Waterloo Mine
Preliminary Assessment Report

Bear Lake County
State of Idaho

Department of Environmental Quality

October 2007

Submitted to:
U. S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, WA 98101

Table of Contents

List of Figures

List of Tables

List of Acronyms

Acronym	Definition
bgs	below ground surface
BLM	United States Bureau of Land Management
Cd	Cadmium
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cr	Chromium
Co	Cobalt
Cu	Copper
DEQ	Idaho Department of Environmental Quality
EPA	United States Environmental Protection Agency
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
Ni	Nickel
PA	Preliminary Assessment
RCRA	Resource Conservation and Recovery Act
RMP	Area Wide Risk Management Plan
SDWIS	Safe Drinking Water Information System
Se	Selenium
SFCC	San Francisco Chemical Company
TDL	Target Distance Limit
USFS	United States Forest Service
USGS	United States Geological Survey
V	Vanadium
Zn	Zinc

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Section 1. Introduction

The Idaho Department of Environmental Quality (DEQ) was contracted by Region 10 of the United States Environmental Protection Agency (EPA) to provide technical support for completion of preliminary assessments at various mines within Idaho.

The DEQ often receives complaints or information about sites that may be contaminated with hazardous waste. These sites can include abandoned or inactive mines, rural airfields that have served as bases for aerial spraying, old landfills, illegal dumps, and abandoned industrial facilities that have known or suspected releases.

In February 2002, DEQ initiated a Preliminary Assessment Program to evaluate and prioritize assessment of such potentially contaminated sites. Due to accessibility and funding considerations, priority is given to sites where potential contamination poses the most substantial threat to human health or the environment.

For additional information about the Preliminary Assessment Program, see the following:

http://www.deq.idaho.gov/waste/prog_issues/mining/pa_program.cfm

This report presents the results of the preliminary assessment (PA) of the Waterloo Mine and also documents the interagency PA and risk screening activities conducted for this *inactive mine site* located within the boundaries of the *Southeast Idaho Phosphate Mining Resource Area* (Figure 1; the green border outlines the resource area). The interagency PA was prepared by the DEQ, in collaboration with the United States Bureau of Land Management (BLM), the United States Forest Service (USFS), and the Idaho Department of Lands (IDL)—the primary mining administration agencies in southeast Idaho. Site descriptions, conditions, data, and photos are taken directly from the *Orphan Mine Site Preliminary Assessment Screening Report* published in 2004 (DEQ, 2004a). Recommendations from the earlier report have been expanded upon in this report, based on DEQ evaluation of the earlier screening report and any additional information DEQ was able to obtain through literature review. A site visit and sampling were not conducted as part of this PA process.

1.1 Background of the Inactive Mine Assessments

Inactive mine sites consist of those historic mining operations not previously scheduled for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site-specific investigations conducted under the ongoing selenium investigation activities (DEQ, 2007a). This PA was conducted to ensure all historic mining sites within the Idaho Phosphate Mining Resource Area have been inspected and evaluated in accordance with the goals and objectives outlined in the *Area Wide Risk Management Plan* (DEQ, 2004b):

- Protecting southeast Idaho's surface water resources by reducing risks to existing aquatic life and sensitive species from selenium and related trace metal concentrations in regional subbasins and stream segments through (a) compliance

with the National Toxics Rule and State Water Quality Regulation numeric criteria (b) development and demonstration of Best Management Practices (BMPs) to prevent future mining releases and associated risks from selenium and related trace metals in receiving streams and water bodies, and (c) development of a long-term monitoring plan for regional surface water resources to ensure effectiveness of risk reduction measures.

- Protecting wildlife, habitat, and ecological resources in southeast Idaho by reducing subpopulation risks to local wildlife to acceptable levels as established by risk-based action levels and by minimizing wildlife risks through the development and demonstration of effective BMPs for future mines.
- Maintaining and protecting multiple beneficial uses of the Southeast Idaho Phosphate Mining Resource Area by reducing livestock grazing risks and associated losses from selenium exposures in forage and drinking water sources and by preventing potential future public health risks by prohibiting residential land use and development in the immediate vicinity of phosphate mining waste units and/or impacted areas.
- Protecting southeast Idaho's ground water resources by identifying, characterizing, and responding to groundwater contamination sources that may present potential public health or ecological risks and by developing and demonstrating BMPs to control future mining releases and associated risks from selenium and related trace metals in groundwater.

The earlier mine site screening effort (DEQ, 2004a) included preliminary assessment activities at fourteen historic mine sites identified through lease records and literature reviews of past mining activities. Preliminary site inspections and environmental sampling of potentially impacted media (surface water, soil, sediment, and vegetation) was conducted by interagency sampling teams in May and July of 2002. Risk evaluation consisted of reviewing site data in terms of site conditions, areas of impact, potential for continued releases, and regional risk-based action levels developed for the Area Wide Risk Management Plan.

1.2 Overview

The Waterloo Mine is located in Bear Lake County, Sections 6 and 7 of Township 13 South, Range 45 East, approximately three aerial miles east of Montpelier, Idaho (Figure 2). The former mine can be reached from Montpelier by driving east along Montpelier Canyon Road then south on Landfill Road.

