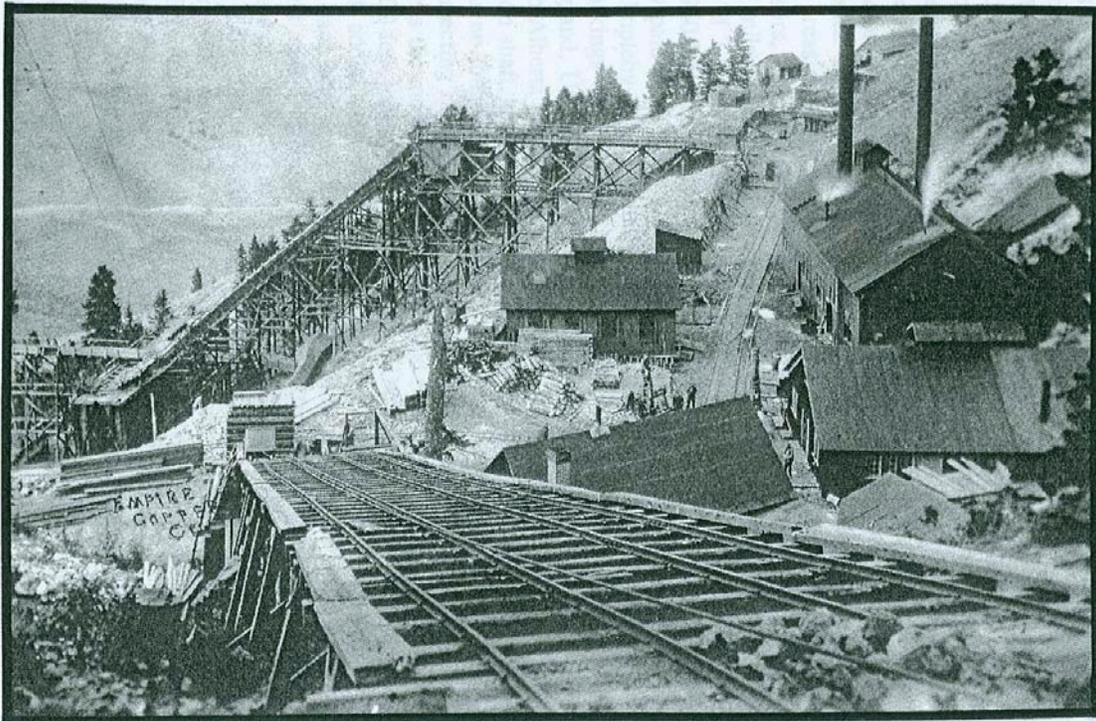


Alder Creek Mining District Preliminary Assessment and Site Investigation



Idaho Department of Environmental Quality

December 2005

Cover photo: Alberta Tunnel, early 1900s.

Alder Creek Mining District Preliminary Assessment and Site Investigation

Idaho Department of Environmental Quality

December 2005

Contents

Section 1: Introduction	1
1.1 Overview.....	1
1.2 Sites Assessed	2
Section 2: Site Description and Regulatory History	7
2.1 Regulatory History	7
2.2 Current and Potential Future Land Uses	8
Section 3: Ownership History and Individual Site Characterization	11
3.1 Ownership and Operational History.....	11
3.1.1 Mining Production	14
3.1.2 Exploration Activities	14
3.2 Individual Site Overview and Waste Characteristics	14
3.2.1 Cossack Tunnel	14
3.2.2 Empire Mill	22
3.2.3 Alberta Tunnel	30
3.2.4 The “Headhouse”	43
3.2.5 Bullion Tunnels	47
3.2.6 Blue Bird workings	50
Section 4: Pathway and Environmental Hazard Assessment.....	57
4.1 Ground Water	57
4.2 Surface Water.....	61
4.2.1 In-water Segment	63
4.2.2 Sample Analysis	64
4.3 Soil Exposure and Air	68
4.3.1 Risk Analysis of Empire Mill Soils	75
4.3.2 Exposure Parameters	75
4.3.3 Risk Estimates	76
4.3.4 Discussion	77
4.3.5 Uncertainty	77
Section 5: Summary and Conclusions	79
Definitions	81
References	83
Appendix A: Empire Mill RCRA Inspection Report.....	85
Appendix B: Analytical Data Sheets	91
Appendix C: Source Water Assessment Figures.....	99
Report Index	103

List of Figures

Figure 1. Location of the Alder Creek Mining District and the City of Mackay within the State of Idaho.....	3
Figure 2. Setting and Topography of the Alder Creek Mining District.....	4
Figure 3. One-mile Radius Setting for Preliminary Assessment Sites.....	5
Figure 4. The “South Custer Historical Society Mackay Mine Hill Tour” brochure cover..	8
Figure 5. Map of the White Knob Challenge Mountain Biking Course. (photo source: http://www.lostrivercycling.org/phpix/index.php?mode=album&album=photos)	9
Figure 6. Aerial photograph of the Cossack Tunnel site in 2004.....	21
Figure 7. Site Sketch of the Cossack Tunnel.....	22
Figure 8. Aerial photo of the Empire Mill.....	29
Figure 9. Site sketch of the Empire Mill site.....	30
Figure 10. Aerial photograph of the Alberta Tunnel Level.....	38
Figure 11. Expanded site sketch of the Alberta tunnel area, as well as the upper workings identified within the same gulch.....	39
Figure 12. Aerial photograph of the tramway head house (right) and the upper and the Bullion Tunnel area (left).....	46
Figure 13. Site schematic of the tramway “Headhouse” (right) and the bullion tunnels (left).....	47
Figure 14. Aerial photograph of the Bluebird Mine Site.....	55
Figure 15. Site Sketch of the Bluebird Mine Site.....	56
Figure 16. Basic geology of the Alder Creek Mining District.....	59
Figure 17. Basic lithology of the Alder Creek Mining District.....	60
Figure 18. View of the Total Distance Limit for surface water (15 miles downstream of the Alder Creek Mining District).....	63
Figure 19. Location of all surface water sampling.....	67
Figure 20. Sensitive environments in the Alder Creek Mining District vicinity.....	71
Figure 21. Precipitation in the Alder Creek Mining District.....	73

List of Photographs

Photo 1. View of the “Mine Hill” facing northwest from the highway just south of Mackay, Idaho.....	2
Photo 2. Cossack Tunnel mill building from P1 location (see Figure 7) facing south. The large building is the compressor building, while the tool shop can be seen in the background.....	15
Photo 3. Looking at the main adit between the compressor building (right) and the blacksmith shop (left). This photo was taken from P2 (see Figure 7) location facing southwest.....	15
Photo 4. Historical photo of mining taking place at the Cossack Tunnel. (Source: http://mackayidaho.com/history.html , 2005).....	16
Photo 5. Looking east from the P2 location (see Figure 7).....	16
Photo 6. Looking west from the P3 location (see Figure 7).....	16
Photo 7. Tailing dams and fluvial morphology from the Rio Grande Canyons’ ephemeral channel. This photo was taken from the P4 (see figure 7) location, facing east.....	17
Photo 8. The ephemeral Rio Grande Canyon from the P5 (see figure 7) location, facing east.....	17
Photo 9. Panoramic view of the Empire Mill from P1 location (see figure 9), facing northwest.....	23

Photo 10. Panoramic view of Empire Mill from P2 location (see figure 9), facing south. 23
Photo 11. Panoramic view of the Empire Mill from P4 location (see Figure 9), facing west..... 24
Photo 12. Alberta tunnel (700 foot level) of the Empire Mine in the early 1900's. Incline tram from 300 foot level (foreground) and the ore chute and bins in the left background. 31
Photo 13. Alberta tunnel panoramic photo from P1 location (see Figure 11) in 2005..... 31
Photo 14. Main Alberta adit, collapsed beyond the portal..... 32
Photo 15. Adit 2, or a possible ventilation shaft. 33
Photo 16. Adit 3..... 33
Photo 17. Collapsed structures between Alberta and the Headhouse..... 34
Photo 18. Photo taken from the P2 location (see Figure 11), facing southwest. Waste rock on the hillside above Alberta is from the North Tunnel and the 300 level. 35
Photo 19. Historic photo of the Alberta Tunnel. The locations marked "a" and "b" on this photograph can also be seen in Photo 18, which was taken in 2005. The "c" location can be seen in photo 20..... 36
Photo 20. Photo taken from P2 location (see Figure 9), looking northwest at the lower waste rock pile and the collapsed ore bin. 37
Photo 21. Exploration hole dug at the P3 location (see Figure 11)..... 40
Photo 22. Two air shafts, or "daylights," above the Alberta tunnel level at the P4 location (see Figure 11)..... 40
Photo 23. Air shaft with waste rock surround the area at the P5 location (see Figure 11). The black pipes coming out of the shaft are presumed to be circulation lines..... 41
Photo 24. Adit located at the P6 location (see Figure 11)..... 41
Photo 25. Collapsed shaft and/or adit at the P7 location (see figure 11). 42
Photo 26. View of the "Headhouse," facing northwest. 43
Photo 27. Photo taken from the P1 location (see Figure 13), facing northwest. 44
Photo 28. Photo taken from the P2 location (see Figure 13), facing southeast. 44
Photo 29. Headhouse adit..... 45
Photo 30. Main upper Bullion Tunnel..... 48
Photo 31. Second upper Bullion Tunnel..... 48
Photo 32. The principle workings at the lower Bullion Adit. 49
Photo 33. Waste rock piles located below the lower Bullion Adit. This panoramic photo was taken from the road facing north..... 49
Photo 34. Panoramic photo taken from the P1 location facing north (see Figure 15).... 51
Photo 35. Photo taken from the P2 location, facing east (see Figure 15)..... 51
Photo 36. Photo of collapsed adit taken at the P3 location (see Figure 15). 52
Photo 37. Photo taken at the P4 location facing north looking at the waste rock pile (see Figure 15)..... 53
Photo 38. Photo taken at the P5 location facing northwest (see Figure 15). 53
Photo 39. Photo taken at the P6 location (see Figure 15) 54
Photo 40. Photo taken at the P7 location of an air shaft (see Figure 15)..... 54
Photo 41. Deer along the Smelter Road in April 2005. 69
Photo 42. Deer hoof print in the tailings at the Empire Mill on August 17, 2005. 69
Photo 43. Photo taken by DEQ personnel on 10/27/03 looking up at the front of the tailings impoundment of the Empire Mill as tailings are mobilized by wind..... 74
Photo 44. Photo taken of vegetation on the tailings dam as evidence of aeolian deposition of tailings..... 75

List of Tables

Table 1. August 17, 2005 sample results for total soil analysis of waste rock, tailings and stream channel sediments.	19
Table 2. Results of the SPLP test performed on the August 17, 2005 CT-3 sample.	19
Table 3. April 13, 2005 surface water quality data from the Cossack Tunnel site.	20
Table 4. August 17, 2005 total soils analysis data from the Empire Mill site.	27
Table 5. Surface Water Probable Point of Entry (PPE) Distances.	62
Table 6. Upper Mine Hill Surface Water Sampling Results.	64
Table 7. Big Lost River Surface Water Quality Sample Results in mg/l.	65
Table 8. Total approximated values of tailings and waste rock in the Alder Creek Mining District.	72
Table 9. Modified exposure parameters for recreational scenario.	76
Table 10. Risk estimates with and without exposure to the exterior concentrate pile.	76

Section 1: Introduction

This document presents the results of preliminary assessment and site investigation (PA/SI) of the Alder Creek Mining District. The 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 a sub-watershed wide preliminary assessment (PA) and a site investigation (SI) at various mines within the Alder Creek Mining District near Mackay, Idaho.

The Idaho Department of Environmental Quality (DEQ) often receives complaints or information about sites that may be contaminated with hazardous waste. These sites can include abandoned 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.state.id.us/waste/prog_issues/mining/pa_program.cfm

1.1 Overview

The Alder Creek Mining District is located in the southeastern part of Custer County, Idaho. As there are multiple mines in this district, all of which are connected through history and current waste characteristics, these preliminary assessment and site inspections are intended to be sub-watershed scale area assessments.

The location of the Alder Creek Mining District is identified in Figure 1. Figure 2 shows the topography within 1-mile and 4-mile radii around the center of the mining district. Both the city of Mackay, population 566, and the Big Lost River are within a 4-mile radius of the site. The area is referred to as “Mine Hill” by local Mackay residents.



Photo 1. View of the “Mine Hill” facing northwest from the highway just south of Mackay, Idaho.

1.2 Sites Assessed

The sites for these assessments include the Cossack Tunnel, Empire Mill, Alberta Tunnel, Tramway “Headhouse,” Bullion Tunnel, and the Blue Bird workings.

A more detailed topographic map of the 1-mile radius of the perimeter sites is located in Figure 3. This map shows the proximity of each operation relative to the different ephemeral stream channels in the drainage. All of these mines are currently inactive.

The most recent mining activity was at the Empire Mill site, which extended operations until 1982. Ore bodies within the mining district are known to occur within an arc-shaped belt measuring more than three miles in length and nearly 1,000 feet in width. The Empire Mill lies at the center of this belt, where copper minerals predominate. Other district properties, to the north, west, and south, including the Blue Bird workings, contain lead-zinc deposits (Farwell 1944).

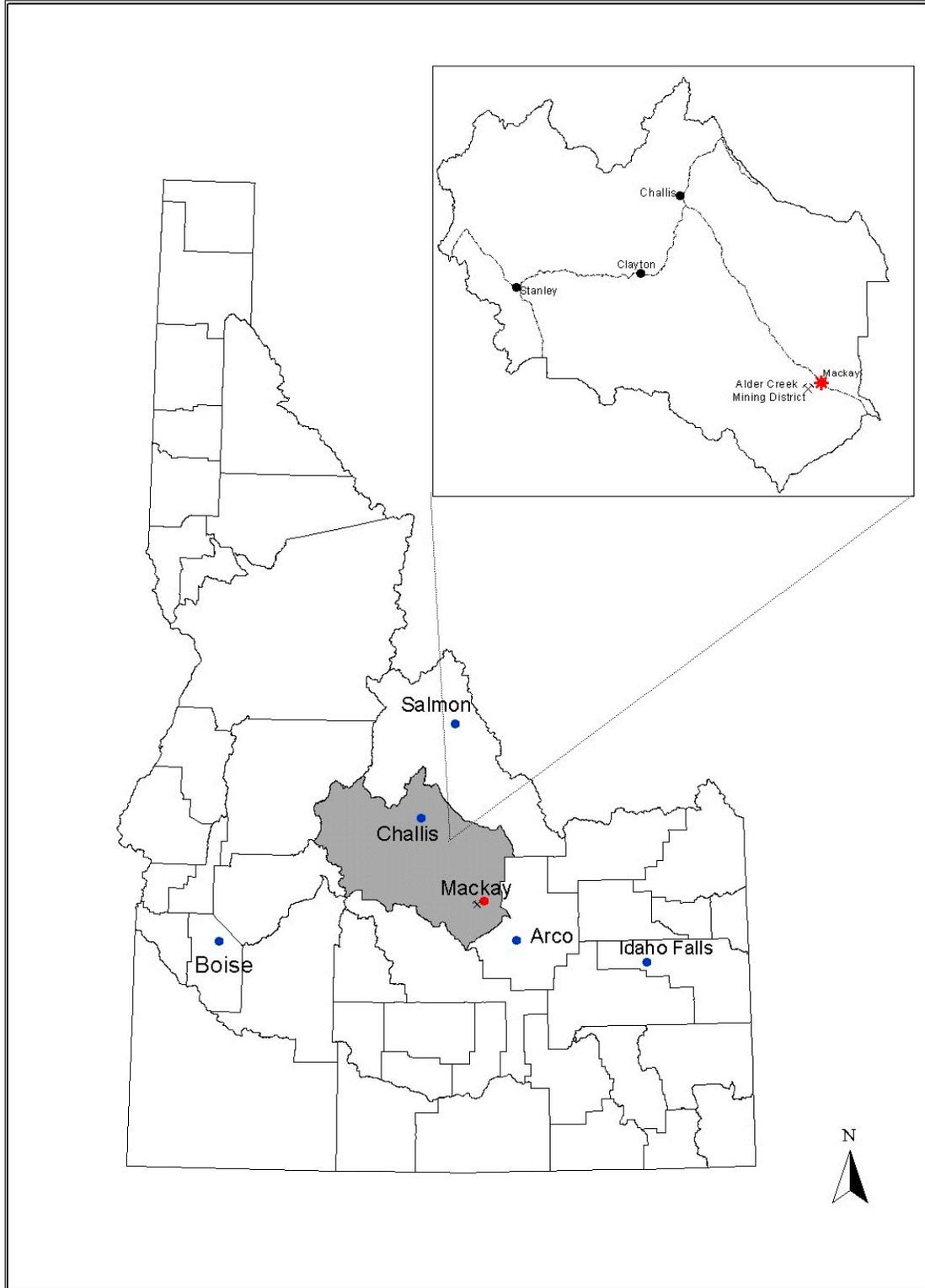


Figure 1. Location of the Alder Creek Mining District and the City of Mackay within the State of Idaho.

