NPL-U29-2-10-R8

HRS DOCUMENTATION RECORD—REVIEW COVER SHEET

Name of Site: Upper Tenmile Creek Mining Area

Contact Persons:

Site Investigation	Documentation Record
MDSL/AMRB P.O. Box 200901 Helena, Montana 59620-0901 (406) 444-2544	David Williams NPL Coordinator U.S. Environmental Protection Agency, Region 8 999 18th Street, Suite 500, Mail Code: 8EPR-SA Denver, Colorado 80202-2405 (303) 312-6757

Pathways, Components, or Threats Not Scored

GROUND WATER PATHWAY

The majority of drinking water for the city of Helena is supplied from surface water bodies, including Tenmile Creek, Moose Creek, Minnehaha Creek, Beaver Creek, Walker Creek, Chessman Reservoir, and Scott Reservoir, supplemented with water obtained from the Missouri River. Two ground water wells periodically used by the Helena Water Treatment Plant for periods of high demand or during times of high turbidity in the surface water; however, it is unknown how deep these wells are and from which aquifer water is drawn. Additionally, several ground water wells in the town of Rimini are used for potable water, however it is unknown how deep these wells are and from which aquifer water is drawn. Based on lack of supporting data the Ground Water Pathway will not be scored as part of this HRS package.

AIR MIGRATION PATHWAY

There are insufficient data to satisfy HRS requirements for establishing an observed release of site contaminants to the Air Migration Pathway in the Upper Tenmile Creek Mining Area.

SOIL EXPOSURE PATHWAY

There are insufficient data to satisfy HRS requirements for establishing observed contamination of the site under the Soil Exposure Pathway in the Upper Tenmile Creek Mining Area.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

EPA NATIONAL PRIORITIES LIST (NPL) July 1999

OSWER/OERR State, Tribal, and Site Identification Center Washington, DC 20460

UPPER TENMILE CREEK MINING AREA
Lewis & Clark County, Montana

The Upper Tenmile Creek Mining Area is located in the Rimini Mining District, southwest of Helena, Montana, and consists of abandoned and inactive hard rock mines producing gold, lead, zinc, and copper. Mining began in the Rimini Mining District before 1870 and continued through the 1920s. Little mining has been performed in the Rimini Mining District since the early 1930s. The site may include the entire drainage basin (i.e., watershed) of Tenmile Creek and its tributaries that are upstream from five City of Helena drinking water intakes: Tenmile Creek; Beaver Creek; Moose Creek; Minnehaha Creek; and Walker Creek that serve an estimated 24,569 people in the City of Helena.

Several possible contaminant sources upstream from the Tenmile Creek drinking water intake include mining wastes at the following mines: Red Water Mine, Red Mountain Mine, and Tenmile Mine. Additionally, the Little Sampson, the Lower Evergreen, and the Avon Mill are all located on Tenmile Creek upstream of the Tenmile Creek drinking water intake. These mines were reclaimed during a 1989 reclamation project by the Montana Department of State Lands, Abandoned Mine Reclamation Bureau (MDSL/AMRB) (currently known as the Montana Department of Environmental Quality (DEQ), Mine Waste Cleanup Bureau); however, there may still be sources of hazardous substances in the Upper Tenmile Creek Mining Area.

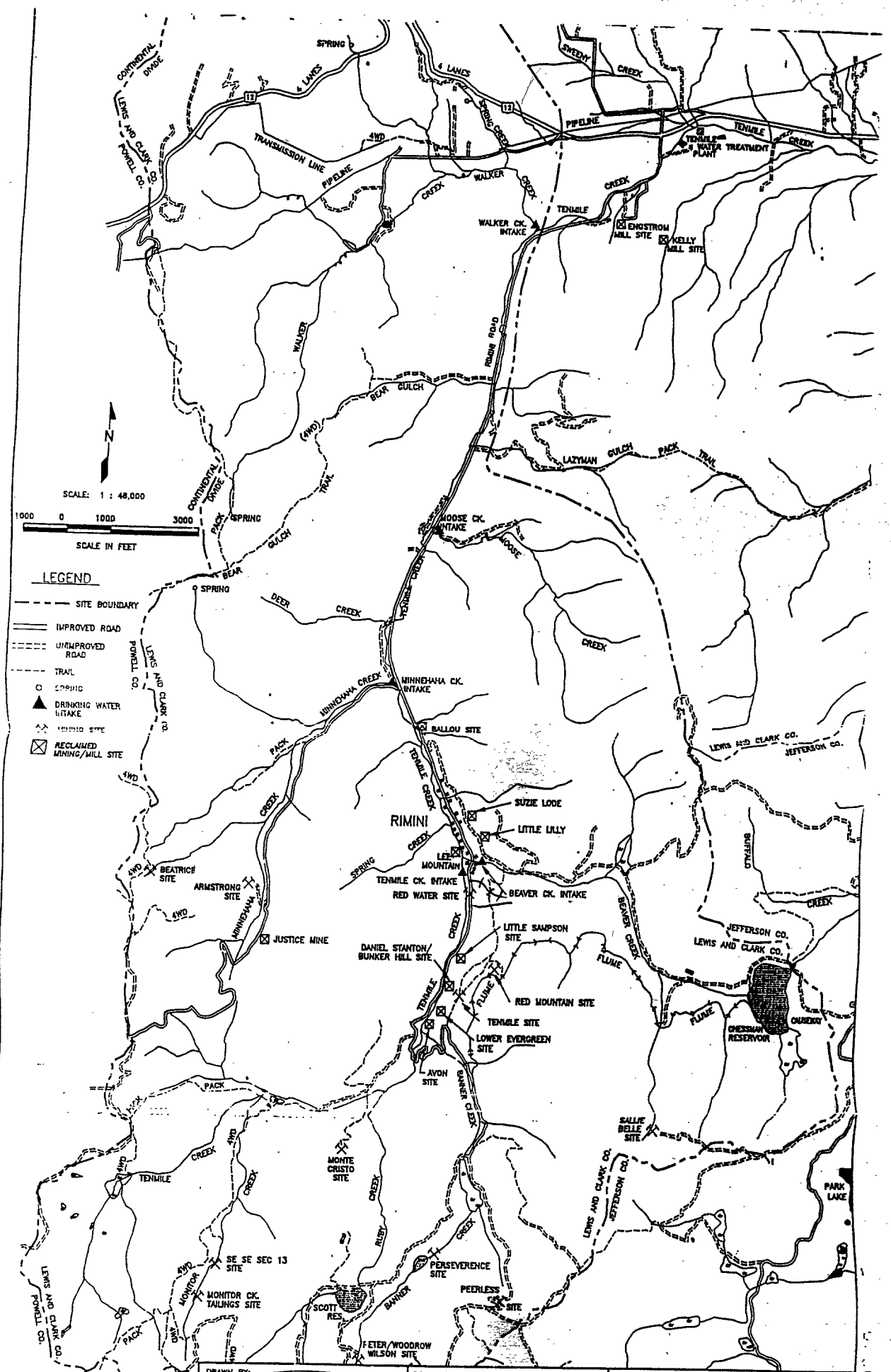
Other tributaries of Tenmile Creek above drinking water intakes include Beaver Creek, Banner Creek, Monitor Creek, Ruby Creek, Minnehaha Creek, Moose Creek, and Walker Creek. There are several additional possible sources on these tributaries, including the mining wastes at the following locations: SE Section 13 Mine located on Monitor Creek, Armstrong Mine located on Minnehaha Creek, Beatrice Mine located on Minnehaha Creek, Monte Cristo Mine located on Ruby Creek, Monitor Creek Tailings Mine located on Monitor Creek, Peerless Group of mines and Peter Mine, both located on Banner Creek, and National Extension Mine located on a tributary to Beaver Creek.

Some mines in the Upper Tenmile Creek Mining Area that are downstream from any drinking water intakes include the following: Lower Tenmile Mine (Engstrom Mill); Valley Forge (Susie Lode); Upper Valley Forge; Little Lily; and Lee Mountain (Figure 1). At least 48 underground mines have been identified in the Rimini Mining District according to the MDSL/AMRB mine inventory database.

Although there are several mines and mills located in the Upper Tenmile Creek Mining Area in the Rimini Mining District, not all have been scored using the Hazard Ranking System (HRS) because of the lack of quality analytical data, lack of sufficient evidence to document a release and/or attribute surface water contamination to the Upper Tenmile Creek Mining Area, or the sources do not impact identified targets. For HRS scoring, only the following sources have been evaluated: Tenmile Mine, Red Water Mine, and Red Mountain Mine.

Tenmile Creek is a documented fishery. Finfish tissue samples have been documented to contain elevated levels of arsenic. Surface water and sediment samples have been documented to contain elevated levels of arsenic, cadmium, copper, lead, and/or zinc that are attributable to the mines.

[The description of the site (release) is based an information available at the time the site was scored. The description may change as additional information is gathered an the sources and Extent of contamination. See 56 FR 5600. February 11, 1991, or subsequent FR notices.]


SCALE: 1 : 48,000
1000 0 1000 3000
SCALE IN FEET
LEGEND
SITE BOUNDARY
IMPROVED ROAD
UNIMPROVED ROAD
TRAIL
SPRING
DRINKING WATER INTAKE
MINING SITE
RECLAIMED MINING/MILL SITE
N
CONTINENTAL DIVIDE
LEWIS AND CLARK CO.
POWELL CO.
4 LANES
12
SPRING
TRANSMISSION LINE
PIPELINE
4WD
WALKER CREEK
SWEENY CREEK
SPRING CREEK
TENMILE CREEK
TENMILE WATER TREATMENT PLANT
WALKER CK. INTAKE
ENGSTROM MILL SITE
KELLY MILL SITE
FIRING ROAD
BEAR GULCH
LAZYMAN GULCH
PACK TRAIL
MOOSE CK. INTAKE
MOOSE CREEK
DEER CREEK
MINNEHAHA CREEK
MINNEHAHA CK. INTAKE
BALLOU SITE
LEWIS AND CLARK CO.
JEFFERSON CO.
SUZIE LODE
RIMINI
LITTLE LILLY
LEE MOUNTAIN
TENMILE CK. INTAKE
RED WATER SITE
BEAVER CK. INTAKE
BEATRICE SITE
ARMSTRONG SITE
JUSTICE MINE
LITTLE SAMPSON SITE
DANIEL STANTON/ BUNKER HILL SITE
RED MOUNTAIN SITE
TENMILE SITE
LOWER EVERGREEN SITE
AVON SITE
BANNER CREEK
BEAVER CREEK
FLUME
BUFFALO CREEK
CHESSMAN RESERVOIR
OUSELEY
SALLIE BELLE SITE
MONTE CRISTO SITE
RUBY CREEK
PERSEVERENCE SITE
PEERLESS SITE
PARK LAKE
SE SE SEC 13 SITE
MONITOR CK. TAILINGS SITE
SCOTT RES.
PETER/WOODROW WILSON SITE
DRAWN BY:
PRECISION Drafting Services, Inc.
DRAWN FOR:
DIONEER
TITLE:
FIGURE 1
DETAILED SITE LOCATION MAP
TENMILE CREEK

HRS DOCUMENTATION RECORD

Name of Site:	Upper Tenmile Creek Mining Area	Date Prepared: 05/10/99
CERCLIS ID:	MT0000105510	
EPA Region:	8	
Street Address of Site:	SE ¼, Section 34, Township 10 North, Range 5 West	
County and State:	Lewis and Clark County, Montana	
General Location in the State:	The Upper Tenmile Creek Mining Area is located southwest of Helena, Montana, in the southwest quarter of the state.	

