
11/03/2009	0911007-005A	RT		3100	COLIFORM (TCR)	A	-	
11/03/2009	0911007-005A	RT		3014	E. COLI	A		-
10/08/2009	0910019-002A	RT		3100	COLIFORM (TCR)	A	-	
10/08/2009	0910019-002A	RT		3014	E. COLI	A		-
10/08/2009	0910019-003A	RT		3014	E. COLI	A		-
10/08/2009	0910019-003A	RT		3100	COLIFORM (TCR)	A	-	
09/03/2009	0909033-001A	RT		3014	E. COLI	A		-
09/03/2009	0909033-001A	RT		3100	COLIFORM (TCR)	A	-	
09/03/2009	0909033-002A	RT		3014	E. COLI	A		-
09/03/2009	0909033-002A	RT		3100	COLIFORM (TCR)	A	-	
08/06/2009	0908012-003A	RT		3100	COLIFORM (TCR)	A	-	
08/06/2009	0908012-003A	RT		3014	E. COLI	A		-
08/06/2009	0908012-004A	RT		3014	E. COLI	A		-
08/06/2009	0908012-004A	RT		3100	COLIFORM (TCR)	A	-	
07/10/2009	0907082-001A	RT		3100	COLIFORM (TCR)	A	-	
07/10/2009	0907082-001A	RT		3014	E. COLI	A		-
07/10/2009	0907082-002A	RT		3100	COLIFORM (TCR)	A	-	

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER (continued)

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc		Fec/EC Result
07/10/2009	0907082-002A	RT		3014	E. COLI	A		-
06/09/2009	0906079-001A	RT		3014	E. COLI	A		-
06/09/2009	0906079-001A	RT		3100	COLIFORM (TCR)	A	-	
06/09/2009	0906079-002A	RT		3100	COLIFORM (TCR)	A	-	
06/09/2009	0906079-002A	RT		3014	E. COLI	A		-
05/19/2009	0905142-001A	RT		3100	COLIFORM (TCR)	A	-	
05/19/2009	0905142-001A	RT		3014	E. COLI	A		-
05/19/2009	0905142-002A	RT		3100	COLIFORM (TCR)	A	-	
05/19/2009	0905142-002A	RT		3014	E. COLI	A		-
05/06/2009	0905049-001A	RT		3100	COLIFORM (TCR)	A	-	
05/06/2009	0905049-001A	RT		3014	E. COLI	A		-
05/06/2009	0905049-002A	RT		3100	COLIFORM (TCR)	A	-	
05/06/2009	0905049-002A	RT		3014	E. COLI	A		-
04/22/2009	0904150-001A	RT		3100	COLIFORM (TCR)	A	-	
04/22/2009	0904150-001A	RT		3014	E. COLI	A		-
04/22/2009	0904150-002A	RT		3014	E. COLI	A		-
04/22/2009	0904150-002A	RT		3100	COLIFORM (TCR)	A	-	
04/01/2009	0904023-001A	RT		3014	E. COLI	A		-
04/01/2009	0904023-001A	RT		3100	COLIFORM (TCR)	A	-	
04/01/2009	0904023-002A	RT		3100	COLIFORM (TCR)	A	-	
04/01/2009	0904023-002A	RT		3014	E. COLI	A		-
03/05/2009	0903047-001A	RT		3100	COLIFORM (TCR)	A	-	
03/05/2009	0903047-001A	RT		3100	COLIFORM (TCR)	A	-	
03/05/2009	0903047-002A	RT		3100	COLIFORM (TCR)	A	-	
03/05/2009	0903047-002A	RT		3014	E. COLI	A		-
01/06/2009	0901062-001A	RT		3100	COLIFORM (TCR)	A	-	
01/06/2009	0901062-002A	RT		3100	COLIFORM (TCR)	A	-	
01/06/2009	0901062-002A	RT		3014	E. COLI	A		-
12/02/2008	0812028-001A	RT		3014	E. COLI	A		-
12/02/2008	0812028-001A	RT		3100	COLIFORM (TCR)	A	-	
12/02/2008	0812028-002A	RT		3014	E. COLI	A		-
12/02/2008	0812028-002A	RT		3100	COLIFORM (TCR)	A	-	
10/31/2008	0811005-002A	RT		3014	E. COLI	A		-
10/31/2008	0811005-002A	RT		3100	COLIFORM (TCR)	A	-	
10/31/2008	0811005-003A	RT		3100	COLIFORM (TCR)	A	-	
10/31/2008	0811005-003A	RT		3014	E. COLI	A		-
09/10/2008	0809122-001A	RT		3100	COLIFORM (TCR)	A	-	
09/10/2008	0809122-001A	RT		3014	E. COLI	A		-
09/10/2008	0809122-002A	RT		3100	COLIFORM (TCR)	A	-	
09/10/2008	0809122-002A	RT		3014	E. COLI	A		-
08/08/2008	0808108-001A	RT		3014	E. COLI	A		-
08/08/2008	0808108-001A	RT		3100	COLIFORM (TCR)	A	-	
08/08/2008	0808108-002A	RT		3014	E. COLI	A		-

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER **(continued)**

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc		Fec/EC Result
08/08/2008	0808108-002A	RT		3100	COLIFORM (TCR)	A	-	
07/14/2008	0807160-001A	RT		3100	COLIFORM (TCR)	A	-	
07/14/2008	0807160-001A	RT		3014	E. COLI	A		-
07/14/2008	0807160-002A	RT		3014	E. COLI	A		-
07/14/2008	0807160-002A	RT		3100	COLIFORM (TCR)	A	-	
06/25/2008	0806263-001A	RT		3100	COLIFORM (TCR)	A	-	
06/25/2008	0806263-001A	RT		3014	E. COLI	A		-
06/25/2008	0806263-002A	RT		3014	E. COLI	A		-
06/25/2008	0806263-002A	RT		3100	COLIFORM (TCR)	A	-	
05/16/2008	0805172-001A	RT		3100	COLIFORM (TCR)	A	-	
05/16/2008	0805172-001A	RT		3014	E. COLI	A		-
05/16/2008	0805172-002A	RT		3014	E. COLI	A		-
05/16/2008	0805172-002A	RT		3100	COLIFORM (TCR)	A	-	
04/18/2008	0804162-001A	RT		3014	E. COLI	A		-
04/18/2008	0804162-001A	RT		3100	COLIFORM (TCR)	A	-	
04/18/2008	0804162-002A	RT		3014	E. COLI	A		-
04/18/2008	0804162-002A	RT		3100	COLIFORM (TCR)	A	-	
03/21/2008	0803168-001A	RT		3014	E. COLI	A		-
03/21/2008	0803168-001A	RT		3100	COLIFORM (TCR)	A	-	
03/21/2008	0803168-002A	RT		3100	COLIFORM (TCR)	A	-	
03/21/2008	0803168-002A	RT		3014	E. COLI	A		-
02/08/2008	0802079-001A	RT		3100	COLIFORM (TCR)	A	-	
02/08/2008	0802079-001A	RT		3014	E. COLI	A		-
02/08/2008	0802079-002A	RT		3100	COLIFORM (TCR)	A	-	
02/08/2008	0802079-002A	RT		3014	E. COLI	A		-
01/07/2008	0801047-001A	RT		3100	COLIFORM (TCR)	A	-	
01/07/2008	0801047-001A	RT		3014	E. COLI	A		-
01/07/2008	0801047-002A	RT		3100	COLIFORM (TCR)	A	-	
01/07/2008	0801047-002A	RT		3014	E. COLI	A		-
12/18/2007	0712154-001A	RT		3014	E. COLI	A		-
12/18/2007	0712154-001A	RT		3100	COLIFORM (TCR)	A	-	
12/18/2007	0712154-002A	RT		3100	COLIFORM (TCR)	A	-	
12/18/2007	0712154-002A	RT		3014	E. COLI	A		-
10/16/2007	0710149-001A	RT		3100	COLIFORM (TCR)	A	-	
10/16/2007	0710149-002A	RT		3100	COLIFORM (TCR)	A	-	
10/16/2007	0710149-003A	RT		3100	COLIFORM (TCR)	A	-	
10/16/2007	0710149-004A	RT		3100	COLIFORM (TCR)	A	-	
10/16/2007	0710149-005A	RT		3100	COLIFORM (TCR)	A	-	
09/18/2007	0709156-001A	RP	0709106-	3100	COLIFORM (TCR)	P	+	
09/18/2007	0709156-001A	RP	0709106-	3014	E. COLI	A		-
09/18/2007	0709156-002A	RP	0709106-	3014	E. COLI	A		-
09/18/2007	0709156-002A	RP	0709106-	3100	COLIFORM (TCR)	P	+	
09/18/2007	0709156-003A	RP	0709106-	3100	COLIFORM (TCR)	P	+	

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER **(continued)**

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc		Fec/EC Result
09/18/2007	0709156-003A	RP	0709106-	3014	E. COLI	A		-
09/18/2007	0709156-004A	RP	0709106-	3014	E. COLI	A		-
09/18/2007	0709156-004A	RP	0709106-	3100	COLIFORM (TCR)	P	+	
09/12/2007	0709106-001A	RT		3014	E. COLI	A		-
09/12/2007	0709106-001A	RT		3100	COLIFORM (TCR)	P	+	
09/12/2007	0709106-002A	RT		3100	COLIFORM (TCR)	P	+	
09/12/2007	0709106-002A	RT		3014	E. COLI	A		-
09/05/2007	0709056-001A	RT		3100	COLIFORM (TCR)	A	-	
09/05/2007	0709056-002A	RT		3100	COLIFORM (TCR)	A	-	
07/02/2007	0707019-001A	RT		3100	COLIFORM (TCR)	A	-	
07/02/2007	0707019-002A	RT		3100	COLIFORM (TCR)	A	-	
06/07/2007	0706084-001A	RP	0706019-	3100	COLIFORM (TCR)	A	-	
06/07/2007	0706084-002A	RP	0706019-	3100	COLIFORM (TCR)	A	-	
06/07/2007	0706084-003A	RP	0706019-	3100	COLIFORM (TCR)	A	-	
06/07/2007	0706084-004A	RP	0706019-	3100	COLIFORM (TCR)	A	-	
06/04/2007	0706019-002A	RT		3100	COLIFORM (TCR)	A	-	
06/04/2007	0706019-003A	RT		3100	COLIFORM (TCR)	P	+	
06/04/2007	0706019-003A	RT		3014	E. COLI	A		-
05/01/2007	0705021-001A	RT		3100	COLIFORM (TCR)	A	-	
05/01/2007	0705021-002A	RT		3100	COLIFORM (TCR)	A	-	
04/03/2007	0704027-001A	RT		3100	COLIFORM (TCR)	A	-	
04/03/2007	0704027-002A	RT		3100	COLIFORM (TCR)	A	-	
03/05/2007	0703047-001A	RT		3100	COLIFORM (TCR)	A	-	
03/05/2007	0703047-002A	RT		3100	COLIFORM (TCR)	A	-	
02/01/2007	0702014-001A	RT		3100	COLIFORM (TCR)	A	-	
02/01/2007	0702014-002A	RT		3100	COLIFORM (TCR)	A	-	
01/02/2007	0701018-002A	RT		3100	COLIFORM (TCR)	A	-	
01/02/2007	0701018-003A	RT		3100	COLIFORM (TCR)	A	-	
12/05/2006	0612038-001A	RT		3100	COLIFORM (TCR)	A	-	
12/05/2006	0612038-002A	RT		3100	COLIFORM (TCR)	A	-	
11/03/2006	0611036-001A	RT		3100	COLIFORM (TCR)	A	-	
11/03/2006	0611036-002A	RT		3100	COLIFORM (TCR)	A	-	
10/03/2006	0610026-001A	RT		3100	COLIFORM (TCR)	A	-	
10/03/2006	0610026-002A	RT		3100	COLIFORM (TCR)	A	-	
09/01/2006	0609009-002A	RT		3100	COLIFORM (TCR)	A	-	
09/01/2006	0609009-003A	RT		3100	COLIFORM (TCR)	A	-	
08/01/2006	0608036-001A	RT		3100	COLIFORM (TCR)	A	-	
08/01/2006	0608036-002A	RT		3100	COLIFORM (TCR)	A	-	
07/05/2006	0607021-001A	RT		3100	COLIFORM (TCR)	A	-	
07/05/2006	0607024-002A	RT		3100	COLIFORM (TCR)	A	-	
06/07/2006	0606070-001A	RT		3100	COLIFORM (TCR)	A	-	
06/05/2006	0606037-001A	RT		3100	COLIFORM (TCR)	A	-	
05/02/2006	0605014-001A	RT		3100	COLIFORM (TCR)	A	-	

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER **(continued)**

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc	Fec/EC Result
05/02/2006	0605014-002A	RT		3100	COLIFORM (TCR)	A	-
04/04/2006	0604013-001A	RT		3100	COLIFORM (TCR)	A	-
04/04/2006	0604013-002A	RT		3100	COLIFORM (TCR)	A	-
03/08/2006	20817	RT		3100	COLIFORM (TCR)	A	-
03/08/2006	20818	RT		3100	COLIFORM (TCR)	A	-
02/08/2006	20665	RT		3100	COLIFORM (TCR)	A	-
02/08/2006	20666	RT		3100	COLIFORM (TCR)	A	-
01/12/2006	20497	RT		3100	COLIFORM (TCR)	A	-
01/12/2006	20498	RT		3100	COLIFORM (TCR)	A	-
12/09/2005	23310	RT		3100	COLIFORM (TCR)	A	-
11/11/2005	23167	RT		3100	COLIFORM (TCR)	A	-
11/11/2005	23168	RT		3100	COLIFORM (TCR)	A	-
10/04/2005	22837	RT		3100	COLIFORM (TCR)	A	-
10/04/2005	22838	RT		3100	COLIFORM (TCR)	A	-
09/07/2005	22561	RT		3100	COLIFORM (TCR)	A	-
09/07/2005	22562	RT		3100	COLIFORM (TCR)	A	-
08/01/2005	22183	RT		3100	COLIFORM (TCR)	A	-
08/01/2005	22184	RT		3100	COLIFORM (TCR)	A	-
07/07/2005	22001	RT		3100	COLIFORM (TCR)	A	-
07/07/2005	22002	RT		3100	COLIFORM (TCR)	A	-
06/02/2005	21675	RT		3100	COLIFORM (TCR)	A	-
06/02/2005	21676	RT		3100	COLIFORM (TCR)	A	-
05/03/2005	21386	RT		3100	COLIFORM (TCR)	A	-
05/03/2005	21387	RT		3100	COLIFORM (TCR)	A	-
04/06/2005	21187	RT		3100	COLIFORM (TCR)	A	-
04/06/2005	21188	RT		3100	COLIFORM (TCR)	A	-
03/09/2005	20995	RT		3100	COLIFORM (TCR)	A	-
03/09/2005	20996	RT		3100	COLIFORM (TCR)	A	-
02/02/2005	20764	RT		3100	COLIFORM (TCR)	A	-
02/02/2005	20765	RT		3100	COLIFORM (TCR)	A	-
01/12/2005	20635	RT		3100	COLIFORM (TCR)	A	-
01/12/2005	20636	RT		3100	COLIFORM (TCR)	A	-
01/04/2005	20559	RT		3100	COLIFORM (TCR)	A	-
01/04/2005	20560	RT		3100	COLIFORM (TCR)	A	-
12/20/2004	20492	RT		3100	COLIFORM (TCR)	A	-
12/20/2004	20493	RT		3100	COLIFORM (TCR)	A	-
11/05/2004	20141	RT		3100	COLIFORM (TCR)	A	-
11/05/2004	20142	RT		3100	COLIFORM (TCR)	A	-
10/01/2004	19867	RT		3100	COLIFORM (TCR)	A	-
10/01/2004	19868	RT		3100	COLIFORM (TCR)	A	-
09/01/2004	19544	RT		3100	COLIFORM (TCR)	A	-
09/01/2004	19545	RT		3100	COLIFORM (TCR)	A	-
08/04/2004	19269	RT		3100	COLIFORM (TCR)	A	-

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER **(continued)**

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc		Fec/EC Result
08/04/2004	19270	RT		3100	COLIFORM (TCR)	A	-	
07/07/2004	18958	RT		3100	COLIFORM (TCR)	A	-	
07/07/2004	18959	RT		3100	COLIFORM (TCR)	A	-	
06/02/2004	18586	RT		3100	COLIFORM (TCR)	A	-	
06/02/2004	18587	RT		3100	COLIFORM (TCR)	A	-	
05/06/2004	18360	RT		3100	COLIFORM (TCR)	A	-	
05/06/2004	18361	RT		3100	COLIFORM (TCR)	A	-	
04/08/2004	18119	RT		3100	COLIFORM (TCR)	A	-	
04/08/2004	18120	RT		3100	COLIFORM (TCR)	A	-	
03/08/2004	17879	RT		3100	COLIFORM (TCR)	A	-	
03/08/2004	17880	RT		3100	COLIFORM (TCR)	A	-	
02/06/2004	17656	RT		3100	COLIFORM (TCR)	A	-	
02/06/2004	17657	RT		3100	COLIFORM (TCR)	A	-	
01/06/2004	17450	RT		3100	COLIFORM (TCR)	A	-	
01/06/2004	17451	RT		3100	COLIFORM (TCR)	A	-	
12/11/2003	031216J001	RT		3100	COLIFORM (TCR)	A	-	
12/11/2003	031216J002	RT		3100	COLIFORM (TCR)	A	-	
11/07/2003	17034	RT		3100	COLIFORM (TCR)	A	-	
11/07/2003	17035	RT		3100	COLIFORM (TCR)	A	-	
10/07/2003	16798	RT		3100	COLIFORM (TCR)	A	-	
10/07/2003	16799	RT		3100	COLIFORM (TCR)	A	-	
09/15/2003	16579	RT		3100	COLIFORM (TCR)	A	-	
09/15/2003	16580	RT		3100	COLIFORM (TCR)	A	-	
09/15/2003	16581	RT		3100	COLIFORM (TCR)	A	-	
09/15/2003	16582	RT		3100	COLIFORM (TCR)	A	-	
09/15/2003	16583	RT		3100	COLIFORM (TCR)	A	-	
08/25/2003	16347	RP	16209	3100	COLIFORM (TCR)	A	-	
08/25/2003	16348	RP	16209	3100	COLIFORM (TCR)	A	-	
08/25/2003	16349	RP	16209	3100	COLIFORM (TCR)	A	-	
08/25/2003	16350	RP	16209	3100	COLIFORM (TCR)	A	-	
08/12/2003	16209	RT		3100	COLIFORM (TCR)	P	+	
08/12/2003	16209	RT		3013	FECAL COLIFORM	A		-
08/12/2003	16210	RT		3100	COLIFORM (TCR)	A	-	
07/01/2003	15672	RT		3100	COLIFORM (TCR)	A	-	
07/01/2003	15673	RT		3100	COLIFORM (TCR)	A	-	
06/06/2003	15407	RT		3100	COLIFORM (TCR)	A	-	
06/06/2003	15408	RT		3100	COLIFORM (TCR)	A	-	
05/06/2003	15073	RT		3100	COLIFORM (TCR)	A	-	
05/06/2003	15074	RT		3100	COLIFORM (TCR)	A	-	
04/24/2003	14950	RT		3100	COLIFORM (TCR)	A	-	
04/24/2003	14951	RT		3100	COLIFORM (TCR)	A	-	
03/28/2003	14704	RT		3100	COLIFORM (TCR)	A	-	
03/28/2003	14705	RT		3100	COLIFORM (TCR)	A	-	