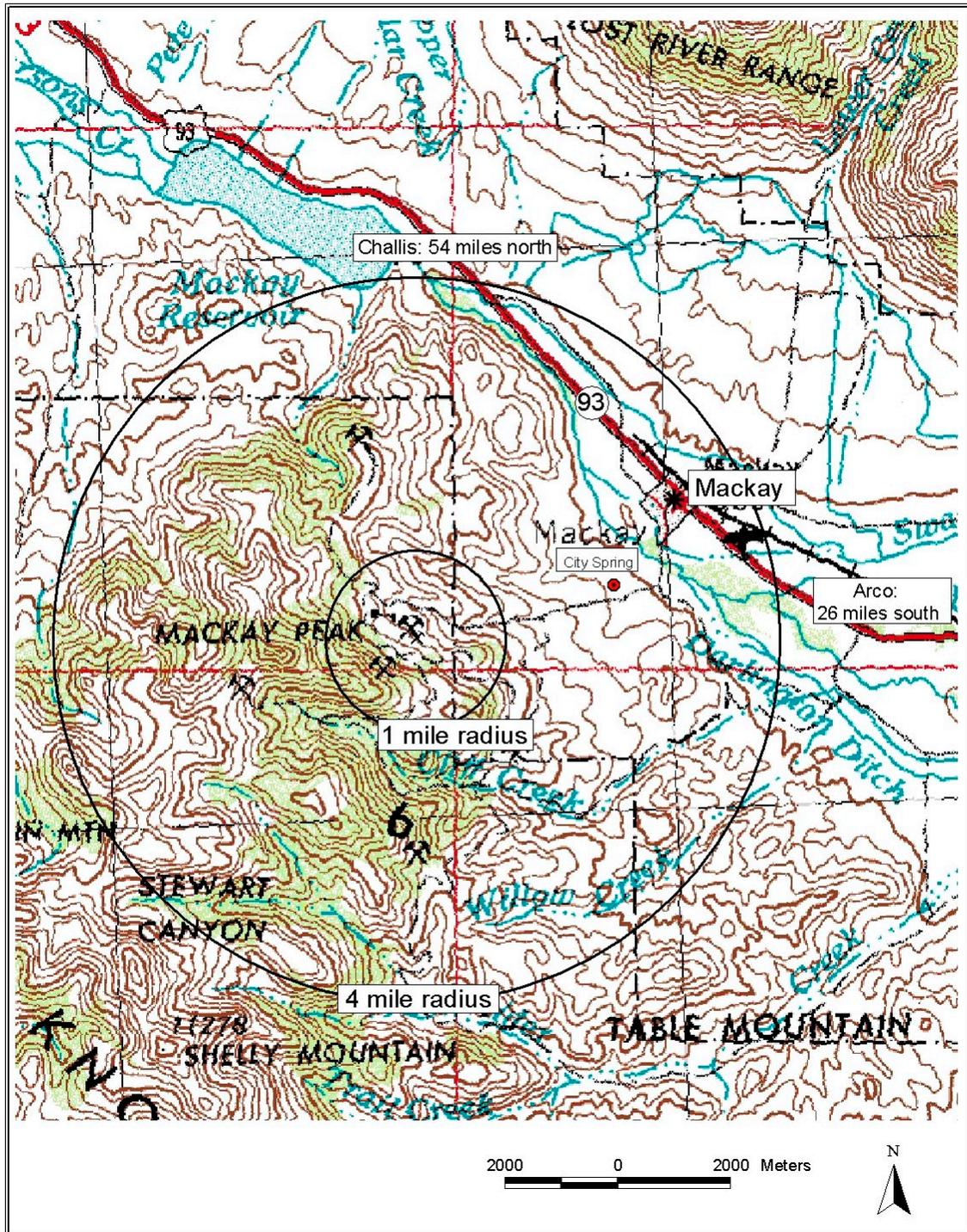


Figure 2. Setting and Topography of the Alder Creek Mining District.

This page intentionally left blank for correct double-sided printing.

Section 2: Site Description and Regulatory History

The regulatory history of the Adler Creek Mining District, along with a discussion of current and future potential land uses, are presented in the following.

2.1 Regulatory History

On July 8, 1995, the Idaho Geological Survey (IGS) conducted a site inspection of the Empire Mill. Under a cooperative agreement with the U.S. Forest Service (Abandoned and Inactive Mine Program), the IGS inventoried site working, assessed physical hazards and evaluated potential pathway concerns. The site discovery report recommended that cleanup actions were warranted (Moye 1995).

In November of 2000, a very general complaint about the wastes on Mine Hill was filed with DEQ. A formal inspection under the *Resource Conservation and Recovery Act* (RCRA) was conducted by DEQ in 2003 at the lower smelter site that is located adjacent to the Big Lost River. This inspection did not identify any RCRA violations, and water samples taken at that time indicated that the tailings and slag on the site were not causing any exceedances of Idaho's toxic water quality standards (DEQ 2003).

In 2004, the property was purchased by Mick Halverson, who capped the tailings and slag pile left on site, alleviating the potential for windborne contaminants and dermal exposure from this site.

DEQ site visits of the sites on the upper Mine Hill in 2003-2004 noted unlabeled drums, sites with solid waste issues, and potential human health concerns due to exposure to tailings and waste rock. During discovery reconnaissance of the patent claim properties, DEQ only identified potential RCRA violations at the Empire Mill.

As a result, on August 16, 2005, DEQ conducted an inspection of the Empire Mill to assess compliance with RCRA, the *Idaho Hazardous Waste management Act* (HWMA), and the *Idaho Rules and Standards for Hazardous Waste*, during which six violations were noted. These violations included: a failure to characterize waste; the release of hazardous waste to the environment (lead-acid batteries); and the release of used oil to the environment (Appendix A).

Recently, DEQ determined that the remaining sites and the workings at the Empire Mill would best be evaluated for human health and environmental impacts under the Preliminary Assessment program. Lonnie Mollberg, president of RMS Enterprises, Inc., the current property leaseholder of most of the private mining claims on Mine Hill, was present during the RCRA inspection and the majority of the PA/SI fieldwork.

DEQ prioritized the area for PA/SI due to the vicinity of the mining sites to the town of Mackay and the ease of access of the public to this site. The encouragement of the public to visit the site (by the local historical society) is of great concern as is the identification of windborne tailings off of the Empire Mill tailings pond, which lies within four miles of Mackay.

On November 10, 2005, DEQ issued a Warning Letter to the owner, Honolulu Copper Company, and current leaseholder to address the RCRA compliance issues at the Mill. Recognizing winter weather conditions and logistics, the DEQ anticipates remedial actions to conclude during the 2006 “construction” season.

2.2 Current and Potential Future Land Uses

Although RMS Enterprises, the current leaseholder, is conducting exploration and negotiating financial contracts for future mining development, no mining activities are occurring currently.

The primary current land use of Mackay’s Mine Hill is recreation, including historical tours, All Terrain Vehicle (ATV) use, a nationally prominent bicycle race, fishing, and residential housing development.

The most promoted recreational use is championed by the South Custer County Historical Society and the White Knob Historical Preservation Committee. These groups provide a brochure, *Mackay’s Mine Hill Tour*, available at local establishments, which promotes a tour of Mine Hill points of interest—including the Cossack Tunnel, the Bullion Tunnels, the Alberta workings, and the tramway Headhouse—to promote the understanding and preservation of Mackay mining history.

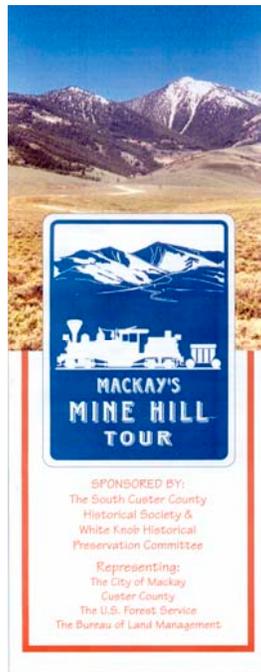


Figure 4. The “South Custer Historical Society Mackay Mine Hill Tour” brochure cover.

Mine Hill is also heavily used by ATV enthusiasts. During the two weeks DEQ personnel were conducting the PA/SI fieldwork, multiple small groups of ATV riders were observed using the site. Many were using ATVs to access the various historical mining sites, which were inaccessible to conventional vehicles. During each DEQ field visit to the Empire Mill's tailings impoundment, evidence of fresh ATV tracks were observed, indicating that it is a favorite place for ATV riders.

The town of Mackay and the Alder Creek mining district is also the location of the annual "White Knob Challenge" mountain bike race, the longest-running mountain bike race in the northwest. Sponsored by the Lost River Cycling organization, this bike race is promoted nationally, which brings increased recreational use to the Mine Hill (Lost River Cycling 2005). During the 2005 race, 141 people participated; the highest number of participants was in 1986, when over 700 people competed in the race. Figure 5, shows the race course. (Holzer 2005)



Figure 5. Map of the White Knob Challenge Mountain Biking Course. (Photo source: <http://www.lostrivercycling.org/phpix/index.php?mode=album&album=photos>)

The Big Lost River, flowing through the town of Mackay below the Mackay Reservoir, is known as a destination sport fishery. With abundant rainbow trout in this stretch of river, multiple fly fishing reports deem it to be an outstanding tail-water fishery.

The total number of annual visitors to Mine Hill is conservatively estimated to be 800 people per year. This estimate is derived by assuming 120 days of weather-

permitted vehicular access, an average of five people per day visiting the site during this time, and the addition of the attendees of the annual bike race.

Mine Hill and the surrounding area has several potential future uses as well. The most likely future use of land area within the 4-mile radius of the mining sites is residential development. Over the past couple of years, residential development along the Smelter Road has increased because a large tract of land along the Big Lost River, and about a quarter mile up the Smelter Road, was recently purchased and subdivided. This subdivision has both riverfront and view properties and has increased the value of the land (Prichard 2005). Although a buffer of public land lies between this lower area, closer to the Big Lost River, and the private mining claims on the Mine Hill, this development still brings property owners closer to the potential threats of historic mining wastes. It is also reasonable to assume that the mining claims themselves may be identified as potential future residential or vacation home locations.

The other likely potential use of the mining lands identified is for future mining. With improved techniques and additional funding, the current leaseholder, Mr. Mollberg, has stated that he could reprocess some of the waste rock and tailings located at the Empire Mill for profit. Additional mining activity may continue on other Empire Mine claims, including the AP pit area, located in an adjacent drainage just south of the Alberta tunnel.

Section 3: Ownership History and Individual Site Characterization

The history of the mines located on Mine Hill, including ownership, production, and exploration, is presented in the following. Also included in the following discussion is the description of the individual mining sites and their associated waste characteristics.

3.1 Ownership and Operational History

The following historical information was compiled by Judith Nielsen for the University of Idaho's Special-Collections manuscript, the *Empire Copper Company*:

“At the height of its production it consisted of 38 mining claims, a smelter capable of handling over 500 tons of ore daily, and a 7 3/4 mile Shay railroad connecting the mines and smelter.

The mine, which was opened about 1884 and worked at various times, was originally organized under the laws of West Virginia as White Knob Mining Co. It was reorganized as White Knob Copper Company on April 24, 1900, under the laws of New Jersey by San Francisco millionaire John W. Mackay and engineer Wayne Darlington, who became president and general manager of the company respectively. They were responsible for a great deal of development work, the construction of a large smelter, and an electric railroad. In 1901 E.J. Mathews succeeded Mackay as president, and in 1902 he was succeeded by Henry J. Luce. Wayne Darlington and his staff resigned in the spring of 1902 after a dispute with Luce and Darlington was replaced by S.F. Boyd, who in turn was replaced by Percy L. Fearn.

In October 1904, after seven different managers had tried unsuccessfully to operate the property at a profit, the company was placed in the hands of a receiver. It was purchased by George W. Young of New York on March 18, 1905, for \$1 million. He immediately transferred the property to a New York consortium which, in February 1905, had organized the White Knob Copper and Development Company. William H. Brevoort of New York was brought in as managing director and he requested Frank M. Leland, who was manager of the mining machinery department at the Risdon Iron Works in San Francisco and who also had a reputation of being a practical mining man, to assume the position of general manager. Leland arrived in Mackay in June with instructions to dismantle the plant and wind up the affairs of the company. While looking around the property he found several thousand tons of low grade copper ore which he thought could be successfully smelted. He began selling off surplus machinery, some property the company owned in Mackay, and arranged for leasers to do the mining. In late June he started the smelter and eventually shipped twenty five car loads of high-grade gold and silver bearing copper matte before shutting down the smelter in the late fall. After convincing the owners that

the mine could be operated at a profit he began ordering new machinery and also replaced the expensive electric railroad with a Shay locomotive.

On October 17, 1905, Ravenel Macbeth leased the entire White Knob property and in 1906 and 1907 the mine was known as Macbeth Lease. Organized under the laws of Maine on May 29, 1907, the Empire Copper Company, Ramsey S. Bogy principal financier, purchased the property of the Macbeth Lease and the White Knob Copper and Development Company for one million dollars.”

(Nielsen, 1982)

Frank Leland was named president and general manager of the new company, but, by October, Leland was forced to shut the mine down when copper prices fell too low. The mine remained idle in 1908 and 1909; and only ore extracted during assessment work was shipped. In December 1909, Leland resigned as the general manager, but remained as president. Between 1910 and 1911, the mine operated under the leasing system. In 1912, when Leland rejoined the Empire as general manager, the mine started shipping its ore to the Garfield, Utah, smelter. Owing to favorable copper prices, the Empire Copper Company declared its first dividend in June 1913. In June 1915, L.R. Eccles, and his associates, purchased the Empire Copper Company, but continued with the leasing system:

“The year 1915 was also the most prosperous one for the mine, June shipments broke all previous records.

In mid 1916 the management of the Empire changed. L.R. Eccles replaced Leland as president and Joseph Eccles replaced Ralph Osborn as vice-president. By the end of the year both Leland and Osborn had resigned from the company.

Frank M. Leland, who spent ten years developing the mine from a failure into the largest, most successful copper mine in Idaho, was the only long term manager the mine had. After he left the company they again had a succession of short term managers.