Topographic Map: The location of the site is shown on the following USGS 7.5' Topographic Maps: Chessman Reservoir, MT; Three Brothers, MT; Black Mountain, MT; Mac Donald Pass, MT

Red Water Mine (Ref 3)	Latitude: 46° 28' 55.5" N	Longitude: 112° 14' 42.5"W
Red Mountain Mine (Ref 4)	Latitude: 46° 28' 22.0" N	Longitude: 112° 14' 19.0"W
Tenmile Mine (Ref 5) (aka: Daniel Stanton/Bunker Hill)	Latitude: 46° 28' 08.0" N	Longitude: 112° 14' 43.5"W

Scores	
Air Pathway	0.00
Ground Water Pathway	0.00
Soil Exposure Pathway	0.00
Surface Water Pathway	100.00
HRS SITE SCORE	50.00

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	NS	NS
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	100	
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	NS	
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	100	10,000
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	NS	NS
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	NS	NS
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		10,000
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root		50.00

NS = Not scored

TABLE 4-1
Surface Water Overland/Flood Migration Component Scoresheet

Factor Categories and Factors	Maximum Value	Value Assigned
Drinking Water Threat		
Likelihood of Release:		
1. Observed Release	550	550
2. Potential to Release by Overland Flow:		
2a. Containment	10	NS
2b. Runoff	25	NS
2c. Distance to Surface Water	25	NS
2d. Potential to Release by Overland Flow (lines 2a[2b+2c])	500	NS
3. Potential to Release by Flood:		
3a. Containment (Flood)	10	NS
3b. Flood Frequency	50	NS
3c. Potential to Release by Flood (lines 3a×b))	500	NS
4. Potential to Release (lines 2d+3c, subject to a maximum of 500)	500	550
5. Likelihood of Release (higher of lines 1 and 4)	550	--
Waste Characteristics:		
6. Toxicity/Persistence	(a)	10,000
7. Hazardous Waste Quantity	(a)	100
8. Waste Characteristics	100	32
Targets:		
9. Nearest Intake	50	50
10. Population		
10a. Level I Concentrations	(b)	49,130
10b. Level II Concentrations	(b)	0
10c. Potential Contamination	(b)	0
10d. Population (lines 10a+10b+10c)	(b)	49,130
11. Resources	5	NS
12. Targets (lines 9+10d+11)	(b)	49,180
Drinking Water Threat Score:		
13. Drinking Water Threat Score ([lines 5×8×12]/82,500, subject to a maximum of 100)	100	100
Human Food Chain Threat		
Likelihood of Release:		
14. Likelihood of Release (same value as line 5)	550	550
Waste Characteristics:		
15. Toxicity/Persistence/Bioaccumulation	(a)	$2x10^8$
16. Hazardous Waste Quantity	(a)	100
17. Waste Characteristics	1,000	320

TABLE 4-1 (Continued)
Surface Water Overland/Flood Migration Component Scoresheet

Factor Categories and Factors	Maximum Value	Value Assigned
Targets:		
18. Food Chain Individual	50	50
19. Population		
19a. Level I Concentrations	(b)	0.3
19b. Level II Concentrations	(b)	0.03
19c. Potential Human Food Chain Contamination	(b)	NS
19d. Population (lines 19a+19b+19c)	(b)	0.33
20. Targets (lines 18+19d)	(b)	50.33
Human Food Chain Threat Score:		
21. Human Food Chain Threat Score ([lines 14×17×20]/82,500, subject to a maximum of 100)	100	100
Environmental Threat		
Likelihood of Release:		
22. Likelihood of Release (same value as line 5)	550	NS
Waste Characteristics:		
23. Ecosystem Toxicity/Persistence/Bioaccumulation	(a)	NS
24. Hazardous Waste Quantity	(a)	NS
25. Waste Characteristics	1,000	
Targets:		
26. Sensitive Environments		NS
26a. Level I Concentrations	(b)	NS
26b. Level II Concentrations	(b)	NS
26c. Potential Contamination	(b)	NS
26d. Sensitive Environments (lines 26a+26b+26c)	(b)	NS
27. Targets (value from line 26d)	(b)	NS
Environmental Threat Score:		
28. Environmental Threat Score ([lines 22×25×27]/82,500, subject to a maximum of 60)	60	NS
Surface Water Overland/Flood Migration Component Score for a Watershed		
29. Watershed Score[c] (lines 13+21+28, subject to a maximum of 100)	100	100
Surface Water Overland/Flood Migration Component Score		
30. Component Score (S_{of}) [c] (highest score from line 29 for all watersheds evaluated, subject to a maximum of 100)	100	100

REFERENCES

Reference Number	Description of the Reference
1	U.S. Environmental Protection Agency (EPA), [Office of the Federal Register National Archives and Records Administration (OFRNARA)], December 14, 1990, 40 CFR Part 300, Hazard Ranking System (HRS), 135 pages. (2 pages)
2.	U.S. Environmental Protection Agency (EPA), 1996. Superfund Chemical Data Matrix. June 1996, 48 pages and 4 appendices. (4 pages)
3.	DynCorp, 1999. Latitude and Longitude Calculation Worksheet for the Red Water Mine. (1 page)
4.	DynCorp, 1999. Latitude and Longitude Calculation Worksheet for the Red Mountain Mine. (1 page)
5.	DynCorp, 1999. Latitude and Longitude Calculation Worksheet for the Tenmile Mine. (1 page)
6.	Pioneer Technical Services, Inc., 1995. Final Site Inspection Report for the Tenmile Creek Site, Helena, Montana, 80 pages and appendices A through E. April 1995. (406 pages)
7.	Pioneer Technical Services, Inc., 1994. Montana Department of State Lands, Abandoned Mine and Reclamation Bureau, Abandoned Hard-Rock Mine Priority Sites, Summary Report, 148 pages. March 1994. (8 pages)
8.	Pioneer Technical Services, Inc., 1993. Montana Department of State Lands, Abandoned Mine and Reclamation Bureau, Hazardous Materials Inventory, Site Investigation Log Sheet, Red Water Mine Site. July 13, 1993. (25 pages)
9.	Montana State University (MSU) and U.S. Department of Agriculture (USDA) Soil Conservation Service, 1980. Geologic Parent Material of Montana Soils, Bulletin 721, 117 pages. November 1980. (8 pages)
10.	U.S. Geological Survey (USGS), 1913. Ore Deposits of the Helena Mining Region, Montana, Bulletin 527. (16 pages)
11.	Roy F. Weston, 1997. Post Excavation Confirmation Sample Results, Red Water Mine Site, Rimini, Montana, WA #1-201 - Memorandum, from Edward F. Gilardi, REAC Program Manager, to Alan Humphrey, EPA/ERTC Work Assignment Manager, 5 pages and appendix. February 7, 1997. (23 pages)
12.	U.S. Environmental Protection Agency (EPA), 1998. Phone Call Memorandum between Rachel Wieland, URS Operating Services, Inc. (UOS) and Tien Nguyen, EPA Region 8 On-Scene Coordinator (OSC), regarding removal action at Red Water Mine. December 9, 1998. (1 page)

13. U.S. Geological Survey (USGS). Black Mountain, Montana, Quadrangle 7.5' Series Topographic Map 1985; Chessman Reservoir, Montana, Quadrangle 7.5' Series Topographic Map 1985; MacDonald Pass, Montana, Quadrangle 7.5' Series Topographic Map 1989; Three Brothers, Montana, Quadrangle 7.5' Series Topographic Map 1985. (4 maps)

14. Montana Department of Health and Environmental Sciences (MDHES), Water Quality Bureau (WQB), 1994. Complaint Investigation Report, Filed by Leonard Willett, City of Helena, investigated by Joe Meek and Luella Schultz, MDHES/WQB. July 6, 1994. (7 pages)

15. Photolog. Photographs taken by EPA Superfund Technical Assessment and Response Team (START) contractor URS Operating Services, Inc. (UOS) and subcontractor, Tetra Tech, EMInc. (TtEMI), 13 photographs. October and November, 1998. (10 pages)

16. Pioneer Technical Services, Inc., 1993. Montana Department of State Lands, Abandoned Mine Reclamation Bureau, Hazardous Materials Inventory, Site Investigation Log Sheet, Red Mountain Mine Site. August 19 and 20, 1993. (21 pages)

17. Tenmile Creek Water Treatment Plant (WTP), 1998. Phone Call Memorandum between Rachel Wieland, URS Operating Services, Inc. (UOS) and Leonard Willett, WTP Production Supervisor, regarding WTP operations and flume. December 9, 1998. (1 page)

18. Pioneer Technical Services, Inc., 1993. Montana Department of State Lands, Abandoned Mine Reclamation Bureau, Hazardous Materials Inventory, Site Investigation Log Sheet, Tenmile Mine Site. July 15, 1993. (26 pages)

19. Montana Department of Health and Environmental Sciences (MDHES), Water Quality Bureau (WQB), 1993. Field Investigation Report, investigated by Eric Martin and Terry Webster, MDHES/WQB, 4 pages and photo log. July 27 and 28, 1993. (21 pages)

20. U.S. Geological Survey (USGS), 1994. Water Resources Data, Montana, Water Year 1994, Water-Data Report MT-94-1, 509 pages. 1994. (3 pages)

21. Tenmile Creek Water Treatment Plant (WTP), 1998. Personal Communication Memorandum between Rachel Wieland, URS Operating Services, Inc. (UOS) and Doug Hahn, Tenmile Creek WTP Operator, regarding WTP operations. October 15, 1998. (1 page)

22. Montana Department of Environmental Quality (DEQ), 1998. Electronic Mail from Mark Smith, Montana DEQ, Water Quality, with attachment of City of Helena, Tenmile WTP information. November 25, 1998. (3 pages)

23. Maynard, Philip, 1998. Phone Call Memorandum between Rachel Wieland, URS Operating Services, Inc. (UOS), and Philip Maynard, Rimini resident, regarding potable water use in Rimini. December 7, 1998. (1 page)

24. U.S. Environmental Protection Agency (EPA), 1992. USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis. Multi-Media, Multi-Concentration. Document Number ILM02.0. (2 pages)

25. Eakin, Kirk, 1999. Personal Communication Memorandum between Kristin Cottle, URS Greiner Woodward Clyde (URSGWC), and Kirk Eakin, Rimini resident, regarding the recreational fishing activity in Tenmile Creek. May 6, 1999. (1 page)

26. Montana Fish Wildlife and Parks (MFWP), 1999. Letter from Don Skaar, MFWP Pollution Control Biologist, to Rachel Wieland, URS Operating Services, regarding the Tenmile Creek brook trout fish tissue samples collected in Fall 1998. February 17, 1999. (2 pages)

27. Montana State University, 1999. Brook trout fish tissue sample report to Montana Fish Wildlife and Parks (MFWP). Fish 98-1 through Fish 98-6 sample results collected by Don Skaar, MFWP, from Tenmile Creek in Fall 1998. February 4, 1999. (2 pages)

28. Montana Fish Wildlife and Parks (MFWP), 1999. Letter from Don Skaar, MFWP Pollution Control Biologist, 1998 Tenmile Fish Population Estimates. June 30, 1999. (2 pages)

29. Montana Fish Wildlife and Parks (MFWP), 1999. Personal Communication Memorandum between Kristin Cottle, URS Greiner Woodward Clyde, and Don Skaar, Pollution Control Biologist, regarding the brook trout fish tissue sample locations (samples Fish 98-1 through Fish 98-6) collected from Tenmile Creek in Fall 1998. May 10, 1999 (1 page)

30. SVL Analytical, 1999. Personal Communication Memorandum between Kristin Cottle, URS Greiner Woodward Clyde, and Kirby Gray, SVL Analytical Inorganic Laboratory Supervisor, regarding solid matrix Contract Required Detection Limits. June 17, 1999 (1 page)

SOURCE DESCRIPTION

2.2 Source Characterization

Number of the source: 1

Name and description of the source: Red Water Mine, pile

Red Water Mine originally included approximately 7,000 cubic yards of mostly uncovered and decayed waste rock located in two piles (waste rock 1 [WR-1] and WR-2) (Ref 6, p II-24; Ref 7, p 5-140). Approximately 2,000 cubic yards were borrowed from WR-1 and spread out to make a level area for the residence located onsite. This flat area is referred to as WR-2 (Figure 2) (Ref 8, p 1; Ref 6, p II-24, Figure II-8 - p II-11). The Montana Department of State Lands/Abandoned Mine Reclamation Bureau (MDSL/AMRB) (currently known as Montana Department of Environmental Quality [DEQ]), Mine Waste Cleanup Bureau) conducted a Site Investigation (SI) and sampled the Red Water Mine in July, 1993. The uncontained waste rock was in Tenmile Creek and had a low pH (3.8 to 6.8) (Ref 6, p II-24).

MDSL/AMRB determined the ore body to be most likely an auriferous silver-lead deposit enclosed in granite. Principle ore minerals are galena, with sphalerite and pyrite, with subordinate arsenopyrite and tetrahedrite. Gangue appears to be quartz-tourmaline (black quartz) rock (Ref 8, p 3).