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER (continued)

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc	Fec/EC Result
02/27/2003	144690	RT		3100	COLIFORM (TCR)	A	-
02/27/2003	14470	RT		3100	COLIFORM (TCR)	A	-
01/21/2003	14154	RT		3100	COLIFORM (TCR)	A	-
01/21/2003	14155	RT		3100	COLIFORM (TCR)	A	-
12/27/2002	13985	RT		3100	COLIFORM (TCR)	A	-
12/27/2002	13986	RT		3100	COLIFORM (TCR)	A	-
11/25/2002	13742	RT		3100	COLIFORM (TCR)	A	-
11/25/2002	13743	RT		3100	COLIFORM (TCR)	A	-
10/23/2002	13476	RT		3100	COLIFORM (TCR)	A	-
10/23/2002	13477	RT		3100	COLIFORM (TCR)	A	-
09/18/2002	13169	RT		3100	COLIFORM (TCR)	A	-
09/18/2002	13170	RT		3100	COLIFORM (TCR)	A	-
08/28/2002	12954	RT		3100	COLIFORM (TCR)	A	-
08/28/2002	12955	RT		3100	COLIFORM (TCR)	A	-
07/26/2002	12596	RT		3100	COLIFORM (TCR)	A	-
07/26/2002	12597	RT		3100	COLIFORM (TCR)	A	-
06/27/2002	12277	RT		3100	COLIFORM (TCR)	A	-
06/27/2002	12278	RT		3100	COLIFORM (TCR)	A	-
05/22/2002	11918	RT		3100	COLIFORM (TCR)	A	-
05/22/2002	11919	RT		3100	COLIFORM (TCR)	A	-
04/17/2002	11573	RT		3100	COLIFORM (TCR)	A	-
04/17/2002	11574	RT		3100	COLIFORM (TCR)	A	-
03/11/2002	11277	RT		3100	COLIFORM (TCR)	A	-
03/11/2002	11278	RT		3100	COLIFORM (TCR)	A	-
02/26/2002	11155	RT		3100	COLIFORM (TCR)	A	-
02/20/2002	11135	RT		3100	COLIFORM (TCR)	A	-
02/20/2002	11136	RT		3100	COLIFORM (TCR)	A	-
01/09/2002	10853	RT		3100	COLIFORM (TCR)	A	-
01/09/2002	10854	RT		3100	COLIFORM (TCR)	A	-
11/12/2001	0111121447	RT		3100	COLIFORM (TCR)	A	-
11/12/2001	0111121448	RT		3100	COLIFORM (TCR)	A	-
10/23/2001	10336	RT		3100	COLIFORM (TCR)	A	-
10/23/2001	10337	RT		3100	COLIFORM (TCR)	A	-
09/20/2001	10052	RT		3100	COLIFORM (TCR)	A	-
09/20/2001	10053	RT		3100	COLIFORM (TCR)	A	-
08/28/2001	9778	RT		3100	COLIFORM (TCR)	A	-
08/28/2001	9779	RT		3100	COLIFORM (TCR)	A	-
07/18/2001	9396	RT		3100	COLIFORM (TCR)	A	-
07/18/2001	9397	RT		3100	COLIFORM (TCR)	A	-
06/08/2001	8966	RT		3100	COLIFORM (TCR)	A	-
06/08/2001	8967	RT		3100	COLIFORM (TCR)	A	-
05/09/2001	8645	RT		3100	COLIFORM (TCR)	A	-
05/09/2001	8646	RT		3100	COLIFORM (TCR)	A	-

Montana Department of ENVIRONMENTAL QUALITY
Data Source: Public Water Supply Section

Public Water Supply System

Return to PWS Query

Return to PWS Reports

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER **(continued)**

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc		Fec/EC Result
05/09/2001	8647	RT		3100	COLIFORM (TCR)	A	-	
05/09/2001	8648	RT		3100	COLIFORM (TCR)	A	-	
05/09/2001	8649	RT		3100	COLIFORM (TCR)	A	-	
05/09/2001	8650	RT		3100	COLIFORM (TCR)	A	-	
04/18/2001	8464	RP	8388	3100	COLIFORM (TCR)	A	-	
04/18/2001	8465	RP	8388	3100	COLIFORM (TCR)	A	-	
04/18/2001	8466	RP	8388	3100	COLIFORM (TCR)	A	-	
04/18/2001	8467	RP	8388	3100	COLIFORM (TCR)	A	-	
04/09/2001	8388	RT		3013	FECAL COLIFORM	A		-
04/09/2001	8388	RT		3100	COLIFORM (TCR)	P	+	
04/09/2001	8389	RT		3100	COLIFORM (TCR)	A	-	
03/06/2001	8111	RT		3100	COLIFORM (TCR)	A	-	
03/06/2001	8112	RT		3100	COLIFORM (TCR)	A	-	
02/28/2001	8051	RT		3100	COLIFORM (TCR)	A	-	
02/28/2001	8052	RT		3100	COLIFORM (TCR)	A	-	
01/30/2001	7845	RT		3100	COLIFORM (TCR)	A	-	
01/30/2001	7846	RT		3100	COLIFORM (TCR)	A	-	
12/28/2000	7646	RT		3100	COLIFORM (TCR)	A	-	
12/28/2000	7647	RT		3100	COLIFORM (TCR)	A	-	
11/30/2000	7473	RT		3100	COLIFORM (TCR)	A	-	
11/30/2000	7474	RT		3100	COLIFORM (TCR)	A	-	
10/30/2000	7237	RT		3100	COLIFORM (TCR)	A	-	
10/30/2000	7238	RT		3100	COLIFORM (TCR)	A	-	
09/28/2000	6992	RT		3100	COLIFORM (TCR)	A	-	
09/28/2000	6993	RT		3100	COLIFORM (TCR)	A	-	
08/28/2000	6653	RT		3100	COLIFORM (TCR)	A	-	
08/28/2000	6654	RT		3100	COLIFORM (TCR)	A	-	
07/31/2000	6328	RT		3100	COLIFORM (TCR)	A	-	
07/31/2000	6329	RT		3100	COLIFORM (TCR)	A	-	
06/27/2000	5974	RT		3100	COLIFORM (TCR)	A	-	
06/27/2000	5975	RT		3100	COLIFORM (TCR)	A	-	
05/25/2000	5943	RT		3100	COLIFORM (TCR)	A	-	
05/25/2000	5944	RT		3100	COLIFORM (TCR)	A	-	
04/05/2000	5941	RT		3100	COLIFORM (TCR)	A	-	
04/05/2000	5942	RT		3100	COLIFORM (TCR)	A	-	
03/30/2000	5062	RT		3100	COLIFORM (TCR)	A	-	
03/30/2000	5063	RT		3100	COLIFORM (TCR)	A	-	
02/29/2000	4840	RT		3100	COLIFORM (TCR)	A	-	
02/29/2000	4841	RT		3100	COLIFORM (TCR)	A	-	
01/31/2000	4650	RT		3100	COLIFORM (TCR)	A	-	
01/31/2000	4651	RT		3100	COLIFORM (TCR)	A	-	
12/20/1999	4424	RT		3100	COLIFORM (TCR)	A	-	
12/20/1999	4425	RT		3100	COLIFORM (TCR)	A	-	

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER **(continued)**

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc	Fec/EC Result
11/29/1999	4253	RT		3100	COLIFORM (TCR)	A	-
11/29/1999	4254	RT		3100	COLIFORM (TCR)	A	-
10/28/1999	4052	RT		3100	COLIFORM (TCR)	A	-
10/28/1999	4053	RT		3100	COLIFORM (TCR)	A	-
09/29/1999	3824	RT		3100	COLIFORM (TCR)	A	-
09/29/1999	3825	RT		3100	COLIFORM (TCR)	A	-
08/30/1999	3488	RT		3100	COLIFORM (TCR)	A	-
08/30/1999	3489	RT		3100	COLIFORM (TCR)	A	-
07/28/1999	3149	RT		3100	COLIFORM (TCR)	A	-
07/28/1999	3150	RT		3100	COLIFORM (TCR)	A	-
06/29/1999	2832	RT		3100	COLIFORM (TCR)	A	-
06/29/1999	2833	RT		3100	COLIFORM (TCR)	A	-
05/25/1999	2419	RT		3100	COLIFORM (TCR)	A	-
05/25/1999	2420	RT		3100	COLIFORM (TCR)	A	-
04/28/1999	2158	RT		3100	COLIFORM (TCR)	A	-
04/20/1999	2095	RT		3100	COLIFORM (TCR)	A	-
03/29/1999	1928	RT		3100	COLIFORM (TCR)	A	-
02/24/1999	1723	RT		3100	COLIFORM (TCR)	A	-
01/27/1999	1533	RT		3100	COLIFORM (TCR)	A	-
11/24/1998	1153	RT		3100	COLIFORM (TCR)	A	-
10/20/1998	895	RT		3100	COLIFORM (TCR)	A	-
09/30/1998	715	RT		3100	COLIFORM (TCR)	A	-
07/29/1998	100	RT		3100	COLIFORM (TCR)	A	-
06/29/1998	W026398	RT		3100	COLIFORM (TCR)	A	-
05/27/1998	W025334	RT		3100	COLIFORM (TCR)	A	-
04/27/1998	W024519	RT		3100	COLIFORM (TCR)	A	-
03/30/1998	W023752	RT		3100	COLIFORM (TCR)	A	-
02/25/1998	W023105	RT		3100	COLIFORM (TCR)	A	-
01/26/1998	W022681	RT		3100	COLIFORM (TCR)	A	-
12/29/1997	W022317	RT		3100	COLIFORM (TCR)	A	-
10/30/1997	W021048	RT		3100	COLIFORM (TCR)	A	-
06/10/1997	4871	RT		3100	COLIFORM (TCR)	A	-
06/10/1997	4872	RT		3100	COLIFORM (TCR)	A	-
04/24/1997	W7-13957	RT		3100	COLIFORM (TCR)	A	-
04/24/1997	W7-13958	RT		3100	COLIFORM (TCR)	A	-
04/09/1997	4484-3	RT		3100	COLIFORM (TCR)	A	-
03/13/1997	4341	RT		3100	COLIFORM (TCR)	A	-
02/24/1997	4234-2	RT		3100	COLIFORM (TCR)	A	-
01/22/1997	W7-9950	RT		3100	COLIFORM (TCR)	A	-
12/10/1996	3889	RT		3100	COLIFORM (TCR)	A	-
11/11/1996	3765-1	RT		3100	COLIFORM (TCR)	A	-
10/30/1996	3706	RT		3100	COLIFORM (TCR)	A	-
10/16/1996	W7-6173	RT		3100	COLIFORM (TCR)	A	-

PWSID: **MT0003746 Name: TOWN PUMP NO 5600 ROCKER** **(continued)**

Collection D	Lab Number	Type	Orig Lab #	Code		TCR Presenc	Fec/EC Result
10/16/1996	W7-6174	RT		3100	COLIFORM (TCR)	A	-
10/16/1996	W7-6175	RT		3100	COLIFORM (TCR)	A	-
10/16/1996	W7-6176	RT		3100	COLIFORM (TCR)	A	-
10/16/1996	W7-6177	RT		3100	COLIFORM (TCR)	A	-
09/04/1996	W7-3801	RT		3100	COLIFORM (TCR)	P	+
08/08/1996	3135	RT		3100	COLIFORM (TCR)	A	-
07/22/1996	1290	RT		3100	COLIFORM (TCR)	P	+
07/15/1996	878	RT		3100	COLIFORM (TCR)	A	-
05/23/1996	2725	RT		3100	COLIFORM (TCR)	A	-
04/22/1996	16216	RT		3100	COLIFORM (TCR)	A	-
03/27/1996	W6-14961	RT		3100	COLIFORM (TCR)	A	-
02/28/1996	13630	RT		3100	COLIFORM (TCR)	A	-
01/10/1996	W6-11444	RT		3100	COLIFORM (TCR)	A	-
11/30/1995	W6-9480	RT		3100	COLIFORM (TCR)	A	-
10/30/1995	7859	RT		3100	COLIFORM (TCR)	A	-
09/29/1995	6131	RT		3100	COLIFORM (TCR)	A	-
08/29/1995	4106	RT		3100	COLIFORM (TCR)	A	-
07/20/1995	1473	RT		3100	COLIFORM (TCR)	A	-
05/18/1995	19877	RT		3100	COLIFORM (TCR)	A	-
05/03/1995	18833	RT		3100	COLIFORM (TCR)	A	-
03/30/1995	16984	RT		3100	COLIFORM (TCR)	A	-
03/28/1995	16793	RT		3100	COLIFORM (TCR)	A	-
02/27/1995	15225	RT		3100	COLIFORM (TCR)	A	-
02/03/1995	10475	RT		3100	COLIFORM (TCR)	A	-
02/03/1995	10476	RT		3100	COLIFORM (TCR)	A	-
02/03/1995	10477	RT		3100	COLIFORM (TCR)	A	-
02/03/1995	14073	RT		3100	COLIFORM (TCR)	A	-
02/03/1995	14074	RT		3100	COLIFORM (TCR)	A	-
01/30/1995	13781	RT		3100	COLIFORM (TCR)	A	-
01/23/1995	13453	RT		3100	COLIFORM (TCR)	A	-
01/18/1995	13292	RT		3100	COLIFORM (TCR)	A	-

Chemical Results

FROM 01/01/1992 TO 06/22/2010

Fac ID: TP001 **Fac Name:** TP FOR WELLS **Avl:**P **Status:** A **Src:** GW

Smp Pt ID: EP502 **Status:** A **Description:** EP FOR WELL 1 TP **Src Typ** FN

Analyte/CAS No	Code	Analyte Name	Type	Collection D	Lab	Sample Numbe	Result	
IOC	1038	NITRATE-NITRITE	RT	10/15/2009	09	0910107-001A	1.95	MG/L
IOC	1038	NITRATE-NITRITE	RT	10/31/2008	09	0811005-001A	2.73	MG/L
IOC	1038	NITRATE-NITRITE	RT	11/01/2007	09	0711017-001	1.82	MG/L
IOC	1038	NITRATE-NITRITE	RT	10/03/2006	09	0610018-001	1.42	MG/L
IOC	1038	NITRATE-NITRITE	RT	02/21/2006	09	0602221001	1.5	MG/L
IOC	1038	NITRATE-NITRITE	RT	02/21/2006	09	0602221002	1.5	MG/L
IOC	1038	NITRATE-NITRITE	RT	02/16/2006	09	060216K003	1.4	MG/L
IOC	1038	NITRATE-NITRITE	RT	02/16/2006	09	060216K004	1.5	MG/L
IOC	1038	NITRATE-NITRITE	RT	11/10/2004	09	041111I003	1.4	MG/L
IOC	1038	NITRATE-NITRITE	RT	12/11/2003	09	031216J003-N502	1.9	MG/L

Montana Department of Environmental Quality
Data Source: Public Water Supply Section

Public Water Supply System

Return to PWS Query

Return to PWS Reports

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER **(continued)**

Fac ID: TP001 **Fac Name:** TP FOR WELLS **Avl:**P **Status:** A **Src:**
Smp Pt ID: EP502 **Status:** A **Description:** EP FOR WELL 1 TP **Src Typ** FN

Analyte/CAS No	Code	Analyte Name	Type	Collection D	Lab	Sample Numbe	Result	
IOC	1038	NITRATE-NITRITE	RT	11/26/2002	09	021127J001-N502	2.2	MG/L
IOC	1038	NITRATE-NITRITE	RT	11/26/2002	09	021127J002-N502	2.1	MG/L
IOC	1038	NITRATE-NITRITE	RT	11/12/2001	09	0111121447-N502	1.7	MG/L
IOC	1038	NITRATE-NITRITE	RT	11/12/2001	09	0111121448-N502	1.4	MG/L
IOC	1038	NITRATE-NITRITE	RT	11/30/2000	09	0011301353N	1.7	MG/L
IOC	1038	NITRATE-NITRITE	RT	09/29/1999	MIG	W036382-I502	1.56	MG/L
IOC	1038	NITRATE-NITRITE	RT	12/07/1998	MIG	W030061-I502	0.05	MG/L
IOC	1038	NITRATE-NITRITE	RT	12/11/1996	MIG	B9610990-I502	1.6	MG/L
IOC	1038	NITRATE-NITRITE	RT	01/29/1996	MIG	C9512-107756-I502	1.75	MG/L

Lead & Copper Sample Summaries

FROM 01/01/1992 TO 06/22/2010

Period Begin	Period End	Collection End	Type	Period Name	Code	Count	Measure	UoM

Violations & Enforcements

FROM 01/01/1992 TO 06/22/2010

Viol Date	Comp Beg	Comp End	Fed F	Type	Sev	Cate	Code	Name
03/16/2009	02/01/2009	02/28/2009	2009	23	MJ	MON	3100	COLIFORM (TCR)
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
2009	5403509	03/20/2009	SIF		ST PUBLIC NOTIF RECEIVED			
2009	5403409	03/16/2009	SIE		ST PUBLIC NOTIF REQUESTED			
2009	5403309	03/16/2009	SIA		ST VIOLATION/REMINDER NOTICE			
12/17/2008	11/01/2008	11/30/2008	2009	23	MJ	MON	3100	COLIFORM (TCR)
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
2009	5403109	12/17/2008	SIF		ST PUBLIC NOTIF RECEIVED			
2009	5403009	12/17/2008	SIE		ST PUBLIC NOTIF REQUESTED			
2009	5402909	12/17/2008	SIA		ST VIOLATION/REMINDER NOTICE			
12/19/2007	11/01/2007	11/30/2007	2008	23	MJ	MON	3100	COLIFORM (TCR)
2008	5402708	12/19/2007	SOX		ST COMPLIANCE ACHIEVED			
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
2008	5402508	01/09/2008	SIF		ST PUBLIC NOTIF RECEIVED			
2008	5402308	12/19/2007	SIE		ST PUBLIC NOTIF REQUESTED			
2008	5402208	12/19/2007	SIA		ST VIOLATION/REMINDER NOTICE			
11/28/2007	10/01/2007	10/31/2007	2008	23	MJ	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
2008	5402608	01/15/2008	SIF		ST PUBLIC NOTIF RECEIVED			
2008	5402008	11/28/2007	SIE		ST PUBLIC NOTIF REQUESTED			
2008	5401908	11/28/2007	SIA		ST VIOLATION/REMINDER NOTICE			
09/20/2007	09/01/2007	09/30/2007	2007	22		MCL	3100	COLIFORM (TCR)
2007	5401707	07/28/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
2008	5401808	10/12/2007	SIF		ST PUBLIC NOTIF RECEIVED			