A three mile aerial tramway to replace the 7 1/2 mile Shay railroad was constructed in 1917 and 1918 at a cost of \$125,000. Labor problems caused a reduction in ore output, and by 1919 the mine was operating exclusively on the leasing system.

In April 1920, the bookkeeper was arrested for embezzlement, and in January 1921 the general manager, Morton Webber, was apprehended on the same charge. With these financial losses, coupled with the low price of copper, the Empire was unable to pay its bills. In July 1921, the company was placed in the hands of a receiver, and on August 5 the mine was totally shut down.

Eccles and his Utah associates reincorporated the company under Idaho laws on October 8, 1921, renaming it Idaho Metals Company. The mine was operated exclusively by leasers until 1927. This system did not permit the necessary development of the Cossack Tunnel and in early 1928 the company was again placed in the hands of a receiver.

The holdings of the Idaho Metals Company passed out of the hands of the receivers in late May 1928 when the property was purchased by A.J. Anderson and W.E. Narkaus of Victoria, B.C., who immediately sold it to the newly formed Mackay Metals, Chase A. Clark, president. The mine and mill plants

were entirely rebuilt, the mine rehabilitated, and an active development campaign started which resulted in the discovery of a large tonnage of new ore in the Cossack tunnel. Lack of money again plagued this new organization and the company suspended operations in August of 1930. Although the leasers continued to work, they stored all their ore. In 1931 the property was sold to the county for taxes.

Although the company remained in receivership until 1939, some leasers worked on the property. In 1937 G.M. Tomle of San Francisco held an option on the property with the Custer County Commissioners, but lack of funds prevented him from doing any work.

Organized by a group of Mackay businessmen for the purpose of operating the old Mackay Metals property, the Mackay Exploration Company acquired the property from the county commissioners in May 1939 and by December twenty sets of leasers were at work; the mine was rehabilitated and reopened to the 1000 foot level, the Cossack Tunnel, at the 1600 foot level, was also reopened and development started. In April 1944 work began under a Reconstruction Finance Corporation (RFC) loan for \$45,000 in rehabilitating the mill and power plant for the purpose of reconditioning the mill and mine to produce 100 tons of ore daily. W.P. Barton became manager of the Mackay Exploration Company in 1945 and a year later he reorganized the company into the Custer Copper Corporation. The mine continued operating under this name until 1950 when it reverted to its former name of Mackay Exploration Company. The mine remained idle through 1953. In 1955, Idaho Alta Metals Corp. of New York acquired a lease and option, which expired in September 1958 (Mitchell, 1997). The mine was idle except for sampling until 1960 when it became the property of R.V. Lloyd and Company, a partnership of R.V. and H.U. Lloyd. The Idaho Inspector of Mines annual report lists the property under this name from 1960 to 1965. In 1968, the report again lists the property under the Mackay Exploration Co., but as an inactive mine. In 1971 the Mackay Exploration Co. was on the inspector's forfeiture list and the Empire group of mines is listed under Lost River Mines, Inc. From 1972 until the inspector's final annual report in 1974, the Empire mines are listed under Honolulu Copper Co. Inc., leased to Ivie Mining Company.”

(Nielsen, 1982)

In 1974, Myko, Inc. acquired the Empire Mill, primarily handling ore from the Phi Kappa and Horseshoe mines. Myko, Inc. concluded operations at the Empire mill in 1982. Ross Moody, the owner of Honolulu Copper, leased the property in 1996 to Lonnie Mollberg of RMS Enterprises, Inc. of Idaho Falls, the current leaseholder.

The Bureau of Mines Project 1406, under the supervision of John W. Taber, operated in the Empire Mine concurrently with the study of the Geological Survey, from December 1942 until September 1943. Twenty-one exploration diamond drill holes, totaling 3,863 feet, were drilled from underground stations; nearly 400 mine and dump samples were taken; and new transit surveys were run in different parts of the mine (Farwell 1944).

3.1.1 Mining Production

The Empire Mine produced 61,689,291 pounds of copper, 41,431.25 ounces of gold, 1,294,531 ounces of silver, 24,110 pounds of lead, and 906,078 pounds of zinc between 1902 and 1975 (Mitchell, 1997). One carload of tungsten (2.08 %) ore, mined from a winze stope beneath the 1,000 foot level, was also shipped from the mine in 1941. Nearly sixty-five percent of the total ore tonnage came from stopes above the 700 foot level (Farwell 1944).

Early production records are not available, but Leland (1957) suggested that most of the production was derived from high-grade oxidized ores, mined from open cuts and treated locally in a small smelter. Production records before 1901 were not retained. Between 1924 and 1931, milling operations concentrated low-grade sulfide ores, averaging about 2.8 percent copper for shipment to Salt Lake smelters (ibid). Farwell and Full (1944) calculated, "Using a cutoff of 2 percent copper, the reserves of indicated and inferred sulphide ore in this ore body are 23,370 tons averaging 2.67 percent copper, 0.066 ounces gold and 0.95 ounces silver per ton; no measured reserves have been estimated." (p. 15)

3.1.2 Exploration Activities

From December 1942 until September 1943, Bureau of Mines Project 1406, under the supervision of John W. Taber, operated in the Empire Mine concurrently with the study of the Geological Survey. Twenty-one diamond drill holes, totaling 3,863 feet, were drilled from underground stations; nearly 400 mine and dump samples were taken; and new transit surveys were run in different parts of the mine (Fallwell & Full, 1944, p.2). Between 1964 and 1975, several unnamed companies drilled approximately 140 shallow vertical holes in the AP pit area and Exxon Minerals drilled 10 deep holes there in 1975. Cambior Exploration USA, Inc. explored the property from 1995 to 1997 and drilled 47 core holes (van Angeren, 2004, p.2).

3.2 Individual Site Overview and Waste Characteristics

The following provides overviews and waste characteristics for the individual sites located at Mine Hill.

3.2.1 Cossack Tunnel

Located at the 1,600 foot level, the Cossack Tunnel area (Photos 1-8, Figures 6-7) comprises two adits, two large tailings impoundments, several waste rock piles, and some historic structures. This is one of the first major mining stops on Smelter Road, above town, and is accessible to all vehicle types. The site is currently a mixed ownership site split between private interests, USFS, and the BLM.



Photo 2. Cossack Tunnel mill building from P1 location (see Figure 7) facing south. The large building is the compressor building, while the tool shop can be seen in the background.



Photo 3. Looking at the main adit between the compressor building (right) and the blacksmith shop (left). This photo was taken from P2 (see Figure 7) location facing southwest.



Photo 4. Historical photo of mining taking place at the Cossack Tunnel. (Source: <http://mackayidaho.com/history.html>, 2005)



Photo 5. Looking east from the P2 location (see Figure 7).



Photo 6. Looking west from the P3 location (see Figure 7).



Photo 7. Tailing dams and fluvial morphology from the Rio Grande Canyons' ephemeral channel. This photo was taken from the P4 (see figure 7) location, facing east.



Photo 8. The ephemeral Rio Grande Canyon from the P5 (see figure 7) location, facing east.

Originally named the *Van-Austin Tunnel* or the *1600-level*, and later dubbed the *Cossack*, this tunnel was driven in 1903 to intersect the ore bodies believed to continue beneath the Alberta Tunnel, the 700 foot level.

Development on the Cossack steadily continued. In 1912 the tunnel was 1,000 feet in length; 2,000 feet in 1913; 4,500 feet in 1915; 5,500 in 1922; and it obtained its maximum length of 6,000 feet by 1930. The ore zone, originally projected to intersect at 2,500 feet from the portal, was finally reached at 4,500 feet. The ore was described to be quite similar to the sulfide ore located in upper workings, and galena (lead sulfide) was also noted (Mitchell 1997).

The two distinct waste rock piles remaining at the site are distinguishable from one another and evaluated based upon color. Observations of the dumps near the portal suggests the preponderance of waste rock is grey limestone, followed in volume by red altered limestone and a lesser volume of light-grey granite porphyry. Red colored waste rock and soil appears to define the country rock from the tunnel's deeper penetration. Most likely, this horizon represents the iron-rich skarn, though minor sulfides may also be included. A veneer of leucogranite mantles the red rocks, reflecting the tunnel's breach through the skarn to its terminus in the granite.

The grey waste rock pile's surface area is approximately 0.22 acres with an estimated volume of 4,260 cubic yards, while the red waste rock is approximately 0.18 acres with an estimated volume of 1,160 cubic yards. The tailings, which cover a large surface area of approximately 2.76 acres, are strewn through the ephemeral Rio Grande stream. An average thickness of two feet was observed across the stream channel, grading to a veneer at its margins. The tailings substantially thicken near the uppermost tailings dam, reaching nearly six feet in depth, while the lower dam appears to reflect the two foot average. The total volume of these tailings is estimated at 10, 200 cubic yards.

The Rio Grande Canyon, an ephemeral creek, flows past the site and through the tailings impoundments. During an early field inspection in April 2005, DEQ representatives documented a small flow due to snowmelt runoff in the stream channel through the tailings. A water sample (Lower Rio Grande at Cossack Tunnel) was taken at that time, and stream sediment samples (up-gradient of the site at CT-4, and down-gradient in the tailings at CT-3) and waste rock (CT-1 & CT-2) were sampled during the official Preliminary Assessment field work in August.

Both an aerial photograph of the site as well as a site sketch are included in Figures 4 and 5, respectively. Sediment samples were also taken from the two distinctly different waste rock piles (CT-1 & CT-2). The data from the sampling events are presented in Tables 1 and 3 and are shown next to the State of Idaho's appropriate standards.

Table 1. August 17, 2005 sample results for total soil analysis of waste rock, tailings and stream channel sediments.

Chemical of Concern	Sample Site Location (cross referenced with Figure 5)				Idaho Initial Default Target Levels under REM
	CT-1 red waste rock	CT-2 grey waste rock	CT-3 DG stream sediments	CT-4 UG stream sediments	
Silver	22.5 mg/kg	0.63 mg/kg	4.91 mg/kg	<0.50 mg/kg	0.189 mg/kg
Arsenic	182 mg/kg	10.2 mg/kg	183 mg/kg	84.5 mg/kg	0.391 mg/kg
Barium	32.1 mg/kg	34.8 mg/kg	15.8 mg/kg	525 mg/kg	896 mg/kg
Cadmium	4.37 mg/kg	1.58 mg/kg	4.49 mg/kg	2.57 mg/kg	1.35 mg/kg
Chromium	20.1 mg/kg	12.9 mg/kg	12.9 mg/kg	8.57 mg/kg	2,130 mg/kg
Copper	3,630 mg/kg	869 mg/kg	434 mg/kg	167 mg/kg	921 mg/kg
Iron	86,200 mg/kg	20,100 mg/kg	10,700 mg/kg	18,600 mg/kg	
Lead	529 mg/kg	31.2 mg/kg	106 mg/kg	144 mg/kg	49.6 mg/kg
Selenium	8.0 mg/kg	<4.0 mg/kg	<4.0 mg/kg	<4.0 mg/kg	2.03 mg/kg
Zinc	794 mg/kg	202 mg/kg	202 mg/kg	245 mg/kg	886 mg/kg
Mercury	0.152 mg/kg	2.80 mg/kg	2.80 mg/kg	0.095 mg/kg	0.00509 mg/kg

*highlighted cells indicate that the concentration exceeds DEQ's Idaho Default Target Limits (IDTL) values.

An additional Synthetic Precipitation Leaching Procedure (SPLP) analysis was performed on the CT-3 sample. This was done to identify the leaching characteristics of this red-oxidized tailings material in the ephemeral channel, where it is most likely to leach into the ground water. Analysis was only run on constituents that were above the Idaho Default Target Limits (IDTL) in the total analysis.

The results of the SPLP test are presented in Table 2, and these indicate that cadmium, lead and zinc showed leaching characteristics. All data sheets are available in Appendix B.

Table 2. Results of the SPLP test performed on the August 17, 2005 CT-3 sample.

Chemical of Concern	
Silver	<0.005 mg/l
Arsenic	<0.025 mg/l
Cadmium	0.0051 mg/l
Lead	0.0106 mg/l
Selenium	<0.04 mg/l
Zinc	0.504 mg/l
Mercury	<0.0002 mg/l

The results for the surface water sample taken on April 13, 2005 are presented in Table 3. This data is compared to both the surface water standard and the ground water standard.

The Idaho numeric water standards for surface water presented in Table 3 are hardness dependant criteria intended for the protection of aquatic life. As this is an ephemeral creek with no documented aquatic life, this standard is presented for comparative purposes only.

The ground water standards for the State of Idaho are also presented; these are based on the protection of human health and are more appropriate for comparison of this data.

Table 3. April 13, 2005 surface water quality data from the Cossack Tunnel site.

Chemical of Concern	Sample Result (Total)	Sample Result (dissolved)	Surface Water Standard adjusted for hardness (IDAPA 58.01.02)		Ground water Standard (IDAPA 58.01.11)
			CMC	CCC	MCL
Hardness	290 mg/l				
Silver	0.00881 mg/l	<0.0001 mg/l	0.02153 mg/l		0.1 mg/l
Arsenic	0.0932 mg/l	<0.003 mg/l	0.36 mg/l	0.19 mg/l	0.05 mg/l
Cadmium	0.0719 mg/l	0.00121 mg/l	0.01172 mg/l	0.00226 mg/l	1.3 mg/l
Copper	2.85 mg/l	0.01 mg/l	0.0464 mg/l	0.0282 mg/l	1.3 mg/l
Iron	55.2 mg/l				0.3 mg/l
Lead	4.33 mg/l	0.00804 mg/l	0.201 mg/l	0.00785 mg/l	0.015
Selenium	0.0076 mg/l	<0.003 mg/l	0.018 mg/l	0.005 mg/l	0.05
Zinc	10.9 mg/l	0.034 mg/l	0.282 mg/l	0.258 mg/l	5

*Hardness is calculated from calcium and magnesium concentrations

*CMC = Criterion Maximum Concentration is defined as the maximum instantaneous or one (1) hour average concentration and should adequately protect aquatic organisms from acute toxicity if not exceeded more than once every three (3) years. This is equivalent to "acute criteria."

*CCC = Criterion Continuous Concentration is defined the four (4) day average concentration of a toxic and should adequately protect aquatic organisms from chronic toxicity if not exceeded more than once every three (3) years. This is equivalent to "chronic criteria."

*Highlighted cells indicate that the concentration exceeds the MCL.



Figure 6. Aerial photograph of the Cossack Tunnel site in 2004.

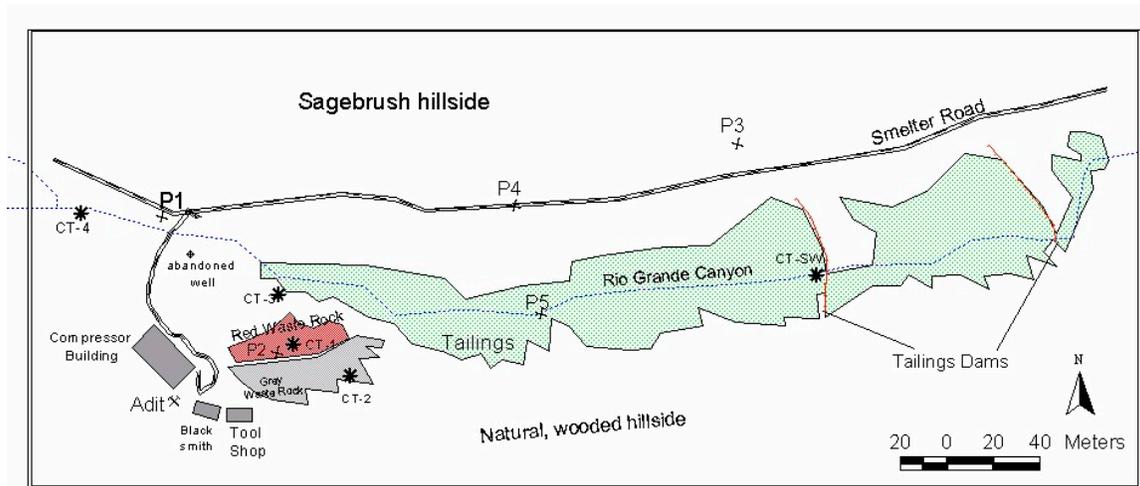


Figure 7. Site Sketch of the Cossack Tunnel.