The following describes the origin of deposits found at the source. Rocks of the granitic Boulder Batholith commonly weather to soils with loamy sand or sandy loam textures over coarse sand or grus (coarse fragments of disintegrated granitic rock). These are well-drained soils with moderate to rapid runoff and rapid permeability. The geologic parent material unit is composed of granitic igneous rocks. The major exposure at the mine is the Boulder Batholith. A dominant rock type of the batholith is light gray coarse- to medium-grained quartz monzonite, with subordinate granodiorite. The main mineral components of the batholith are plagioclase feldspar, potassium feldspar, and quartz with 15 percent or less hornblende and biotite (Ref 9, p 66-68). The ore bodies of the Rimini mining district are silver-lead deposits containing some gold enclosed in granite. The principle ore mineral is galena, accompanied by sphalerite and pyrite (Ref 10, p 81).

One open adit discharges to Tenmile Creek; this adit tunnel is 4,000 feet long and also drains the Red Mountain Mine dumps (Ref 6, p II-24). The discharge flowed at approximately 0.064 cfs (29 gpm) across WR-1 then flowed into Tenmile Creek (Ref. 6, p II-24; Ref 7, p 5-140). MDSL/AMRB measured the discharge pH at 6.79 (Ref 6, p II-24; Ref 7, p 5-140).

In October and November 1996, the U.S. Environmental Protection Agency (EPA) Emergency Response Cleanup Services (ERCS) contractor (Smith Environmental) conducted site activities at Red Water Mine for EPA Region 8, including removal of approximately 5,700 cubic yards of waste rock from the existing waste rock pile and depositing it on the northern end of the mine. Approximately 1,800 cubic yards of contaminated material was removed from the top 18 inches within the wooded area just to the north of the waste rock pile, and from the area adjacent to the onsite residence and was placed on the northern end of the waste rock pile. A bench was installed as a means of providing support to the existing original surface which has a slope of approximately 1 to 1. Large rocks were placed on the bench to buttress the slope to hold it in place (Ref 11, p 1).

A sample was collected on the bench along the southern end of the waste rock pile (Ref 11, p 1). The bench sample contained 100 parts per million (ppm) arsenic (equal to the site cleanup level of 100 ppm arsenic) and 64 ppm lead (below site cleanup level of 500 ppm lead). Based on these results, it was determined that a geosynthetic clay liner (GCL) not be placed on the bench or the original slope above and below the bench (Ref

11, p 1). In 1997, EPA and their removal contractor returned to the mine to fix some of the topsoil that had begun sliding because of heavy rains and snowmelt during the year (Ref 12).

Location of the source, with reference to a map of the site: The mine is located in the northwest quarter of Section 4, T. 8 N., R. 5 W. (Ref 13). Access is gained to the mine through a private residential yard from Rimini Road in Rimini, or walking along the west bank of Tenmile Creek; there are no restrictions to the mine (Ref 6, p II-24; Figure II-8 - p II-11; Ref. 13). Tenmile Creek flows along the base of the waste rock dumps, approximately 200 yards upstream of the city of Helena Tenmile Creek drinking water intake (Ref 7, p 5-140).

Containment

- Gas release to air—Air Migration Pathway not scored
- Particulate release to air—Air Migration Pathway not scored
- Release to ground water—Ground Water Migration Pathway not scored
- Release via overland migration and/or flood.

A contaminant factor value of 10 is assigned for the surface water migration pathway because there is evidence of hazardous substance migration from the source area.

As described in the 1993 SI, Red Water Mine lies on the east side of Tenmile Creek. Water from the mine enters the creek about 200 yards above the Helena drinking water supply intake (Ref 8, pgs 3 & 6). There no runon/runoff controls from the waste rock to Tenmile Creek. Precipitation water drains downslope towards Tenmile Creek and adit #1 flows across WR-1 prior to entering the creek (Figure 2). The rocks in Tenmile Creek are discolored approximately 20 feet downstream of the confluence with the adit discharge (Ref 8, p 11 & photo #22). The highwalls, pits, trenches, and slope of WR-1 are described as unstable where the WR-2 barrow material was taken from. The section of WR-1 along Tenmile Creek has very steep, eroding banks (Ref 8, p 14; Figure 2).

The Red Water Mine was reclaimed in 1996 by EPA ERCS contractor. Waste rock was excavated and moved to the northern end of the mine, and contaminated material, from the wooded area north of the waste rock pile and from adjacent to the onsite residence, was placed on top of the waste rock. A bench was placed on the existing original surface and large rocks (rip rap) were placed on the bench to add support. A clay liner was not placed on the bench or the original slope above and below the bench (Ref 11, p 1). In 1997, EPA and their removal contractor returned to the mine to fix some of the topsoil that had begun sliding because of high rains and snowmelt during the year (Ref 12).

Additionally, the adit discharging from the Red Water Mine was gauged in 1993 at a rate of 0.064 cfs directly to Tenmile Creek, approximately 200 yards upstream of the Tenmile Creek drinking water intake (Ref 7, p 5-140). The 1996 excavation of waste rock at the mine by EPA ERCS contractor indicates that the mine adit water continues to discharge to Tenmile Creek (Ref 11, p 2; Ref. 13).

2.4.1 Hazardous Substances

A final SI Report prepared by MDSL/AMRB, dated April 1995, indicated the presence of the following metals at the Red Water Mine in composite waste rock samples (25-007-WR-1 and 25-007-WR-2), at levels significantly above background concentrations: antimony, arsenic, copper, mercury, lead, and zinc (Ref 6, p II-25).

The EPA ERCS contractor collected samples from the Red Water Mine following the excavation of onsite waste rock in 1996. REAC provided analytical support for environmental samples collected from the mine following procedures consistent with those specified in REAC SOP #1008, including QA/QC, data review, and preparation of an analytical report containing a summary of the analytical methods, results, and QA/QC results (Ref 11, p 1 and Appendix A).

Hazardous Substance	Evidence (Source Area Samples)		Concentrations (mg/kg - ppm)	References
	Station Location No.	Laboratory Sample ID No.		
Antimony	C of WR-1A through 1E	25-007-WR-1	43 J	Ref 6, p II-25; Ref 8, p 9
Arsenic	C of WR-1A through 1E	25-007-WR-1	8,260 J	Ref 6, p II-25; Ref 8, p 9
	EA 1	A07207	56,000	Ref 11, p 3
Copper	C of WR-1A through 1E	25-007-WR-1	96 J	Ref 6, p II-25; Ref 8, p 9
Lead	C of WR-2A through 2C	25-007-WR-2	2,290 J	Ref 6, p II-25; Ref 8, p 9
	EA 6	--	3,000	Ref 11, p 3
Mercury	C of WR-2A through 2C	25-007-WR-2	0.499	Ref 6, p II-25; Ref 8, p 9
Zinc	C of WR-1A through 1E	25-007-WR-1	678	Ref 6, p II-25; Ref 8, p 9

C = Composite sample
J = The value is below the method detection limit and is estimated.

2.4.2. Hazardous Waste Quantity

2.4.2.1.1. Hazardous Constituent Quantity

Insufficient information to evaluate HWQ under this tier

Hazardous Constituent Quantity Value (S): NA

2.4.2.1.2. Hazardous Wastestream Quantity

Insufficient information to evaluate HWQ under this tier

Hazardous Wastestream Quantity Value (W): NA

2.4.2.1.3. Volume

Source area 1 is evaluated as a waste pile (Ref 1, Table 2-5 - p 51591; Ref 6, p II-24; Ref 11, p 1). MDSL/AMRB estimated that waste rock at the mine consisted of approximately 7,000 cubic yards of material in 1993 (Ref 6, p II-24). The 1996 excavation at the mine by the EPA ERCS contractor indicated as much as 7,500 cubic yards of waste rock and contaminated material (5,700 yd^3 of waste rock and 1,800 yd^3 of contaminated material which was placed on top of waste rock) (Ref 11, p 1). Conservatively, 7,000 cubic yards of material will be used to determine the Red Water Mine waste rock volume value.

By following the procedure outlined in Section 2.4.2 and Table 2-5, p 51591 of the HRS (Ref 1), the volume value is assigned as follows: 7,000/2.5 = 2,800

Dimension of source (yd^3): 7,000

References(s): Ref 1; Ref 6, p II-24; Ref 11, p 1

Volume Assigned Value: 2,800

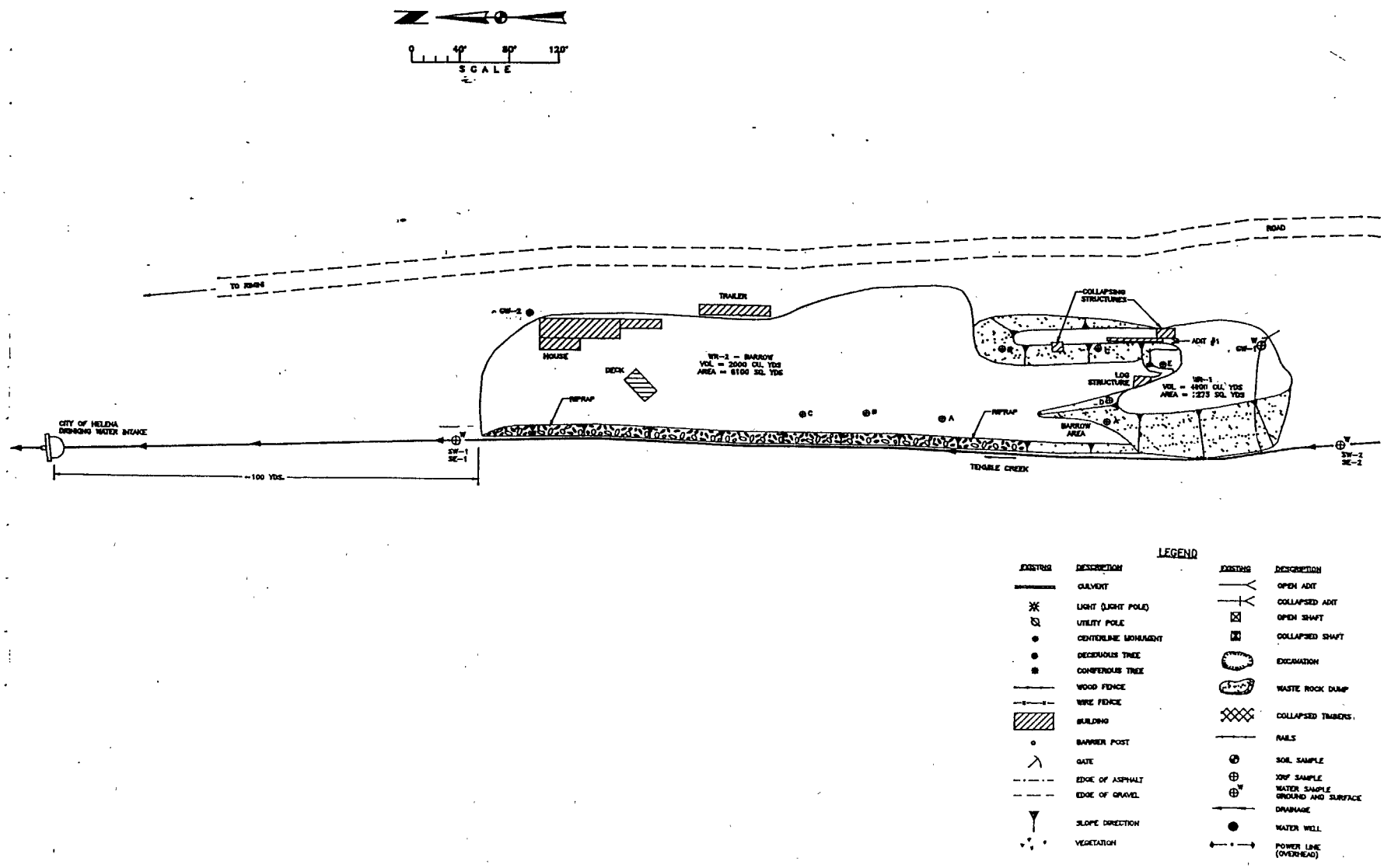
2.4.2.1.4. Area

Tier C evaluated, therefore Tier D was not evaluated for this source.

Area Assigned Value: NA

2.4.2.1.5. Source Hazardous Waste Quantity Value

Source Hazardous Waste Quantity Value: 2,800



REVISION BY: PRECISION DRAFTING SERVICES, INC. 7/13/94 PT331303.DWG

PIONEER TECHNICAL SERVICES, INC.