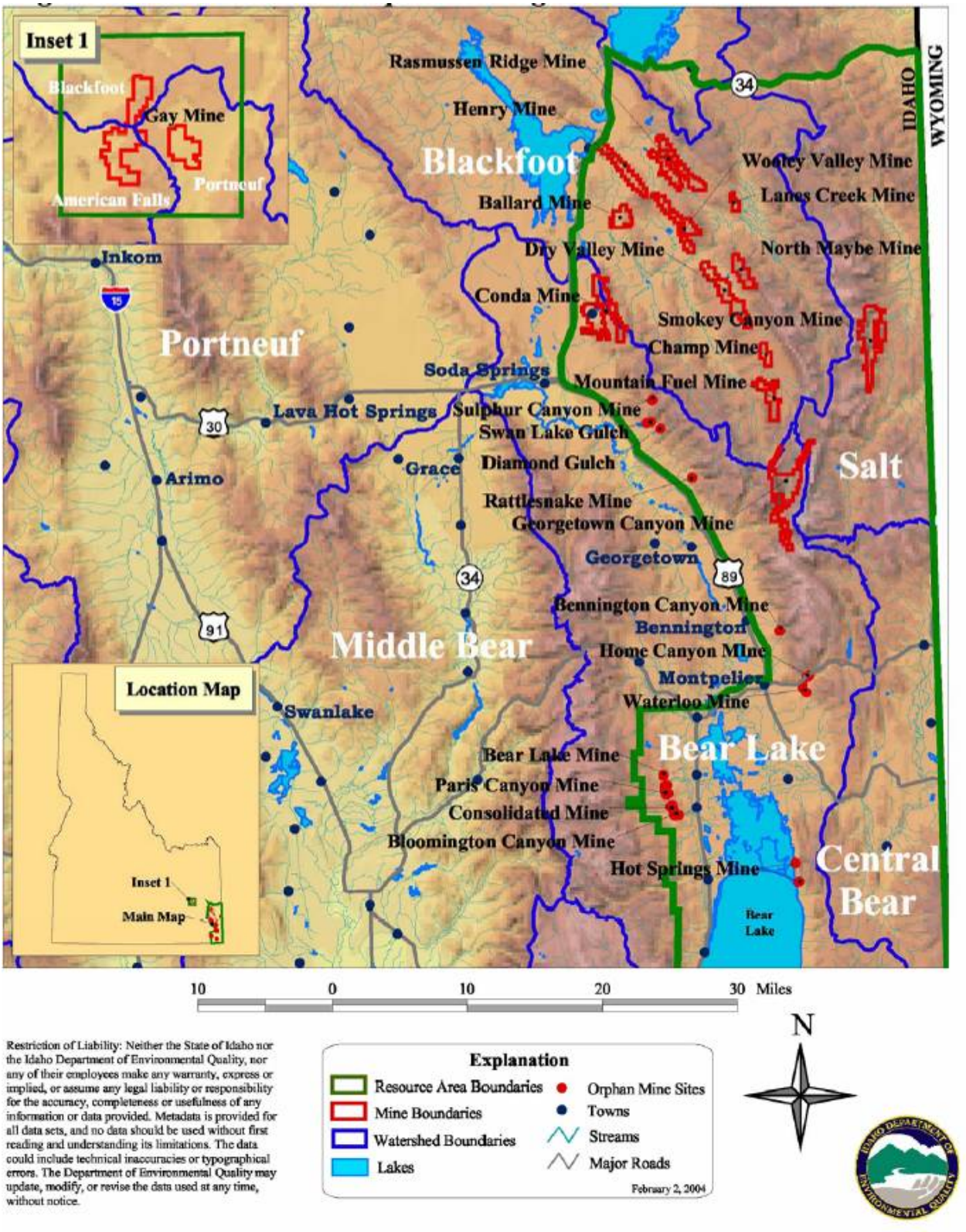

Figure 1. Location of the Waterloo Mine within the state of Idaho and delineation of the Southeast Idaho Phosphate Mining Resource Area (green boundary).

Figure 2. Aerial overview of the Waterloo Mine area.

Section 2. Site Description, Operational History, and Waste Characteristics

Physical characteristics of the Waterloo Mine site are presented in the following, along with the mine's operational history and characteristics of the wastes that remain.

2.1 Ownership

The Waterloo Mine property is currently owned by the Idaho Department of Fish and Game (IDFG) and Bear Lake County. The original claim was staked by Charles Colcock Jones in 1903, who quit claim deeded the mine to Iron Mountain Investment Company in January 1904. The San Francisco Chemical Company (SFCC) obtained the deed in July 1904. In 1971 the mine, consisting of approximately 400 acres of patented claims, was donated to IDFG, who optioned most if not all of the disturbed portion of the mine to the city of Montpelier for a landfill.

2.2 Historical Perspective

The Waterloo Mine is located in Township 13 South, Range 45 East, Sections 6 and 7, Bear Lake County, Idaho, on patented land owned by IDFG and Bear Lake County. The mine is surrounded by both public and private land. Historic mining operations include underground workings from 1903 through 1929 and open pit operations from 1945 through 1960. Currently, the main pit area functions as the county landfill, while the southernmost pit is operated as a public rifle range.

In 1909, the first reported shipment of phosphate rock (735 tons) was shipped to San Francisco, California. By 1911, the Waterloo mine was shipping approximately 500 tons of phosphate rock annually to SFCC's chemical plant. By 1916, that number had increased to about 100 tons/day. Operations were suspended in 1918 because of an overabundance of ore at the chemical plant.

The mine operated briefly from 1919-1920, and then operations were suspended again until 1929, at which time the underground operation was permanently closed. By the end of underground mining, there were about 3,000 feet of tunnels and drifts accessed by three adits.

In 1945, SFCC reopened the mine as an open pit operation. Operations lasted from 1945 through 1947, producing approximately 675,000 tons of ore. The mine briefly reopened and closed in 1960. During the life of the mine, about 212 acres were disturbed, and 1.25 million tons of ore were produced.

2.3 Regional Climate

Climate in southeast Idaho is influenced by major topographic features, including the Pacific coast, and local mountain ranges. The mountains affect local wind, precipitation, and temperature patterns.

Summer temperatures in the valleys are typically dry with average maximum temperatures in the low 80s (˚F) and average minimum temperatures in low to mid 40s (˚F) (Western Regional Climate Center, 2007). Summer precipitation is usually associated with thunderstorms. Fall and winter are dominated by cold, dry continental air and by cyclonic storms. The average maximum temperatures during February are in the low 30s (˚F) with the average minimums below 10 ˚F. Most precipitation during fall and winter falls as snow accumulating in the valleys and on the surrounding mountains. Spring precipitation usually results from cool marine air flowing in from the south.

The average annual precipitation varies widely throughout the resource area and with elevation. Lifton pumping station, located at the north end of Bear Lake, has an average total annual precipitation of 10.62 inches based on a 1935 to 2007 period of record while, on the north end of the resource area, Conda reports an annual total average precipitation of 18.91 inches over a period of record from 1948 to 1978 (Western Regional Climate Center, 2007). Precipitation in the surrounding mountains ranges from 25 to 35 inches annually (BLM, 2000). The heaviest 1-day rainfall during the period of record at Montpelier was 2.50 inches on June 16, 1939. Thunderstorms occur on about 24 days each year, and most occur between May and August (Natural Resource Conservation Service, 2007).

> "The average seasonal snowfall is 58.3 inches. The greatest snow depth at any one time during the period of record at Montpelier was 31 inches recorded on March 4, 1952. On an average, 108 days per year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record was 13.0 inches recorded on December 19, 1951".
>
> (Natural Resource Conservation Service, 2007)

The prevailing wind direction is from the west-southwest, causing accumulation of snow on east and north facing ridges. Ralston et al. (1980) states that snow melt is the largest source of ground water recharge to the areas bedrock aquifers, giving the east and north facing ridges the greatest potential for significant recharge.

2.4 General Geology

The Waterloo Mine lies within the northern region of the Basin and Range physiographic province which is characterized by linear, north-trending fault-bounded ranges and basins created by extensional tectonism initiated during the last 10 to 20 million years (Figure 3). Ranges in southeastern Idaho are generally composed of deformed Paleozoic and Mesozoic sedimentary rocks, including thick marine clastic units, comprising cherts and limestones. The valleys are largely in-filled with Quaternary alluvium and colluvium that overlie Pleistocene basalt flows. Middle Pleistocene rhyolite flows of the Snake River Plain regions cover much of the area and complete the geologic sequences in the region.

Massive accumulations of marine sediment occurred during the Paleozoic era over large areas of eastern Idaho. During the Permian Era, the Phosphoria Formation was deposited, forming the western phosphate field, part of which is located in the Idaho Phosphate Mining Resource Area.