3.2.2 Empire Mill

The Empire Mill (Photos 9-11, Figures 8-9), located directly west of the Cossack Tunnel site, was the focus of the most recent mining activity on Mine Hill. DEQ performed a joint RCRA inspection at the mill at the time of the PA/SI fieldwork to respond to concerns regarding various chemicals and batteries being stored on site.

There are many structures remaining at this site, some of which are structurally unsound, including a mill building, conveyor system, roundhouse, shops, boiler shed, core building, and a portal access shed. In addition to the buildings at the site, there are large quantities of scrap metal, 55-gallon drums of various chemicals, and old batteries. A relatively large tailings impoundment is at the site as well as waste rock piles and three concentrate (Cons) piles, one outside of the main mill building and two inside.

In 1956, an adit was driven more than 1,500 feet, approximating the 1,100-foot level of the Empire Mill. While driving this tunnel, a sulfide ore body was discovered and subsequently developed (Nelson & Ross 1969). According to Mitchell's *History of Selected Mines in the Alder Creek Mining District* (p.34), R.V. Lloyd & Co "built a new flotation mill at the portal of the 1,100 tunnel in 1961 and constructed a new compressor building during 1962" (Mitchell 1997).

The mill was equipped with a 175 tons per day (tpd) concentrator, which initially processed ore from the old stopes. The 1,100 level was the main haulage, and mining continued sporadically through the 1970s.

In 1974, Myko, Inc. acquired the Empire Mill, primarily handling silver and lead ores from the Phi Kappa and Horseshoe mines. Myko, Inc. concluded operations at the Empire Mill in 1982. Though the Empire was credited with production in 1982, apparently only Phi Kappa ore was processed during that year (Mitchell 1997).

Observations of the waste rock piles and terraces at the Mill noted the lack of mineralization. It appears that most of the waste rock mined through tunnel development was used to provide building stability and in the construction of the mill's tailings impoundment. The volume of waste rock at the site is estimated to be 30,000 cubic yards. DEQ did not observe any ore stockpiles within the mill area, though processed Cons piles were identified.

The tailings impoundment's surface area is approximately 1.83 acres with an estimated volume of 48,249 cubic yards, perhaps 25% of which is waste rock from its construction. An average thickness of fifteen feet was assumed for the tailings impoundment, grading to a depth of 1.5 feet at its margins.

Access to the Empire Mill is good with a high clearance vehicle, and although this site is not marked officially in the tour brochure, it is on the path to the Shay trestle and railroad bed. Curious visitors, as well as ATV riders, were using the site recreationally during the PA/SI fieldwork, both in mid-August, as well as early September.



Photo 9. Panoramic view of the Empire Mill from P1 location (see figure 9), facing northwest.



Photo 10. Panoramic view of Empire Mill from P2 location (see figure 9), facing south.



Photo 11. Panoramic view of the Empire Mill from P4 location (see Figure 9), facing west.

DEQ personnel conducted a RCRA inspection at Empire Mill on August 16, 2005, during which six violations were noted. These violations included: a failure to characterize waste; the release of hazardous waste to the environment (lead-acid batteries); and the release of used oil to the environment (Appendix A). (Violations of RCRA regulations are being addressed administratively through the RCRA process at DEQ, as discussed in Section 2.2.)

A source of surface water has not been documented at this site, and the tailings do not appear to have been significantly eroded from the dump and into the ephemeral stream at the base of the dump. Nor was water observed in this channel during any DEQ field visit.

There are no ephemeral channels identified up-gradient of the site, except for rill erosion off of the adjoining road. The primary mechanism for transport of these tailings appears to be wind erosion, as discussed in Section 4.3.

During the DEQ site tour to an adjacent mining site, the Darlington Shaft and pit, on October 27, 2003, DEQ personnel Katy McKinley and Rensay Owen documented tailings becoming airborne by afternoon thermal winds, a phenomenon that is common every day in this mountainous region. On August 17, 2005, both Brian Gaber and Katy McKinley were on site, performing the PA/SI fieldwork, when thermals lifted large amounts of tailings off of the tailings impoundment.

Sediment samples (EM1, EM2, and EM3) were taken from the tailings impoundment as well as the concentrate pile (EM-Con Pile) located outside of the mill building. These samples were analyzed for total metals. The tailings impoundment has a complete surface area of approximately 1.83 acres, which includes the surface area of the face of the impoundment dam. The tailings are not believed to be homogeneous.

Historic references suggest that the mill retrofitted to accommodate several different milling processes over a long period of time, which would generate tailings with significantly different size and geochemical characteristics. DEQ verified this assumption by taking stratified samples. The EM1 sampling location was sampled at six distinctly different layers, down to 12.5 feet. A description of each of the layers sampled is as follows:

- Layer A: Top layer, thickness = 2 feet

- Layer B: Red in color, thickness = 1 foot, hardpan hit in bottom 2 inches of this layer
- Layer C: Dark black/grey in color, thickness = 6 inches
- Layer D: Brown/grey in color, thickness = 3-4"
- Layer E: Grey in color, thickness = 7 feet
- Layer F: Black, thickness > 1.5 feet (DEQ only went 1.5 feet into this layer, the exact thickness of this layer is unknown)

A weighted composite sample of the layers was then taken and analyzed for SPLP to define overall leaching characteristics of the tailings impoundment. This SPLP was done for constituents which were identified to be of concern after total metals analysis were received. This data, shown in Appendix B, reported that none of the constituents showed leaching characteristics through this test.

The EM2 and EM3 samples were also taken from the tailings pond, each from about two feet below the surface. The EM-Con sample was taken from the concentrate ore pile located outside of the southeast corner of the mill building, from approximately six inches beneath the surface. Data from each layer of EM1, as well as the results from the EM2 and EM3 locations, are presented in Table 4.

This page intentionally left blank for correct double-sided printing.

Table 4. August 17, 2005 total soils analysis data from the Empire Mill site.

Chemical of Concern	EM1-A 0-2'	EM1-B 2'-3'	EM1-C 3-3.5'	EM1-D 3.5-3.75'	EM1-E 3.75-10.75'	EM1-F 10.75- 12.25'	EM2	EM3	EM- Con Pile	Idaho Initial Default Target Levels under REM
Silver	20.3 mg/kg	14.4 mg/kg	15.8 mg/kg	17.6 mg/kg	5.01 mg/kg	4.14 mg/kg	13.1 mg/kg	15.5 mg/kg	89.7 mg/kg	0.189 mg/kg
Arsenic	130 mg/kg	347 mg/kg	492 mg/kg	105 mg/kg	60.5 mg/kg	48.1 mg/kg	376 mg/kg	84.5 mg/kg	283 mg/kg	0.391 mg/kg
Barium	60.7 mg/kg	24.3 mg/kg	29.6 mg/kg	20.6 mg/kg	19.9 mg/kg	12.7 mg/kg	16.6 mg/kg	51.9 mg/kg	1.81 mg/kg	896 mg/kg
Cadmium	75.3 mg/kg	44.3 mg/kg	51.6 mg/kg	11.9 mg/kg	3.30 mg/kg	7.29 mg/kg	79.7 mg/kg	70.3 mg/kg	1,130 mg/kg	1.35 mg/kg
Chromium	16.8 mg/kg	11.4 mg/kg	16.3 mg/kg	29.0 mg/kg	21.1 mg/kg	13.3 mg/kg	16 mg/kg	17.7 mg/kg	4.23 mg/kg	2,130 mg/kg
Copper	1,150 mg/kg	1,590 mg/kg	1,300 mg/kg	3,940 mg/kg	1,550 mg/kg	1,370 mg/kg	1,580 mg/kg	249 mg/kg	17,800 mg/kg	921 mg/kg
Iron	39,300 mg/kg	121,000 mg/kg	115,000 mg/kg	86,900 mg/kg	61,400 mg/kg	64,400 mg/kg	136,000 mg/kg	15,700 mg/kg	161,000 mg/kg	
Lead	2,900 mg/kg	1,630 mg/kg	1,330 mg/kg	332 mg/kg	83.2 mg/kg	158 mg/kg	842 mg/kg	1,880 mg/kg	7,310 mg/kg	49.6 mg/kg
Selenium	6.6 mg/kg	19.9 mg/kg	22.9 mg/kg	5.0 mg/kg	<4.0 mg/kg	<4.0 mg/kg	26.4 mg/kg	<4.0 mg/kg	96.1 mg/kg	2.03 mg/kg
Zinc	8,160 mg/kg	7,330 mg/kg	9,850 mg/kg	1,560 mg/kg	192 mg/kg	703 mg/kg	15,600 mg/kg	7,670 mg/kg	312,000 mg/kg	886 mg/kg
Mercury	<0.0330 mg/kg	<0.0330 mg/kg	<0.0330 mg/kg	0.0750 mg/kg	<0.0330 mg/kg	<0.0330 mg/kg	<0.033 mg/kg	0.0433 mg/kg	0.05 mg/kg	0.00509 mg/kg

*highlighted cells indicate that the concentration exceeds DEQ IDTL values.

This page intentionally left blank for correct double-sided printing.



Figure 8. Aerial photo of the Empire Mill.

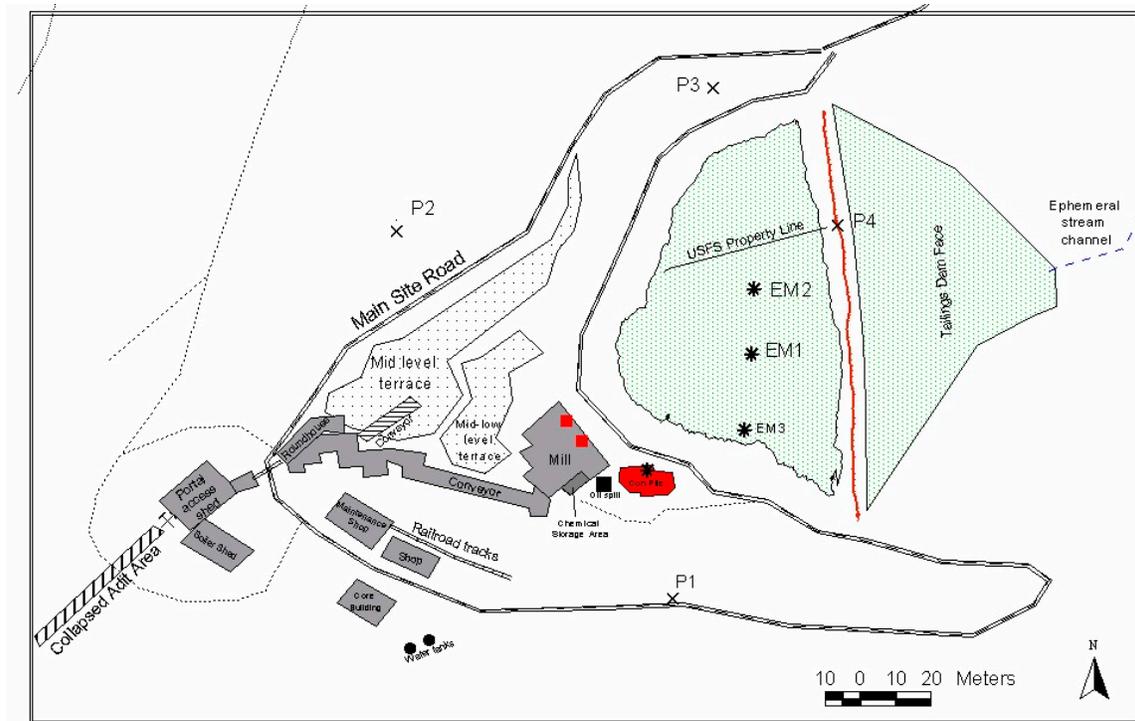


Figure 9. Site sketch of the Empire Mill site.

3.2.3 Alberta Tunnel

The Alberta Tunnel (700 foot level, Photos 12-25, Figures 10-13) is located up the mountain, south-southwest of the Empire Mill. This site contains several historic structures, waste rock dumps, and some ore stockpiles. It also includes a lower level, where there is a collapsed ore bin and another waste rock pile.

Ore was moved from the portal, along tracks to an inclined ore chute, which fed four large ore bins. It appears that the ore was sorted into the bins, located on the south side of the former Shay railroad track, while the waste rock was conveyed into a pile on the north side. Most of the ore chute and bins are gone, though some ore remains in one of the collapsed bins.

The upper waste dump, which is a common stop for tourists on the “Mackay Mine Hill Tour,” offers an amazing view of the city of Mackay. The dump is located directly off the main tour road. This site is accessible to low clearance vehicles.

A historic photograph from approximately 1910 or 1915 (Photo 12) contrasts with a photograph, taken from a similar perspective, during the 2005 field season (Photo 12). Remnants of the ore chute are still found at the site.

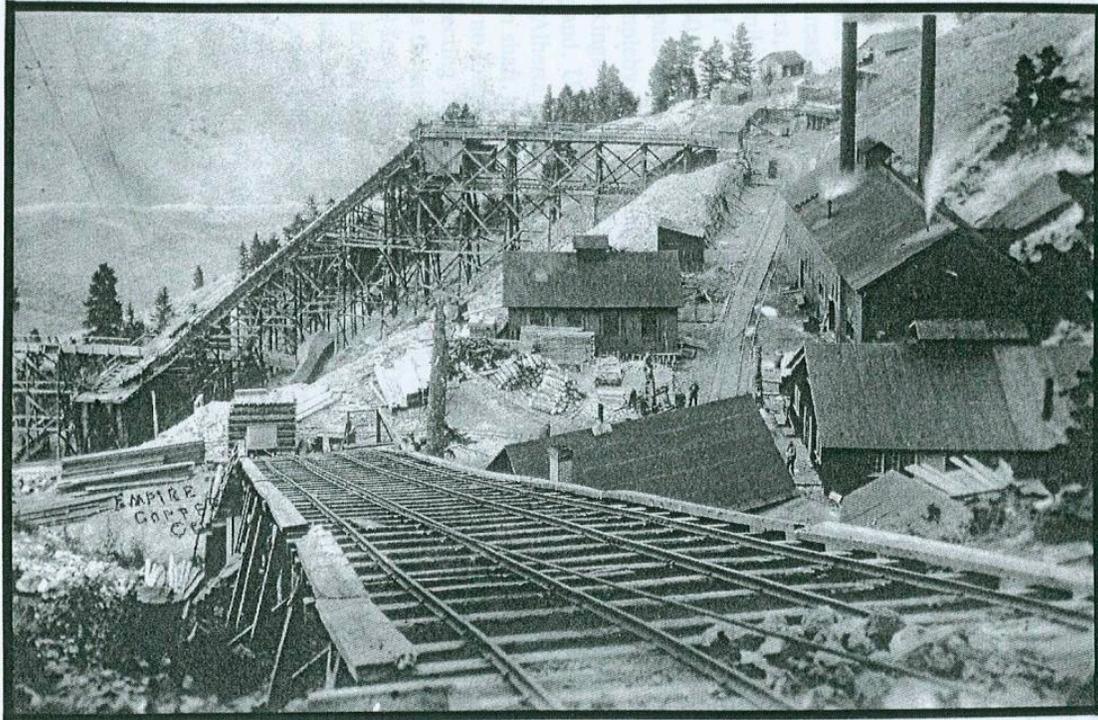


Photo 12. Alberta tunnel (700 foot level) of the Empire Mine in the early 1900's. Incline tram from 300 foot level (foreground) and the ore chute and bins in the left background. (Source: <http://mackayidaho.com/history.html>, 2005)



Photo 13. Alberta tunnel panoramic photo from P1 location (see Figure 11) in 2005.