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER **(continued)**

Viol Date	Comp Beg	Comp End	Fed F	Type	Sev	Cate	Code	Name
2007	5401607	09/20/2007	SIE		ST PUBLIC NOTIF REQUESTED			
2007	5401507	09/20/2007	SIA		ST VIOLATION/REMINDER NOTICE			
2007	5401307	09/20/2007	MPH		PHONE CALL TO SYSTEM			
2007	5401407	09/20/2007	MHA		HEALTH ADVISORY			
09/18/2007	08/01/2007	08/31/2007	2007	23	MJ	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
2007	5401107	09/18/2007	SIE		ST PUBLIC NOTIF REQUESTED			
2007	5401007	09/18/2007	SIA		ST VIOLATION/REMINDER NOTICE			
08/29/2007	07/01/2007	07/31/2007	2007	24	MN	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
2007	5400807	08/29/2007	SIE		ST PUBLIC NOTIF REQUESTED			
2007	5400707	08/29/2007	SIA		ST VIOLATION/REMINDER NOTICE			
02/10/2006	01/01/2005	12/31/2005	2006	03	MJ	MON	NITR	CDS NITRATE NITRITE
2006	5400506	02/28/2006	SOX		ST COMPLIANCE ACHIEVED			
2006	5400606	02/17/2006	SIF		ST PUBLIC NOTIF RECEIVED			
2006	5400406	02/10/2006	SIE		ST PUBLIC NOTIF REQUESTED			
2006	5400306	02/10/2006	SIA		ST VIOLATION/REMINDER NOTICE			
01/17/2002	12/01/2001	12/31/2001	2002	23	MJ	MON	3100	COLIFORM (TCR)
2005	5400205	02/13/2005	SOX		ST COMPLIANCE ACHIEVED			
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
2002	5125902	01/20/2002	SIE		ST PUBLIC NOTIF REQUESTED			
2002	5125802	01/20/2002	SIA		ST VIOLATION/REMINDER NOTICE			
07/06/1999	01/01/1997	12/31/1997	1999	03	MJ	MON	1040	NITRATE
2009	5403809	05/15/2009	SOX		ST COMPLIANCE ACHIEVED			
10/28/1996	09/01/1996	09/30/1996	1997	25	MJ	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
09/26/1996	08/01/1996	08/31/1996	1996	24	MN	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
08/29/1996	07/01/1996	07/31/1996	1996	25	MJ	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
07/28/1996	06/01/1996	06/30/1996	1996	23	MJ	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
1996	1170696	07/31/1996	SIA		ST VIOLATION/REMINDER NOTICE			
01/24/1996	12/01/1995	12/31/1995	1996	23	MJ	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			

PWSID: MT0003746 Name: TOWN PUMP NO 5600 ROCKER **(continued)**

Viol Date	Comp Beg	Comp End	Fed F	Type	Sev	Cate	Code	Name
1996	1068496	01/30/1996	SIA		ST VIOLATION/REMINDER NOTICE			
11/01/1995	01/01/1994	12/31/1994	1996	03	MJ	MON	1040	NITRATE
2009	5403709	05/15/2009	SOX		ST COMPLIANCE ACHIEVED			
07/25/1995	06/01/1995	06/30/1995	1995	23	MJ	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			
1995	174795	08/01/1995	SIA		ST VIOLATION/REMINDER NOTICE			
11/16/1994	10/01/1994	10/31/1994	1995	23	MJ	MON	3100	COLIFORM (TCR)
2009	5402809	11/19/2008	SOX		ST COMPLIANCE ACHIEVED			
2009	5403909	09/24/2009	SOX		ST COMPLIANCE ACHIEVED			

Responsiveness Summary – Rocker Timber Framing and Treating Operable Unit

The responsiveness summary includes comments received on the draft Rocker OU five-year review report (Volume 5) during the December 12, 2010 through January 31, 2011 comment period. The comments are shown as received but were edited to include only those comments pertaining to the Rocker OU. EPA responses are included in italicized text.

<u>Comments from Atlantic Richfield</u>

ROCKER

AR appreciates the level of data analysis incorporated into EPA's review of the Rocker OU.

EPA Response: Comment noted.

Specific Comments

1. Issue #2. Atlantic Richfield submitted a technical impracticability evaluation for a waiver of the arsenic standard in groundwater in 2007. Recommendation #2: Review the technical impracticability waiver petition submitted in 2007.

AR agrees with this recommendation and is willing to work cooperatively to facilitate EPA's review of the Technical Impracticability (TI) document petition.

EPA Response: Comment noted.

2. Issue #3: The Town Pump and Ayers wells exceed the recently-promulgated 10 ug/L drinking water standard for arsenic. Recommendation #3: Evaluate possible mitigation measures for nearby drinking water wells that exceed the arsenic Maximum Concentration Level (MCL) of 10 ug/L.

Both the Town Pump and Ayers wells had arsenic concentrations that were well below the 18 ug/L MCL when the remedy was implemented (1998). Since implementation of the remedy, the Ayers well has been on a steady decline of arsenic concentrations that has been most apparent since 2006. The quarterly water-sampling monitoring events for the Ayers well has demonstrated that arsenic concentrations have been at or below the new MCL of 10 ug/L since the third quarter of 2008. The Town Pump well has had quarterly arsenic concentrations at or below 10 ug/L since the end of the first quarter of 2010. The Town Pump well is not used as a source of drinking water. Therefore no mitigation measures are necessary.

EPA Response: Subsequent to the release of the draft five year review, EPA re-examined well data for the Ayers residence. It also received a report from the Montana Bureau of Mines and Geology that looked at well data and ground water flow direction in depth. In response, EPA concludes that the Ayers domestic well is at or below the current 10 ug/l drinking water standard, and that the well is located outside the Rocker OU's arsenic contamination influence at this time. The recommendation regarding the Ayer's domestic well has been removed from the report. However, the MBMG report and further EPA data analysis confirms EPA's concerns with the Town Pump domestic well – both because full use of the well could expand the Rocker OU plume or otherwise affect the site remediation, and because full use of the well for domestic purposes could result in drinking water at or above the current drinking water standard. Accordingly, the recommendation regarding further action to prevent the Town Pump well from use has been retained and strengthened in the final report

3. Issue # 4. Cleanup and restoration activities in the SSTOU (e.g. walking trails) have increased the likelihood recreationalists and trespassers could access the Rocker OU area. Recommendation #4: Evaluate possibilities to integrate site with future recreational corridor plans while maintaining site security.

The Rocker OU has an O&M Plan and is inspected annually for issues related to integrity of the remedy, which includes security. Maintenance issues associated with fencing were addressed under the routine maintenance plan and were completed by the time of the issuance of the 5-Year Review Draft. Upgrades to the fencing are planned for 2011 and should address future security issues.

> *EPA Response: EPA acknowledges the fencing repair and other site security measures that were taken by ARCO in recent months. EPA has modified the recommendation accordingly.*

4. Issue #5: Increasing concentrations in shallow well RH-44 adjacent to SBC may indicate plume expansion in the shallow groundwater. The shallow groundwater may be impacting SBC. Recommendation #4: Evaluate the current or potential contribution, if any, of arsenic contamination to SBC from shallow groundwater.

Monitor well RH-44 arsenic concentrations decreased significantly and steadily over the time period of 1998 to 2006, following remediation. Hydrologic changes likely associated with implementation of the Streamside Tailings remedy resulted in a slight rise in arsenic concentrations since 2006. However, the arsenic concentrations are currently about half the concentrations that existed immediately following remediation in 1998. The footprint of the arsenic plume has not increased based on the RH-44 well. It is AR's understanding that US EPA has asked the Montana Bureau of Mines and Geology (MBMG) to conduct a hydrologic study of the area, that will include an evaluation of whether shallow groundwater at monitor well RH-44 has any significant impacts to SBC. AR has offered to provide technical support to EPA and MBMG to help complete this study.

> *EPA Response: The draft 2010 MBMG report is now completed and attached to the final five year review report as an appendix. That report indicates uncertainties concerning the contribution of the Rocker OU arsenic plume to in-stream contamination in Silver Bow Creek. The final five-year review report's text reflects these findings and the recommendation for additional sampling of Silver Bow Creek remains in the final report.*

5. Issue #6: The 1/4-mile radius controlled groundwater area may be overly restrictive. Recommendation: Evaluate the protectiveness and continuation of the 1/4-mile radius well ban. AR understands that the EPA/MBMG hydrologic study described above will include an evaluation of the protectiveness of the Controlled Groundwater Area (CGWA). One of the primary topics is whether the boundaries of the CGWA can be adjusted to provide a smaller CGWA and still maintain the protectiveness of the remedy. AR has offered to provide technical support to EPA and MBMG to help complete this study.

> *EPA Response: The EPA/MBMG report indicates that some adjustments to the Controlled Ground Water Area may be appropriate. This recommendation remains in the report.*

6. Issue #7: Vehicle Tracks in repository cap have not been repaired. Recommendation #7: Repair tracks in repository cover and provide more appropriate road base for field truck access. The OU has an O&M Plan and is inspected annually for issues related to integrity of the remedy, which includes monitor wells and cap vegetation and stability. Maintenance issues associated with these items were identified and addressed under the routine maintenance plan and were completed by the time of the issuance of the 5-Year Review Draft.

EPA Response: EPA acknowledges the repair efforts that ARCO has undertaken at the site, and has removed this recommendation from the report.

7. Issue #8: Some well heads are not secure and show evidence of frost heave. Recommendation # 8: Repair and secure damaged well heads. Response same as for issue #7 above.

EPA Response: Please see the response to the comment immediately above.

8. Last Recommendation: Evaluate possible long-term groundwater monitoring optimization. The Rocker OU has a very high density of monitor wells, frequency of sampling, and number of analytes measured during each quarterly event. AR and US EPA have already initiated discussions about revising the monitoring program to optimize the appropriate level of monitoring with the efforts and resources required.

EPA Response: The EPA/MBMG report also recommends changes to the ground water well monitoring program that include adding some wells and monitoring locations and reducing others. EPA agrees with ARCO that revisions to the well program are needed in response to this recommendation.

Comments from CTEC

15. CTEC supports the proposal for additional monitoring and evaluation of migration of the arsenic plume at the Rocker OU. Additional wells are needed between the arsenic plume and Silver Bow Creek to monitor the plume and determine if the plume is impacting the creek.

EPA Response: EPA appreciates CTEC's comments and will be working to improve the monitoring program at the Rocker OU. Please see our responses to comments above for more information about these issues.

This page left intentionally blank.

ROCKER TIMBER FRAMING AND TREATMENT PLANT OU CONTROLLED GROUNDWATER AREA EVALUATION

April 2011
Final Report Subject to Review

Prepared for:
Montana Department of Environmental Quality
Helena, MT59620
Contract No 400022-TO-41

Prepared by:
Garrett Smith/Gary Icopini/Ted Duaime
Hydrogeologists

Montana Bureau of Mines and Geology
1300 West Park Street
Butte, MT 59701-8997
406-496-4841
gsmith@mtech.edu
gicopini@mtech.edu
tduaime@mtech.edu

ROCKER TIMBER FRAMING AND TREATMENT PLANT OU CONTROLLED GROUNDWATER AREA EVALUATION

April 2011
Final Report Subject to Review

Prepared for:
Montana Department of Environmental Quality
Helena, MT59620
Contract No 400022-TO-41

Prepared by:
Garrett Smith/Gary Icopini/Ted Duaime
Hydrogeologists

Montana Bureau of Mines and Geology
1300 West Park Street
ButteMT59701-8997
406-496-4157
gsmith@mtech.edu
gicopini@mtech.edu
tduaime@mtech.edu

Approvals:

Ted Duaime — 6/09/11

Ted Duaime, Project Manager — Date
Montana Bureau of Mines and Geology

Gary Icopini — 6/09/11

Gary Icopini, Project Manager — Date
Montana Bureau of Mines and Geology

Contents

1.0 Problem Definition

This evaluation was performed through the Montana Department of Environmental Quality (DEQ) Contract No. 400022-TO-41. The purpose of this project is to provide technical assistance to DEQ and U.S. Environmental Protection Agency (U.S. EPA) concerning the Rocker Timber Framing and Treatment Plant Operable Unit (OU) of the Silver Bow Creek/Butte Area National Priorities List (NPL) Site. In addition to meeting with the stakeholders to discuss the site (e.g. DEQ, U.S. EPA, BP-ARCO), the scope of work for this reporting period included Tasks 1, 2, and 3 of the six project tasks:

- Task 1. Review and evaluate historic documents including Remedial Investigation Report (RI), Data Summary Report Addendum – 1993 Supplemental Investigation, Town Pump Aquifer Test, Controlled Groundwater Petition, and Annual O & M Reports.
- Task 2. Identify data gaps and approach to document whether the area of the Controlled Groundwater Area (CGWA) can be reduced which may include developing and/or running groundwater models (models may be analytical, numerical, or both) and preparing a draft and final report.
- Task 3. Participate in various meetings with the stakeholders including EPA, DEQ, Rocker Sewer and Water District, Butte Silver Bow Health Department, Atlantic Richfield, and DNRC.
- Task 4. If necessary and approved by DEQ, collect additional data and/or run the groundwater models.
- Task 5. If appropriate and approved by DEQ, produce draft and final documents (petition) for DNRC.
- Task 6. If necessary, participate in hearings/meetings regarding the petition.

The following report addresses these tasks by providing a summary history and description of the Rocker site, as well as an updated site conceptual model that discusses the hydrogeologic and geochemical (primarily arsenic concentrations) changes over time at the site. Monitoring data gaps are also identified and initial recommendations are made, concerning redefining the boundaries of the CGWA. A comprehensive groundwater model was not developed for this interim report.

2.0 Site Description

2.1 History

The Rocker OU is located approximately 7 miles west of Butte, along the southern bank of Silver Bow Creek (SBC). The site covers an area of about 16 acres, with a concentrated arsenic plume covering about 6.5 acres.

"*Historically, the alluvial bench, now occupied by the Rocker site, was impacted by pre-1900 tailings and placer mining waste disposal along SBC which was evaluated under the Streamside Tailings OU. In the late 1880s, construction of rail lines and rail sidings at the Rocker site resulted in placement of fill material of unknown origin but some of which probably included mine waste rock materials containing elevated metals concentrations.*" (RI, BP-ARCO, 1995a)

Around 1909, wood treatment facilities were constructed on additional fill material at the Rocker site to treat mine timbers and utility poles. Initially, creosote was used to prevent the degradation of the timbers, but later arsenic solutions were used as well, for the same purpose. Operations ended in 1957 and most of the buildings were demolished. Buildings and other facilities at the site included a framing mill, wood conveyance systems and loading areas, boiler house, wood preserving building, carpenter shop, office, preservative storage tank, a treatment pressure vessel (retort), and two dip tanks (RI, BP-ARCO, 1995a).

Most of the wood treating operations occurred on the west end of the OU, while a small area on the north side of the creek was used for timber storage. Contamination of the soil and groundwater at the Rocker site ultimately led to the Rocker site being named an OU of the Silver Bow Creek Superfund/Butte Area Site (RI, BP-ARCO, 1995a). Silver Bow Creek crosses the site and consequently the Streamside Tailings OU crosses through the Rocker OU. Remedial construction for the Streamside Tailings OU had some short-term effects on the Rocker OU (discussed later in Hydrogeologic Conditions). Additionally, a railroad line and part of a rail yard crosses the site and the fill associated with the railroad lines is not part of the Rocker OU. A map of the Rocker site and the current surface-water and groundwater monitoring sites is shown in figure 1 (from BP-ARCO, 2009). The wells that are sampled quarterly for water quality are classified by location and hydrologic unit in Table 1 (BP-ARCO, 2009).

2.2 Pre-ROD Investigations and Remedial Action

"*In 1987 and 1988 ARCO employed Hydrometrics, Inc. to conduct preliminary characterization of the soils and groundwater at the site. These investigations identified high levels of arsenic and lower levels of creosote compounds in the soil and shallow groundwater beneath the site. The high levels of arsenic in the soil (>10,000 mg/kg) resulted in ARCO being enjoined by the State of Montana to conduct the interim removal action.*" (RI, BP-ARCO, 1995a)

In 1989, the site underwent interim remedial action by BP-ARCO to remove shallow soils having arsenic concentrations greater than 10,000 mg/kg (1%). Approximately 1,000 cubic yards of soil and debris were removed to an offsite repository. Surface debris that remained after soil removal (e.g. scrap wood, steel banding, concrete slabs) was placed in an existing trench that traversed the west-central portion of the site. The trench was then backfilled and covered with soil. Other portions of the site were also covered with about one foot of uncontaminated soil and initially re-vegetated. The vegetative cover was established to enhance evapotranspiration thereby reducing infiltration from precipitation and stabilize the soil cover (FS, BP-ARCO, 1995b).

In 1990, BP-ARCO began the process to conduct a Remedial Investigation (RI) of the site, under the direction of the U.S. EPA. The field investigation portion of the RI was conducted in 1991 and 1992, with additional data gathering in 1993 and 1994. The field work consisted primarily of soil, groundwater, and surface water sampling and analysis, and the installation of groundwater monitoring wells. Upon completion of the RI and Feasibility Study (FS) process, the final Record of Decision (ROD) was published at the end of 1995.

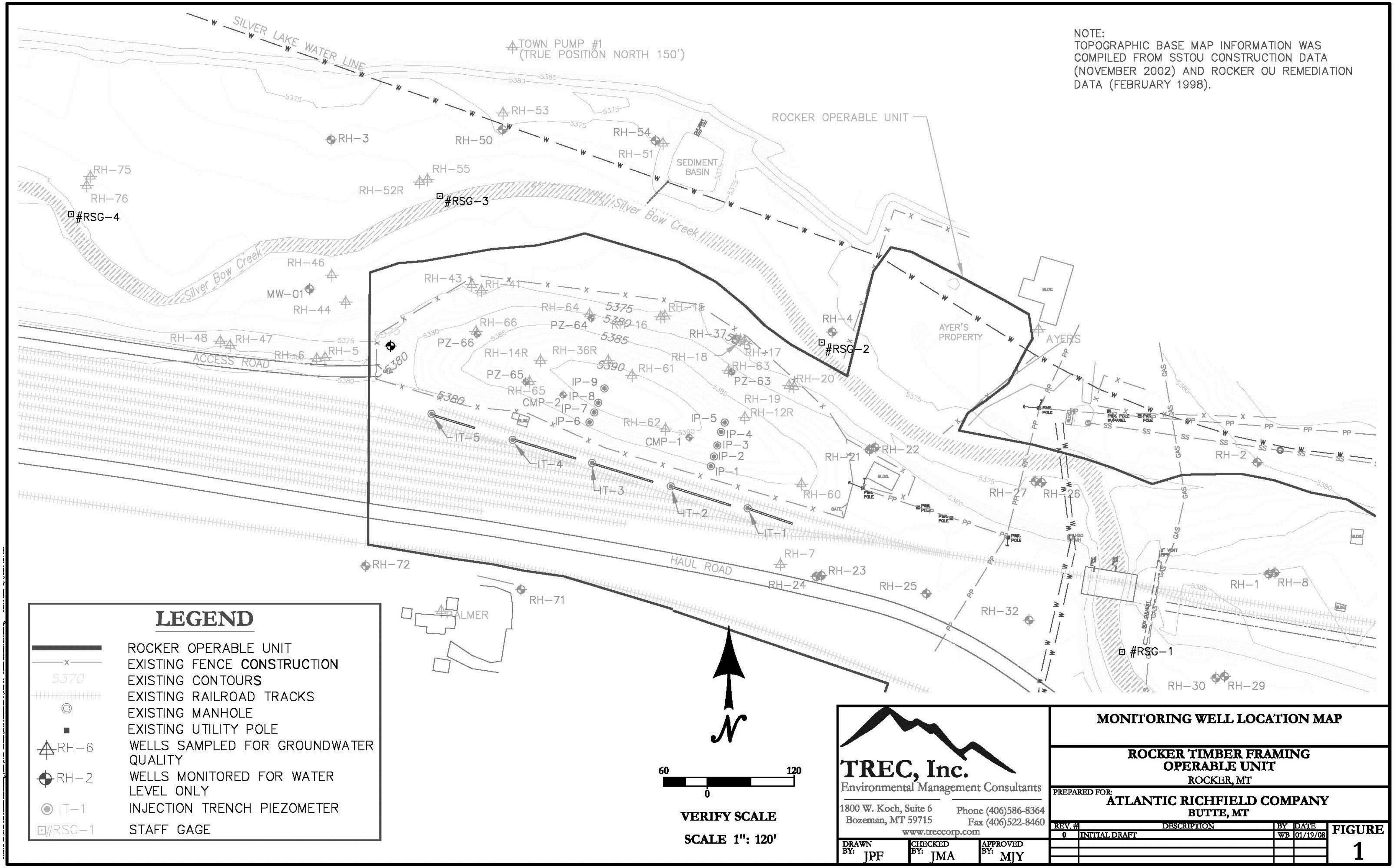


Figure 1. Map of the Rocker site and the current surface and groundwater monitoring sites (generated by TREC, Inc. for BP-ARCO, 2009)