2.5 Stratigraphy and Lithology

The stratigraphy of the phosphate mining resource area is characterized by Paleozoic and Mesozoic sediments overlain by Pleistocene igneous extrusions. The stratigraphy most encountered by mining activities in the resource area is generally limited to four principal rock units. The stratigraphy, approximate ages, and a description of each unit are summarized in Table 1.

Table 1. Generalized Stratigraphic Setting of Project Area[1].

Unit Name	Age	Description
Dinwoody Formation	Triassic	Interbedded claystone, limestone, and siltstone; ranges from 1,000 to 2,000 feet thick in project area
Phosphoria Formation	Permian	Composed of cherty mudstone, phosphatic mudstone, chert, phosphorite, limestone, and dolomite; phosphorite is the source of phosphate ore and is typically found in the lowermost portion of the formation.
Grandeur Limestone	Permian Pennsylvanian	Massive limestone that is discontinuous in the project area
Wells Formation	Pennsylvanian	Fine to very fine grain quartzitic to calcareous sandstone; approximately 1,500 to 2,000 feet thick in the project area.
Notes: 1. By convention, units are presented from top to bottom, as youngest to oldest.		

At the eastern edge of the resource area, the Phosphoria Formation corresponds to an ancient ocean shelf and is more calcareous and less argillaceous than Phosphoria Formation outcrops to the west.

The Phosphoria Formation includes four members: Meade Peak Phosphatic Shale, Rex Chert, Cherty Shale, and Retort Phosphatic Shale. The Meade Peak member, which ranges in thickness from about 55 to 200 feet, is the oldest and is either overlain by the Rex Chert or the Cherty Shale. The Retort member is discontinuous and is found in the north and eastern parts of the resource area. The Meade Peak member of the Phosphoria Formation is the source of the majority of the produced phosphate ore. Concentrations of phosphate minerals in the Meade Peak member are significantly higher than typical concentrations found in other marine sedimentary rock. (Montgomery Watson, 1998)

2.6 Structure

The Waterloo Mine and the surrounding area are located in the Idaho-Wyoming-Utah Overthrust belt, which extends from the Snake River Plain to near Salt Lake City and is part of the Cordilleran Foreland thrust belt that extends from Alaska to Mexico. Folding

and thrusting occurred during the late Jurassic to early Cretaceous, when movement began on the Paris Thrust, the westernmost thrust plate.

Compressional tectonics ended in the Cretaceous Period. Subsequently, the resource area underwent a period of extensional tectonics in the Miocene Epoch, during which high-angle normal faults cut across the older rocks and Mesozoic folds and thrusts. These large and extensive block fault systems formed the north-trending ranges and valleys of the Basin and Range province.

The major thrust plates in the study area are the Paris and Meade Overthrusts. The ore bearing units at the mine consist of Pennsylvanian to Triassic age rock (**Error! Reference source not found.**) within an overturned syncline.

2.7 Hydrogeology

The major ground water flow systems within the phosphate mining resource area exist in the valley fill sediments, Thaynes, Dinwoody, and Wells formations. The Phosphoria formation has not been found to support any major ground water flow systems and generally acts as a confining unit between the Dinwoody and Wells formations.

Ground water flow in the valley sediments is generally from the valley margins towards the valley center then down-valley towards lower elevations. Ground water flow within the bedrock aquifers is often controlled by stratigraphy and structural geology, flowing along the bedding in the direction of dip and/or plunge. Regional and localized faulting may form preferential flow paths or boundaries to ground water flow within the bedrock systems.

The general ground water flow in the mine area is thought to be to the south-southwest, based on the Waterloo site report prepared by the BLM (2002). However, ground water mounding appears to be occurring in the bedrock aquifer beneath the landfill resulting in near radial flow from the mine to the surrounding area. (The ground water mounding conjecture is based on ground water elevation data in the bedrock aquifer obtained from five landfill monitoring wells.)

2.8 Current and Potential Future Land Uses

Current land uses in the area surrounding the Waterloo mine include a national wildlife refuge (about 5 miles to the southwest), the community of Montpelier (within 4 miles of the mine), a commercial camping facility, camping, fishing, biking, hiking, horseback riding, off-road vehicle touring, and grazing.

Future land uses at the former mine site is likely to remain consistent until the landfill is full and closed. IDFG had plans to use their portion of the site as deer winter range, yet that use never developed (BLM, 2000). Land use on federal properties is likely to remain consistent into the near future. Future land use on private parcels of property could potentially include some year-round and/or seasonal homes as is typical else where around Bear Lake.

2.9 Area Fish Species

According to the IDFG database, fish in the Bear River drainage and its tributaries include Bonneville cutthroat trout, rainbow (hatchery) trout, brown trout, smallmouth bass, largemouth bass, walleye, channel catfish and unlisted non-game species (IDFG, 2007).

2.10 Wetlands

Official wetland surveys for the area indicate that the Waterloo Mine is not adjacent to any wetlands. The wetlands located within the 15-mile target distance limit (TDL) to the west of the mine are approximately 9,000 total acres in size and support a number of sensitive plant and animal species. The majority of the total acreage is occupied by the Bear Lake National Wildlife Refuge, which extends south to Bear Lake.