The Alberta tunnel was a major haulage from stopes and other workings within the oxidized ore zone, primarily located up to the 300 foot level. Two main groups of ore shoots are recognized above the Alberta Tunnel: the north and south shoots:

“The ore bodies, unlike those of most contact-metamorphic replacement deposits, occur within the main igneous mass, well back from its border. Most of the production was come from shoots of ore situated from 100 to 800 feet out in the granite porphyry, and two carloads were obtained from an ore body situated 1,200 feet from the main igneous contact. No deposits of proved importance occur in the main limestone area. Each of the stopes from the Copper Bullion tunnel is bordered on one side either by limestone or its common equivalent, white marble, and on the other either by garnet rock of by granite porphyry. Limestone forms one end of the north stope above the Alberta tunnel on several

floors and garnet rock or locally granite porphyry forms the other. In the south group of stopes above the Alberta tunnel limestone is absent, but even here the garnet rock locally has a faint strataform appearance which suggests the bedding of limestone not completely metamorphosed.

Garnet rock accompanies all the important ore bodies and in most of the primary ore this mineral is the dominant constituent. The ore shoots are almost invariably bordered on one side, and in many places are completely surrounded, by garnet rock. The margins of included limestone blocks are intensely mineralized in several places, as is clearly illustrated by all the larger stopes in the Copper Bullion tunnel; and the ore bodies for 400 feet above the Alberta tunnel are very definitely related to a fissure which strikes N 20°-30° E and dips 50°-60° SE. The fissure may be traced by a pronounced gouge wherever it traverses the granite porphyry, but within the area of garnet rock it is not discernible in many places, and within the ore bodies it is entirely obliterated in the lower stopes in the north end of the mine. In the south end of the mine, however, it appears as a smooth crack, possibly post-mineral movement along a pre-mineral fault. In the Copper Bullion tunnel the ore shoots do not appear to be related to any such dominant feature”

(Umpleby, 1917, p. 45).



Photo 14. Main Alberta adit, collapsed beyond the portal.



Photo 15. Adit 2, or a possible ventilation shaft.



Photo 16. Adit 3.



Photo 17. Collapsed structures between Alberta and the Headhouse.



Photo 18. Photo taken from the P2 location (see Figure 11), facing southwest. Waste rock on the hillside above Alberta is from the North Tunnel and the 300 level.

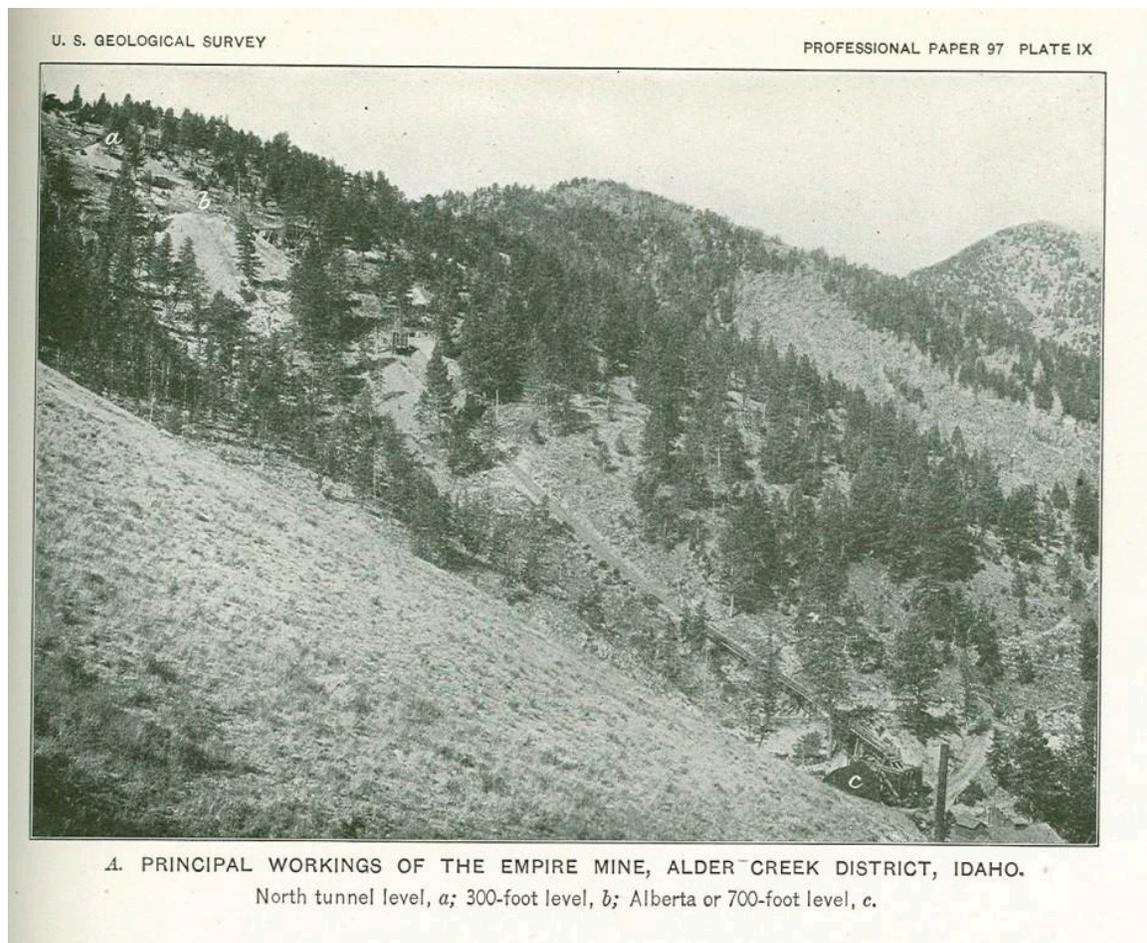


Photo 19. Historic photo of the Alberta Tunnel. The locations marked “a” and “b” on this photograph can also be seen in Photo 18, which was taken in 2005. The “c” location can be seen in photo 20.

No environmental samples were taken from this location; however estimations of the volume of waste rock were calculated. The approximate surface area for each of the piles is as follows:

- The upper waste rock pile, which is believed to be a veneer of rock on top of the natural hillside, is 0.61 acres and is estimated to be 3,000 cubic yards.
- The ore stock pile has one main pile, with the majority of area being a veneer, and is estimated to be 0.42 acres and 7,000 cubic yards.
- The lower waste rock pile comprises a conical pile with an additional veneer of waste rock down the gulch and is estimated to have approximately 10,000 cubic yards over 0.57 acres.

The upper workings (south of the road) were identified while DEQ personnel hiked this upper gulch area to identify additional adits, air shafts, and waste rock piles. Several of the areas had waste rock, but these wastes may have been the result of exploration pits or air shaft excavation, or some may have been from adits into the underground workings. Though subsequent exploration road

construction activities dispersed much of the waste rock from these workings, it is estimated the waste rock encompasses approximately 10,000 cubic yards over 1.5 acres on the hillside above the Alberta level.



Photo 20. Photo taken from P2 location (see Figure 9), looking northwest at the lower waste rock pile and the collapsed ore bin.



Figure 10. Aerial photograph of the Alberta Tunnel Level.

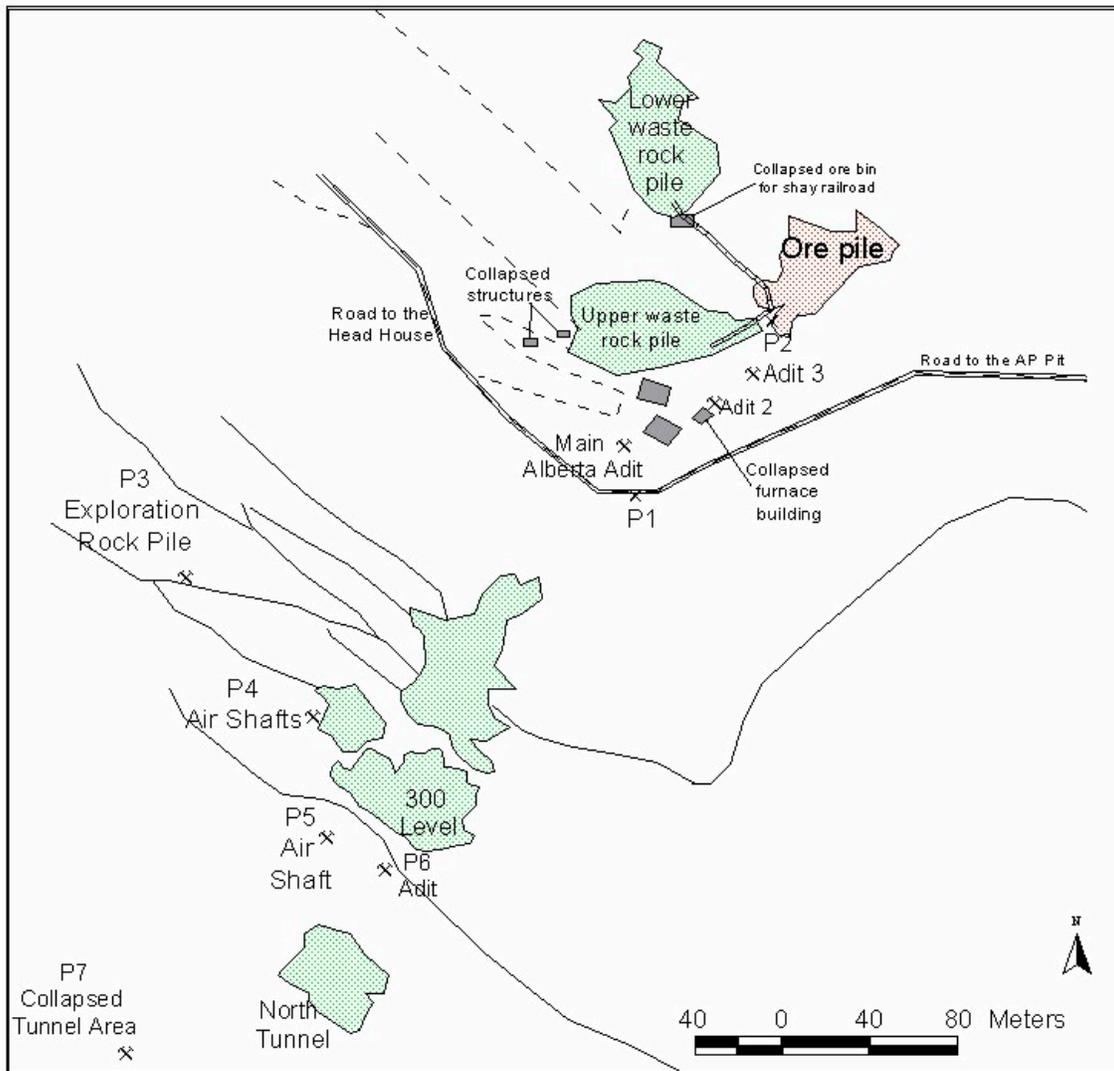


Figure 11. Expanded site sketch of the Alberta tunnel area, as well as the upper workings identified within the same gulch.



Photo 21. Exploration hole dug at the P3 location (see Figure 11).



Photo 22. Two air shafts, or "daylights," above the Alberta tunnel level at the P4 location (see Figure 11).



Photo 23. Air shaft with waste rock surround the area at the P5 location (see Figure 11). The black pipes coming out of the shaft are presumed to be circulation lines.



Photo 24. Adit located at the P6 location (see Figure 11).



Photo 25. Collapsed shaft and/or adit at the P7 location (see figure 11).

3.2.4 The “Headhouse”

The aerial tramway “Headhouse” site (Photos 26-29, Figures 12-13) contains a large and impressive structure, which was used in the early 1900’s to transport ore from the upper mountain down to the smelter located on the Big Lost River. The remaining tram station, which consists of three ore bins, loading area, and offices, is the only standing structure at this site.

Several collapsed structures still remain on site. One adit, here referred to as the “Headhouse” adit, is not specifically described in the literature, but appears to have been driven to connect with other 700 foot level workings, specifically those of the Alberta. It is assumed that this tunnel was opened following the tramway’s completion to provide better ore transfer.

The entire waste rock surface area is estimated to be 1.25 acres. The waste rock at this location was not sampled, but it appears similar in composition to the waste rock identified at the Alberta level. A waste rock ramp, estimated to be 10,000 cubic yards in volume, was constructed to carry the ore cars from the portal to the ore bins. A second volume of rock, possibly excavated during subsequent road construction, is located on the east side of the road and is estimated to be 15,000 cubic yards. A third waste rock/ore pile, estimated to be 500 cubic yards, lies against the west side of the Headhouse structure. An unknown quantity of ore may remain within the ore bins, but safety concerns prohibited this estimation.



Photo 26. View of the “Headhouse,” facing northwest.



Photo 27. Photo taken from the P1 location (see Figure 13), facing northwest.



Photo 28. Photo taken from the P2 location (see Figure 13), facing southeast.



Photo 29. Headhouse adit.



Figure 12. Aerial photograph of the tramway head house (right) and the upper and the Bullion Tunnel area (left).

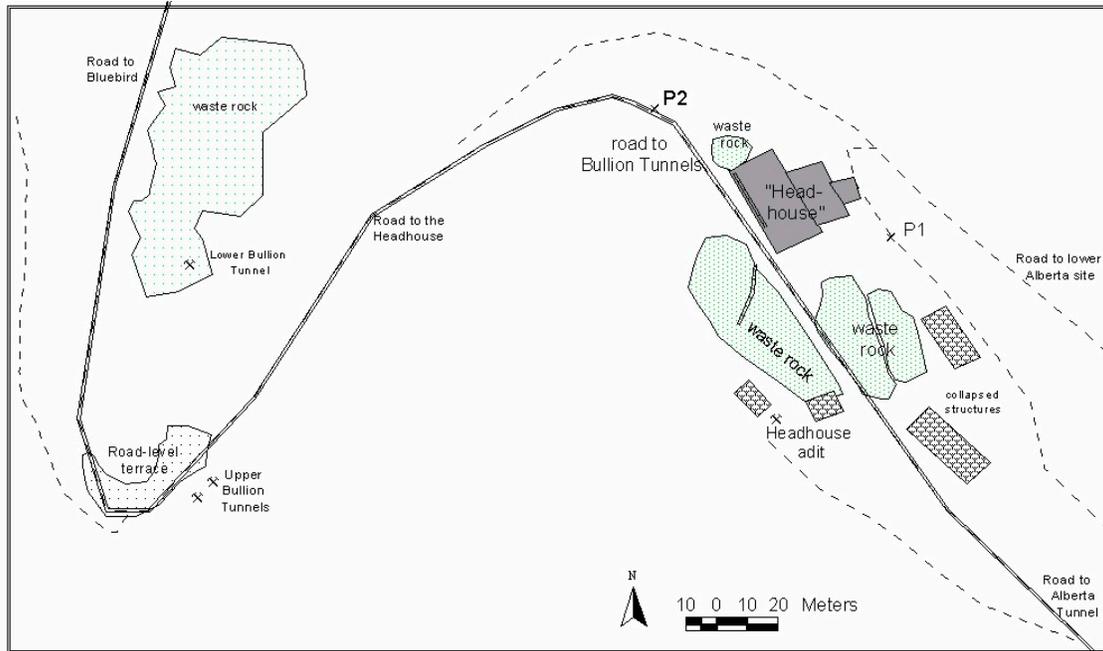


Figure 13. Site schematic of the tramway "Headhouse" (right) and the bullion tunnels (left).