DRAWN MWC DATE 10/93
DESIGNED TDS JOB NO. 93-17
APPROVED F.B. NO.

THOMAS, DEAN & HOSKINS INC.
ENGINEERING CONSULTANTS
GREAT FALLS-BOZEMAN-KALISPELL MONTANA
SPOKANE WASHINGTON

FIGURE 2
DETAILED SITE LOCATION MAP
RED WATER MINE PA# 25-007
SOURCE: 1993 MDSL HAZ. MATERIAL INVENTORY

SHEET NO. 1
SHEETS 1

SOURCE DESCRIPTION

2.2 Source Characterization

Number of the source: 2

Name and description of the source: Red Mountain Mine, pile

The Red Mountain Mine consists of approximately 13,300 cubic yards of mostly uncovered waste rock in nine dumps (WR-1 through WR-9) (Figure 3), with a low pH between 3.5 to 6.2 (Ref 6, p II-29, Figure II-10 - p II-13; Ref 15, photos 5 and 6). The mine sits at an elevation of 6,300 feet above mean sea level with a slope of 15 to 20 degrees (Ref 16, p 2). Two shafts and three collapsed adits are associated with this mine (Ref 16, p 3).

The general character of the ore was sulfurated, galena predominates, accompanied by zinc blende (sphalerite), chalcopyrite and arsenopyrite in a gangue of milky quartz, altered wallrock, and chalcedony (Ref 16, p 3).

The following describes the origin of deposits found at the source. Rocks of the granitic Boulder Batholith commonly weather to soils with loamy sand or sandy loam textures over coarse sand or grus (coarse fragments of disintegrated granitic rock). These are well-drained soils with moderate to rapid runoff and rapid permeability. The geologic parent material unit is composed of granitic igneous rocks. The major exposure at the mine is the Boulder Batholith. A dominant rock type of the batholith is light gray coarse- to medium-grained quartz monzonite, with subordinate granodiorite. The main mineral components of the batholith are plagioclase feldspar, potassium feldspar, and quartz with 15 percent or less hornblende and biotite (Ref 9, p 66). The ore bodies of the Rimini mining district are silver-lead deposits enclosed in granite. The principle ore mineral is galena, accompanied by sphalerite and pyrite (Ref 10, p 81). It was noted during the MDSL/AMRB sampling event in 1993 that waste rock pile WR-7 was badly eroded (Ref 16, p 15).

Two tributaries (the eastern and western tributaries) cross through the mine, and join near the base of WR-7 (Figure 3). The two tributaries come in contact with or traverse several of the waste rock dumps (Ref 6, Figure II-10 - p II-13, p II-29; Ref 15, photos 7 and 8).

A manmade galvanized metal flume carrying water to Chessman reservoir, one of the two city of Helena drinking water storage reservoirs, runs through the mine (Ref. 13). A seep at the toe of waste rock pile 1 (WR-1) that discharges into the manmade flume is considered a potential adit discharge (Ref 6, Figure II-10 - p II-13). MDSL/AMRB sampled the mine in August of 1993 and gauged the flow of the seep at less than 1 gallon per minute (gpm) with a pH of 6.67 (Ref 7, p 5-145; Ref 6, p II-30).

The flume begins at Banner Creek, a tributary to Tenmile Creek, and ends at Chessman Reservoir approximately two miles east of the mine. During the 1993 sampling event MDSL/AMRB noted that waste rock had sloughed off from the waste rock dumps directly into the flume (Ref 6, Figure II-2 - p II-4, p II-30). Employees of the WTP periodically place wood planks over portions of the flume at steep and difficult to reach areas to provide a walkway over the flume for WTP employees to access the flume (Ref 17). Wood planks have been placed over the portion of the flume that crosses the waste rock piles at the Red Mountain Mine (Ref 17; Ref 15, photos 9 and 10); however it appears that weathered and eroded waste rock material can reach the flume through the spaces between the wood slats (Ref 15, photo 9).

Location of the source, with reference to a map of the: The mine is located less than 0.5 miles above (east) Tenmile Creek, approximately one mile southeast of the town of Rimini (Ref 16, p 3; Ref 13). The mine is

located in the southeast quarter of the southwest quarter of Section 4, T 8N, R 5W (Ref 13, Figure 1). The mine is located above the Tenmile and Red Water Mine (Ref 16, p 2).

The mine can be accessed by a difficult 4-wheel drive road through private land (Ref 16, p 2). Although the mine is located on private land, evidence of recreational use (vehicle tracks and campfire rings) was observed (Ref. 16, p 15). The nearest residence identified in the 1993 SI by MDSL/AMRB was a new cabin under construction approximately 200 feet below waste rock pile WR-8 (Ref 16, p 13).

Containment

- Gas release to air—Air Migration Pathway not scored
- Particulate release to air—Air Migration Pathway not scored
- Release to ground water—Ground Water Migration Pathway not scored
- Release via overland migration and/or flood.

The Red Mountain Mine consists of approximately 13,300 cubic yards of mostly uncovered waste rock in nine dumps (WR-1 through WR-9) (Ref 6, p II-29, Figure II-10 - p II-13). The mine sits at an elevation of 6,300 feet above mean sea level with a slope of 15 to 20 degrees (Ref 16, p 2).

A contaminant factor value of 10 is assigned for the surface water migration pathway because no maintained or engineered cover, or a functioning and maintained run-on control system and runoff management system is in place at the mine (Ref 1, Table 4-2—p 51609).

2.4.1 Hazardous Substances

A final SI Report prepared by MDSL/AMRB dated April 1995, indicated the presence of the following metals in surface waste rock samples at concentrations significantly above background concentrations: antimony, arsenic, copper, lead, mercury, and zinc. The highest concentrations from the grab and composite waste rock samples that were collected [25-019-WR-1, 3, 4 were composite samples; 25-019-WR-2 was a grab sample] are listed below (Ref 6, p II-25).

Hazardous Substance	Evidence (Source Area Samples)		Concentrations (mg/kg - ppm)	References
	Station Location No.	Laboratory Sample ID No.		
Antimony	G of WR-3	25-019-WR-2	164	Ref 6, p II-25; Ref 16, p 8
Arsenic	G of WR-3	25-019-WR-2	19,000	Ref 6, p II-25; Ref 16, p 8
Copper	G of WR-3	25-019-WR-2	304	Ref 6, p II-25; Ref 16, p 8
Lead	G of WR-3	25-019-WR-2	7,860	Ref 6, p II-25; Ref 16, p 8
Mercury	G of WR-3	25-019-WR-2	1.16	Ref 6, p II-25; Ref 16, p 8
Zinc	G of WR-3	25-019-WR-2	489	Ref 6, p II-25; Ref 16, p 8

G = Grab sample

2.4.2. Hazardous Waste Quantity

2.4.2.1.1. Hazardous Constituent Quantity

Insufficient information to evaluate HWQ under this tier.

Hazardous Constituent Quantity Value (S): NA

2.4.2.1.2. Hazardous Wastestream Quantity

Insufficient information to evaluate HWQ under this tier.

Hazardous Wastestream Quantity Value (W): NA

2.4.2.1.3. Volume

Source area 2 is evaluated as a waste pile (Ref 1, Table 2-5 - p 51591; Ref 6, p II-29). In 1993 MDSL/AMRB determined that waste rock at the mine consisted of approximately 13,300 cubic yards of material (Ref 6, p II-29).

By following the procedure outlined in Section 2.4.2 and Table 2-5, p 51591 of the HRS (Ref 1), the volume value is assigned as follows: 13,300/2.5 = 5,320

Dimension of source (yd^3): 13,300

Reference(s): Ref 1; Ref 6, p II-29

Volume Assigned Value: 5,320

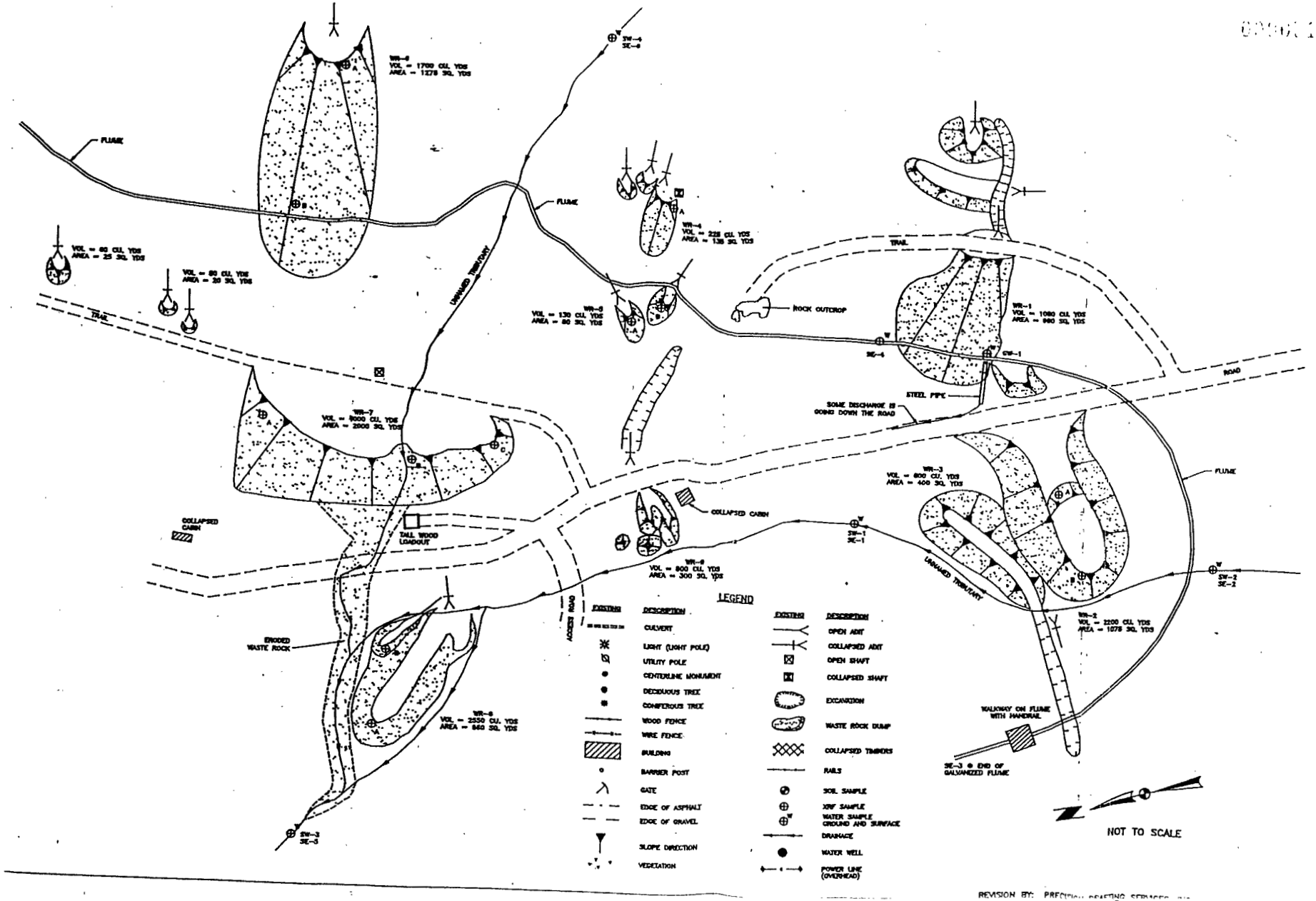
2.4.2.1.4. Area

Tier C evaluated, therefore Tier D was not evaluated for this source.

Area Assigned Value: NA

2.4.2.1.5. Source Hazardous Waste Quantity Value

Source Hazardous Waste Quantity Value: 5,320



REVISION BY: PRECISION DRAFTING SERVICES, INC.

DRAWN MEC DATE 12/93
DESIGNED TPK JOB NO. 93-17
APPROVED F.N. NO.