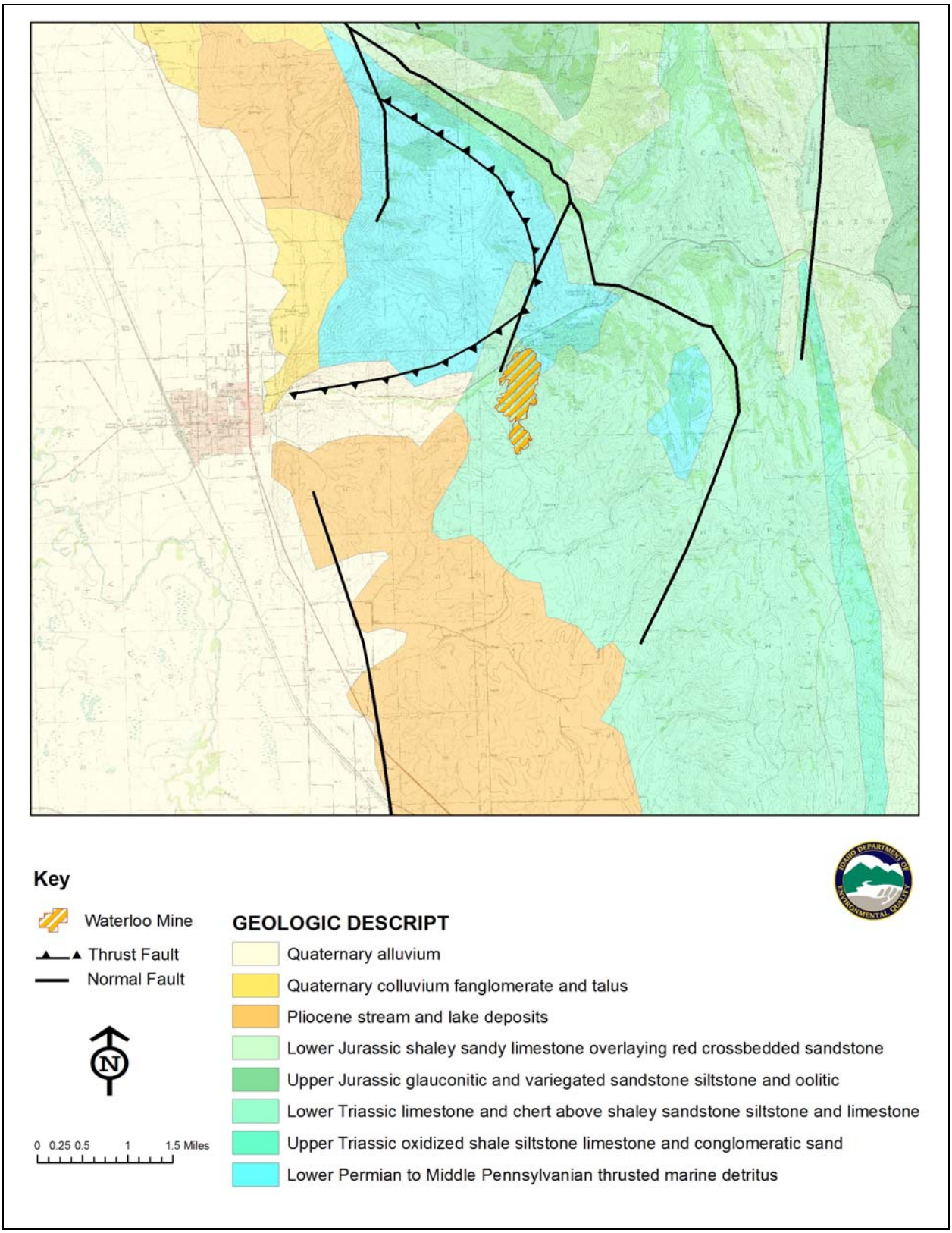

Figure 3. Geologic Map of Waterloo Mine Area (Bond, 1978).

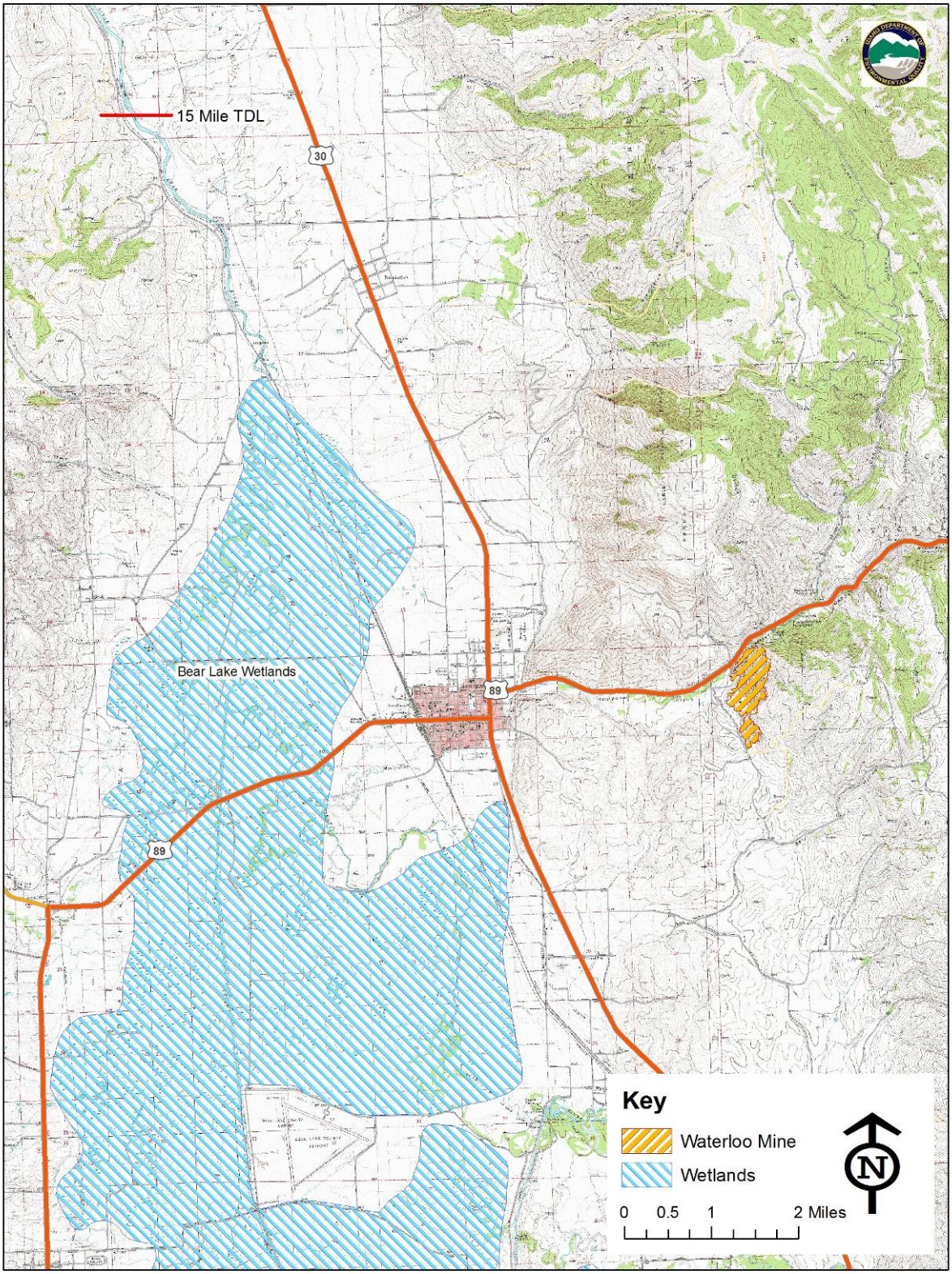

Figure 4. Wetlands in the Waterloo Mine Area

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Section 3. Site Overview, Sampling, and Waste Characterization

An interagency team conducted a site visit to the Waterloo Mine during the spring of 2002 (DEQ, 2004a), in accordance with the goals and objectives in the *Area Wide Risk Management Plan*. The visit included a visual inspection of the mine and the collection of three (3) vegetation samples and four (4) soil samples. Sampling locations are shown in Figure 5 and Photos 8.1, 8.2, and 8.3 in the Appendix. Samples were analyzed for trace metals and compared to action levels developed for the Area Wide Rick Management Plan (DEQ, 2004b).

3.1 Area Wide Risk Management Plan Action Levels

The Area Wide Risk Management Plan (RMP) was written as a discretionary guidance document to assist Lead and Support Agency representatives with their mine-specific risk management decision-making responsibilities regarding historic mining operation releases and associated impacts from selenium and related trace metals in the Southeast Idaho Phosphate Mining Resource Area. The plan provides removal action goals, objectives, and action levels intended to assist in identifying site-specific areas of concern, focusing regulatory resources, and supporting consistent decision-making using a regional perspective.