3.2.5 Bullion Tunnels

The Bullion Tunnels, also known as the Copper Bullion, are located just around the corner to the west of the Headhouse. The Bullion Tunnel site contains no structures, however, there are two upper tunnels and one lower collapsed adit. There also is a large waste rock pile at the lower site, with an approximate volume of 9,750 cubic yards covering 0.65 acres. Environmental samples were not collected from this waste rock pile.

"The Copper Bullion tunnel, situated at an elevation of 7,160 feet, is about 1,600 feet long, and its laterals, raises, and winzes total perhaps 800 feet more" (Umpleby 1917). "Each of the stopes from the Copper Bullion tunnel is bordered on one side either by limestone or its common equivalent, white marble, and on the other either by garnet rock or by granite porphyry. The margins of included limestone blocks are intensely mineralized in several places, as is clearly illustrated by all the larger stopes in the Copper Bullion tunnel" (ibid, p.45). Unlike the Alberta, the Copper Bullion's ore shoots do not appear to be related to any dominant feature

(Umpleby, 1917, p. 45)



Photo 30. Main upper Bullion Tunnel.

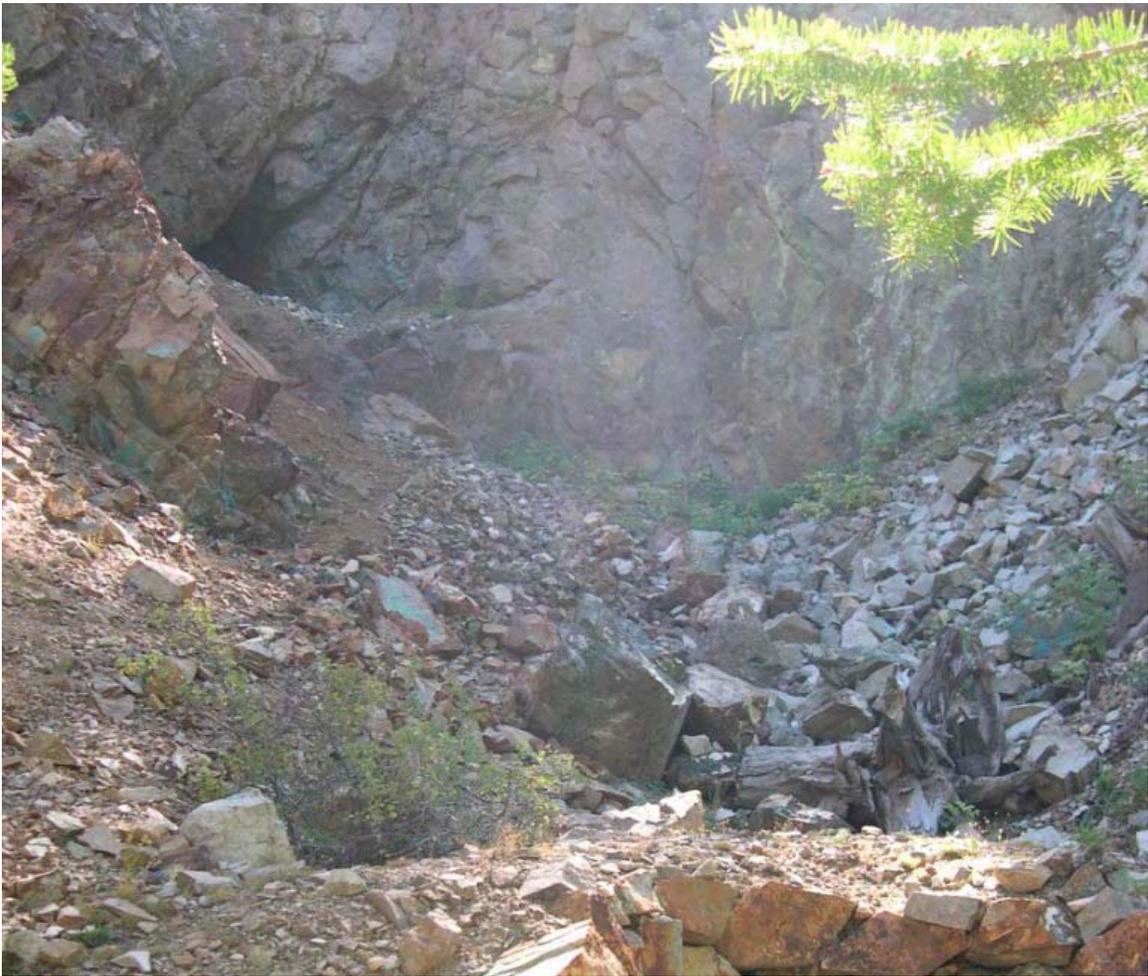


Photo 31. Second upper Bullion Tunnel.



Photo 32. The principle workings at the lower Bullion Adit.



Photo 33. Waste rock piles located below the lower Bullion Adit. This panoramic photo was taken from the road facing north.

3.2.6 Blue Bird workings

The Blue Bird Mine (Photos 34-40, Figures 14-15), also known as the Easlie Group, is located northwest of the rest of the other mine workings discussed in this assessment. The site is easily accessible by driving up the road from the Cossack Tunnel and going west at the fork in the road. All vehicle types could access this site when the roads are dry.

Several adits and open cuts, or prospect pits, were identified in this area, as well as several waste rock piles. The majority of waste rock, approximately 0.76 acres, is located on the east side of the road at a lower elevation.

No surface water was identified during the PA/SI field work, however, the type and thickness of vegetation at the east adit, as well as the channel morphology, suggests that seep and ephemeral flows come out of the adit at certain times of the year. A dry ephemeral channel was also identified in the upper workings, on the west side of the road, and is noted in Figure 15. Samples of the waste rock were not taken at this location.

On July 8, 1994, the Idaho Geological Survey (IGS) conducted a site inspection of the Blue Bird Mine. Under cooperative agreement with the U.S. Forest Service (Abandoned & Inactive Mine Program), the IGS inventoried site workings, assessed physical hazards, and evaluated potential pathway concerns. This site discovery report did not recommend that additional actions were warranted (Moye, 1994).

Mitchell (1997, pp. 35 & 42) summarized the history of the Blue Bird:

“When Umpleby (1917) visited the district in 1912, the Easlie group was developed by a shaft and several short tunnels, all of which were inaccessible. The claims covered a large limestone mass surrounded by granite porphyry. The tunnels followed the east contact between the limestone and the granite, while the shaft and several prospect pits were on the west contact. A small carload of ore, containing 30 percent lead and between 8 and 9 ounces of silver per ton, was produced in 1909 (Umpleby, 1917)...Lessees made important ore discoveries during 1925, and several lots of ore were shipped. In 1928, a lessee shipped a few hundred tons of smelting-grade sulfide lead ore and sent one carload of lead-zinc ore to a custom flotation mill at Midvale, Utah...The mine was inactive from 1929 to 1935. In 1936, production from the Blue Bird was credited with increasing the output of lead-silver ore from the district...The Blue Bird produced ore in 1938 and 1939. During 1938, Mackay Metals Consolidated was organized to consolidate the Blue Bird and several other properties adjoining the Empire Mine...According to McHugh and others (1991), the main shaft on the Blue Bird was at least 100 feet deep. Other development on the property consisted of several pits and short adits. Between 1918 and 1939, the property produced 1,530 tons of ore. From this was obtained 23 ounces of gold, 16,426 ounces of silver, 12,595 pounds of copper, 509,165 pounds of lead, and 3,111 pounds of zinc.”

Based upon direct observation, the majority of waste rock appears consistent with Umpleby’s description; granite porphyry and limestone dominates with lesser amounts of sparsely mineralized rock. The volume of waste rock is very hard to

calculate, owing to its dispersal throughout the site. A vague estimate assumes a volume of 8,000 cubic yards.



Photo 34. Panoramic photo taken from the P1 location facing north (see Figure 15).



Photo 35. Photo taken from the P2 location, facing east (see Figure 15).



Photo 36. Photo of collapsed adit taken at the P3 location (see Figure 15).



Photo 37. Photo taken at the P4 location facing north looking at the waste rock pile (see Figure 15).



Photo 38. Photo taken at the P5 location facing northwest (see Figure 15).



Photo 39. Photo taken at the P6 location (see Figure 15)



Photo 40. Photo taken at the P7 location of an air shaft (see Figure 15).

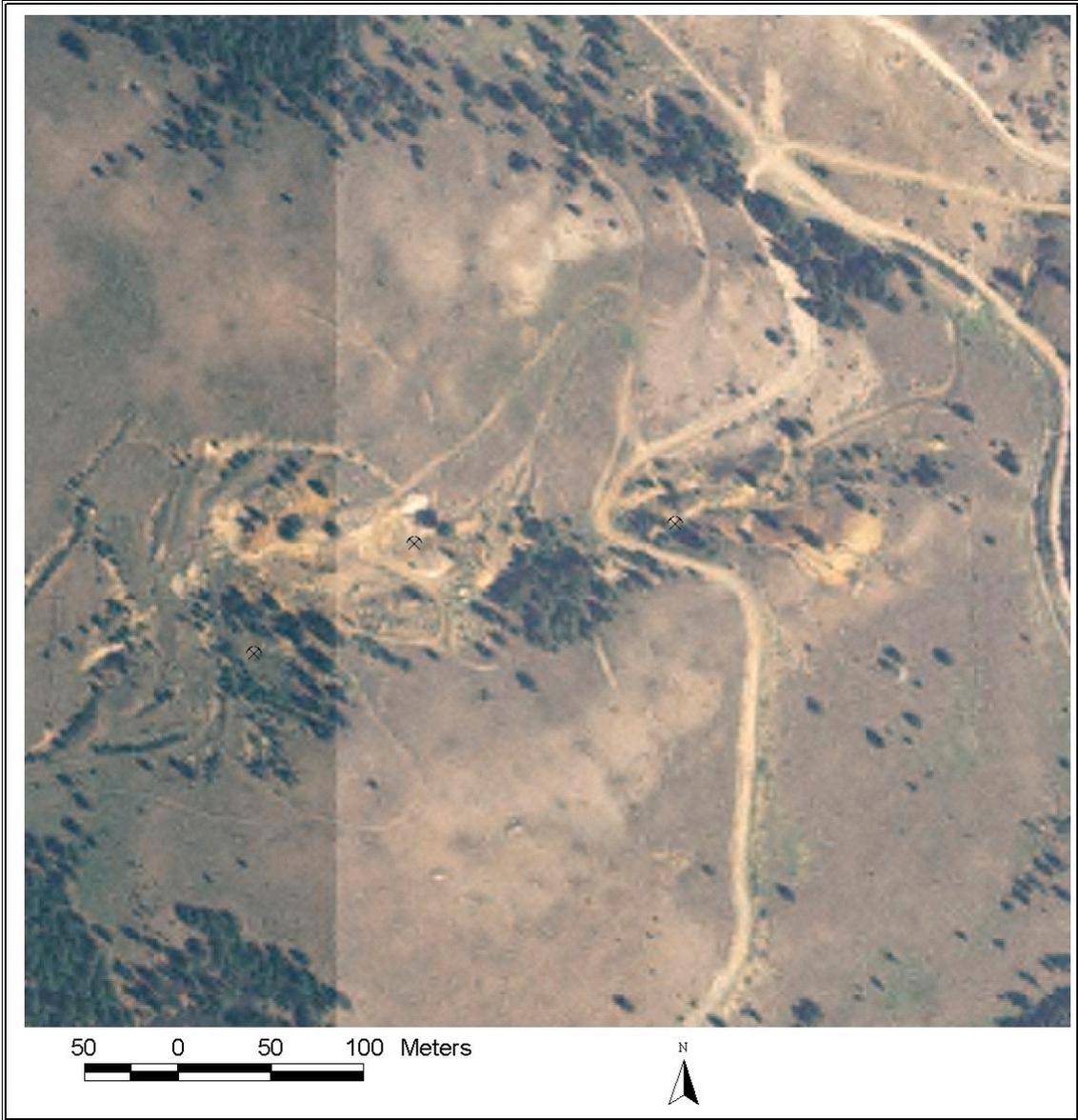


Figure 14. Aerial photograph of the Bluebird Mine Site.

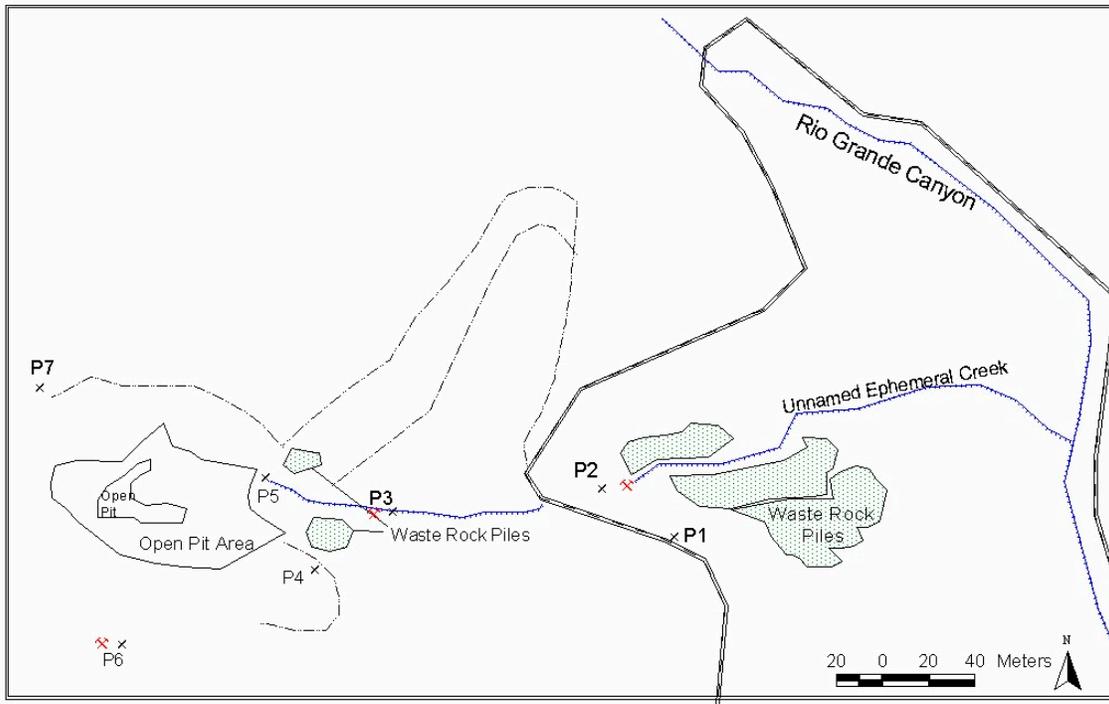


Figure 15. Site Sketch of the Bluebird Mine Site.

Section 4: Pathway and Environmental Hazard Assessment

Pathways for transport of potential pollutants, and the environmental hazards presented by these pollutants, are discussed in the following.