PIONEER TECHNICAL SERVICES, INC. MYTYE #8

TD&H
THOMAS, DEAN & HOSKINS INC.
ENGINEERING CONSULTANTS
GREAT FALLS—BOZEMAN—KALSPELL MONTANA
SPOKANE

FIGURE 3
DETAILED SITE LOCATION MAP
RED MOUNTAIN MINE PA# 25-019
SOURCE: 1993 MDSL HAZ. MATERIAL INVENTORY

SHEET NO. 1

1

SOURCE DESCRIPTION

2.2 Source Characterization

Number of the source: 3

Name and description of the source: Tenmile Mine, pile

The Tenmile Mine (Daniel Stanton/Bunker Hill) consists of approximately 3,040 cubic yards of mostly uncovered waste rock in three dumps (WR-1 through WR-3) (Figure 4) with a low pH (3.6 to 5.6). Three additional dumps at the mine were reclaimed by the MDSL/AMRB (Daniel Stanton/Bunker Hill) (Ref. 6, p II-29; Ref 15, photos 11, 12, and 13). Two discharging adits are present: the upper adit had an estimated flow rate of 0.25 gpm with a pH of 6.29; the lower adit discharged to a wetlands on the bank of Tenmile Creek and had an estimated flow rate of 2 gpm with a pH of 8.39 (Ref 6, p II-29).

The following describes the origin of deposits found at the source. Rocks of the granitic Boulder Batholith in the geographic area commonly weather to soils with loamy sand or sandy loam textures over coarse sand or grus (coarse fragments of disintegrated granitic rock). These are well-drained soils with moderate to rapid runoff and rapid permeability. The geologic parent material unit is composed of granitic igneous rocks. The major exposure at the mine is the Boulder Batholith. A dominant rock type of the batholith is light gray coarse- to medium-grained quartz monzonite, with subordinate granodiorite. The main mineral components of the batholith are plagioclase feldspar, potassium feldspar, and quartz with 15 percent or less hornblende and biotite (Ref 9, p 68). The ore bodies of the Rimini mining district are silver-lead deposits enclosed in granite. The principle ore mineral is galena, accompanied by sphalerite and pyrite (Ref 10, p 81).

MDSL/AMRB sampled the three uncovered waste rock piles in July 1993 but did not sample the reclaimed dumps (Ref 6, p II-29). The Montana Department of Health and Environmental Sciences, Water Quality Bureau (MDHES/WQB) (currently known as the Montana Department of Environmental Quality (DEQ), WQB) investigated turbidity problems reported in Tenmile Creek on July 26, 1993, after the MDSL/AMRB investigation. The WQB found that the upper discharging adit water at the Tenmile Mine, which had been naturally caved, backed up and the confined water pressure caused failure of the caved plug and released a significant volume of water. The blowout caused a mudslide down the hillside, over the upper (unreclaimed) waste rock dump called WR-1 in the MDSL/AMRB investigation, through the three reclaimed dumps, and into Tenmile Creek. The mudslide was 10 to 20 feet wide and 3 to 5 feet deep at the base. The mudslide occurred approximately one mile upstream of the city of Helena Tenmile Creek drinking water intake (Ref 6, p II-32).

Location of the source, with reference to a map of the site: The Tenmile Mine is located approximately one mile south of the town of Rimini, adjacent to Tenmile Creek (east), and is located in the southeast quarter of the southeast quarter of Section 5, T 8N, R 5W (Ref 13; Ref 18, p 2). The mine ranges from 5,600 up to 6,000 feet above mean sea level, with slopes of 30 to 35 degrees (Ref 18, p 2).

During the SI, MDSL/AMRB noted that a wooden ore loadout bin (logs) was leaning downhill and waste rock pile 1 (WR-1) was very steep and unstable. The mine is closed with an unlocked gate at the base of the dump. An open road reaches the top of the mine where evidence of recreational use (litter) at the mine was observed during the SI (Ref 6, p 14).

Containment

- Gas release to air—Air Migration Pathway not scored
- Particulate release to air—Air Migration Pathway not scored
- Release to ground water—Ground Water Migration Pathway not scored
- Release via overland migration and/or flood.

The Tenmile Mine consists of approximately 3,040 cubic yards of mostly uncovered waste rock in three dumps (Figure 4). Three additional dumps at the mine were reclaimed by the MDSL/AMRB (Daniel Stanton/Bunker Hill) (Ref 6, p II-29).

A contaminant factor value of 10 is assigned for the surface water migration pathway because no maintained or engineered cover, or a functioning and maintained run-on control system and runoff management system is in place on three of the waste rock dumps at the mine (Ref 1, Table 4-2 - p 51609). Additionally, a blowout of the upper adit at the mine caused a mudslide, down the hillside, over the upper (unreclaimed) waste rock dump, through the three reclaimed dumps, and into Tenmile Creek. The mudslide was 10 to 20 feet wide and 3 to 5 feet deep at the base. The mudslide occurred approximately one mile upstream of the city of Helena Tenmile Creek drinking water intake (Ref 6, p II-32).

2.4.1 Hazardous Substances

A final SI Report prepared by MDSL/AMRB, dated April, 1995, indicated the presence of the following metals in composited surface waste rock samples (25-005-WR-1 and 25-005-WR-2), at concentrations significantly greater than background from the Tenmile Mine: antimony, arsenic, cadmium, copper, lead, mercury, and zinc (Ref 6, Table II-3 - p II-25, p II-29). The highest concentration of each analyte is listed in the table below.

The MDHES/WQB investigators sampled the material contained in the mudslide after the mudslide occurred in 1993 (Ref 6, p II-32 - 33). Mudslide samples (3117 and 3118) indicated the presence of arsenic, cadmium, copper, lead, and zinc at concentrations significantly greater than the background sample used for the Tenmile Mine collected for the MDSL/AMRB investigation (25-007-SS-1) (Ref 6, Table II-3—p II-25, p II-29, Table II—p II-33).

Hazardous Substance	Evidence (Source Area Samples)		Concentrations (mg/kg - ppm)	References
	Station Location No.	Laboratory Sample ID No.		
Antimony	C of WR1-A through 1C	25-005-WR-1	37 J	Ref 6, p II-25; Ref 18, p 7
Arsenic	C of WR-3A, 3B, 4 3118	25-005-WR-2 --	5,530 4,730	Ref 6, p II-25 and II-33; Ref 18, p 7; Ref 19
Cadmium	C of WR-3A, 3B, 4 3117	25-005-WR-2 --	14.3 10.7	Ref 6, p II-25 and II-33; Ref 18, p 7; Ref 19
Copper	C of WR1-A through 1C 3118	25-005-WR-1 --	231 200	Ref 6, p II-25 and II-33; Ref 18, p 7; Ref 19
Lead	C of WR-3A, 3B, 4 3117	25-005-WR-2 --	3,220 4,500	Ref 6, p II-25 and II-33; Ref 18, p 7; Ref 19
Mercury	C of WR1-A through 1C	25-005-WR-1	0.634	Ref 6, p II-25; Ref 18, p 7
Zinc	C of WR-3A, 3B, 4 3117	25-005-WR-2 --	989 1,000	Ref 6, p II-25 and II-33; Ref 18, p 7; Ref 19

C = Composite sample
J = The value is below the method detection limit and is estimated.

2.4.2. Hazardous Waste Quantity

2.4.2.1.1. Hazardous Constituent Quantity

Insufficient information to evaluate HWQ under this tier.

Hazardous Constituent Quantity Value (S): NA

2.4.2.1.2. Hazardous Wastestream Quantity

Insufficient information to evaluate HWQ under this tier.

Hazardous Wastestream Quantity Value (W): NA

2.4.2.1.3. Volume

Source area 3 is evaluated as a waste pile (Ref 1, Table 2-5 - p 51591; Ref 6, p II-29). MDSL/AMRB determined that waste rock at the mine consisted of approximately 3,040 cubic yards of uncovered waste rock material in 1993 (not including the volume of the reclaimed dumps) (Ref 6, p II-29).

By following the procedure outlined in Section 2.4.2 and Table 2-5, p 51591 of the HRS (Ref 1), the volume value is assigned as follows: 3,040/2.5 = 1,216

Dimension of source (yd^3): 3,040

Reference(s): Ref 1; Ref 6, p II-29

Volume Assigned Value: 1,216

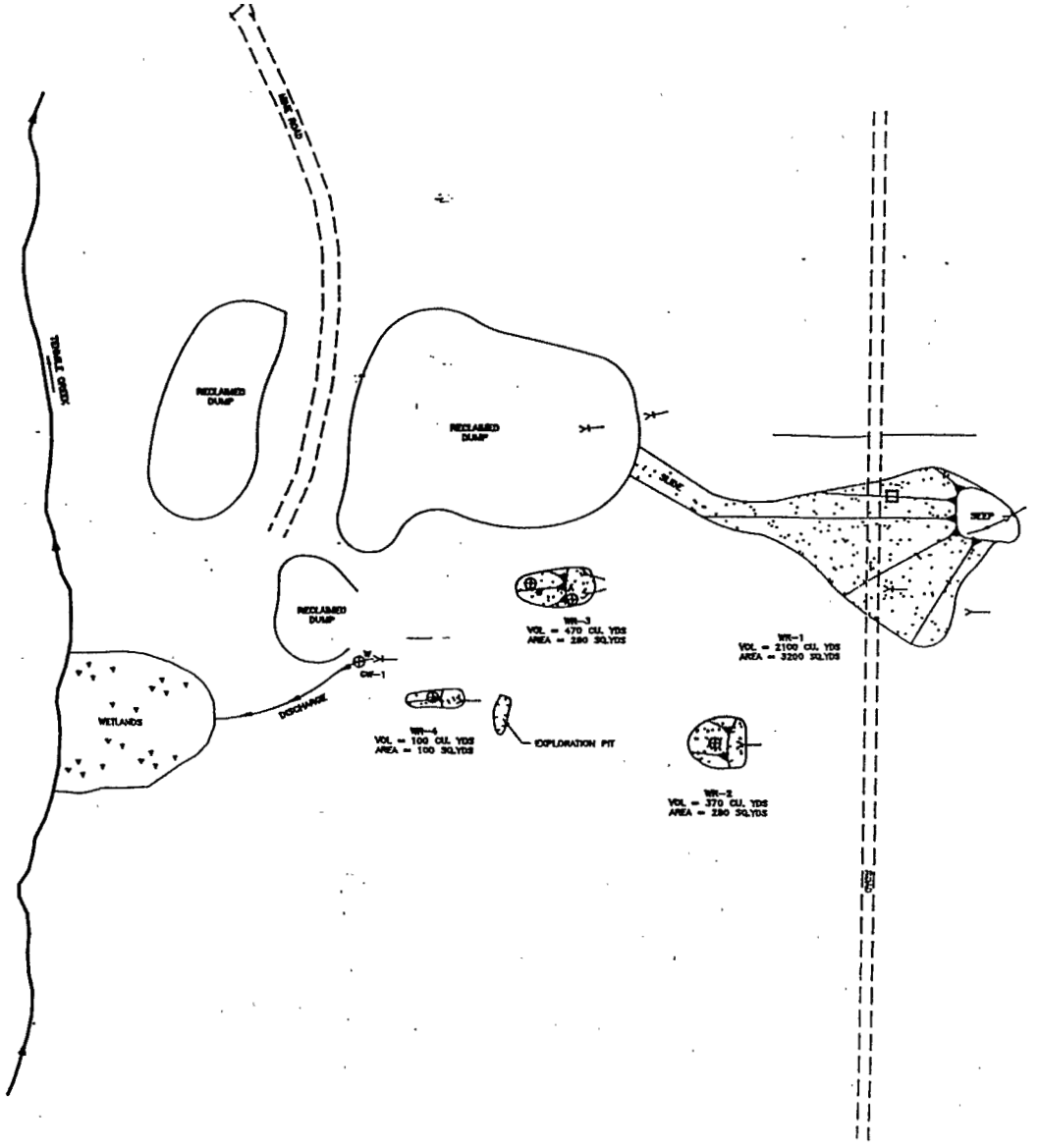
2.4.2.1.4. Area

Tier C evaluated, therefore Tier D was not evaluated for this source.