Table 1: Wells Sampled for Groundwater Quality at the Rocker Operable Unit

Well Name	Northing	Easting	Measuring Point Elevation	Mid-Screen Elevation	Hydro-stratigraphic Unit	Depth
RH-60	654806.80	1178655.43	5387.72	5370.72	Gravel	19
RH-61	654956.28	1178421.30	5393.29	5372.79	Gravel	25
RH-62	654882.66	1178467.85	5392.78	5371.78	Gravel	27
RH-63	654962.88	1178554.50	5383.77	5368.27	Gravel	19
RH-64	655041.10	1178362.92	5382.59	5371.09	Gravel	16
RH-65	654947.65	1178280.30	5390.88	5371.88	Gravel	26
RH-66	655017.22	1178206.23	5383.91	5372.41	Gravel	16
RH-05	654981.18	1177997.26	5379.73	5366.73	Shallow	20
RH-07	654695.73	1178625.88	5383.89	5368.89	Shallow	20
RH-15	655038.49	1178466.71	5378.01	5365.51	Shallow	18
RH-17	655003.62	1178576.68	5378.03	5369.03	Shallow	15
RH-19	654942.35	1178637.98	5378.64	5366.64	Shallow	18
RH-41	655074.15	1178213.72	5377.14	5359.64	Shallow	23
RH-44	655057.66	1178026.70	5375.76	5358.76	Shallow	22
RH-47	654997.38	1177866.94	5381.35	5373.35	Shallow	16
RH-52R*	655223.53	1178128.35	5374.98	5354.98	Shallow	25
RH-75	655230.40	1177674.72	5373.69	5353.19	Shallow	23
RH-12R*	654898.61	1178577.36	5388.83	5352.53	Deep	44
RH-14R	654977.08	1178295.20	5392.12	5350.12	Deep	49
RH-16	655036.96	1178460.94	5377.71	5336.21	Deep	47
RH-18	655005.04	1178571.03	5378.01	5339.01	Deep	47
RH-20	654941.04	1178645.25	5380.86	5336.86	Deep	49
RH-51*	655277.03	1178463.92	5376.27	5342.27	Deep	40
RH-55	655226.75	1178139.06	5375.18	5325.18	Deep	55
RH-76*	655218.12	1177668.75	5371.88	5332.88	Deep	44
RH-06	654979.56	1177986.65	5379.57	5345.57	Tertiary	40
RH-36R*	654976.93	1178388.69	5392.31	5302.31	Tertiary	98
RH-43	655081.13	1178200.33	5377.35	5269.35	Tertiary	113
RH-46*	655094.51	1178007.44	5373.83	5308.83	Tertiary	70
RH-48	655003.45	1177853.46	5381.57	5348.57	Tertiary	38
RH-53*	655318.19	1178243.48	5376.21	5262.21	Tertiary	130
Ayers*	655020.01	1178992.81	-	-	Tertiary	160
Palmer*	654631.35	1178168.21	-	-	Tertiary	83
Town Pump	655559.20	1178266.70	-	-	Tertiary	154

* Denotes a contingency well
- Denotes elevations that were unavailable (not measured during surveys of the site)
All elevation and depth values are given in feet, and the locations are given in NAD83- State Plane Feet

The remedy included treatment of the arsenic-rich source materials that contributed to groundwater contamination, as well as surface soil hot-spots (to maximum practical extent). The goal was to reduce mobility of arsenic through the combination of standard excavation and on-site disposal technologies. Natural and enhanced arsenic attenuation processes were used to treat groundwater (ferrous sulfate and lime treatments), and contingency monitoring wells were installed to measure any unexpected groundwater migration off site. A temporary well ban (CGWA) and an alternative water supply for Rocker residents and the Town Pump facility were included as components of the remedy (AERL, 2000a). The different aspects of the remedy are discussed further below.

2.3 Post-ROD Remedial Action

The ROD required that surface material exceeding 380 mg/kg of arsenic should be covered with at least 18 inches of clean soil, while material containing more than 1,000 mg/kg of arsenic must be excavated and replaced with clean soil to a maximum depth of 18 inches. Source materials which fell within the 10,000 µg/L groundwater arsenic isopleth (volume defined in the FS, BP-ARCO, 1995a, p. 3- 20), were also required to be removed, to a depth of 5 feet below the minimum historic groundwater levels. The boundaries of these materials were delineated through comprehensive soil sampling.

The remedy for the source materials included excavation, chemical fixation (mixing media with ferrous sulfate, lime and water), and then backfilling the excavated area with washed gravel to an elevation of one foot above the historic high groundwater level. Then, a filter fabric was placed over the gravel unit and the remainder of the excavated area was filled with the treated source material. An additional cover of 18 inches of non-contaminated cover soil was also required to provide adequate areas for vegetative growth and to protect the treated material. (AERL, 2000b)

The primary excavated zone had a surface area of about 2 acres. Soil and sediments were excavated to at least 5 feet below minimum historic groundwater levels (~42,600 cubic yards). The east and west ends of the floodplain were excavated to groundwater level and the center of the floodplain was excavated to 18 inches below groundwater level (1,272 cubic yards). Two small zones, to the east and west of the primary area were excavated to a depth of 6 inches and produced approximately 335 and 200 cubic yards of material, respectively. The top 18 inches of material were also removed from a former holding pond area to the east of the primary excavation zone (722 cubic yards). The source materials excavation was completed in October, 1997 (all from AERL, 2000b). As a result of the remediation, some wells were removed and when necessary, reinstalled. Reinstalled wells are designated with an “R” following the well name (e.g. RH-52R).

As stated in the ROD, as groundwater was exposed during the excavation process, it was treated with ferrous sulfate, followed by the addition of potassium permanganate with a pH-adjustment as needed (calcium carbonate). Groundwater underlying the rail yard, just adjacent to the footprint excavation area, was also treated with ferrous sulfate through a PVC pipe injection system. The injection system was made out of a vertical riser connected to lengths of perforated poly-vinyl-chloride (PVC) laterals, which were installed in gravel packed trenches ~1 foot above the high groundwater elevation (BP-ARCO, 2007).

A similar injection system was also used to decrease arsenic concentrations in the vicinity of wells RH-62 and RH-65. The aquifer was first treated with a potassium permanganate solution to oxidize the gravel zone. Then, a solution of ferrous sulfate was added to the oxidizing environment, to oxidize Fe^{+2} to Fe^{+3}(which can co-precipitate an arsenic-iron hydroxide). The treatments were delivered in alternating patterns to create a reaction zone which would optimize the adsorption and removal of arsenic. These treatments were applied in multiple stages from September to November 2001 and then again from August to December 2002 (BP-ARCO, 2007).

Another requirement in the ROD involved the enhancement of the existing water supply system serving the community of Rocker. Improvements that were made include increasing the size of the system supply line from 6inch to 12inch pipe and providing a 300,000 gallon storage reservoir.

2.4 Controlled Groundwater Area (CGWA)

The Butte-Silver Bow Health Department petitioned the Montana Department of Natural Resources and Conservation (DNRC) to establish a temporary controlled groundwater area at the Rocker OU (Petition No. 100828-76G). The request was based upon two main concerns: 1) water in the shallow alluvial aquifer is not suitable for drinking; and 2) groundwater withdrawals from the aquifers in this area might cause contaminant migration, both laterally and vertically. DNRC granted a temporary CGWA in May 1997. The CGWA Order indicates that "the above-described area shall be closed to all new appropriations of groundwater". As part of the CGWA, a ban was implemented for all new wells within the Rocker area to prevent increased groundwater use that could influence the arsenic plume migration(AERL, 2000a).

The restrictions apply to all three aquifers within the area identified in figure 2. The boundaries of the CGWA correspond closely to the boundaries of the Rocker OU, with an additional 1/4 mile radius, buffer-zone around the area (circular, covering approx. 160 acres). There is also an area which covers part of the SBC floodplain to the east of the site (DNRC, 1997).

During the community interviews for the Silver Bow Creek Five-Year Review, the public expressed concerns about the current boundaries and duration of the groundwater ban. As a result, this evaluation project was implemented to investigate the potential to revise the boundaries for the CGWA.

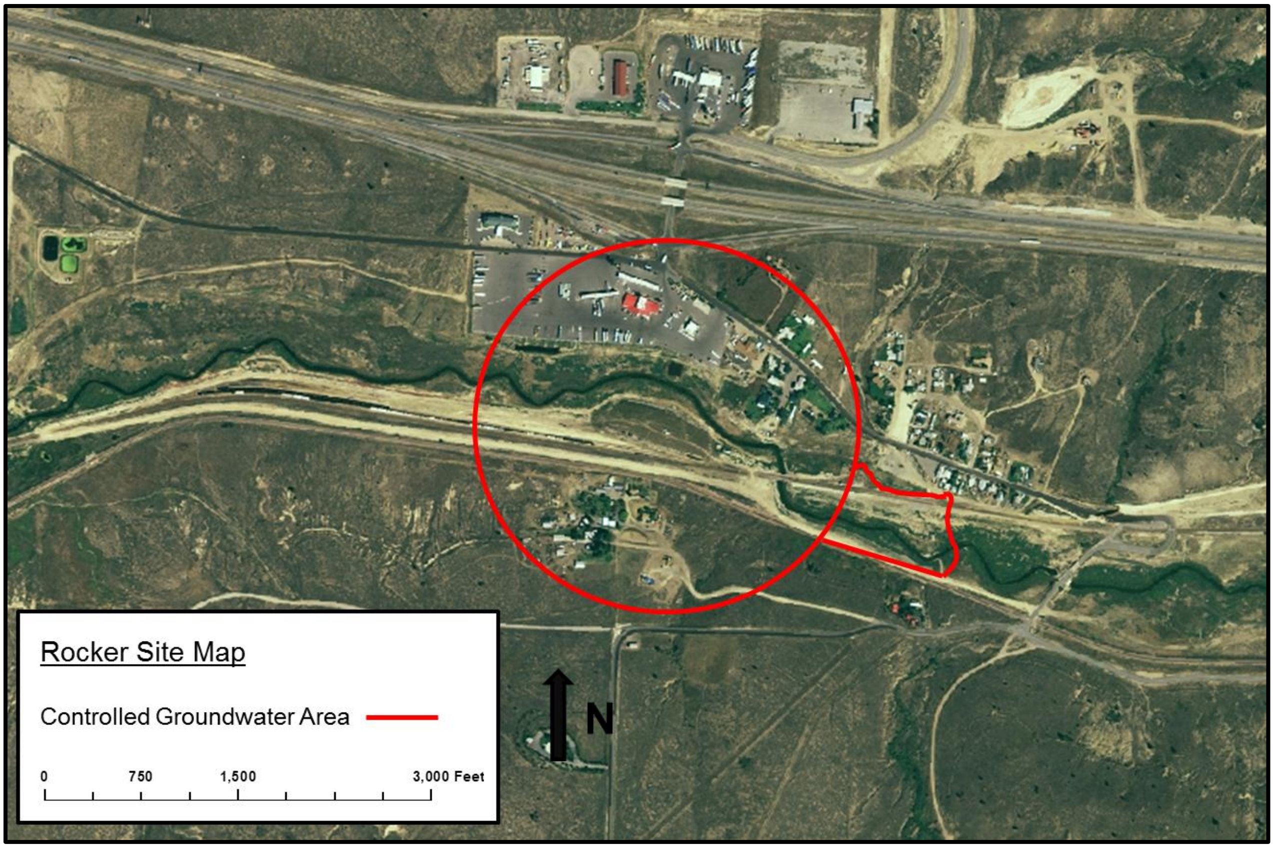


Figure 2. Map of the Rocker site with the approximate location of the CGWA boundaries (based upon map from CGWA Petition, 1996).

3.0 Site Conceptual Model

3.1 Geology

"*The Rocker site and local area is underlain by Cretaceous-age intrusive, crystalline, granitic rocks. Overlying the crystalline bedrock is a complex deposit of Tertiary age sediments and extrusive volcanic strata. The upper part of the Tertiary strata which immediately underlies the Rocker site consists of inter-bedded weathered volcanic tuffs and granitic sediments that have been reworked and deposited under fluvial (stream) and lacustrine (lake) conditions. This material, referred to as Tertiary undivided sediments or Tertiary sediments, is the deepest and oldest material penetrated by wells installed during the RI. Based on the drillers log for a commercial water supply well drilled about 500 feet north of the Rocker site, the Tertiary undivided sediments are at least 600 feet thick in this area.*" (RI, BP-ARCO, 1995a)

"*Overlying the Tertiary sediments are Quaternary-age alluvial deposits consisting of fine to coarse grained sand, silt and clay. The fine grained materials are generally more prevalent in the upper part of the alluvial sediments and on the eastern side of the site. Deeper parts of the alluvial sediments contain coarse gravel and cobbles of weather granite.*" (RI, BP-ARCO, 1995a)

The Quaternary alluvium overlies the eroded surface of the underlying Tertiary sediments. The alluvial sediments are at least 80 feet thick under the center of the site. Near the western end of the site, the top of the Tertiary sediments rise up closer to the surface (within 20 feet), which may represent the side of a north-northwest trending paleo-valley that is not evident at the surface today. The top of the Tertiary sediments in the eastern side of the site was not established during the RI (RI, BP-ARCO, 1995a).

3.2 Hydrogeologic System

Previous studies have identified three primary aquifers in this area. The Quaternary alluvial sediments are subdivided into deep and shallow aquifers based upon well depth and chemistry. The upper 20 feet of sediments are described as the shallow alluvial aquifer, while the deep alluvial aquifer extends from about 20 feet to the top of the under lying Tertiary sediments. The Tertiary aquifer is the other major aquifer at the site (all from the RI, BP-ARCO, 1995a). The gravel aquifer, which was created by the remediation activities, is thought to have limited connection with the shallow alluvial sediments, but it exhibits little control on total groundwater movement at the site (BP-ARCO, 2009). Silver Bow Creek also appears to be connected to the shallow alluvial aquifer in this area and may be receiving or contributing to groundwater in the shallow aquifer. Summaries of these components of the hydrogeologic system from previous reports are provided below.

3.2.1 Silver Bow Creek

Silver Bow Creek flows through the Rocker OU, and based upon information in the RI, the Rocker site was believed to have little to no effect on SBC in terms of flow volume and water quality. A stream-flow study conducted during the RI reached no definitive conclusion about communication between groundwater and SBC, except that the stream may be gaining during one portion of the year and losing during another (RI, BP-ARCO, 1995a).

3.2.2 Gravel Backfill Zone

As previously described, a gravel unit was created during remedial actions in 1997. However, this gravel zone does not significantly affect groundwater flow through the whole site, because the hydraulic properties of the surrounding materials ultimately control inflow and outflow from the gravel zone (BP-ARCO, 2009). The water within the gravel zone has little influence on the other units, although vertical exchange with the shallow alluvium may exist in the eastern part of the gravel unit. Water elevation data collected in 2009 indicate that the water level in the gravel layer fluctuates about 0.4 feet between highest and lowest quarterly water levels (Aug. and Feb., respectively). However, hydraulic gradients are consistently low, due to the high permeability of the gravel unit. A tracer study performed in 2003 estimated groundwater velocity within the gravel zone to be approximately 5 feet per day (BP-ARCO, 2007).

3.2.3 Shallow Alluvial Aquifer

The shallow alluvial aquifer covers the entire site as a thin layer of saturated alluvium, which predominately range in size from fine sand to gravel. The aquifer material also contains discontinuous silt and clay lenses. Groundwater movement is generally from the east to the west and the pre-remediation or pre-pumping hydraulic gradient was approximately 0.006 feet per feet (figure 3; MBMG, 1994). Hydraulic conductivity values for the shallow aquifer range from 0.08 to 223 feet per day, with a geometric mean of 6.5 feet per day (BP-ARCO, 1995a). The pre-remediation potentiometric surface also indicates that the alluvial aquifer was discharging to the creek between RH-41 and RH-16 (figure 3; MBMG, 1994). Elsewhere along the Silver Bow Creek the interaction between the stream and the aquifer is more ambiguous and the stream may be gaining or losing.

3.2.4 Deep Alluvial Aquifer

The lower portion of the alluvial sediments (> 20 feet deep) were identified as a separate aquifer based on the absence of elevated arsenic concentrations, but it is physically similar to the shallow alluvial aquifer. The hydraulic conductivity estimated for the deep alluvial aquifer ranges from 0.07 to 27 feet per day, with a geometric mean of 5.0 feet per day (RI, BP-ARCO, 1995a). The potentiometric surface of the deep alluvial aquifer was also indistinguishable from the shallow aquifer prior to remediation or pumping of the Town Pump well (figure 3).

3.2.5 Tertiary Sediments

Groundwater in the Tertiary deposits moves through a complex system of discontinuous sedimentary beds and fracture zones. Well yields can be highly variable, both vertically and spatially, with hydraulic conductivity values ranging from 0.08 to 103 feet per day, with a geometric mean of 4.5 feet per day (RI, BP-ARCO, 1995a). The pre-remediation potentiometric surface for the Tertiary aquifer indicated that water moved from east to west in this aquifer (figure 4; MBMG, 1994). The pre-remediation horizontal hydraulic gradient within the Tertiary aquifer was very flat (0.0007 feet/feet). Also, the pre-remediation Tertiary potentiometric surface was below that of the alluvial aquifer by approximately 2.7 feet near RH-44 and 5.3 feet near RH-33. Therefore a significant downward gradient from the deep alluvial aquifer to the Tertiary aquifer existed prior to remediation with the largest potential vertical gradients near RH-33 (central area of site).