The risk-based action levels were developed using deterministic single media dose proportions as the initial basis. These action levels were tested and validated using probabilistic methods that assume simultaneous exposure from all action level media to numerous limited home range surrogate species representing sensitive receptors from the various feeding guilds present in the Resource Area. Due to the limited area of impact and low likelihood of population-level effects, the action level development approach used by DEQ applied slightly less conservative assumptions regarding acceptable hazard quotient ranges than a typical population-level ecological risk assessment might. However, many of the receptor dose model parameters, such as site use, bioavailability and secondary media exposure point concentrations, remained conservatively-biased to represent receptors residing exclusively in impacted areas during toxicologically critical periods such as spawning, nesting, and breeding. The DEQ's risk management decisions focus resources in areas where efforts to minimize potential impacts to ecological subpopulations will provide the greatest benefit.

Action levels were established for the primary media that support sensitive habitats and are most amenable to standard industry measurement and mitigation techniques, which were surface water, groundwater, sediments, fluvial/riparian soils, and vegetation. Elevated contaminant concentrations in the selected action level media are also indicative of the presence of past and/or ongoing releases.

3.2 Sampling

Seven samples and one field X-ray fluorescence (XRF) sample were collected at the Waterloo Mine. The first sample, OS-WLM-SO-01-01, was collected from a waste dump on the north end of the south pit. Samples OS-WLM-SO-02-01, and OS-WLM-VE-03-01 were collected from a stable slope, 15 to 20 feet below a waste dump toe, on the southwest side of the main pit. OS-WLM-02-01 was composed of red-brown soil with clay and minor limestone gravel. OS-WLM-VE-03-01 was rabbit brush. Sample OS-WLM-SO-04-01 was a brown clay rich soil sample collected approximately 50 feet below the toe of an older generation waste dump. Samples OS-WLM-SO-05-01 (soil), -VE-06-01 (snowberry), and -VE-07-01 (grass) were all collected from the floodplain of Montpelier Creek in an area of undisturbed soil and vegetation.

3.3 Sampling Results

Analysis of soil sample OS-WLM-SO-01-01 from the waste dump below the south pit showed concentrations of cadmium (Cd), chromium (Cr), nickel (Ni), selenium (Se), vanadium (V), and zinc (Zn) 2.0 to 9.4 times greater than the action levels set by the RMP (DEQ 2004b). Table 2 summarizes the laboratory analysis results for collected soil samples.

The analysis of soil sample OS-WLN-SO-02-01 showed no analytes above the RMP action levels. Soil sample OS-WLN-SO-04-01 analysis resulted in a value 1.3 times the RMP action level for Ni. All other analytes were below action levels. Analysis of soil sample OS-WLM-SO-05-01 showed concentrations of Cd, Cr, Ni, Se, V, and Zn 2.2 to 4.4 times greater than action levels.

Table 3 summarizes vegetation sampling results. Chemical analysis of vegetation samples OS-WLM-VE-06-01 and OS-WLM-VE-07-01, collected in the Montpelier Creek flood plane northwest of the mine, resulted in exceedances of 1.8 and 1.1 times the RMP action level for Se, respectively. Vegetation sample OS-WLM-VE-03-01 analysis resulted in all analyte concentrations below the RMP action levels.

Analytical results from the field XRF were not provided in the report.

3.4 Inspection Findings

Disturbed land, as a result of mining activities, cover about 200 acres. There appeared to be sediment control measures in-place but little reclamation. The majority of the waste rock dumps were not shaped or contoured to 3:1 slopes. Mine areas associated with recent landfill activities were avoided by the 2002 investigation team.

The south pit is approximately 300 meters long with bedding dipping moderately to the west; the east highwall is the dip-slope from which the phosphate was removed. No reclamation has been done. This pit is currently being used as a rifle range with all of the necessary facilities. At the northwest edge of the pit is a waste dump that is approximately 50 feet wide and runs down the face of the hill an estimated 200 meters.

The 2002 investigation team did not enter the main pit area, which is surrounded by a series of waste rock dumps. These dumps have different degrees of revegetation due to age and black shale content. No surface water was noted at the mine; however, Montpelier Creek runs within a hundred feet of the north end of the mine.