Area Assigned Value: NA

2.4.2.1.5. Source Hazardous Waste Quantity Value

Source Hazardous Waste Quantity Value: 1,216



N

NOT TO SCALE

LEGEND

EXISTING	DESCRIPTION	EXISTING	DESCRIPTION
	CULVERT		OPEN ADIT
	LIGHT (LIGHT POLE)		COLLAPSED ADIT
	UTILITY POLE		OPEN SHAFT
	CENTERLINE MONUMENT		COLLAPSED SHAFT
	DECIDUOUS TREE		EXCAVATION
	CONIFEROUS TREE		WASTE ROCK DUMP
	WOOD FENCE		COLLAPSED TIMBERS
	WIRE FENCE		RAILS
	BUILDING		SOIL SAMPLE
	BARRIER POST		SOIL SAMPLE
	GATE		WATER SAMPLE GROUND AND SURFACE
	EDGE OF ASPHALT		DRAINAGE
	EDGE OF GRAVEL		WATER WELL
	SLOPE DIRECTION		POWER LINE (OVERHEAD)
	VEGETATION		

REVISION BY: PRECISION DRAFTING SERVICES, INC. 7/13/94

PT331302.DWG

DRAWN KRC DATE 10/93
DESIGNED TPR JOB NO. 33-17
APPROVED F.B. NO.

PIONEER TECHNICAL SERVICES, INC.

TDSH
THOMAS, DEAN & HOSKINS INC.
ENGINEERING CONSULTANTS
GREAT FALLS—BOZEMAN—KALISPELL MONTANA
SPOKANE WASHINGTON

FIGURE 4
DETAILED SITE LOCATION MAP
TEN MILE MINE PA# 25-005
SOURCE: 1993 HAZARDOUS MATERIAL INVENTORY

SHEET NO. 1 SHEETS 1

SITE SUMMARY OF SOURCE DESCRIPTIONS

Source No.	Source Hazardous Waste Quantity Value	Containment: Ground Water	Surface Water	Gas	Air Particulate
1	2,800	NS	10	NS	NS
2	5,320	NS	10	NS	NS
3	1,216	NS	10	NS	NS
Sum of Values	9,336				

NS = Not scored

2.4.2.2 Hazardous Waste Quantity Value

According to Table 2-6 in the HRS Final Rule, and based on a source summary total hazardous waste quantity value of 9,336, the hazardous waste quantity factor value is 100 (Ref 1, p 51591-Table 2-6).

Source Summary Total Hazardous Waste Quantity Value: 100

4.1 OVERLAND/FLOOD MIGRATION COMPONENT

4.1.1.1 Definition of Hazardous Substance Migration Path for Overland/Flood Component

Tenmile Creek is the primary drainage basin (i.e., watershed) in the Upper Tenmile Creek Mining Area; it flows to the north in a deep gorge between Red Mountain on the east and Lee Mountain on the west (Ref 13; Ref 6, p II-40). The headwaters of Tenmile Creek are located approximately 4.5 miles upstream of the Tenmile Mine. Tenmile Creek flows for 22 miles before entering Lake Helena (Ref 13). The average annual flow for Tenmile Creek is 17.3 cfs (Ref 20, p 121).

The Red Water Mine lies on the east bank of Tenmile Creek, which flows north (Ref 13). Water from the mine enters the creek approximately 200 yards above the Tenmile Creek drinking water supply intake (Ref 8, p 3; Figure 2). The Red Mountain Mine is located approximately 0.5 mile above Tenmile Creek on the east side of the drainage (Ref 13). Water discharging from the mine flows west in an unnamed tributary 0.5 miles into Tenmile Creek, which flows north (Ref 16, p 3; Ref 15, Photos 7 & 8, Figure 3). The Tenmile Mine lies on the east bank of Tenmile Creek. Water from the upper portion of the site flows into an unnamed tributary that discharges to the wetland area along Tenmile Creek (Figure 4). The distance from the reclaimed dump to Tenmile Creek is 20 feet (Ref 18, p 10). Precipitation water flows west from this area into Tenmile Creek (Ref 15, Photos 11,12, & 13; Figure 4).

There are numerous mines affecting the water quality in the Tenmile Creek Watershed (Figure 1). Three mine sources were characterized for the HRS documentation (i.e., Tenmile, Red Mountain, and Red Water mines). Probable point of entry one (PPE 1) is located in Tenmile Creek west of the Tenmile Mine and reclaimed dumps (Figure 4) (Ref 13). PPE 2 is located in Tenmile Creek northwest of Red Mountain Mine where the unnamed tributary flows into Tenmile Creek (Figure 3) (Ref 13). PPE 3 is located in Tenmile Creek along the western edge of the Red Water Mine (Figure 2) (Ref 13). PPE 3 is evaluated at surface water and sediment sample location TM-SW/SD-2. The 15-mile downstream limit from PPE 1 on Tenmile Creek ends 7 miles downstream of the Tenmile Creek Water Treatment (Ref 13).

4.1.2.1 Likelihood of Release

4.1.2.1.1 Observed Release

An observed release by direct observation and chemical analysis can be documented for surface water contamination of Tenmile Creek by the three sources being evaluated in the Upper Tenmile Creek Mining Area for this HRS package; Red Water Mine, Red Mountain Mine, and the Tenmile Mine.

Direct Observation

- Basis for Direct Observation

Red Water Mine—On July 6, 1994, the Montana Department of Health and Environmental Sciences (MDHES), (currently known as the Montana Department of Environmental Quality [DEQ]), Water Quality Bureau (WQB) logged a complaint investigation report by Leonard Willett, City of Helena, regarding turbidity in Tenmile Creek (Ref 14). The report details a mine discharge that entered Tenmile Creek the evening before and resulted in the closure of the Tenmile Water Treatment Plant (WTP) until it was determined that the water was safe. The previous evening, the turbidity at the plant jumped to levels exceeding the reporting values of the plants monitoring system (approximately 190 NTU). The plant was shut down before any of the water reached the distribution system for the city of Helena. An employee from the WTP investigated and determined that two men, claiming to have purchased the mine, opened the mine shaft (located at the Red Water Mine which drains the Red Mountain Mine) and allowed the water backed up behind the timbers to drain. The discharge ran over the tailings and entered Tenmile Creek. Based on a "high water mark" of red precipitate visible on the timbers, it was determined that water was backed up approximately 18 inches above the adit floor. The released water apparently flowed to the edge of the waste rock pile and caused an erosion cut in the bank before entering the creek. Further investigation indicated that the toe of the waste rock at the mine is in direct contact with Tenmile Creek (Ref 14, p 1-3).

Red Mountain Mine—Flume beginning at Banner Creek, a tributary to Tenmile Creek, and ends at Chessman Reservoir approximately two miles east of the mine runs through the Red Mountain Mine. Periodically, water is discharged from Chessman Reservoir to Beaver Creek to supplement the city of Helena drinking water intake on Beaver Creek. During the 1993 sampling event, MDSL/AMRB noted that waste rock, sloughed off from the waste rock piles, dumps directly into the flume (Ref 6, Figure II-2—p II-4, p II-30). Employees of the WTP periodically place wood planks over portions of the flume, at steep and difficult to reach locations, to provide a walkway over the flume for WTP employees to access the flume (Ref 17). Wood planks have been placed over the portion of the flume that crosses the waste rock piles at the Red Mountain Mine (Ref 17; Ref 15, photos 9 and 10); however, weathered and eroded waste rock material can reach the flume through the spaces between the wood slats (Ref 15, photo 9).

Tenmile Mine—MDHES/WQB investigated turbidity problems reported in Tenmile Creek on July 26, 1993, after the MDSL/AMRB SI in early July 1993. The WQB found that the upper discharging adit water at the Tenmile Mine, which had been naturally caved, backed up and the confined water pressure caused failure of the caved plug and released a significant volume of water. The blowout caused a mudslide down the hillside, over the upper (unreclaimed) waste rock dump called WR-1 in the MDSL/AMRB investigation, through the three reclaimed dumps, and into Tenmile Creek. The mudslide was 10 to 20 feet wide and 3 to 5 feet deep at the base. The mudslide occurred approximately one mile upstream of the city of Helena Tenmile Creek drinking water intake (Ref 6, p II-32).

- Hazardous Substances in the Release

Red Water Mine—In July 1993, MDSL/AMRB sampled the adit that discharges to Tenmile Creek that drains the Red Water and Red Mountain Mines (Sample 25-007-GW-1). This adit had a discharge flow rate of 0.064 cfs with a pH of 6.79. Analytes detected in this sample included antimony (33.1 parts per billion [ppb]), arsenic (131 ppb), barium (41 ppb), cadmium (73.9 ppb), cobalt (13.8 ppb), copper (16 ppb), iron (6,160 ppb), lead (1.02 J ppb), manganese (6,250 J ppb), and zinc (14,100 J ppb) (Ref 6, pp II-24, II-27).

Source samples collected from the Red Water Mine by MDSL/AMRB in 1993 indicated elevated concentrations of antimony (43 J ppm), arsenic (8,260 J ppm), copper (96 J ppm), lead (2,290 J ppm), mercury (0.499 ppm), and zinc (678 ppm) (Ref 6, pp II-24, II-25).

Red Mountain Mine—In August 1993, MDSL/AMRB sampled the Red Mountain Mine waste rock piles. The data indicated the presence of the following metals in waste rock: antimony (164 ppm), arsenic (19,000 ppm), copper (304 ppm), lead (7,860 ppm), mercury (1.16 ppm), and zinc (489 ppm) (Ref 6, pp II-25, II-30).

Tenmile Mine—In July 1993, MDSL/AMRB sampled the Tenmile Mine waste rock piles. The data indicated the presence of the following metals in waste rock (maximum concentrations shown in parenthesis): antimony (37 J ppm), arsenic (5,530 ppm), cadmium (14.3 ppm), copper (231 ppm), lead (3,220 ppm), mercury (0.634 ppm), and zinc (989 ppm) (Ref 6, Table II-3—p II-25, p II-29).

Chemical Analysis

MDSL/AMRB conducted an SI sampling event in 1993 and 1994 to characterize sources at the site, define migration pathways and releases and assess potential human and environmental targets. Sampling on September 21 and 22, 1994, included collecting surface water and sediment samples from five locations on Tenmile Creek and four locations on tributaries to Tenmile Creek to document the presence of contamination in the surface water pathway (Ref 6, pp II-1, III-1). All sample locations are depicted on Figure IV-1 of the MDSL/AMRB SI (Ref 6, Figure IV-1 - p IV-6). The surface water and sediment samples used for this HRS evaluation include (SW denotes surface water, SD denotes sediment): TM-SW-1/SD-1, background sample collected upstream of sources on Tenmile Creek near the Continental Divide; TM-SW-2/SD-2, collected at PPE 3 on Tenmile Creek, downstream of all three sources, just downstream of the Red Water Mine; TM-SW-5/SD-5, collected at the City of Helena drinking water intake on Tenmile Creek, approximately 600 feet (0.11 miles) downstream of TM-SW-2 (PPE 3) and 0.9 miles downstream of PPE 1; TM-SW-8/SD-8, collected in Tenmile Creek downstream from its confluence with Minnehaha Creek, approximately 2.8 miles downstream of PPE 1; and TM-SW-9/SD-9, collected in Tenmile Creek downstream from its confluence with Walker Creek, approximately 7 miles downstream from the PPE 1 (Ref 6, pp III-1 - III-7, Figure IV-1 - p IV-6; Ref 13).

Surface water samples TM-SW-1 and TM-SW-2 were analyzed for total and dissolved metals, TM-SW-5 was analyzed for dissolved metals only, and TM-SW-8 and TM-SW-9 were analyzed for total metals only. Total and dissolved metals analyses were accomplished through Contract Laboratory Program (CLP) Statement of Work (SOW) 3/92 and EPA Method 200.9. All sediment samples were analyzed for total metals (CLP SOW 3/92) (Ref 6, pp III-3, III-4).

The total metals surface water data showed several metals elevated at least three times the background concentration, or above the contract required detection limit (CRDL) if background was not detected. Arsenic, cadmium, and zinc are the total metals detected at elevated concentrations in surface water samples and attributable to the mines evaluated for this HRS package. Dissolved metal concentrations of zinc were detected at elevated concentrations in samples TM-SW-2 and TM-SW-5 and are attributable to the mines. In sediment samples, total metals arsenic, cadmium, copper, lead, and zinc were detected at elevated concentrations and are attributable to the mines (Ref 6, pp IV-4 - IV-7).

- Background Concentrations

On September 21, 1994, MDSL/AMRB collected co-located surface water (TM-SW-1) and surface sediment samples (TM-SD-1) for the SI. The samples were collected in Tenmile Creek near the Continental Divide, upstream of any obvious mining impacts (Ref 6, IV-4; Ref. 13).