4.1 Ground Water

The Empire Mine property encloses a contact zone between the Paleozoic White Knob Limestone and a Tertiary granitic complex. Fossil evidence indicates the White Knob Limestone ranges from Early Mississippian to Early Permian in age (Ross, 1962, p.385). It is more than 7,300 ft. thick at the type locality in the White Knob Mountains and consists mainly of pure limestone, commonly with chert, and locally some minor non-persistent silty, sandy, and even conglomeratic beds (ibid). The Mackay Granite dominates intrusive igneous rocks, which include small bodies and dikes of andesite porphyry, quartz monzonite, diorite, and aplite. The Mackay stock grades to a porphyritic phase, along its northeastern margin, where it contacts the limestone at the Empire Mine (Farwell & Full, 1944). The contact metamorphic zone at the Empire consists of an east-dipping garnet-pyroxene-magnetite skarn, which extends more than 9,800 feet in length and nearly 1,000 feet in width (Van Angeren, 2004).

In the vicinity of the Empire Mine, Umpleby observed the dikes and veins of porphyry granite within the limestone and numerous engulfed blocks of limestone within the granite. A zone of contact metamorphism developed within the limestone along the stock boundary. Fallwell and Full noted, "Large blocks of limestone included in the granite porphyry border phase of the stock have been partly or completely converted to masses of garnet-diopside rock, know as "tactite", and a zone of white marble up to 100 feet in width has been developed in limestone adjoining the igneous bodies and tactite masses" (1944, p.7).

The limestone has been strongly folded in an "intricate and nonsystematic manner" (Nelson & Ross, 1968, p. A23), its bedding trending chiefly to the northwest. Faults and fractures within the limestone, trend chiefly to the northeast, but show only minor displacement. "A number of strong faults, striking northeast and dipping southeast, persist from level to level in the mine... They carry gouge consisting of decomposed granite porphyry, clay, and limonite with occasional white calcite, pyrite, and crushed garnet over widths of two inches to six feet or more. Most of the dikes also have a northeast trend, as do some of the stringers of garnet and sulfides. Recurrent movement has taken place along the faults and some of the dikes" (Fallwell & Full, 1944, p.13). "The dike zone which trends northeastward through the area is evidence of fracturing and faulting. The fractures in this zone must have developed between the time of emplacement of

the Mackay Granite and the time of emplacement of the dikes” (Nelson & Ross, 1968, p. A23).

“The limestone beds are not noticeably deformed by the igneous rock, which lies against them with extreme irregularity...but in the Empire workings the contact is almost vertical for 700 feet below the surface” (Umpleby, 1917, p. 32). “In the Mackay deposits oxidation extends several hundred feet below ground-water level. Near the outcrops water stands in workings less than 100 feet deep, but ground waters circulate to much greater depths...The south Alberta shoot has been explored to a vertical depth of 700 feet and the ores are oxidized throughout. At what level water would stand in this shoot is not known, as the Alberta tunnel drains it, but near-by shafts contain water at a depth of 30 or 40 feet, and at the time of visit water stood in the under-hand stopes from the “big quarry” on the hill above it“ (ibid, p.67).

The literature suggests that the fracturing and faulting occurred prior to mineralization. The resulting shear zones enabled oxidation of the ore zone to extend to the 700 foot level of the Empire. Evidence of ground water movement through the oxidized zone, as reported by Umpleby, was verified during the PA/SI field work by DEQ personnel. The presence of berry bushes growing in moist ground near the Alberta portal suggests an active seep from this level. The lack of oxidation within the Cossack Tunnel also suggests that the shear zone is not persistent at depth, thus severely hampering ground water movement.

The basic geology and lithology for the Alder Creek Mining District are presented in Figures 16 and 17, respectively.

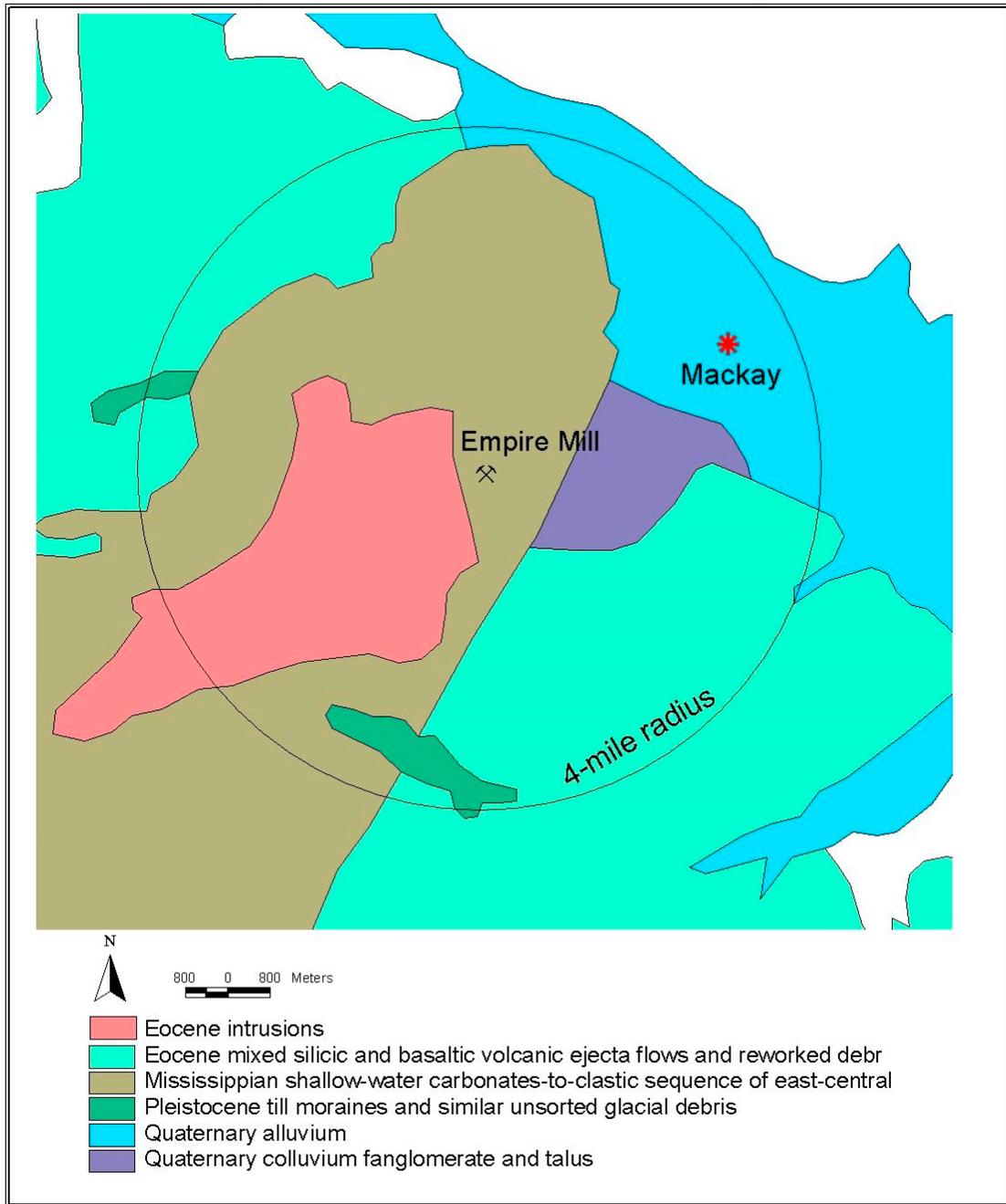


Figure 16. Basic geology of the Alder Creek Mining District.

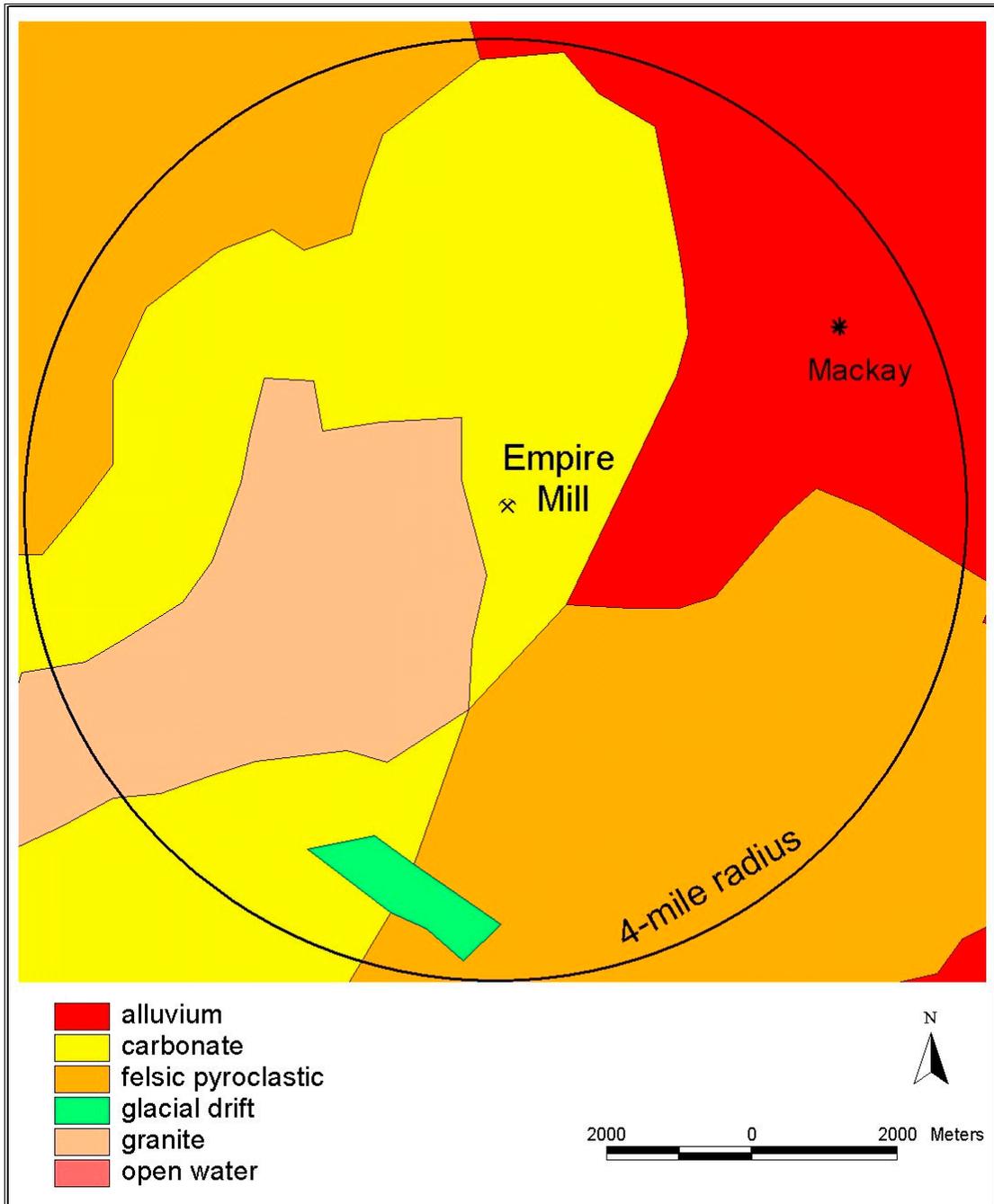


Figure 17. Basic lithology of the Alder Creek Mining District.

Ground water use within a 1-mile radius of the Empire Mill is minimal, with only one domestic, single residential well located on the 1-mile perimeter. Within a 4-mile radius of the mine hill, however, there is extensive ground water domestic use, as the city of Mackay is within this boundary. There are roughly 83 wells within a 4-mile radius of the site, two of which are public water system wells for the City of Mackay.

Mackay's drinking water is supplied by two ground water wells located within town and a spring located just down the Smelter road from the Alder Creek mining district.

DEQ completed the Source Water Assessment (SWA) Final Report for these wells in April of 2003 (DEQ 2003). The SWA identifies public drinking water sources, zones of water contribution, and any potential sources for contamination within these zones.

The SWA for the Mackay wells states that the community water system supplies approximately 650 people. Delineation of the water supplies is done as part of the SWA, using a hydrologic model to determine the "time of travel" (TOT) zones for each drinking water supply source. "The delineated area for the City Spring is three concentric circles that cover an area of 20 acres for the 3-year TOT zone, 23 acres for the 6-year TOT zone, and 35 acres for the 10-year TOT zone." (DEQ 2003) (The figure used to illustrate the delineated area in the SWA is included in Appendix C of this document.)

The two ground water wells, located within Mackay, used for the city drinking water supply were assigned TOT zones. "Each of the resulting 4.3 mile-long capture zones encompasses an approximate area of 2 square miles (1.4 square miles for the 0- to 3-yr travel times and 0.6 square mile for the 3- to 6-yr travel times)" (DEQ 2003) Each of these figures are also presented in Appendix C.

The work presented in the SWA indicates that it is unlikely that the mining activity higher on the mountain would impact the public drinking water supply for the city of Mackay. At this point, individual domestic wells are located far enough away that it is also unlikely that they would be impacted. This situation could, however, change as residential development occurs at higher elevations on the mine hill. The domestic well, which is located approximately 1 mile away from the site, is located in a separate canyon and is most likely hydro-geologically separate from the alder creek mining area.

4.2 Surface Water

The closest perennial stream, one which flows year round, to the Alder Creek Mining District is the Big Lost River, located approximately three miles away. The entire sub-watershed in which the mining district is located is dominated by ephemeral drainages (Figure 18).

These ephemeral drainages include Horseshoe Canyon and Bullion Gulch, which are both tributaries of the Rio Grande Canyon, itself a tributary of the Big Lost River. During DEQ field visits to the site, water was not observed flowing in the lower Rio Grande Canyon, and discussions with local Mackay residents implies that in recent history water has never been seen flowing in the lower Rio Grande Canyon. However, the existing channel morphology implies that, historically, water has flowed through the entire canyon from the headwaters to the Big Lost River.

The probable point of entry (PPE) for each mine site to surface water is presented in Table 5. This data is displayed to show the PPE for the closest ephemeral channel as well as distance and path to the Big Lost River, as this is the closest perennial stream to these mining sites.

Table 5. Surface Water Probable Point of Entry (PPE) Distances.

Site	Pathway to PPE for surface water	Total Approximate Distance to the Big Lost River
Cossack Tunnel	From its location on the Rio Grande Canyon to the Big Lost River	2.6 miles
Empire Adit	Down an unnamed gulch (0.44 mi) to the Rio Grande Canyon, then to the Big Lost River (2.68 mi)	3.12 miles
Alberta Tunnel	Down an unnamed gulch (0.28 mi) to Empire Mill site, then follows same pathway as the Empire Mill site	3.4 miles
Headhouse Adit	Down an unnamed gulch (0.29 mi) to Empire, then follows same pathway as the Empire Mill site	3.41 miles
Bullion Gulch	Down Bullion Gulch (0.63 mi) to Rio Grande Canyon, then to the Big Lost River (3.12 mi)	3.75 miles
Bluebird Adit	Down an unnamed gulch (0.13 mi) to the Rio Grande Canyon, then to the Big Lost River (3.65 mi)	3.78 miles

During the 2005 field season, water was documented flowing in the upper Rio Grande channel, both adjacent to and up-gradient of the Cossack Tunnel, and was sampled by DEQ personnel in April. Sample results are presented in Table 6.

The flow in the channel was caused by snowmelt runoff and persisted for only a short period of the day. No riparian vegetation was present in these channels as they were primarily characterized by sagebrush.

Horseshoe Canyon was found to have flowing water at the road crossing during the DEQ site visit on September 7, 2005 and was sampled at that time. Riparian vegetation, such as willows, suggests that water flows in this canyon the majority of the year.