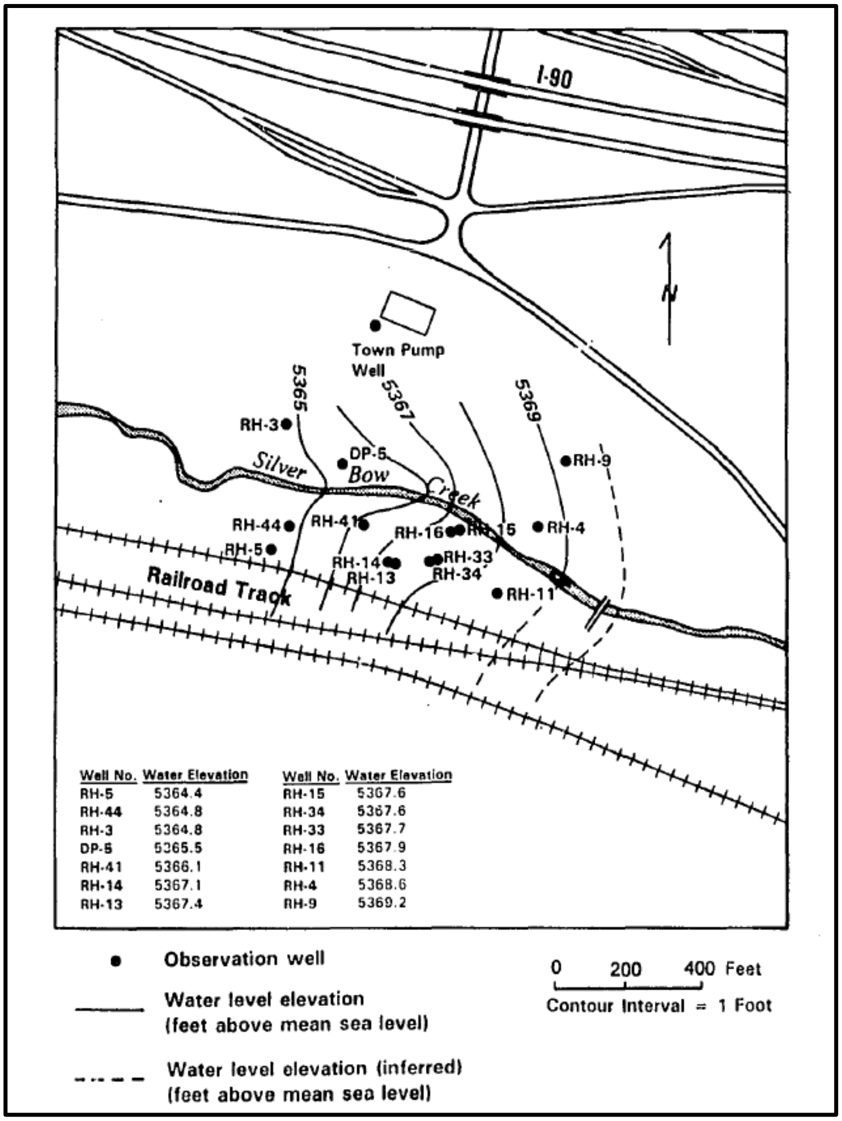


Figure 3. Potentiometric surface of groundwater in the Quaternary alluvial sediments including wells installed in both the shallow and deep alluvial aquifers prior to remediation or pumping (from MBMG, 1994).

3.3 Tertiary Aquifer Test

An aquifer test was performed by the Montana Bureau of Mines and Geology (MBMG) using the Town Pump well (north of the site), which was completed in the Tertiary aquifer. The well was pumped at 100 gallons per minute for seven days and resulted in estimated transmissivity values of ~15,000 to 38,000 ft^2/day (MBMG, 1994). The storativity values (0.000036 to 0.032, geometric mean of 0.0012) indicate that the aquifer ranges from confined to unconfined and probably acts as a leaky confined aquifer (MBMG, 1994). During the aquifer test, the drawdown cone in the Tertiary aquifer extended south beneath the Rocker site (at least to RH-43), but drawdown was not observed in the shallow alluvial wells. However, precipitation events on days one and three (0.5 inches each) of the aquifer test may have masked the drawdowns in the shallow wells. Although the degree of connectivity between the alluvial aquifers and the Tertiary aquifer could not be determined with the aquifer test, it seems likely that there are restrictive layers within or between the aquifers, as suggested by the storativity estimates.

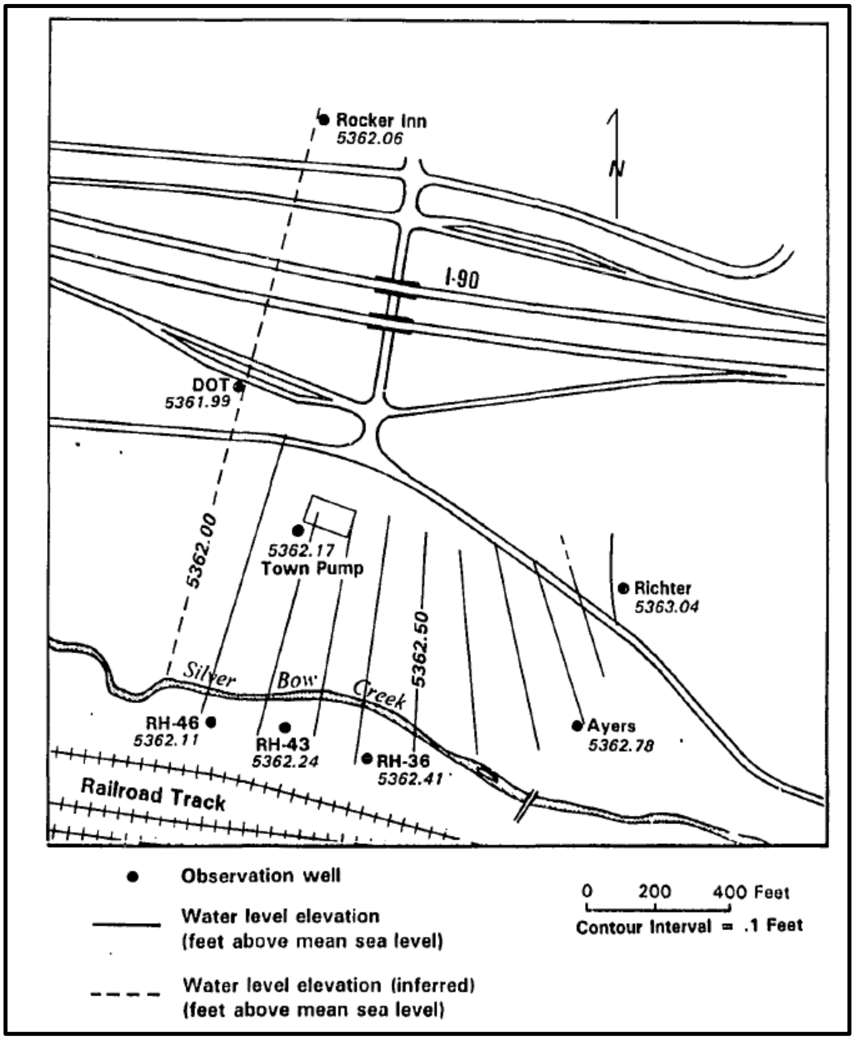


Figure 4. Potentiometric surface of groundwater in the Tertiary sediments aquifer prior to remediation or pumping (from MBMG, 1994).

4.0 Post-Remediation Hydrogeologic Conditions

The relationships between the various components of the hydrogeologic system were evaluated by generating 3-dimensional (3-D) potentiometric surfaces for each component using the August 2009 quarterly monitoring data. Silver Bow Creek was also depicted as a surface with dimensions that correspond to the gauging site locations (blue contoured surface in figure 5; software limitations require a rectangular shape bounded by the outermost points). The extension of the stream “surface” away from the stream is an artifact from the software and only the water elevation differences adjacent to the stream are relevant. In this depiction, areas where the blue surface underlies the multi-colored surface, the water elevation in SBC is below the water elevation in the shallow aquifer. Therefore, those reaches of SBC have the potential to gain groundwater. Similar to the pre-remediation data (figure 3), the area near RH-41 (RH-43 on figure 3) appears to be an area where groundwater is discharging to the stream as the potentiometric surface for the shallow alluvial aquifer is above the elevation of the stream (figure 5). In other areas, it appears that the stream has the potential to be a losing stream with the elevation of the stream above local groundwater. The locations of these apparent gaining and losing zones do not seem to fluctuate greatly through the year (when compared to other quarterly data, not presented). The overall gradient for the shallow alluvial potentiometric surface is

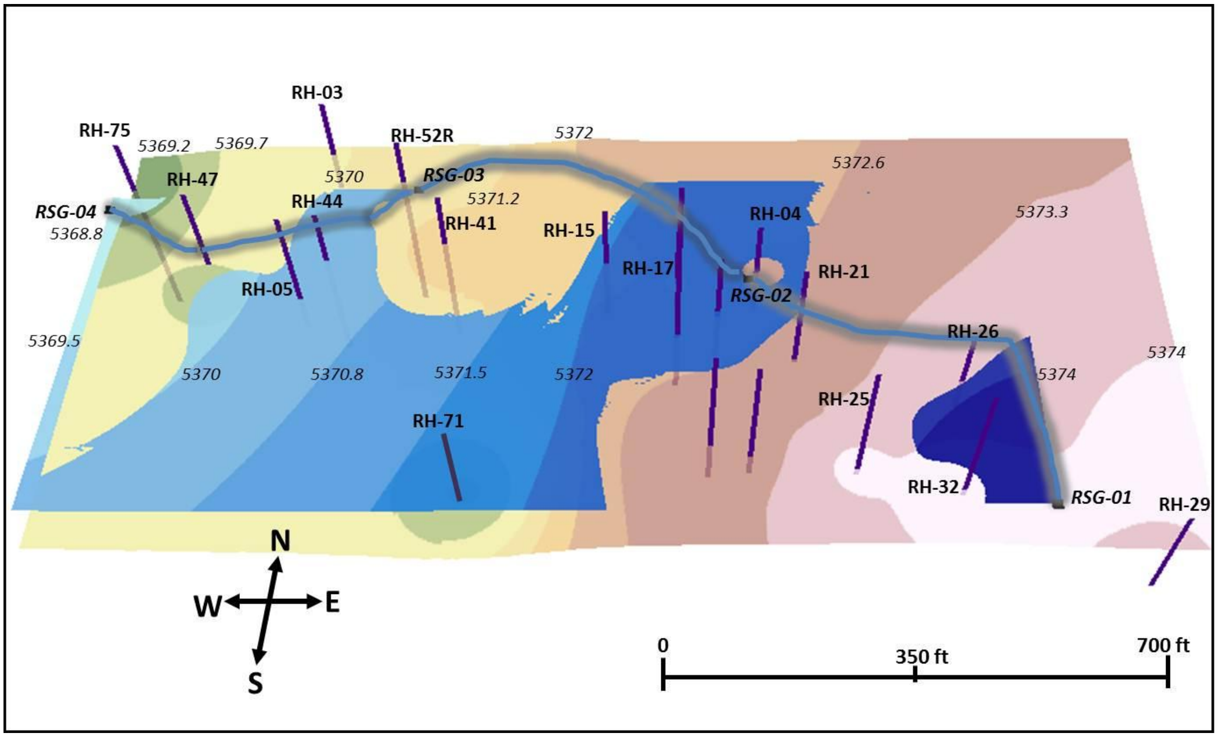


Figure 5. This oblique view shows the water-elevation surfaces for SBC in shades of blue and the shallow alluvial aquifer in multi-color (August, 2009 data). By looking at areas of color overlap, vertical gradients between SBC and the shallow alluvial aquifer can be distinguished. Selected well names are shown for spatial reference and the staff gage sites (*RSG*) are shown as squares. The elevations for each contour boundary are presented on or near the boundary in feet. Although the blue plane appears to extend throughout the entire site, those water elevations correspond only to points along the blue/gray line, which indicates the approximate location of SBC (extrapolated area due to software).

approximately 0.0042 feet per feet with a slight downward steepening in the northwest corner of the mapped surface.

The connection between the shallow alluvium and SBC was also demonstrated during construction on the Streamside Tailings OU. Silver Bow Creek was dewatered to allow remedial actions, and during that time, water elevations in the alluvial system dropped noticeably. However, the normal seasonal patterns in the Tertiary groundwater elevations were relatively unchanged during construction (BP-ARCO, 2007). The 2009 water elevation data indicates that Silver Bow Creek fluctuates about 0.5 feet between highest and lowest water elevations, which is consistent with the seasonal changes observed in the three main aquifers (figure 9).

Groundwater within the constructed gravel zone is thought to have limited connection with the other units (BP-ARCO, 2009). Groundwater elevation data suggest that vertical exchange with the shallow alluvium may exist in small areas in the eastern part of the site, as seen in figure 6. Slight upward vertical gradients exist near gravel wells RH-60, RH-62, and RH-63, which show some of the highest arsenic concentrations at the site.

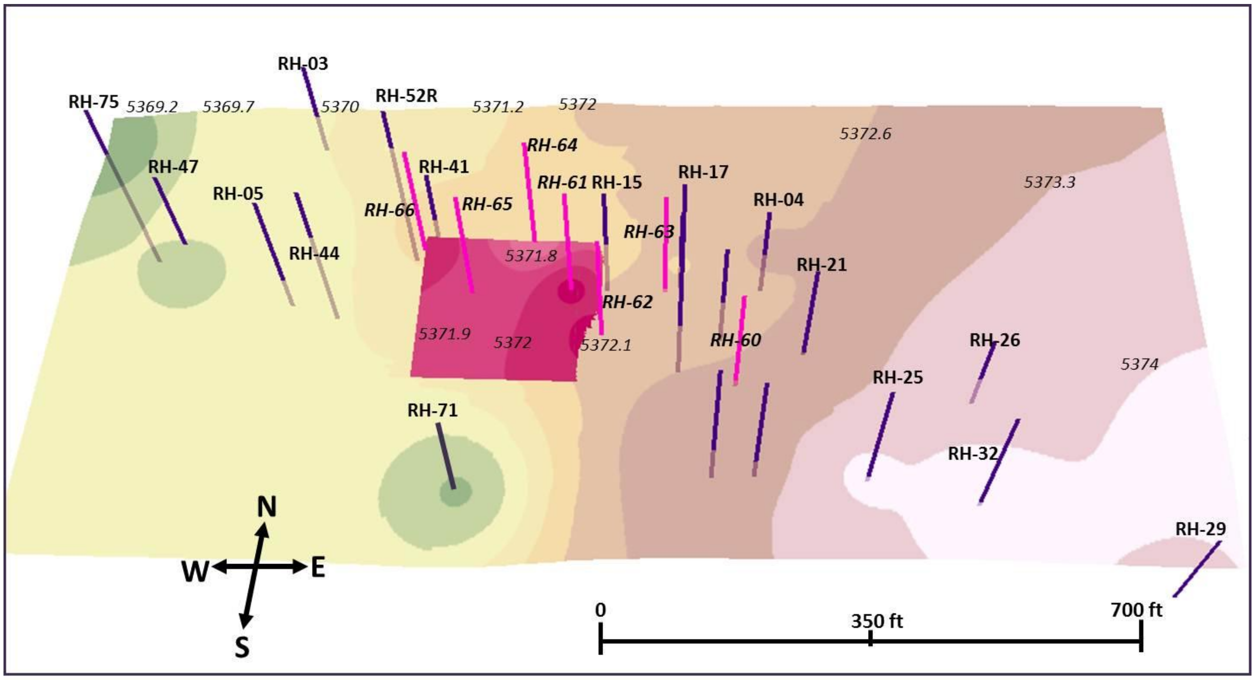


Figure 6. Water elevations are shown for the gravel and shallow alluvial aquifers during August 2009. This oblique view shows the gravel-zone water elevations in red/pink and the shallow alluvial aquifer in multi-color. Gravel wells are shown in pink with names in italics, and the shallow alluvial wells are shown in purple for spatial reference. The elevations for each contour boundary are presented on or near the boundary in feet. Slight upward gradients occur between the two units on the eastern side of the site (around RH-60 and RH-63), but the gravel zone ultimately has little effect on groundwater movement at the Rocker Site.

Unlike the shallow alluvial aquifer, the deep alluvial aquifer's current potentiometric surface is different from pre-remedial conditions. Prior to remediation, the water levels in the shallow and deep alluvial wells were very similar across the site (figure 3); the three sets of paired wells present at the time indicated either an upward gradient (0.3 feet) or a downward gradient (0.1 or 0.3 feet). In the eastern portion of the site, water elevations between the shallow and deep alluvial aquifers are still similar to one another (figure 7). For example, the water level in RH-16 (Deep well) appears to be similar to the pre-remediation water level. The horizontal gradient within the deep aquifer is about 0.0034 feet per feet on the eastern side of the site, which is similar to pre-remediation conditions (MBMG, 1994). However, the horizontal gradient of the deep aquifer surface steepens to 0.019 feet per feet in the northwestern part of the site (west from RH-16). In the northwestern part of the site there is a large elevation difference between the deep and shallow alluvial aquifers, with water levels in the deep aquifer being up to 6 feet lower than those in the upper unit.

The deep aquifer wells showing the most depressed groundwater elevation are just south and southwest of the Town Pump well (RH-55 and RH-76, respectively), which appears to have been in continuous use since the mid 1990s. During the aquifer test conducted on the Town Pump well, the drawdown cone extended beyond the present location of RH-55 (MBMG, 1994), which didn't exist in 1994. In addition to the Town Pump well, there may be additional groundwater withdrawals from industrial wells to the north/northwest of the site (e.g. hotels, gas station), outside of the CGWA. It is quite possible that the water levels in wells RH-55 and RH-76

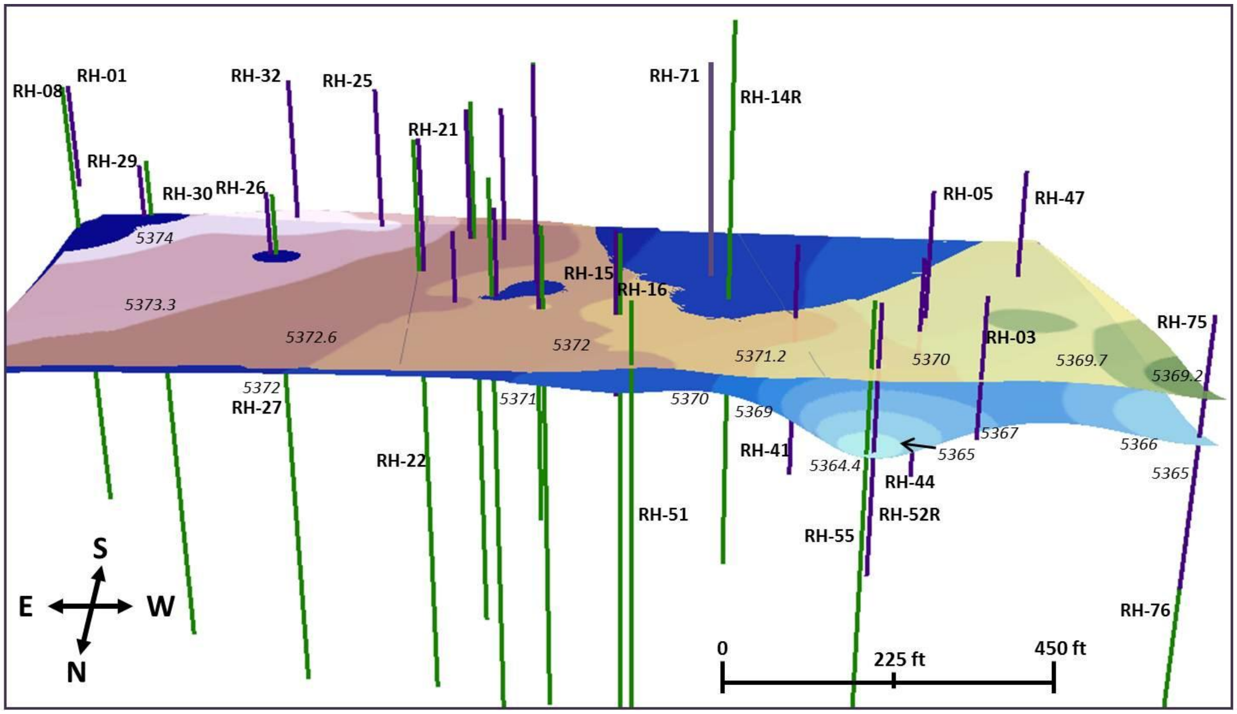


Figure 7. Potentiometric surfaces for the shallow and deep alluvial aquifers during August 2009, looking south. This oblique view shows the shallow alluvial aquifer in multi-color and the deep aquifer in shades of blue. Selected well names are shown for spatial reference and the elevations for each contour boundary are presented on or near the boundary in feet. Slight upward vertical gradients occur between units on the eastern and central parts of the site, while steeper, downward gradients occur to the northwest.

represent two points along a drawdown cone or general depression, resulting from pumping the Town Pump and other wells to the north of the site.