Sample ID	Sampling Location	Depth	Date	Reference
TM-SW-1	Tenmile Creek	grab	9/21/94	Ref 6, p III-1
	near Continental Divide			Ref 6, Appendix D
TM-SD-1	Tenmile Creek	grab	9/21/94	Ref 6, p III-1
	near Continental Divide			Ref 6, Appendix D

Sample ID	Hazardous Substance	Concentration (μg/l)	Contract Required Detection Limit (CRDL) (μg/l)	Reference
TM-SW-1	**Total metals:**			Ref 6, p IV-2,3;
	arsenic	ND	10	Ref 24
	cadmium	ND	5	
	zinc	ND	20	
	Dissolved metals:			
	zinc	ND	20	

CRDL = Contract Required Detection Limit
ND = Compound was analyzed for but not detected.
μg/l = Micrograms per liter

Sample ID	Hazardous Substance	Concentration (mg/kg)	Contract Required Detection Limit (CRDL) (mg/kg)	Reference
TM-SD-1	**Total metals:**			Ref 6, p IV-5;
	arsenic	4.2	2	Ref 30
	cadmium	1.1 U	1	
	copper	4.8 B	5	
	lead	6.9 S	0.6	
	zinc	15.8	4	

B = Analyte detected above the Instrument Detection Limit (IDL), but below the Contract Required Detection Limit (CRDL)
CRDL = Contract Required Detection Limit
mg/kg = Milligrams per kilogram
S = Reported value was determined by Methods of Standard Additions.
U = Compound was analyzed for but not detected.

- Contaminated Samples

Surface water (SW) and sediment (SD) samples were collected by MDSL/AMRB on September 21 and 22, 1994, for the SI (Ref 6, Figure IV-1—p IV-6). The samples used for this HRS evaluation are listed below (Ref 13). Contaminants listed below are those that are at least three times the background concentration, or above the detection limit if a background concentration was not detected, and that have been determined to be attributable to the sources in the Upper Tenmile Creek Mining Area.

Sample ID	Sampling Location	Depth	Date	Reference
TM-SW/SD-2	Tenmile Creek at PPE 3	grab	9/21/94	Ref 6, p IV-1 - 5, App A, p 91
TM-SW/SD-5	Tenmile Creek intake	grab	9/21/94	Ref 6, p IV-1 - 5, App A, pp 91, 93
TM-SW/SD-8	Tenmile Creek downstream of Minnehaha Creek	grab	9/21/94	Ref 6, p IV-1 - 5, App A, pp 91, 93
TM-SW/SD-9	Tenmile Creek downstream Walker Creek	grab	9/21/94	Ref 6, p IV-1 - 5, App A, pp 92, 93

Surface Water Sample ID	Hazardous Substance	Concentration (μg/l)	Contract Required Detection Limit (CRDL) (μg/l)	Reference
TM-SW-2	**Total metals:**			Ref 6, p IV-3;
	cadmium	5.4	5	Ref 24
	zinc	812	20	
TM-SW-2	**Dissolved metals:**			Ref 6, p IV-2;
	zinc	831	20	Ref 24
TM-SW-5	**Dissolved metals:**			Ref 6, p IV-2;
	zinc	811	20	Ref 24
TM-SW-8	**Total metals:**			Ref 6, p IV-3;
	arsenic	25.2	10	Ref 24
	cadmium	8.3	5	
	zinc	1,430	20	
TM-SW-9	**Total metals:**			Ref 6, p IV-3;
	arsenic	31.3	10	Ref 24
	zinc	133	20	

CRDL = Contract Required Detection Limit
μg/L = Micrograms per liter

Sediment Sample ID	Hazardous Substance (Total metals)	Concentration (mg/kg)	Contract Required Detection Limit (CRDL) (mg/kg)	Reference
TM-SD-2	arsenic	262	2	Ref 6, p IV-5
	cadmium	13.8	1	Ref 30
	copper	40.4	5	
	lead	484	0.6	
	zinc	1,840	4	
TM-SD-5	arsenic	363	2	
	cadmium	6.1	1	
	copper	39.1	5	
	lead	540	0.6	
	zinc	675	4	
TM-SD-8	arsenic	158 *	2	
	cadmium	6.6	1	
	copper	45	5	
	lead	186	0.6	
	zinc	767	4	
TM-SD-9	arsenic	47.6	2	
	cadmium	2.5	1	
	lead	39.4	0.6	
	zinc	225	4	

*Duplicate analysis not within control limits.
CRDL = Contract Required Detection Limit
mg/kg = Milligrams per kilogram

Attribution:

Arsenic, cadmium, and zinc, are present in total metals analysis of surface water release samples at concentrations three times background concentrations, or above the detection limit if background concentrations were not detected (Ref 6, p IV-3). Zinc was detected in dissolved metals analyses of surface water release samples at concentrations three times background levels, or above the detection limit if background concentrations were not detected (Ref 6, p IV-2). In sediment release samples, arsenic, cadmium, copper, lead, and zinc were detected at concentrations three times background levels, or above the detection limit if background concentrations were not detected (Ref 6, p IV-5).

All of the above listed analytes were detected in waste rock samples collected from the three sources (Red Water Mine, Red Mountain Mine, Tenmile Mine) evaluated for this watershed (Refer to Source Characterization Section 2.4.1, Hazardous Substances for the three sources). The Red Water Mine and Red Mountain Mine waste rock samples contained arsenic, copper, lead, and zinc . The Tenmile Mine waste rock samples contained arsenic, cadmium, copper, lead, and zinc (Ref 6, p II-25).

Hazardous Substances Released:

The hazardous substances from total metals analyses that meet the criteria for an observed release in surface water include; arsenic, cadmium, and zinc (Ref 6, p IV-3; Ref 13).

The hazardous substance from dissolved metals analysis that meet the criteria for an observed release in surface water is zinc (Ref 6, p IV-2; Ref 13).

The hazardous substances that meet the criteria for an observed release in sediment include; arsenic, cadmium, copper, lead, and zinc (Ref 6, p IV-5).

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Observed Release Factor Value: 550

4.1.2.2 Waste Characteristics

4.1.2.2.1 Toxicity/Persistence

Hazardous Substance	Source No.	Toxicity Factor Value	Toxicity/ Persistence Factor Value	Persistence Factor Value (Table 4-12)	Reference
arsenic	1,2,3	10,000	10,000	1	Ref 1, p 51613, Ref 2, p B-2
cadmium	3	10,000	10,000	1	Ref 1, p 51613, Ref 2, p B-4
copper	1,2,3	--	--	1	Ref 1, p 51613, Ref 2, p B-6
lead	1,2,3	10,000	10,000	1	Ref 1, p 51613, Ref 2, p B-13
mercury	1,2,3	10,000	4,000	0.4	Ref 1, p 51613, Ref 2, p B-13
zinc	1,2,3	10	10	1	Ref 1, p 51613, Ref 2, p B-20

==========

Toxicity/Persistence Factor Value: 10,000

4.1.2.2.2 Hazardous Waste Quantity

Source Number	Source Hazardous Waste Quantity Value (Section 2.4.2.1.5)	Is source hazardous constituent quantity data complete? (yes/no)
1	2,800	yes
2	5,320	yes
3	1,216	yes
Sum of values:	9,336	

4.1.2.2.3 Waste Characteristics Factor Category Value

Toxicity/persistence factor value
X hazardous waste quantity factor value: $1x10^6$
$10,000 \times 100 = 1x10^6$

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Hazardous Waste Quantity Factor Value: 100
Waste Characteristics Factor Category Value: 32

4.1.2.3 Drinking Water Targets

The city of Helena, Montana, maintains the Tenmile WTP located at the junction of Highway 12 and Rimini Road. The plant has five drinking water supply intakes in the Tenmile Creek drainage basin and utilizes two reservoirs (i.e., Chessman Reservoir and Scott Reservoir). The drinking water intakes in the Tenmile Creek drainage basin are located at; Walker Creek, Moose Creek, Minnehaha Creek, Beaver Creek, and Tenmile Creek at the town of Rimini (Ref 13). Valves are present to manually turn on and off the water supply at the intakes; the use of the various intakes is random, based on demand and water quality (turbidity). Chessman Reservoir and Scott Reservoir are maintained to supply water to intakes (Ref 15, photos 3 and 4). A flume carries water from Banner Creek to Chessman Reservoir. The reservoir then discharges water to Beaver Creek which has a drinking water intake located approximately 800 feet prior to where Beaver Creek discharges to Tenmile Creek (Ref 13) (Ref 15, photo 2). Scott Reservoir is in a larger drainage basin and does not need to be filled with additional water; it discharges to Ruby Creek, a tributary of Tenmile Creek. One or both of the reservoirs are generally used in severely cold weather when smaller tributaries freeze and sometimes in summer to supplement the tributaries (Ref 6, p II-40-41; Ref 21). The Montana Department of Environmental Quality (MDEQ) has a record of 9,035 active connections with the city of Helena Tenmile Creek WTP, serving 24,569 residents in Helena (Ref 22, p 1).

Thirteen known homeowners in the town of Rimini use surface water from Tenmile Creek as a potable water supply. Water is piped off of Tenmile Creek at the city of Helena Tenmile Creek drinking water intake to some sort of holding area/structure (Ref 15, photo 1). Each homeowner has a pipe that directs water to their residence. Each resident is responsible for treatment, if any, of their own water. One of the 13 homeowners interviewed, stated that it is unknown if any of the residents actually use this water for their drinking water, but rather, the surface water supply is used for household uses such as bathing, washing dishes, and laundry. This resident reported that his family uses bottled water for drinking water (Ref 23).

Level I Concentrations

Sample ID: TM-SW-2
Sample Medium: Surface Water
Location: Tenmile Creek at PPE 3, 0.85 miles downstream of PPE 1
Reference: Ref 6, p IV-2, 3; Ref 13

Hazardous Substance	Hazardous Substance Concentration	Benchmark Concentration	Benchmark
Total metals:			
cadmium	5.4 μg/l	5 μg/l	DW MCL

Sample ID: TM-SW-8
Sample Medium: Surface Water
Location: Tenmile Creek below Minnehaha Creek (2.8 miles downstream of PPE 1)
Reference: Ref 6, p IV-3; Ref 13

Hazardous Substance	Hazardous Substance Concentration	Benchmark Concentration	Benchmark
Totals metals:			
arsenic	25.2 μg/l	11 μg/l/0.057 μg/l	RDSC/CRSC
cadmium	8.3	5 μg/l	DW MCL

Sample ID: TM-SW-9
Sample Medium: Surface Water
Location: Tenmile Creek below Walker Creek (7 miles downstream of PPE 1)
Reference: Ref 6, p IV-3; Ref 13

Hazardous Substance	Hazardous Substance Concentration	Benchmark Concentration	Benchmark
Total metals:			
arsenic	31.3 μg/l	11 μg/l/0.057 μg/l	RDSC/CRSC

Reference for Benchmarks: Ref 2

Most Distant Level I Sample

Sample ID: TM-SW-9
Distance from the probable point of entry: 7 miles (from PPE 1)
Reference: Ref 13

Most Distant Level II Sample

Sample ID: TM-SD-9
Distance from the probable point of entry: 7 miles (from PPE 1)
Reference: Ref 13

4.1.2.3.1 Nearest Intake

Location of Nearest Drinking Water Intake: City of Helena Tenmile Creek intake
Distance from the probable point of entry: 0.9 miles downsteam from PPE 1 (600 feet [0.11 miles] downstream from PPE 3)
Reference: Ref 6, p III-6; Ref 8, p 1; Ref 13

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Nearest Intake Factor Value: 50

4.1.2.3.2 Population

4.1.2.3.2.2 Level I Concentration

Intake	Distance Along the In-water Segment from the Probable Point of Entry (PPE 1)	Population	References
Tenmile Creek	0.9 miles	4,913 (24,569÷5 intakes)	Ref 22, p 1; Ref 21

The city of Helena operates one intake for drinking water just south of the town of Rimini, Montana. This intake is one of five supplying water to the city of Helena residents. This intake is the only one on Tenmile Creek; the four remaining intakes are on tributaries to Tenmile Creek. The apportionment of water from the five intakes cannot be determined because use of the intakes is random. Apportioning of water from intakes is done on a semi-random basis, depending on how much water is available in Tenmile Creek and the tributaries, and the water quality (i.e., turbidity) at the time the water is drawn (Ref 21, Ref 13).