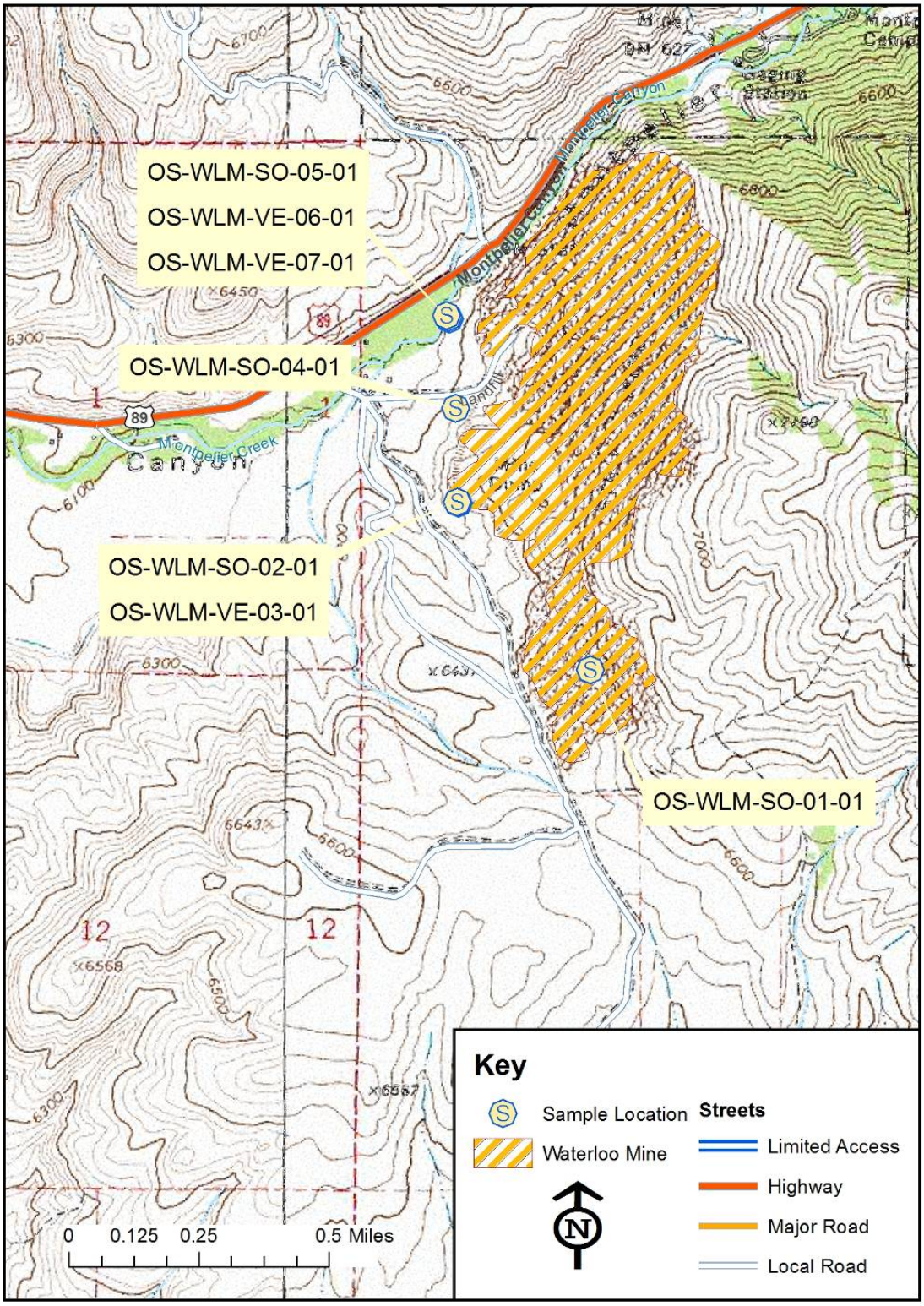

Figure 5. Waterloo Mine Sample Locations from DEQ, 2004a.

Table 2. Waterloo Mine Soil Sampling Analytical Results.

Sample ID	Media	Metal Concentrations in Parts Per Million (ppm)								Species/Type
		Cd	Co	Cr	Cu	Ni	Se	V	Zn	
OS-WLM-SO-01-01	Soil	**75**	2.7	**390**	53	**140**	**23**	**680**	**1200**	Dump
OS-WLM-SO-02-01	Soil	1	10	41	26	27	0.44	62	92	Soil
OS-WLM-SO-04-01	Soil	4.2	8.4	54	37	**59**	0.81	71	150	Soil
OS-WLM-SO-05-01	Soil	**46**	7.8	**410**	54	**130**	6.6	**560**	**880**	Soil
Areawide Risk Criteria		**9.2**		**187.0**	**402**	**44**	**7.5**	**72**	**210**	

Table 3. Waterloo Mine Vegetation Sampling Analytical Results.

Sample ID	Media	Metal Concentrations in Parts Per Million (ppm)								Species/Type
		Cd	Co	Cr	Cu	Ni	Se	V	Zn	
OS-WLM-VE-03-01	Vegetation	<0.4	<0.12	0.94	7.6	<2.0	1.0	1.2	22.0	Rabbit brush
OS-WLM-VE-06-01	Vegetation	1.9	0.48	0.6	14	<2.0	**8.8**	0.7	58.0	Snow berry
OS-WLM-VE-07-01	Vegetation	2.8	3.9	0.97	14	2.5	**5.6**	1.0	95.0	Grass
Areawide Risk Criteria		**4.2**		**30.6**	**88.0**	**35.5**	**5.0**	**55.9**	**615.0**	

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Section 4. Pathway and Environmental Hazard Assessment

Risk pathways and environmental hazards were assessed for surface water, soil/air exposure, and groundwater in accordance with the RMP. The findings from these assessments are presented in the following.

4.1 Surface Water

Montpelier Creek runs below the northern extent of the main pit, winding its way to the west and the Bear River. The Bear River and the Bear Lake National Wildlife Refuge wetlands are located 3.5 to 5 miles to the west-southwest of the mine and may receive some impact from the mine in the form of runoff into Montpelier Creek.

4.2 Soil/Air Exposure

Access to the main mine pit and surrounding waste dumps is restricted by the county landfill. However; the south pit (rifle range) is open to the public. Due to the proximity of the mine to public roads and recreational areas, soil ingestion for occasional recreation is considered likely. Additionally, exposure to air borne contaminants from landfill activities creating fugitive dust from disturbed waste dumps is possible.

4.3 Groundwater

Idaho Department of Water Resources (IDWR) records show Bear Lake Valley regional ground water flow moves from the highlands toward the valley floor. This flow is consistent with the topography of the area.

Ground water levels near the site range from 4 to 76 feet below ground surface (bgs), based on water level information found in drillers reports for domestic wells within 2 miles of the site. Depth to water appears to increases with distance from the mine.

According to IDWR records, 36 domestic water wells are reported to be located within a 4-mile radius of the site (Figure 6). The BLM (2002) reported approximately 57 homes within a 4-mile radius of the mine, which equates to 171 residents relying on ground water wells for domestic water, based on 3 persons per household. The majority of these wells are located west and potentially down hydraulic gradient of the mine. Eight public water systems are located within a 4-mile radius of the site:

- Montpelier KOA – located 0.8 mile west of the mine, transient non-resident system.
- City of Montpelier, wells No. 1 and 2 – located 3 miles west of the mine; the entire system supplies water to 3000 residence.
- City of Montpelier, well No. 3 – located 3.5 miles west of the mine.

- City of Montpelier, - well No. 4 – located 3.5 miles west-southwest of the mine; analysis of the August 21, 2007 water quality sample showed barium, chromium, nickel, and selenium at concentrations of 34, 2, 1 and 1 microgram per liter, respectively. All prior water quality samplings of this well and others water sources the system have resulted in non-detections for these metals.
- City of Montpelier, spring No. 1 – located 1.8 miles northeast of the mine
- City of Montpelier, springs No. 2 and 3 – located 2.5 miles north-northeast of the mine
- USFS Montpelier Canyon Campground well – located 1 mile northeast of the mine, transient non-community system.

The public water system wells west of the mine (Figure 6) are potentially downgradient from any of the mining activities; the blue, red, and green hatching, seen at the left of Figure 6, represent the 0-3, 3-6, and 6-10 year travel times for groundwater to migrate from the perimeter of the hatching to the extraction well. This gives a relative groundwater travel time for the area west of the mine. Wells appear to be completed in the alluvial materials associated with the Bear Lake Valley. Here, groundwater is very shallow and would travel at a much faster rate than in the surrounding highlands.

4.3.1 Potential Receptors

Potential receptors include county landfill employees, IFG employees, local residents, and those that use the rifle range. Cattle activity surrounding the mine site is unknown; but grazing allotments are located near the mine. County landfill employees, IDFG employees, and those using the rifle range may enter the pits or come in contact with the waste rock dumps. Landfill employees, IDFG employees, residents, and wildlife are the likeliest potential receptors, as they work, reside nearby, or use surrounding land for recreational activities, forage, breeding, or bedding areas.

The land within a two-mile radius of the site is a mix of private, BLM, US Forest Service, State, and Bear Lake County owned land. The parcels of land occupied by the mine and waste dumps are owned by Bear Lake County and IDFG.

4.3.2 Schools, Day-Care Facilities, Private Residences

There are no schools, day-care facilities, or private residences within 200 feet of the site.