The Tertiary aquifer's potentiometric surface is relatively flat, with flow to the west to northwest and an overall gradient of 0.0005 feet per feet (figure 8), which is similar to the 1994 surface (MBMG, 1994). Downward vertical gradients exist between the deep alluvial and Tertiary aquifers across the site, also similar to pre-remediation conditions. Compared to the pre-remediation elevation though, the Tertiary potentiometric surface appears to have dropped approximately two feet. In figure 8, the apparent rise in the Tertiary water levels in the southwest part of the site is a function of two shallow Tertiary wells (RH-06 and RH-48, ≤ 40 feet deep), which are likely to be in greater connection with the deep alluvial aquifer than the deeper (>100 feet) Tertiary aquifer. The water elevations in the deeper Tertiary wells near the northwest end of the site approach the water elevations observed in the deep alluvial wells.

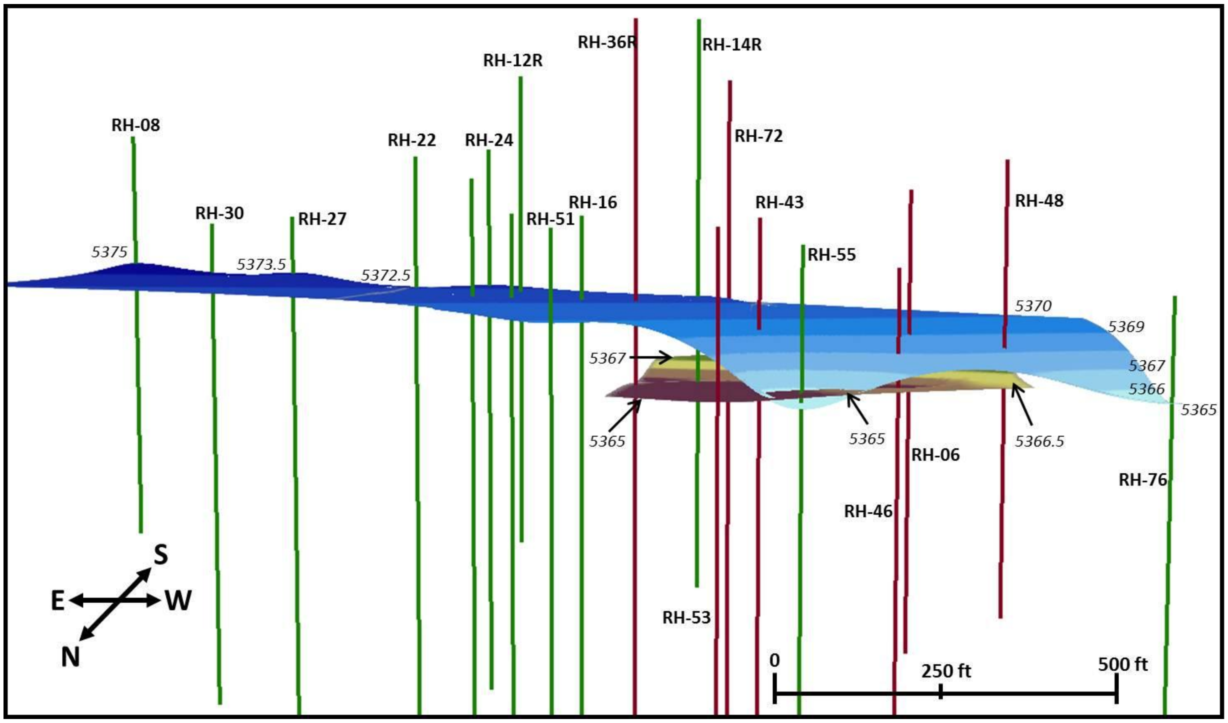


Figure 8. Potentiometric surfaces for the deep alluvial and Tertiary aquifers during August, 2009. This side view, although looking south, offers the best perspective of these two aquifers, with the deep alluvial aquifer shown in shades of blue and the Tertiary aquifer in multi-color. The deep alluvial wells are shown in green and the Tertiary wells are red. Selected well names are shown for spatial reference and the elevations for each contour boundary are presented on or near the boundary in feet.

Hydrographs of wells in the shallow alluvial aquifer differ from hydrographs of wells in the deep alluvial and Tertiary aquifers (figure 9). Water levels in all aquifers dropped between 1999 and 2002, but the decreases were actually the greatest (~2 feet) in the deep alluvial and Tertiary wells. This drop in water levels may be connected to work performed on the Streamside Tailings OU. However, if the Streamside Tailings work was the only cause for the decrease in water levels, then one would expect the decreases to be the most pronounced in the shallow alluvial aquifer. After approximately 2002 the water levels appear to stabilize, but also have aberrant spikes that may be related to specific recharge events or other disturbances. The general trend for the shallow alluvial aquifer surface is to peak during either the May or August sampling times, with an annual low in February. The deep alluvial and Tertiary hydrographs show more of a saw-tooth pattern with lows in both August and February. The February lows are probably reflecting the overall lows in the hydrologic system in the winter. However, the August lows in the deeper aquifers do not appear to be associated with the seasonal recharge patterns. These trends may be a result of increased pumping in the Town Pump well, and possibly other wells to the north of the site, during the summer months.

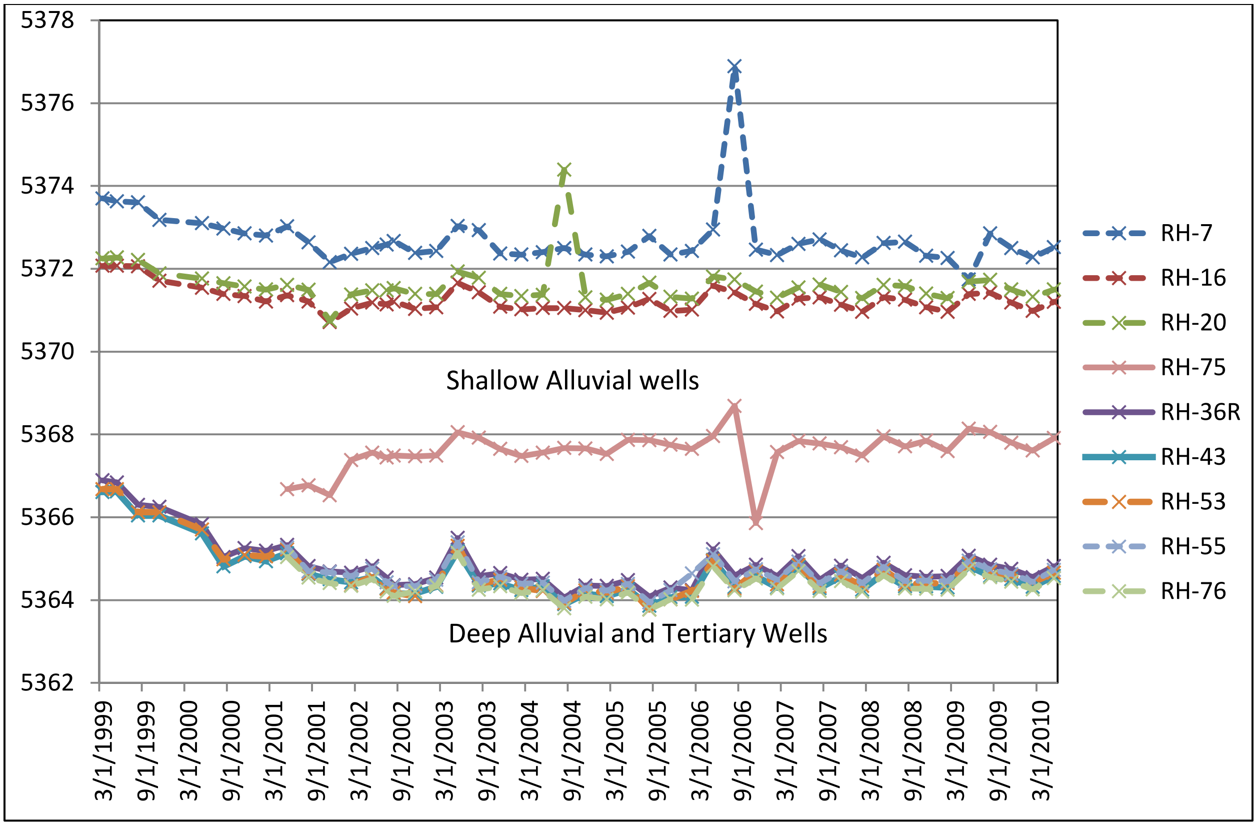


Figure 9. Hydrographs for wells installed in the shallow alluvial, deep alluvial and Tertiary aquifers.

5.0 Water Quality- Arsenic Concentrations

Prior to remediation, arsenic concentrations exceeded 100 µg/L in all three hydrogeologic units. Several discrete areas of elevated arsenic concentrations were present within the site, near the holding pond area on the east side and an area southeast of the treatment plant. The arsenic in these areas likely came from the disposal of wood treating chemicals or from leaching of mine waste materials, or both. Although downward hydraulic gradients are present at the site, they have not resulted in a significant downward migration of arsenic, except in limited areas. Geochemically favorable conditions (principally iron in the shallow alluvium) may also help keep the arsenic from penetrating deeply and spreading into the other aquifer units (RI, BP-ARCO, 1995a). Generally, arsenic concentrations have been decreasing since remediation for each of the units at the site. The changes in arsenic concentration within each unit are described below and shown in separate figures. Note that the concentration contour intervals in each figure do not follow the same standard scale, due to the wide range of arsenic concentrations encountered in the different units at the Rocker site. Like the water-elevation figures, the boundaries of the contoured areas were determined by the outermost data points for each unit.

5.1 Gravel Wells

The highest arsenic concentrations before and after remediation occur in the zone now occupied by the gravel layer installed during the remediation. Arsenic concentrations were around 23,000 µg/L at monitoring well RH-33 prior to remediation (BP-ARCO, 1995a), but RH-33 was removed during remediation. The closest replacement well is RH-62, where arsenic concentrations are generally less than half of the pre-remediation levels, but spike during the first quarter of the year (up to 18,590 µg/L in 2006). The highest arsenic concentrations occur in the area around well RH-62, both before and after remediation. Figures 10a and 10b show the distribution of arsenic concentrations for wells in the gravel zone in 2001 and 2009, using averaged values. These figures illustrate that the general location of high arsenic concentrations in the gravel unit have not changed, but the concentrations have decreased with time. As seen in figure 6, upward vertical gradients from the shallow alluvium in this area may impact the distribution and movement of arsenic. Other gravel wells down-gradient from RH-62 have shown variable trends over time, but seem to converge around 2,000-3,000 µg/L arsenic. This suggests that arsenic is being attenuated, whether by dispersion, adsorption, or perhaps precipitation/co-precipitation as a solid phase.

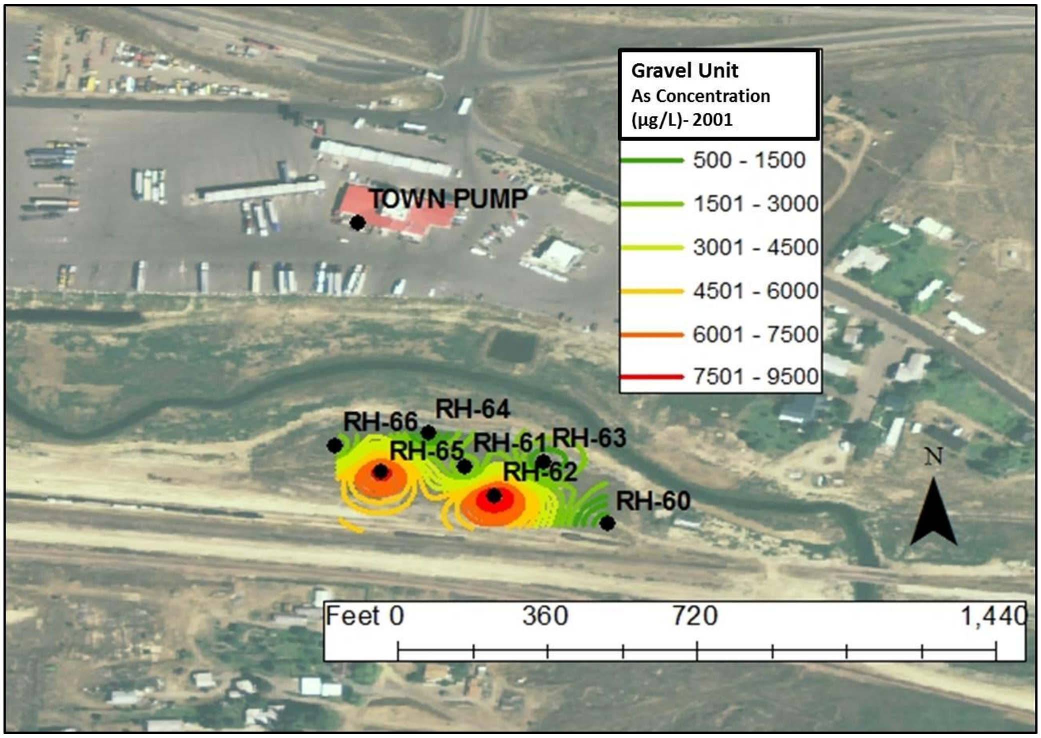


Figure 10a. Water-quality contour map showing the distribution of arsenic concentrations (µg/L-2001 average) for wells completed in the gravel unit. The contour lines only extend to the spatial limit of available data, and the Town Pump well (although completed in the Tertiary aquifer) is shown for reference. The highest arsenic concentrations occurred near wells RH-62 and RH-65.

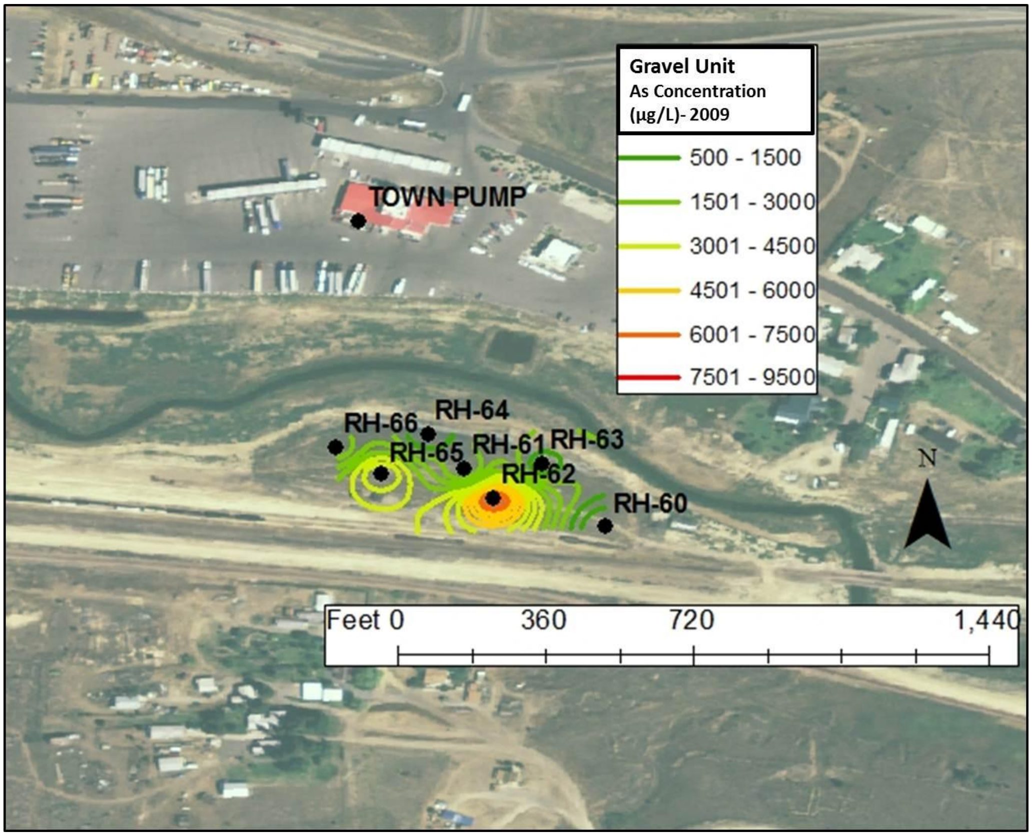


Figure 10b. Water-quality contour map showing the distribution of arsenic concentrations (µg/L- 2009 average) for wells completed in the gravel unit. The highest arsenic concentrations are shown around the same wells showing high concentrations in figure 10a, but the concentrations have decreased with time.

5.2 Shallow Alluvial Wells (Post Remedy)

The highest arsenic concentration in the shallow alluvial wells (prior to remediation) was measured in RH-41 (11,800 µg/L in 1992; BP-ARCO, 1995a). Since remediation, arsenic concentrations have decreased significantly for many of the remaining shallow alluvial wells. The highest arsenic concentrations (RH-41 and RH-05) appear to converge around 2,000 µg/L, similar to many of the gravel wells. Arsenic concentrations from 2001 and 2009 for the shallow alluvial wells are shown in figures 11a and 11b, respectively. RH-75 and RH-05 show increasing arsenic concentrations between 2001 and 2009 (means of 9.5 to 16 µg/L and 948 to 2000 µg/L, respectively), but these calcium-sulfate waters were originally thought to be associated with sulfide mineral weathering from the railroad ballast material, remaining on the right-of-way at the site (BP-ARCO, 1995a). However, it is also possible that RH-05 may be on the western edge of the main arsenic plume, instead of an isolated hot-spot related to the railroad. A downward gradient exists between the shallow and deep alluvial aquifers at these well locations, and the elevation difference between the shallow and deep alluvial aquifers is greatest in this western part of the site. More data is needed to the east of RH-05 in order to determine if the elevated concentrations observed in RH-05 are a continuation of the high concentrations near RH-41(part of the same plume) or if the arsenic originated from the isolated railroad ballast material.

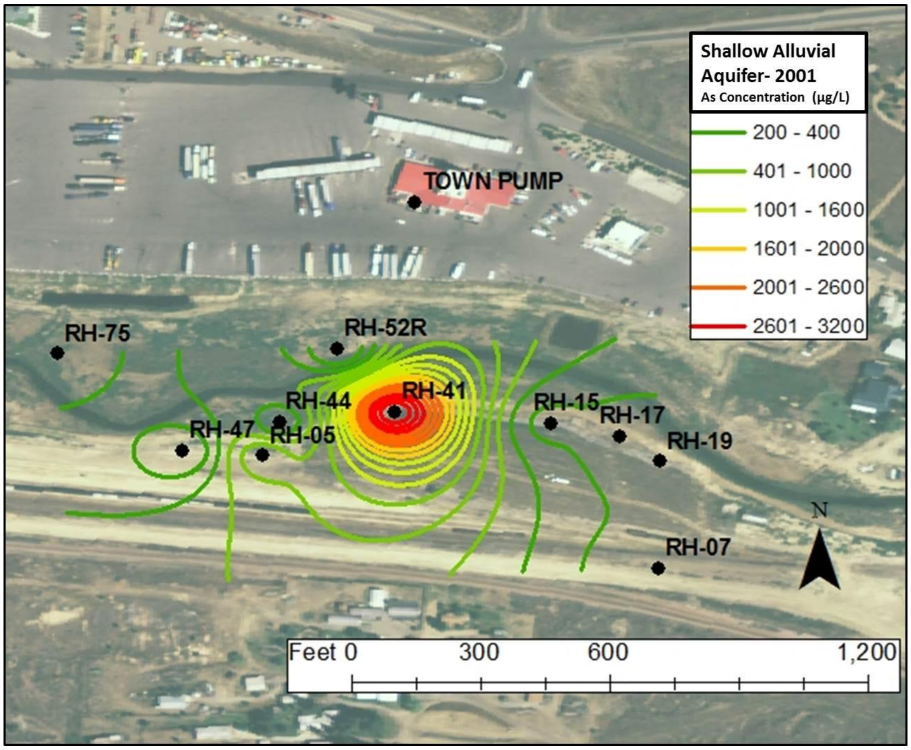


Figure 11a. Water-quality contour map showing the distribution of arsenic concentrations (µg/L-2001 average) for wells completed in the shallow alluvium. The contour lines only extend to the spatial limit of available data, and the Town Pump well (although Tertiary) is shown for reference.