The Water Treatment Plant supplies water to 24,569 city of Helena users (Ref 22, p 1). This population estimate does not include the town of Rimini users. Some Rimini residents use Tenmile Creek water for non-potable purposes (e.g., dishes, laundry, bathing, etc.) but drink bottled water or private-domestic well water (Ref 23).

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Population Served
by Level I Intakes: 4,913

Level I Population Factor Value: 49,130

4.1.2.3.2.3 Level II Concentration

Intake	Distance Along the In-water Segment from the Probable Point of Entry	Population	References
NA	--	0	--

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Level II Population Factor Value: 0

4.1.2.3.2.4 Potential Contamination

Intake	Average Annual Flow (cfs)	Population Served	References
NA	--	0	--

Type of Surface Water Body	Total Population	Dilution-Weighted Population (Table 4-14)
-		

Dilution-Weighted Population Served by Potentially Contaminated Intakes: 0

Potential Contamination Factor Value: 0

4.1.2.3.3 Resources

Resources not scored for this HRS package.

- Irrigation (5 acre minimum) of commercial food crops or commercial forage crops
- Watering of commercial livestock
- Ingredient in commercial food preparation
- Major or designated recreation area, excluding drinking water use
- Any portion of the surface water is designated by a state for drinking water use under Section 305(a) of the Clean Water Act as amended
- Any portion of the surface water is usable for drinking water purposes

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Resources Factor Value: 0

4.1.3.2 Waste Characteristics

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

Hazardous Substance	Source No.	Toxicity Factor Value	Persistence Factor Value	Bioaccu-mulation Value	Toxicity/ Persistence/ Bioaccumulation Factor Value (Table 4-16)	Ref.
Arsenic	1,2,3	10,000	1	5	5×10^4	Ref 1, p 51619; Ref 2, p B-2
Cadmium	3	10,000	1	5,000	5×10^7	Ref 1, p 51619; Ref 2, p B-4
Copper	1,2,3	--	1	50,000	0	Ref 1, p 51619; Ref 2, p B-6
Lead	1,2,3	10,000	1	50	5×10^5	Ref 1, p 51619; Ref 2, p B-13
Mercury	1,2,3	10,000	0.4	50,000	2×10^8	Ref 1, p 51619; Ref 2, p B-13
Zinc	1,2,3	10	1	500	5,000	Ref 1, p 51619; Ref 2, p B-20

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Toxicity/Persistence/Bioaccumulation Factor Value: 2×10^8

4.1.3.2.2 Hazardous Waste Quantity

Source Number	Source Hazardous Waste Quantity Value (Section 2.4.2.1.5.)	Is source hazardous constituent quantity data complete? (yes/no)
1	2,800	yes
2	5,320	yes
3	1,216	yes

Sum of values: 9,336

4.1.3.2.3 Waste Characteristics Factor Category Value

Toxicity/persistence factor value
X hazardous waste quantity factor value: $4x10^5$
$4,000 \times 100 = 4x10^5$

(Toxicity/persistence x hazardous waste quantity)
X bioaccumulation potential factor value: 2×10^{10}
$4x10^5 \times 50,000 = 2 \times 10^{10}$

Ref 1, p 51592, Table 2-7

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Hazardous Waste Quantity Assigned Value: 100
Waste Characteristics Factor Category Value: 320

4.1.3.3 Human Food Chain Threat-Targets

Actual Human Food Chain Contamination

The Department of Natural Resources and Conservation (DNRC) lists many uses for surface water within 15 miles downstream of PPE 1 in Tenmile Creek including irrigation, stock, domestic, mining, municipal, exploratory drilling, recreation, lawn and garden, supplemental sprinkler, industrial, geothermal, commercial, and fish and wildlife (Ref 6, p II-40).

Tenmile Creek is a recreational fishery. The fishing use in the segment from below Minnehaha Creek to above the Tenmile Water Treatment Plant (WTP) (Ref 13) is described as occasional use, and primarily fished in the summer months. The fishing use in the Tenmile Creek 12-to-15 mile HRS total distance limit (TDL) segment is described as regular use in the summer months (Ref 25).

Montana Rivers Information System (MRIS), has collected base fishery data for the Tenmile Creek segment of water from the Helena National Forest Boundary (approximately 4 miles downstream from Rimini) to 8.2 miles downstream, which is downstream from the Upper Tenmile Creek Mining Area. According to MRIS, the trout biomass is 6 pounds/1,000 feet and there are 34 fishing days per year per mile (Ref 6, p II-40).

In October 1998, the Montana Fish, Wildlife, and Parks (MFWP) collected brook trout and rainbow trout biomass information for the segment of Tenmile Creek from Rimini to the National Forest boundary (Ref 26; Ref 27; Ref 28). Six composite brook trout fish samples were collected from six locations along an 8.4-mile segment of Tenmile Creek. The most upgradient sample was collected approximately 1.2 miles upstream from Rimini, Montana, upstream from the Tenmile, Red Mountain, and Red Water mines. The downstream samples were collected at locations approximately 0.4 miles below Rimini (fish sample 98-3); above the confluence with Moose Creek (fish samples 98-5 and 98-6); and at the Tenmile Creek Water Treatment Plant (fish sample 98-4) (Ref 26, Ref 29, Ref 13). MFWP compiled fish population estimates in Tenmile Creek and tributaries of Tenmile Creek (i.e., Minnehaha Creek, Banner Creek, Moose Creek, and Monitor Creek) within the Upper Tenmile Creek watershed. The pounds of fish per 1,000 feet in Tenmile Creek ranged from 0 to 13.98/1,000 feet (Ref 28).

Surface Water and Sediment Samples

Sample ID	Distance from Probable Point of Entry (PPE 1)	Hazardous Substance	Bioaccumulation Potential Factor Value
TM-SW-2	Tenmile Creek at PPE 3	cadmium	5,000
(total and dissolved)	(0.85 mile from PPE 1)	zinc	500
TM-SD-2	Tenmile Creek at PPE 3	arsenic	5
(total)	(0.85 mile from PPE 1)	cadmium	5,000
		copper	50,000
		zinc	500
TM-SW-5	0.9 mile	zinc	500
(dissolved)			
TM-SD-5	0.9 mile	arsenic	5
(total)		cadmium	5,000
		copper	50,000
		zinc	500
TM-SW-8	2.8 miles	arsenic	5
(total)		cadmium	5,000
		zinc	500
TM-SD-8	2.8 miles	arsenic	5
(total)		cadmium	5,000
		copper	50,000
		zinc	500
TM-SW-9	7 miles	arsenic	5
(total)		zinc	500
TM-SD-9	7 miles	arsenic	5
(total)		cadmium	5,000
		zinc	500

Closed Fisheries

Identity of fishery	Hazardous Substance

No fisheries in the study area have been closed due to hazardous substances that meet the observed release criteria in the Upper Tenmile Creek Mining Area.

Sample ID	Distance from Probable Point of Entry	Hazardous Substance
NA		

Finfish Tissue Samples

Montana Department of Fish Wildlife and Parks collected brook trout fish tissue samples from Tenmile Creek in the fall of 1998. The fish tissues samples were brook trout fillets with the skin left on. The samples were analyzed by the Montana State University Agricultural Experiment Station Analytical Laboratory for arsenic, lead, copper, mercury and zinc (Ref 26; Ref 27). The sample numbers and locations are listed in the table below (Ref 13; Ref 29).

Sample ID	Distance from the probable point of entry (PPE 1)	Organism
Fish 98-1	Blind duplicate of 98-2	Brook Trout
Fish 98-2	Tenmile Creek-below confluence with Banner Creek (500 feet upstream)	Brook Trout
Fish 98-3	Tenmile Creek-below Rimini at Beaver Creek Turnoff (2 miles downstream)	Brook Trout
Fish 98-4	Tenmile Creek-at Water Treatment Plant (8.5 miles downstream)	Brook Trout
Fish 98-5	Tenmile Creek-above confluence with Moose Creek (4 miles downstream)	Brook Trout
Fish 98-6	Tenmile Creek-above confluence with Moose Creek (4 miles downstream)	Brook Trout

Reference: Ref 26; Ref 13; Ref 29

Level I Concentrations

Tenmile Creek brook trout finfish tissue samples are subject to Level I concentrations because the hazardous substance concentrations (i.e., arsenic) equal or exceed the lowest human food chain benchmark concentration (Ref 27; Ref 2, p B-2; Ref 1, p 51620).

Sample ID: Fish 98-3, Fish 98-5, and Fish 98-6
Sample Medium: Fish tissue composite samples, brook trout fillets
Locations: (see above Finfish Tissue Sample table)
Reference: Ref 26; Ref 27

Hazardous Substance	Hazardous Substance Concentration(ppm)	Benchmark Concentration	Benchmark
Sample Fish 98-3			
Arsenic	0.20	0.0021mg/kg	Cancer Risk
Sample Fish 98-5			
Arsenic	0.17	0.0021mg/kg	Cancer Risk
Sample Fish 98-6			
Arsenic	0.29	0.0021mg/kg	Cancer Risk

Reference for Benchmarks: Ref 2, p B-2

Most Distant Level I Sample

Sample ID: Fish 98-5 and Fish 98-6
Distance from the probable point of entry (PPE 1): 4 miles
Reference: Ref 13; Ref 29

Level I Fisheries

The Tenmile Creek fishery between the most upstream PPE (i.e., PPE 1) and the most distant observed release finfish tissue sample location (Fish 98-5 and Fish 98-6) is subject to Level I concentrations (Ref 1, p 51620; Ref 13).

Identity of fishery	Extent of the Level I Fishery (Relative to Probable Point of Entry [PPE 1])
Tenmile Creek	4 miles

Most Distant Level II Sample

Sample ID: TM-SW/SD-9
Distance from the probable point of entry: 7 miles
Reference: Ref 13; Ref 29

Level II Fisheries

The Tenmile Creek fishery between the most distant observed release finfish tissue sample location (Fish 98-5 and Fish 98-6) and the most distant observed release surface water and sediment sample location (i.e., TM-SW/SD-9) is subject to Level II concentrations (Ref 1, p 51620; Ref 13).

Identity of fishery	Extent of the Level II Fishery (Relative to Probable Point of Entry)
Tenmile Creek	2.8 miles

4.1.3.3.1 Food Chain Individual

Tenmile Creek fishery subject to Level I concentrations, therefore a Food Chain Individual Factor Value of 50 is assigned (Ref 1, p 51620).

Sample ID: Fish 98-3
Hazardous Substance: arsenic
Bioaccumulation Potential: 5

Sample ID: Fish 98-5
Hazardous Substance: arsenic
Bioaccumulation Potential: 5

Sample ID: Fish 98-6
Hazardous Substance: arsenic
Bioaccumulation Potential: 5

Identity of Fishery	Type of Surface Water Body	Dilution Weight	Reference
Tenmile Creek	Small to moderate stream	0.1	Ref 20 Ref 1, pp 51613, 51615

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Food Chain Individual Factor Value: 50

4.1.3.3.2 Population

4.1.3.3.2.1 Level I Concentrations

The Tenmile Creek fishery is subject to Level I concentrations in the study area.

Identity of Fishery	Annual Production (pounds/1,000 feet)	Reference	Human Food Chain Population Value
Tenmile Creek	0 to 13.98	Ref 26; Ref 28 Ref 1, p 51621 Ref 13; Ref 29	0.03

Sum of Human Food Chain Population Values: 0.03
Human Food Chain Population Values x 10 = 0.3

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Level I Concentrations Factor Value: 0.3

4.1.3.3.2.2 Level II Concentrations

The Tenmile Creek fishery is subject to Level II concentrations in the study area.

Identity of Fishery	Annual Production (pounds/1,000 feet)	Reference	Human Food Chain Population Value
Tenmile Creek	9.1 to 13.98 lbs	Ref 26; Ref 28; Ref 1, p 5162; Ref 13; Ref 29	0.03

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Level II Concentrations Factor Value: 0.03

4.1.3.3.2.3 Potential Human Food Chain Contamination

The Tenmile Creek fishery subject to Level I and Level II concentrations, therefore potential human food chain contamination was not scored for this HRS package.

Identity of Fishery	Annual Production (pounds)	Type of Surface Water Body	Average Annual Flow	Ref.	Population Value (P_i)	Dilution Weight (D_i)	$P_i x D_i$
--							

Sum of P_i x D_i: --
(Sum of P_i x D_i)/10: —

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Potential Human Food Chain Contamination Factor Value: 0