4.3.3 Plant and Animal Species of Concern

One plant and seven animal species are listed as species of concern in the proximity of the site (IDFG, 2002). Table 4 lists all plant and animal species within a four-mile radius and the 15-mile TDL of the mine. Figure 7 shows the general location of the species of concern in relation to the Waterloo mine.

4.3.4 Soil Sample Concentrations

Soil samples contained the following constituent concentrations:

- Selenium (Se) from 0.44 to 23 mg/kg
- Copper (Cu) from 26 to 54 mg/kg
- Cobalt (Co) from 2.7 to 10 mg/kg
- Cadmium (Cd) from 1 to 75 mg/kg
- Chromium (Cr) from 41 to 410 mg/kg
- Vanadium (V) from 62 to 680 mg/kg
- Nickel (Ni) from 27 to 140 mg/kg
- Zinc (Zn) from 92 to 1200 mg/kg

Complete analytical results are presented in Table 2. Arsenic was not analyzed for during this sampling event.

Table 4. Plant and Animal Species of Concern in the Waterloo Mine Area

Common Name	Scientific Name	Classification	Listing Status	Ecological Concern
American Peregrine Falcon	Falco peregrinus anatum	Vertebrate	No Status	Historic Eyrie
Long-legged Myotis	Myotis evotis	Vertebrate	No Status	Roost
Merriam's Shrew	Sorex merriami	Vertebrate	No Status	Museum Specimen
Starving Milk-vetch	Astragalus jejunus var. jejunus	Vascular Plant	No Status	
Townsend's Big-eared Bat	Corynothinus townsendii	Vertebrate	No Status	Hibernaculum
Unita Chipmunk	Neotamias umbrinus	Vertebrate	No Status	Museum Specimen
Western Small-footed Myotis	Nyotis ciliolabrum	Vertebrate	No Status	Hibernaculum / Night Roost
Great Gray owl	Strix nebulosa	Vertebrate	No Status	Nesting Territory

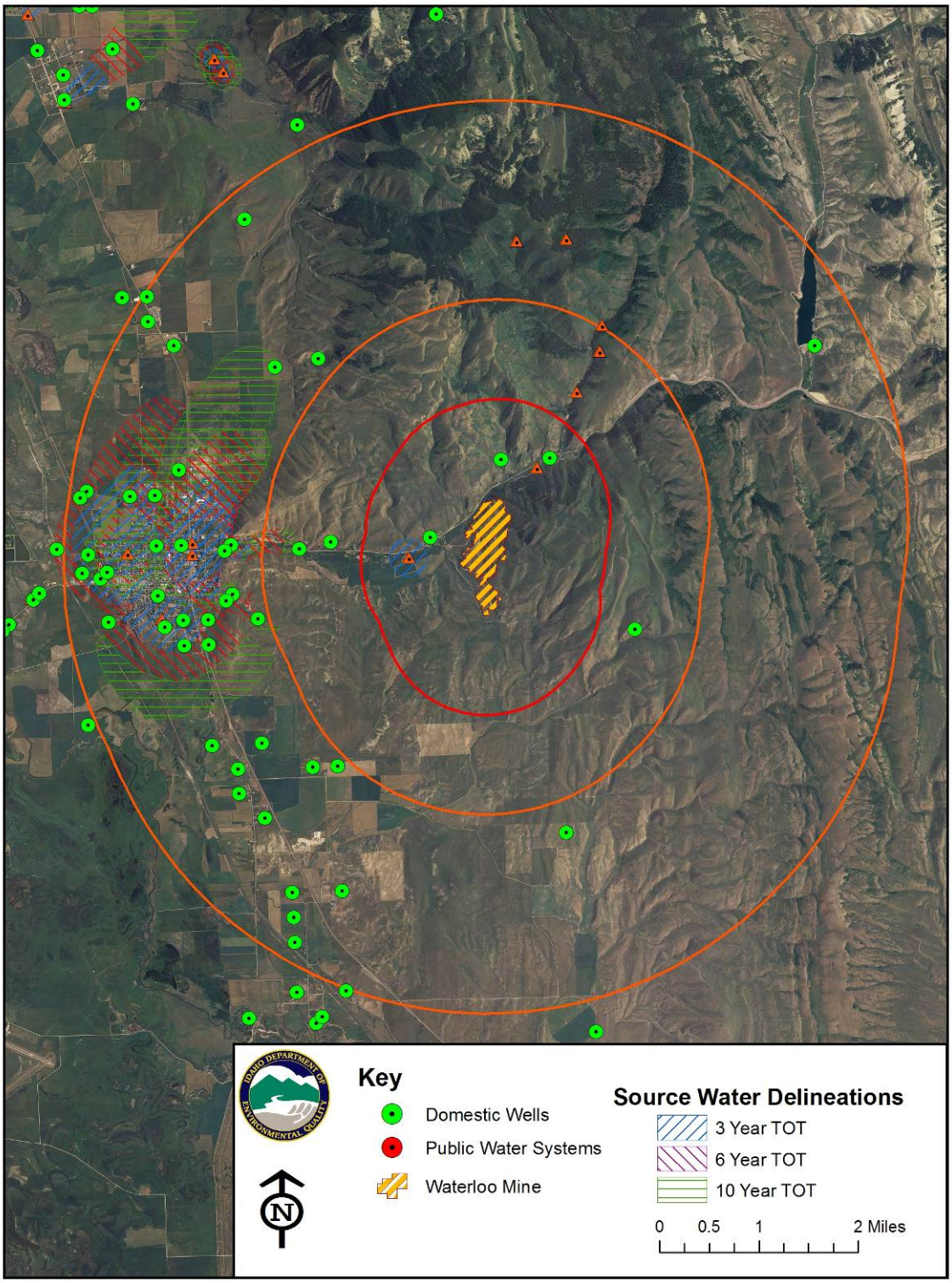

Figure 6. Domestic and Public Water System wells within a 1-, 2-, and 4-mile radius of the Mine.