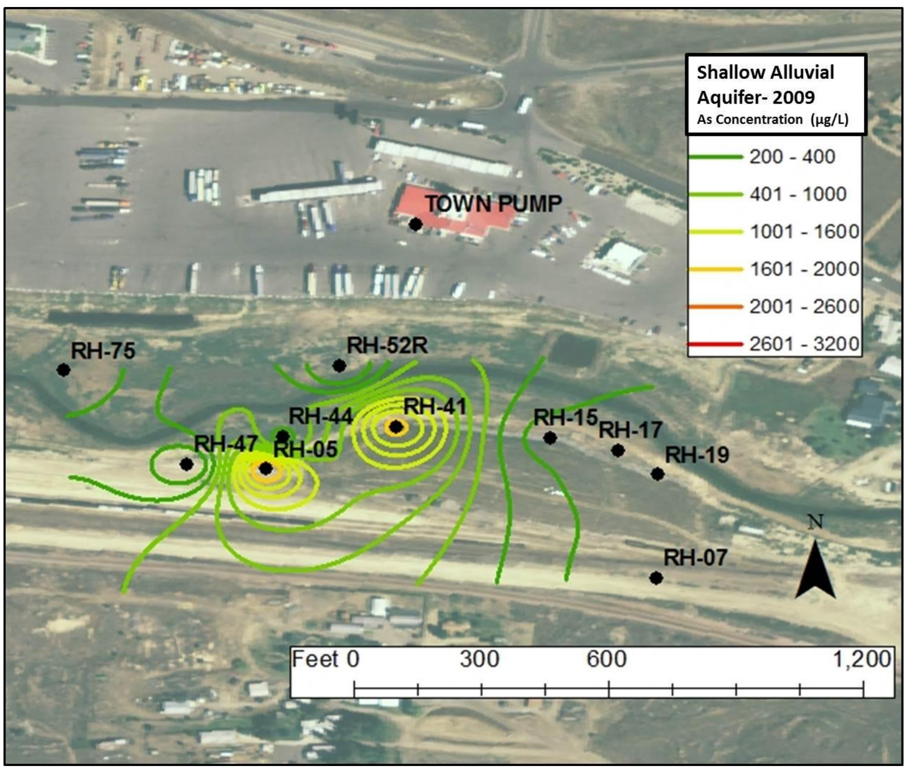


Figure 11b. Water-quality contour map showing the distribution of arsenic concentrations (µg/L-2009 average) for wells completed in the shallow alluvium. The highest arsenic concentrations are shown near RH-41 and RH-05, but generally, arsenic concentrations have decreased with time.

5.3 Deep Alluvial Wells

In general, the water in the deep alluvium has been classified as a calcium-bicarbonate water. The highest arsenic concentration in the deep alluvial wells (prior to remediation) was measured in RH-14, on the west side of the site. In 1992, the arsenic concentration was as high as 6,060 µg/L at a depth of 30 to 40 feet (BP-ARCO, 1995a). This well was removed during remediation and then replaced with RH-14R. The replacement well has shown some increase in arsenic concentration following remediation, but has leveled off at a concentration similar to that noted for the gravel wells (<2,000 µg/L). The average arsenic concentrations in the deep alluvial wells from 2001 and 2009 are shown in figures 12a and 12b, respectively.

As seen in figures 12a and 12b, RH-14R consistently shows the highest arsenic concentration, which is likely because some of the highest concentrations in the gravel and shallow alluvium were situated slightly above this location. At this location, underlying the old processing area, the arsenic may have diffused or migrated deeper into the aquifer, from a zone of contamination which was not removed during remediation. In the other deep alluvial wells, arsenic concentrations remain relatively low and steady, with some wells showing slight decreases. Consistency in these arsenic concentrations and those of the contingency wells indicate that the arsenic plume is not expanding in the deep alluvial aquifer.

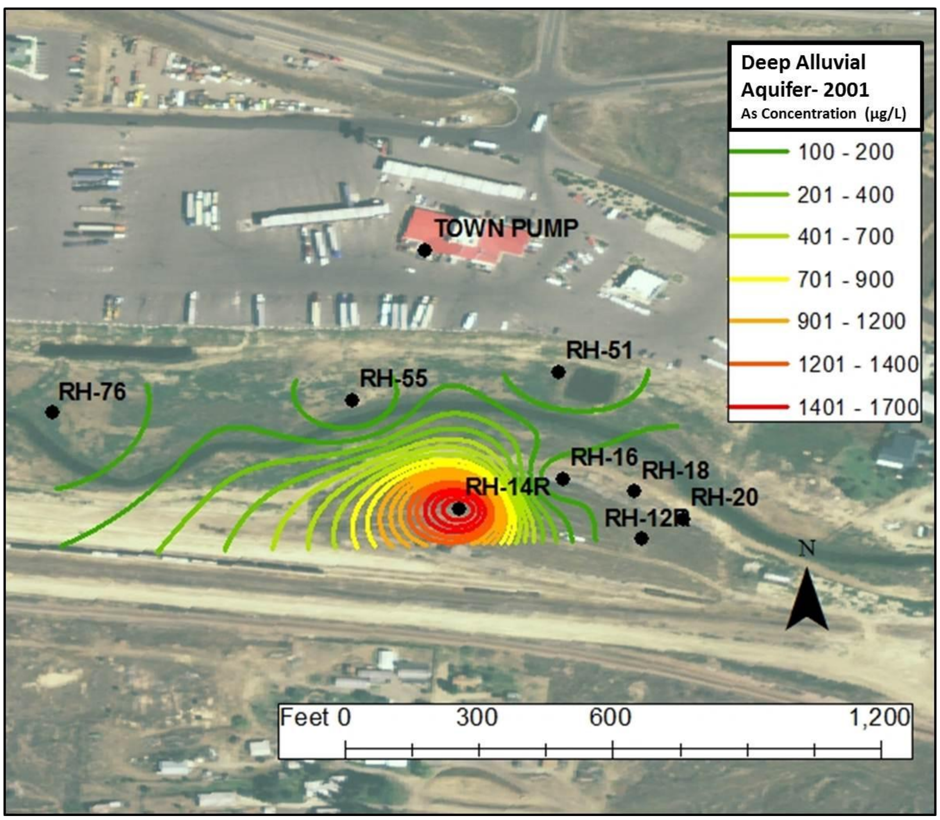


Figure 12a. Water-quality contour map showing the distribution of arsenic concentrations (µg/L-2001 average) for wells completed in the deep alluvium. The contour lines only extend to the spatial limit of available data, and the Town Pump well (although Tertiary) is shown for reference. The highest arsenic concentration occurred in RH-14R, which is completed just below the old processing area.

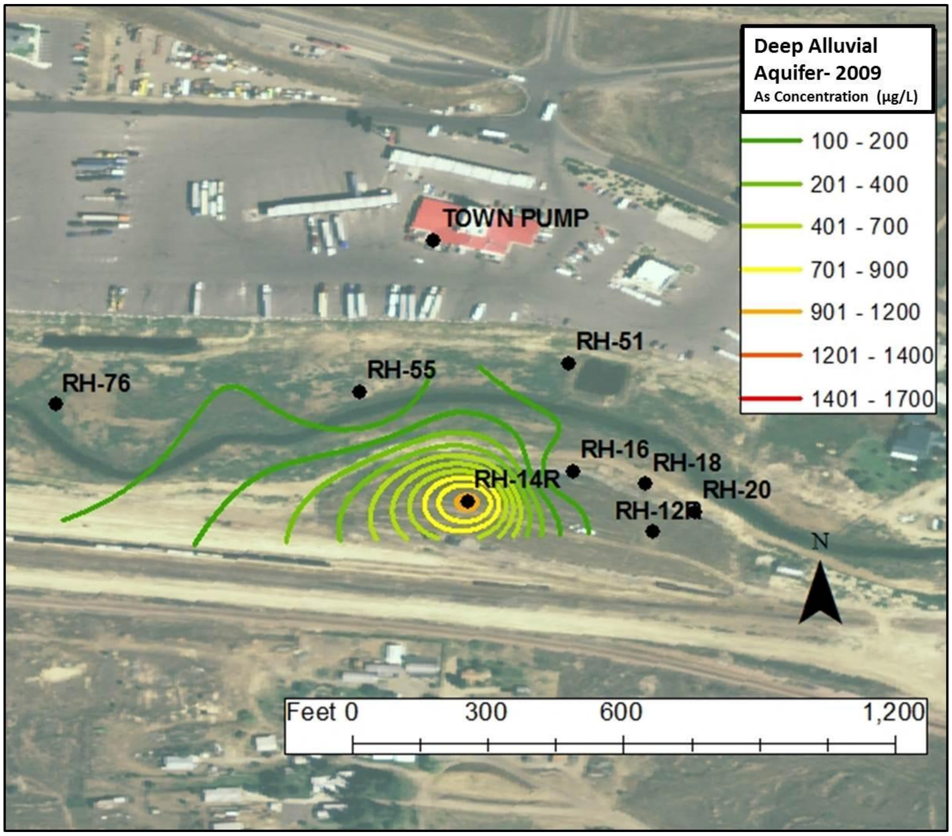


Figure 12b. Water-quality contour map showing the distribution of arsenic concentrations (µg/L-2009 average) for wells completed in the deep alluvium. The highest arsenic concentrations is found in RH-14R (like in 2001), but the concentration has decreased with time.

5.4 Tertiary Wells

Prior to remediation, arsenic concentrations in the Tertiary aquifer were relatively low compared to the alluvial aquifers. In general, water from the Tertiary unit has been classified as a calcium-sulfate water. The highest arsenic concentrations were found near RH-06 (875 µg/L in 1991) and RH-48 (52 µg/L in 1996). Both of these wells are on the western side of the site and completed in very shallow Tertiary sediments (<42 feet), which is similar to the depth of the deep alluvial wells. These wells appear to have better hydrologic connection with the deep alluvial wells than other Tertiary wells. These two wells also show the products of sulfide mineral weathering (higher sulfate, iron, and manganese concentrations). These trends are consistent with those seen in nearby alluvial wells (RH-05 and RH-47), which may also be influenced by the edge of the plume. Arsenic concentrations for the Tertiary wells from 2001 and 2009 are shown in figures 13a and 13b, respectively.

Recently, there have been requests by BP-ARCO to re-classify RH-06 (and possibly RH-48) as a deep alluvial well, considering the aforementioned similarities to the nearby deep alluvial wells (2005 and 2006 Monitoring Reports and 9-27-06 meeting with Agencies). This re-classification seems reasonable, but it may also be useful to install new wells in the area, deeper into the Tertiary sediments. Even though RH-46 (70 feet deep) is completed nearby, it is the only well located to the west of the Rocker OU boundary that exceeds 50 feet. Deeper wells in this area would allow regular monitoring of the deeper portion of Tertiary aquifer, which would help in better understanding the connection between aquifers on the western end of the site.

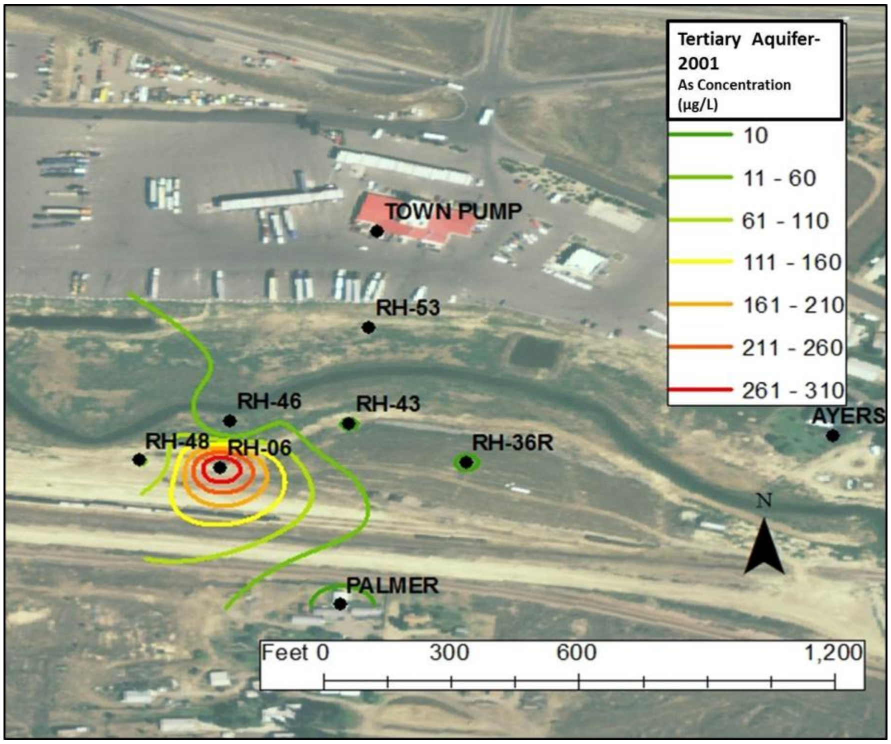


Figure 13a. Water-quality contour map showing the distribution of arsenic concentrations (µg/L-2001 average) for wells completed in the Tertiary aquifer. The contour lines only extend to the spatial limit of available data. The highest arsenic concentrations occurred near RH-06 and RH-48.

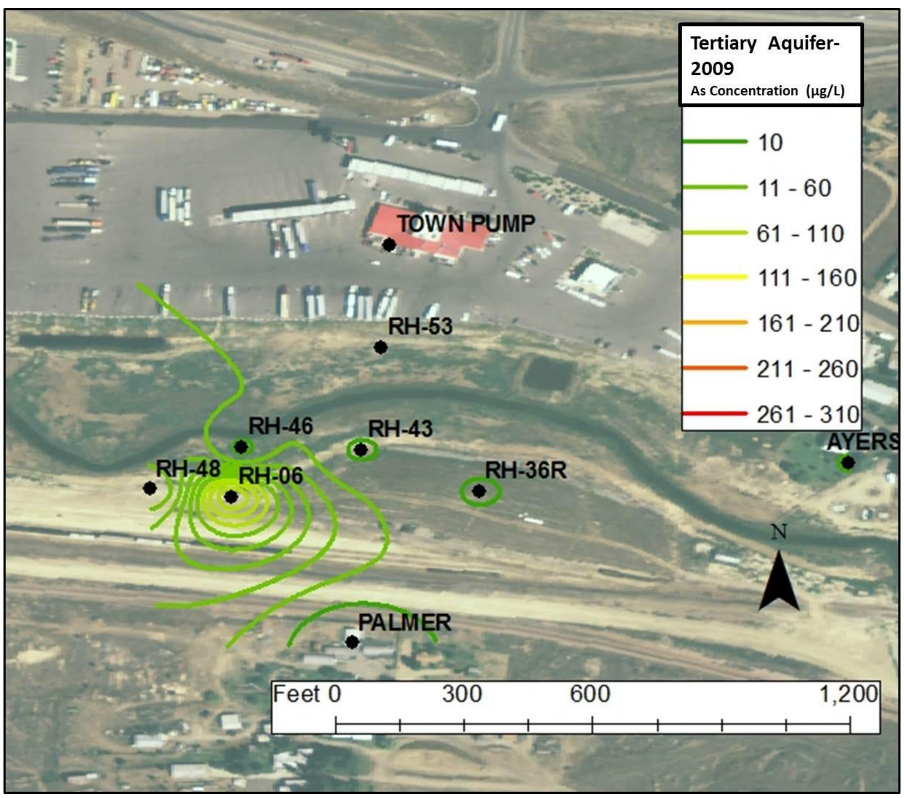


Figure 13b. Water-quality contour map showing the distribution of arsenic concentrations (µg/L-2009 average) for wells completed in the Tertiary aquifer. The highest arsenic concentrations still occur near RH-06 and RH-48, but the concentrations have decreased with time.

Concentrations of arsenic have decreased significantly for both RH-06 and RH-48 since remediation, although elevated concentrations persist in these same locations as they did prior to remedial action (average of 97 and 12 µg/L in 2009, respectively). The arsenic concentrations remain low in the other Tertiary monitoring wells, with an average of 8.9 µg/L in 2009 (range 2.7 to 11.5 µg/L). With arsenic at these concentrations, it may be difficult to determine whether the arsenic is originating from contamination at the Rocker site or from the Tertiary volcanic sediments themselves.

Water-quality data was gathered from the Ground-Water Information Center database (GWIC; http://mbmggwic.mtech.edu) for seven wells completed in Tertiary sediments outside of the Rocker CGWA site (within 3 mile radius). The wells show arsenic concentrations ranging from 6.8 to 33 µg/L, over a range of depths (30 to 260 feet), providing a rough estimate of background arsenic concentrations in Tertiary sediments in the area.

5.5 Contingency Wells

The list of contingency wells includes monitoring points from each of the units discussed above (except the gravel zone). Appendix F of the Operations & Maintenance Plan (AERL, 2000b) provides a Statistical Evaluation and Implementation Plan (SEIP), which identifies the statistical methods that should be used to analyze water-quality data collected from the wells. This approach involves evaluating the changes in arsenic concentration to objectively identify any spatial expansion of the arsenic groundwater plume.

According to the Mann-Kendall statistical analyses (as defined in the SEIP), there has not been a significant increase in arsenic approaching 18 µg/L in any of the contingency wells. Therefore, no contingent remedy measures are required at the Rocker OU, and there does not appear to be an expansion of the arsenic plume to the contingency wells (BP-ARCO, 2009).

6.0 CGWA Evaluation

6.1 Data Gaps and Plume Shape

During the review and development of the site conceptual model, a number of gaps in the monitoring and sampling data became apparent. Even though the contingency wells do not indicate an expansion of the arsenic plume, it is difficult to accurately map or model the full extent of contamination with the current dataset.

Using data from 2009, areas of high arsenic concentration were mapped by depth, without regard to lithologic classifications (figures 14a and 14b). This combined view shows a relatively shallow plume, with the highest concentrations found in the gravel and shallow alluvium. The highest concentrations were found around well RH-62, and the shallow plume appears to extend to the northwest through RH-41, with a general trend towards the area with the lowest water elevation in the deep alluvial aquifer. Because a similar plume shape existed prior to remediation, it is not possible to determine if pumping by Town Pump or other wells to the north and northwest have influenced the plume shape. There are few wells along the plume trend, down gradient from RH-41 (to the northwest), so it is difficult to determine the extent of the plume. Elevated arsenic concentrations are also observed to the west at RH-05. However, without data points between RH-05 and the main body of the plume it is difficult to determine if RH-05 represents an isolated "hot-spot" or if the plume is broader than depicted (as discussed in section 5.2).

There are also a few places where very abrupt changes in concentration occur, but the reasons for these changes are unclear. Near the western edge of the site, arsenic concentrations fluctuate in the shallow alluvium from 327 µg/L (RH-44, 2009 mean) to 2000 µg/L (RH-05, 2009 mean) over relatively short distances (~100 feet). These wells were completed south of SBC at similar depths (20-25 feet), in an area where groundwater movement is to the west-northwest. Following this flow-path to the north side of SBC, only one shallow well is sampled for water quality (RH-75), and it shows low arsenic concentrations (16 µg/L, 2009 mean). Because this well is over 350 feet away from RH-05 and RH-44, it is difficult to determine if this large decrease in arsenic is due to attenuation in the subsurface, or whether the shallow groundwater is discharging to SBC, as indicated by the water-elevation data between RH-5 and RH-75 (figure 5).

Similarly, arsenic concentrations drop from ~1850 µg/L (RH-41, 2009 mean) to 2.5 µg/L (RH-52R, 2009 mean) within approximately 170 feet (also after crossing SBC to the north). Given the potential for groundwater discharge to SBC near this area and the shallow nature of the plume (< 20 feet deep), it seems likely that contaminated groundwater could discharge to SBC near RH-41. More arsenic data to the north and west of RH-41 (between RH-55 and RH-44), including stream water-quality data, might better explain plume migration in this area.

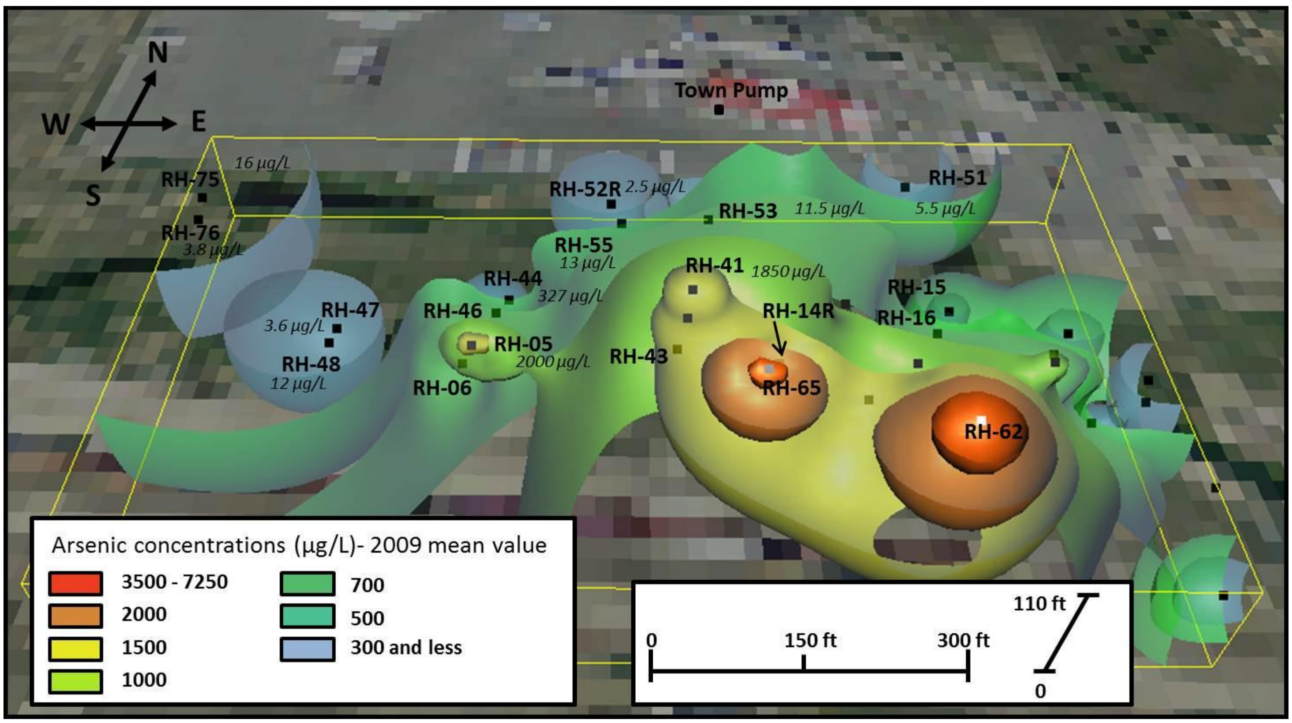


Figure 14a. 3-dimensional water-quality contour map showing arsenic concentrations from August 2009, looking north. This oblique view shows 3-D concentration contours/surfaces at the mid-screen depth for all wells, regardless of unit classification. The plume shape follows the general direction of down-gradient groundwater movement (to the northwestern part of the site). The spherical volumes shown in this model are extrapolated within the Voxler® software to best-fit the concentration data within the site area. As a result, the actual volume affected by high arsenic concentrations in the center of the site (RH-62 and RH-65) are likely to be shallower than what is indicated in these illustrations.

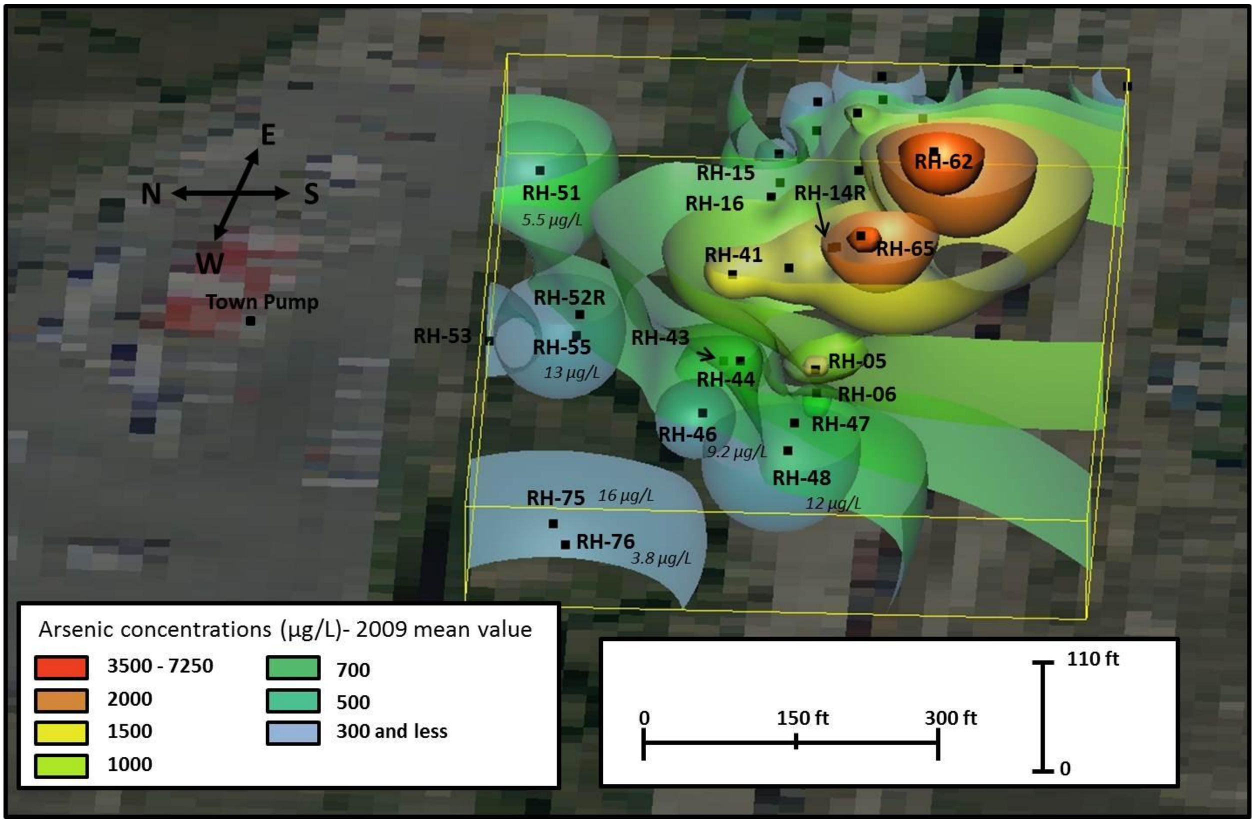


Figure 14b. 3-dimensional water-quality contour map showing arsenic concentrations from August 2009, looking east. This sideways oblique view shows the same concentration contours/surfaces for all wells from figure 14a, regardless of geologic unit classification. This perspective offers another view of the relatively shallow plume, as well as the places where more arsenic data would be helpful.

If more refined water-quality data were available within these gaps, a better image of the plume's dimensions could be developed, which may lead to a better understanding of the plume's behavior. For that purpose, it may be necessary to install new shallow wells (~20 feet deep) between the Rocker site fence-line and SBC (around RH-05, RH-41, and RH-44). Wells on the north bank of SBC (between RH-52R and RH-75) would also offer new data for the noted gaps. Other shallow wells already exist in some of these areas (RH-03, RH-50, and RH-54), but they are only monitored quarterly for water elevations. It may not be beneficial to add these wells to the regularly sampled list though, because these wells are all < 7 feet deep, much shallower than the wells that exhibit high arsenic levels. To consider the inexpensive alternative first, these three wells should be sampled before drilling any new wells, to determine their current usefulness in plume monitoring.

Other data gaps affect the extent and accuracy of water elevation maps. Water elevation data is collected from the shallow and deep alluvial aquifers over much of the Rocker CGWA site, but water-level data for SBC and the Tertiary wells are definitely lacking. The water surface created for SBC in figure 3 is limited, because the plane was created from only four data points. If more staff gauge sites were located along this stretch of stream, better elevations and locations could be used to more accurately depict SBC in this model.

The extent of the Tertiary aquifer potentiometric surface shown in figure 8 is also greatly limited because of the limited number of water elevations measured in Tertiary wells. Adding water-elevation data from wells that are only sampled for water quality (Town Pump, Ayers, Palmer) would allow for the extension of the Tertiary potentiometric surface map over a greater area. Historically, water levels were not measured in these wells when they were sampled, due to pumps placed within the wells. The water-quality data from these sites are important, because these wells are the farthest from the Rocker site (north, east, and south, respectively). However, because updated survey points (location and elevation) and water elevations are not available for these wells, it was not possible to include these wells in the hydrogeologic assessment during this review. These wells are located in residential areas which would most likely be affected by a change in the CGWA boundary. Therefore, water elevations from these wells and/or other Tertiary wells in the area are particularly important for this evaluation.

As discussed previously, the western-most Tertiary wells, RH-48 and RH-06 are relatively shallow (38 and 40 feet, respectively) and show more connection to the deep alluvial flow system. While these wells allow sampling and monitoring at the top of the Tertiary sediments, it is unclear how the deeper portion of the Tertiary aquifer behaves in this area. If deeper wells existed to the west and north of the site, more accurate models and predictions could be made about this deeper groundwater system.

Water usage estimates from the Town Pump and other wells to the northwest of the site would be very helpful in assessing the impact well usage has had on groundwater. We have requested this data from Town Pump but have not received the data. From personal communications with Town Pump staff, our understanding is that the well has been in continuous production at the facility since it was installed. Recently, usage was limited to non-potable water only, but usage has not stopped, despite the CGWA ban. Similarly, usage rates from the other industrial wells would be useful to assess the impact those wells may be having on water levels at the site. Another approach to evaluating the impact the Town Pump well may have on water elevations at the site, would be to cease pumping. If water levels in the nearest monitoring wells rose dramatically with cessation of pumping the Town Pump well, it would indicate that the pumping was impacting water levels at the site. If water levels didn't respond to cessation of pumping, it may indicate that the Town Pump well does not influence groundwater at the site, or possibly that other wells to the north and northwest are influencing water levels at the site. Also, if the Palmer well (south of the site) is still in use, having usage rates for that well would be useful in assessing the impact that water withdrawals from the south are having on the groundwater flow at the site.

6.2 CGWA Boundary Review

The site conceptual model presented here, is one of generally decreasing arsenic concentrations across the site, with the highest arsenic concentrations continuing to exist in the same physical areas as before remediation. From this evaluation, as well as statistical analysis of contingency well data (BP-ARCO, 2009), there is little evidence to suggest that the plume is expanding. The only evidence for possible plume expansion or migration is in the shallow alluvial well RH-5. Following the removal of the high-arsenic sediments, arsenic attenuation within the aquifer may be responsible for this apparent stability. However, the data gaps identified above may also present a false image of the plume's shape, migration, and ultimate fate. If the boundaries of the CGWA are to be changed in the future (and previously banned groundwater use resumes), it is important that regular monitoring and sampling continues to take place to ensure that the plume is not affected.

Based upon the groundwater elevation and arsenic distribution analyses discussed above, there appear to be few areas in the CGWA which may be considered for groundwater use. In particular, the residential areas to the east, southeast, and northeast of the Rocker site seem unlikely to impact or be impacted by the arsenic plume. The deeper wells found in this area (> 100 ft; Ayers, Richter) are upgradient and relatively far away from the current location of the plume (> 700 feet). These wells are also likely to be used for domestic purposes, so withdrawals would be relatively small and intermittent. Wells in these eastern areas are unlikely to impact or be impacted by the arsenic plume, although this conjecture should be confirmed by modeling the groundwater flow in the area.

The current and past usage rate of the Town Pump well appears to be impacting water levels in parts of the deep alluvial and Tertiary aquifers, which may be influencing plume migration on site. The arsenic concentrations in the Town Pump well have consistently fluctuated between 8 and 12 µg/L with few upward outliers (data from 1999 to 2010). At the current time, there is no indication that pumping has caused arsenic to migrate from the Rocker site to the Town Pump well. The decreasing arsenic concentrations in the plume indicate that attenuation of arsenic in the subsurface and/or the possible discharge of arsenic-bearing groundwater to SBC is currently limiting plume migration. Unless subsurface attenuation or surface water discharge can effectively limit arsenic movement in the future, arsenic from the Rocker plume may get to the Town Pump well, given enough time.

Pumping from other Tertiary wells at a similar depth and a similar rate is not advisable, adjacent to or downgradient from the plume's current location. This type of pumping would be especially ill-advised near the western half of the Rocker site. To the south and southwest of the site (e.g. Palmer well area), the potential to impact the plume may be greater, because without a possible interception boundary (like SBC to the north), only subsurface attenuation would prevent arsenic migration.

Rather than completely opening the aforementioned areas to groundwater use, it may be best to create gradual, limited-use buffer zones. These new zones would act conservatively, by allowing smaller (presumably domestic) groundwater withdrawals closest to the site, while restricting higher-capacity wells to zones further from the site. It will also be necessary to leave some zones of the current CGWA in place (e.g. central area, west, southwest of site) to protect the public and environment, as well as to prevent migration of the plume. By using a groundwater-flow model, it should be possible to determine possible boundaries for these buffer zones, and their associated withdrawal rates.

Hydrogeologic parameters discussed in this report and in previous investigations should be used to develop a groundwater-flow model for the Rocker site. But, as mentioned previously, some key pieces of data would greatly enhance a modeling effort (e.g. water elevations for SBC and Tertiary wells, historic and current pumping rates for Town Pump and other nearby wells). A program like MODFLOW (Harbaugh and others, 2000), which uses a 3-dimensional, finite-difference approach, may be the best choice for modeling groundwater flow at this site. The model should treat the area as a highly stratified, unconfined system, and it should account for the different transmissivities within lithologic layers. Different scenarios should also be modeled, using a variety of well locations and pumping rates, to see the possible effects on the plume.

7.0 Summary

As directed by DEQ Contract No. 400022-TO-41, a comprehensive evaluation of historic documents and monitoring data from the Rocker OU was performed, to determine if the boundaries of the current CGWA can be modified. The following conclusions were reached:

- Groundwater-quality data suggest that the highest arsenic concentrations have been reduced to below pre-remediation levels, although high arsenic concentrations (2 to 3 mg/L) still exist in the same general locations where previously high concentrations existed. Arsenic concentrations in nearly all areas decreased with time from 2001 to 2009.
- Consistent water-quality data from monitoring wells and analysis of data from contingency wells indicate that the arsenic plume is not expanding, except for increasing concentrations in one shallow alluvial well. The plume appears to be relatively shallow, and migrating to the northwest.
- Water-quality data gaps exist for the shallow alluvium on the west and north side of the site (near SBC), especially between areas of elevated arsenic concentration. Having data from these areas (as well as from gauging sites within SBC), would help to better define the boundaries and behavior of the arsenic plume, and determine if shallow groundwater is indeed discharging into SBC or if the plume is migrating downward.
- Despite the CGWA ban, the current and past usage rate of the Town Pump well (and perhaps other wells) appears to be impacting water levels in both the deep alluvial and Tertiary aquifers. Currently, there is no indication that pumping has caused arsenic to migrate from the Rocker site to the Town Pump well, but this may change given enough time.
- It seems reasonable to modify some of the boundaries of the CGWA, allowing domestic groundwater-use in certain areas (e.g. more distant, residential areas). However, it may be best to create buffer zones, with defined pumping-rates, to keep high-capacity wells further from the plume. Other areas of the CGWA should be kept in place (e.g. central and western portions of the site).
- A 3-dimensional groundwater-flow model would help to better understand aquifer dynamics, to estimate “safe” pumping rates, and to understand how groundwater withdrawals might affect plume migration.
- In addition to other data gaps, updated survey data (location and elevation) and water elevations are needed for SBC and many of the off-site Tertiary wells. These data would greatly enhance the groundwater flow model. Determining the groundwater elevations in these off-site areas is particularly important, because they are most likely to be opened to groundwater usage.

If the boundaries of the CGWA are to be changed, it is important that regular monitoring and sampling continues to take place to ensure that the plume’s migration is not affected.

References

AERL, 2000a, Remedial action construction completion report, Rocker timber framing and treating plant operable unit: ARCO Environmental Remediation L.L.C., May, 2000.

AERL, 2000b, Operations & maintenance plan, Rocker timber framing and treating operable unit: ARCO Environmental Remediation L.L.C., July, 2000.

BP-ARCO, 1995a, Final remedial investigation report, Rocker timber framing and treating operable unit: ARCO, March, 1995.

BP-ARCO, 1995b, Draft feasibility study, Rocker timber framing and treating operable unit: ARCO, April, 1995.

BP-ARCO, 2007, Draft groundwater technical impracticability evaluation, Rocker timber framing and treating plant operable unit: Atlantic Richfield Company, October 2007.

BP-ARCO, 2009, 2008 Annual monitoring report, Rocker timber framing and treating plant operable unit: Atlantic Richfield Company, April 2009.

DNRC, 1997, Proposal for Decision- Designation of a Controlled Groundwater Area (No. 100828-76G), Department of Natural Resources and Conservation for MT, February, 1997.

Harbaugh, A.W., Banta, E.R., Hill, M.C., and McDonald, M.G., MODFLOW-2000, the U.S. Geological Survey modular groundwater model: USGS Open-File Report 00-92, 2000.

MBMG, 1994. Results for the town pump aquifer test: Montana Bureau of Mines and Geology, September, 1994.

U.S. EPA, 1995a, Final record of decision, Rocker timber framing and treating plant operable unit, Silver Bow Creek/Butte area, Rocker, Montana: Environmental Protection Agency and Montana Department of Environmental Quality, December, 1995.