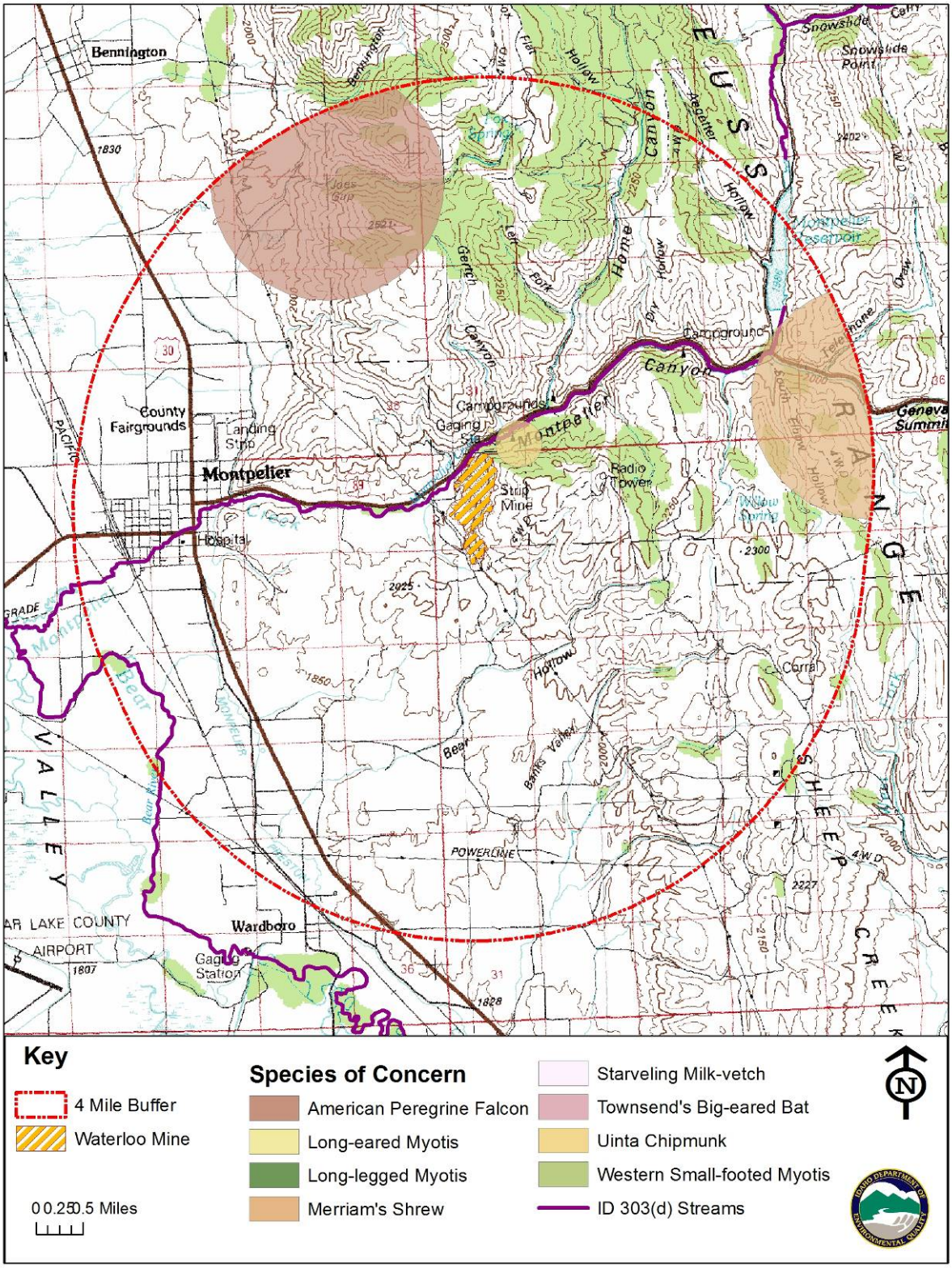

Figure 7. Species of Concern within the Waterloo Mine Area.

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Section 5. Conclusions and Recommendations

The recommendations contained herein address not only localized release pathways and associated ecological risks but also any public safety concerns regarding the presence of open adits, portals, or mine shafts. Because the Waterloo Mine is currently regulated by the DEQ under Subtitle D of the Resource Conservation and Recovery Act, it is recommended that all future actions be handled under DEQ's landfill authority.

5.1 Presence of Wetlands

Based on official wetland surveys and aerial photographs of the area, approximately 9,000 total acres of wetlands exist near the site or within the 15-mile TDL.

5.2 Impacts on Water Quality

The BLM (2002) reported meteoric run-off escaping the mine site and entering Montpelier Creek. Analytical results from Montpelier Creek water samples, collected from above and below the mine, indicated mine run-off has not significantly impacted water quality. Additionally, water samples collected from a creek-fed stock watering pond, located near the southern end of the site, resulted in similar water quality to those collected from the creek. The report concludes that surface water quality poses no hazard to wildlife. Montpelier Creek exhibited some occasional exceedances of surface water criteria during the Area Wide Investigation process; however, the source of the exceedance has not been identified.

Analysis of ground water samples collected from three of the five Bear Lake County Landfill monitoring wells resulted in exceedances of the RMP ground water action level for selenium between February 2003 and June 2006. The highest selenium concentrations of 11 to 31.8 mg/L were detected in monitoring well MW-2 between May 2005 and June 2006. Monitoring well MW-2 is located on the northwest corner of the landfill approximately 500 ft from Highway 89 and Montpelier Creek. No analytical data was available for the remaining two wells.

Analysis of the August 21, 2007 water quality sample for City Montpelier public water supply Well No. 4, resulted in concentrations of Cr, Ni, and Se of 2, 1, and 1 milligrams per liter, respectively (DEQ, 2007b). These values are below the RMP action levels. Prior water quality analyses for this well and all other wells in the system have not detected these constituents, based on available data (DEQ, 2007b).

Montpelier Creek, several domestic wells, and a public water supply well are located near the mine. Based on the distance to surface water sources and domestic wells, there is potential for the Waterloo Mine to impacted local ground water systems.

5.3 Potential Exposure for Wildlife and Vegetation

The waste rock piles with or without vegetation present potential exposure pathways for wildlife. Native plant species may bio-accumulate high concentrations of metals that may be consumed by the local wildlife. Wildlife, such as deer and elk, that may be exposed to elevated concentrations of metals (via water, soil, or plant material) may be harvested and consumed by humans.

5.4 Potential Exposure for Humans

Land use associated with the landfill operations restrict free access to the mine, limiting exposure potentials to the general public (DEQ 2004a). Landfill personnel may frequently be exposed to soil contaminated with selenium and other metals, through inhalation and incidental ingestion, as a regular part of their jobs.

Commercial or subsistence fishing does not occur within the 15-mile downstream distance, but sport fishing does.

Fugitive dust and direct contact with the waste piles are the two main mechanisms through which humans could be exposed to the metal concentrations at the site. These sources do not appear to present any immediate threat.

5.5 Recommendations

The agencies performing the 2002 PA recommended that any additional actions at the Waterloo Mine site and the Bear Lake County Landfill be dealt with by DEQ under Subtitle D of RCRA.

Additional recommendations for those portions of the mine not associated with the landfill, based on DEQ's current evaluation of the data, include the following:

- Re-contouring and re-vegetating those waste piles where natural vegetation has not established itself, and, if necessary, placing clean soils and re-vegetating these locations.
- Continued monitoring of landfill and public water system wells for metals
- Periodic sampling of surface water above and below the Waterloo mine.

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Appendix: Photographs

The following photographs were taken during the Preliminary Assessment (DEQ, 2004a).

Photo 8.1
Sample site OS-WLM-S0-01-01. View to north. Black waste shale with grass cover.

Photo 8.2
Waterloo Mine, sample location OS-WLM-SO-02-01 and OS-WLM-VE-03-01. View to north.
Sample on stable slope, partially vegetated waste dump above.

Photo 8.3
Waterloo Mine, sample site OS-WLM-SO-04-01. View to southeast. Stable slope with poorly vegetated waste dump in background.

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Report Index