None of these water bodies, including the Big Lost River, is used for public or private drinking water systems. The primary water use of surface water from the Big Lost River is for irrigation of farmlands.

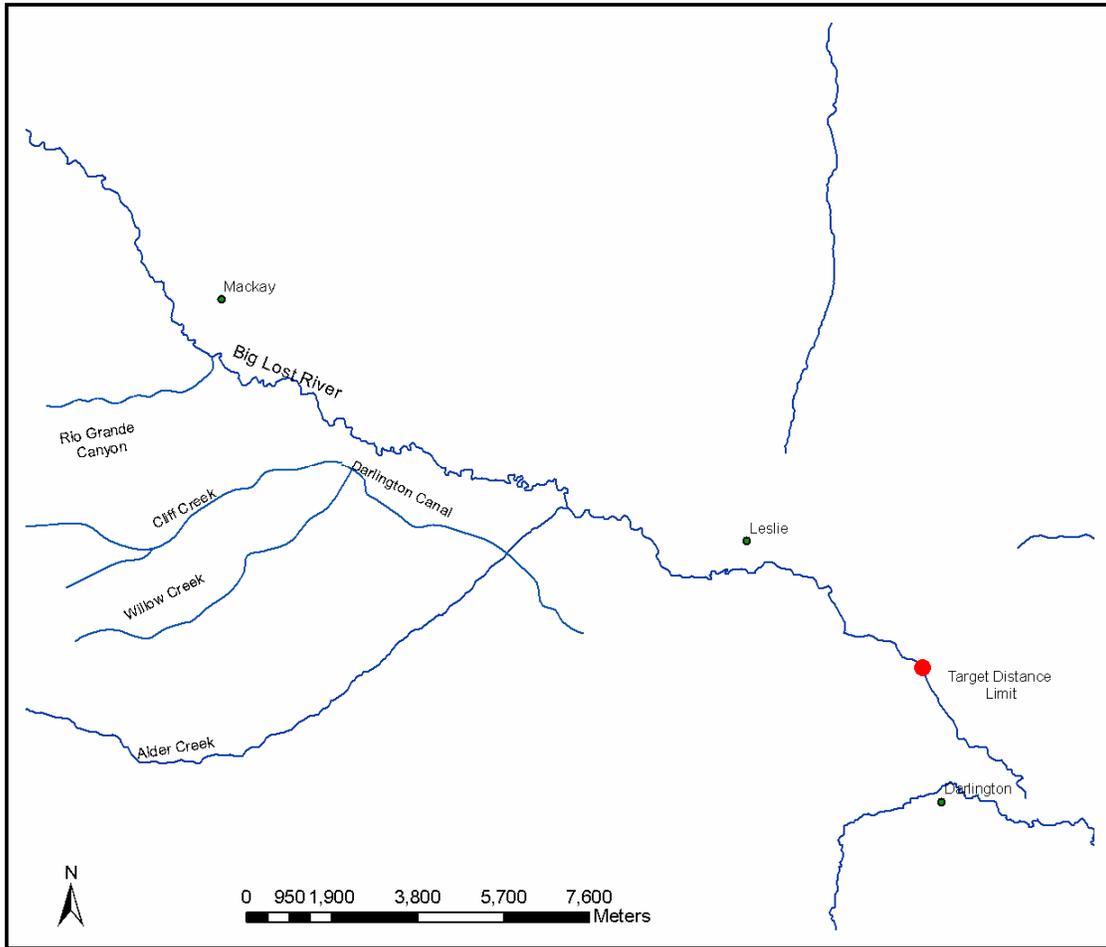


Figure 18. View of the Total Distance Limit for surface water (15 miles downstream of the Alder Creek Mining District).

4.2.1 In-water Segment

There are no drinking water intakes within the 15-mile Total Distance Limit (TDL) shown in **Error! Reference source not found.**18. The following TDL in-water segment was calculated from the Cossack Tunnel location (see Table 5).

Traversing eastward down Rio Grande Canyon, the surface water pathway merges with the Big Lost River at 2.6 miles (see Table 5). At 3.2 miles the river's flow is partially diverted into the south flowing Darlington Ditch and at 3.9 miles into the east flowing Burnett Ditch. An unnamed stream enjoins from the east at 7.75 miles, Alder Creek enjoins from the west at 8.25 miles, Spring Creek enjoins from the north at 9.75 miles, an unnamed stream enjoins at 11.25 miles from the south, and another branch of Spring Creek enjoins at 11.6 miles from the north. At 12.4 miles the river's flow is partially diverted into the east flowing Beck and Evan Ditch, at 13.6 miles into the south flowing Blaine Canal and is enjoined by an unnamed stream at 14.75 miles. The Big Lost River continues to the southeast for the remainder of the 15-mile TDL.

The Big Lost River, which is located within a 4-mile radius of the site, supports brook trout, rainbow trout, cutthroat trout, whitefish and sculpin (IDFG 2001). This portion of the river has not been listed for any pollutants through the water quality assessment process and therefore did not have any Total Maximum Daily Loads (TMDLs) developed for it by DEQ in 2004, when the TMDL was completed for the Big Lost River watershed.

4.2.2 Sample Analysis

As stated earlier, surface water quality samples have been collected from ephemeral creeks on Mine Hill, as well as from the Big Lost River. Sample locations are presented in Figure 19, while the data results are presented in Tables 6 and 7.

Sample results for the Cossack Tunnel and Horseshoe Creek are compared to Idaho's ground water standard, which is based on human health as opposed to aquatic life. The ground water standard is used as the comparative standard for these sample locations because the water in these ephemeral creeks does not contain any fisheries, nor does it merge with any other surface water before it sinks into the subsurface.

The water samples taken on the Big Lost River, however, are compared to Idaho's surface water quality criteria, as this river is considered to be "Waters of the State" and has a vital fishery.

Table 6. Upper Mine Hill Surface Water Sampling Results.

	Sample Result (Total)			Idaho Ground Water Standard (IDAPA 58.01.11) MCL (mg/l)
	Horseshoe Creek	Upper Rio Grande Below the confluence with Horseshoe Creek	Lower Rio Grande at Cossack Tunnel	
Date	9/7/2005	4/13/2005	4/13/2005	
Hardness	48.3		290 mg/l	
Silver	<0.0050	0.00033	0.00881 mg/l	0.1
Arsenic	<0.025	0.0114	0.0932 mg/l	0.05
Cadmium	<0.0003	0.00229	0.0719 mg/l	0.005
Copper	<0.003	0.065	2.85 mg/l	1.3
Iron		7.67	55.2 mg/l	0.3
Mercury	<0.0002			0.002
Lead	0.00066	0.217	4.33 mg/l	0.015
Selenium	<0.005	<0.003	0.0076 mg/l	0.05
Zinc	<0.01	0.261	10.9 mg/l	5

*Hardness is calculated from Calcium and Magnesium Concentrations

*CMC = Criterion Maximum Concentration is defined as the maximum instantaneous or one (1) hour average concentration and should adequately protect aquatic organisms from acute toxicity if not exceeded more than once every three (3) years. This is equivalent to "acute criteria".

*CCC = Criterion Continuous Concentration is defined the four (4) day average concentration of a toxic and should adequately protect aquatic organisms from chronic toxicity if not exceeded more than once every three (3) years. This is equivalent to "chronic criteria".

*Highlighted cells indicate that the concentration exceeds the MCL.

Table 7. Big Lost River Surface Water Quality Sample Results in mg/l.

Constituent of Concern	Big Lost River Down Gradient of Rio Grande channel			Big Lost River (UG) at the Bridge on Smelter Road			Idaho's Surface Water Standard, adjusted for hardness (IDAPA 58.01.02)	
	Sample Result (Total)	Sample Result (filtered)	Sample Result (filtered)	Sample Result (Total)	Sample Result (filtered)	Sample Result (filtered)	CMC	CCC
	9/7/2005		8/26/2005	9/7/2005		8/26/2005		
Hardness	134			135				
Silver	<0.0050	<0.0050	<0.005	<0.0050	<0.0050	<0.005	0.006	
Arsenic	<0.025	<0.025	<0.003	<0.025	<0.025	<0.003	0.36	0.19
Antimony			<0.005			<0.005		
Barium	0.0969	0.0944		0.096	0.0929			
Beryllium			<0.002			<0.002		
Cadmium	<0.0003	<0.0003	<0.002	<0.0003	<0.0003	<0.002	0.005	0.00129
Chromium	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006		
Copper	<0.003	<0.003	<0.003	<0.003	<0.003	0.01	0.022	0.01
Iron	<0.06	<0.06		<0.06	<0.06			
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.002	0.000012
Lead	<0.00055	0.0028	<0.003	<0.00055	<0.00055	<0.003	0.089	0.00348
Selenium	<0.005	<0.005	<0.003	<0.005	<0.005	<0.003	0.018	0.01
Zinc	<0.01	<0.01	<0.005	<0.01	<0.01	<0.005	0.147	0.13

*Hardness is calculated from Calcium and Magnesium Concentrations

*CMC = Criterion Maximum Concentration is defined as the maximum instantaneous or one (1) hour average concentration and should adequately protect aquatic organisms from acute toxicity if not exceeded more than once every three (3) years. This is equivalent to "acute criteria".

*CCC = Criterion Continuous Concentration is defined the four (4) day average concentration of a toxic and should adequately protect aquatic organisms from chronic toxicity if not exceeded more than once every three (3) years. This is equivalent to "chronic criteria".

This page intentionally left blank for correct double-sided printing.

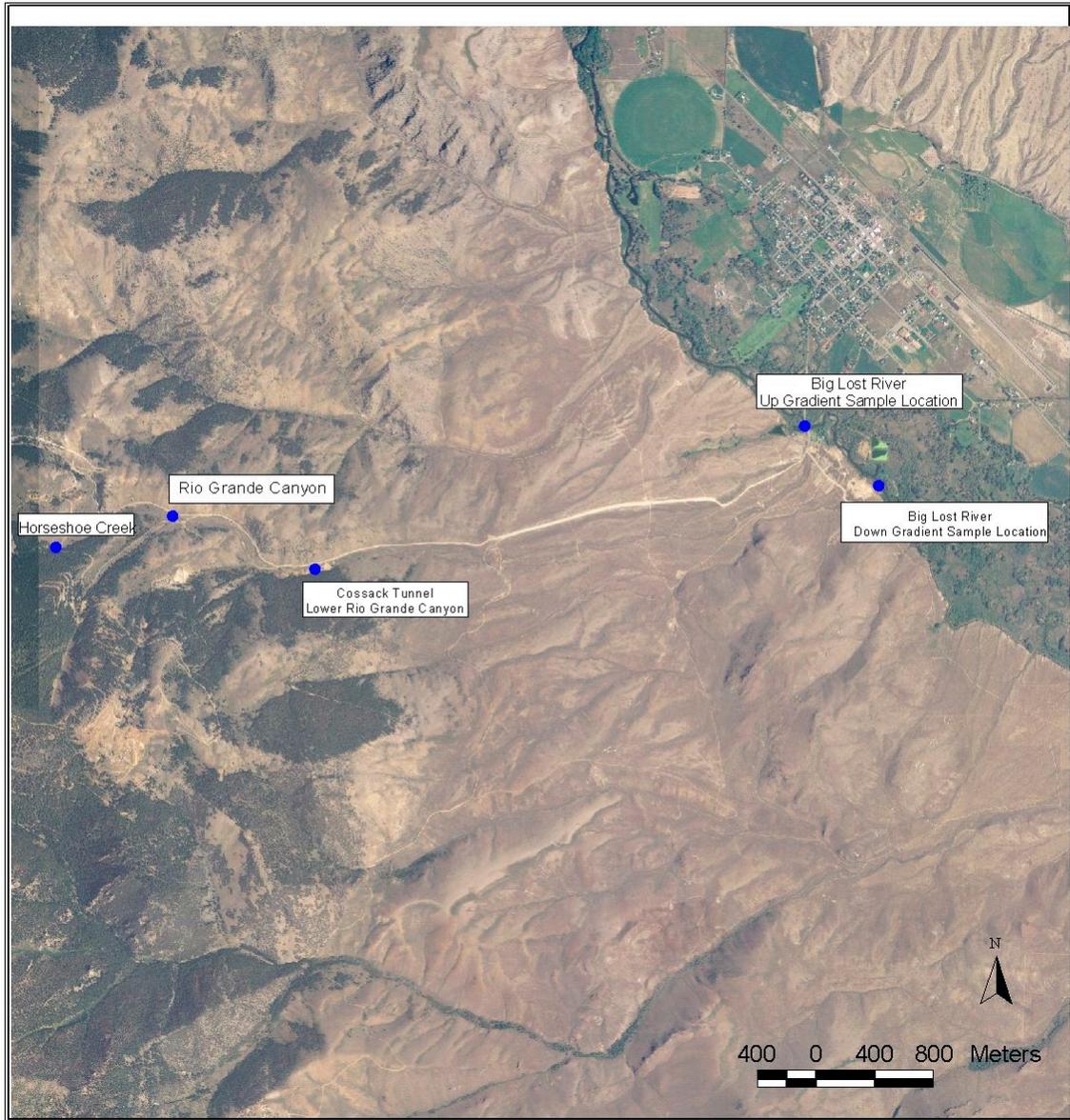


Figure 19. Location of all surface water sampling.

4.3 Soil Exposure and Air

There are no current residences, schools, or daycare facilities within 200 feet of any of the mines in the Alder Creek Mining District that have been assessed in this PA/SI.

There are no current working populations at the site, as there is no mining operation or other industry taking place at this time. There is some exploration work taking place within this sub-watershed for potential future mining operations, however, workers in this regard would only be at the site for a limited time period for a one-time exposure.

Recreational use is the primary activity at these sites, currently, and this activity is discussed in further detail in Section 2.2.

The primary population within a 4-mile radius of the site is the town of Mackay. Property along the west side of the Big Lost River and up the Smelter Road is being subdivided, and individual homes are being built, decreasing the distance between year-round residential populations and the mining activity on the hill.

The City of Mackay reports having 566 full time residents in the year 2000, 180 of whom were below the age of 19. The two largest employers are the school district and the Idaho National Laboratory (INL), with angling-related jobs as the third largest employment sector. These statistics indicate that a future potential economic base is in tourism.

Currently, real estate is being advertised as “just over the hill from Sun Valley” and, the area could eventually be discovered as a resort community for outdoor activities and vacation homes. (Mackay Action Center 2005) Real estate development and sales are rising in the area over the past couple of years due to a large tract of land along the Big Lost River and the Smelter road being recently subdivided (Prichard 2005). Residential development on or in proximity to inactive and abandoned mines has resulted in numerous inquiries by local realtors and potential buyers regarding the risks associated with mine properties.

Development of these types of properties around the state has often resulted in the discovery of hazardous wastes and materials by potential buyers and developers, which indicates the rising numbers of potential receptors and risks at these sites.

Deer have been identified on site, based upon both visual observation along the Smelter Road and by hoof prints found directly in the tailings at the Empire Mill site. Deer are believed to be attracted to the inorganic salts that form on the mine waste piles.



Photo 41. Deer along the Smelter Road in April 2005.



Photo 42. Deer hoof print in the tailings at the Empire Mill on August 17, 2005.

The species of concern within a 4-mile radius of the site have been identified by the Idaho Department of Fish and Game, and these include the Lost River milkvetch (unconfirmed presence), lynx (unconfirmed specimen), Welsh's buckwheat (unconfirmed presence), and the Townsend's big-eared bat (confirmed trapped specimen). Figure 20 shows the identified habitats of species of concern as well as the potential wolf range and the wetlands environment along the Big Lost River.

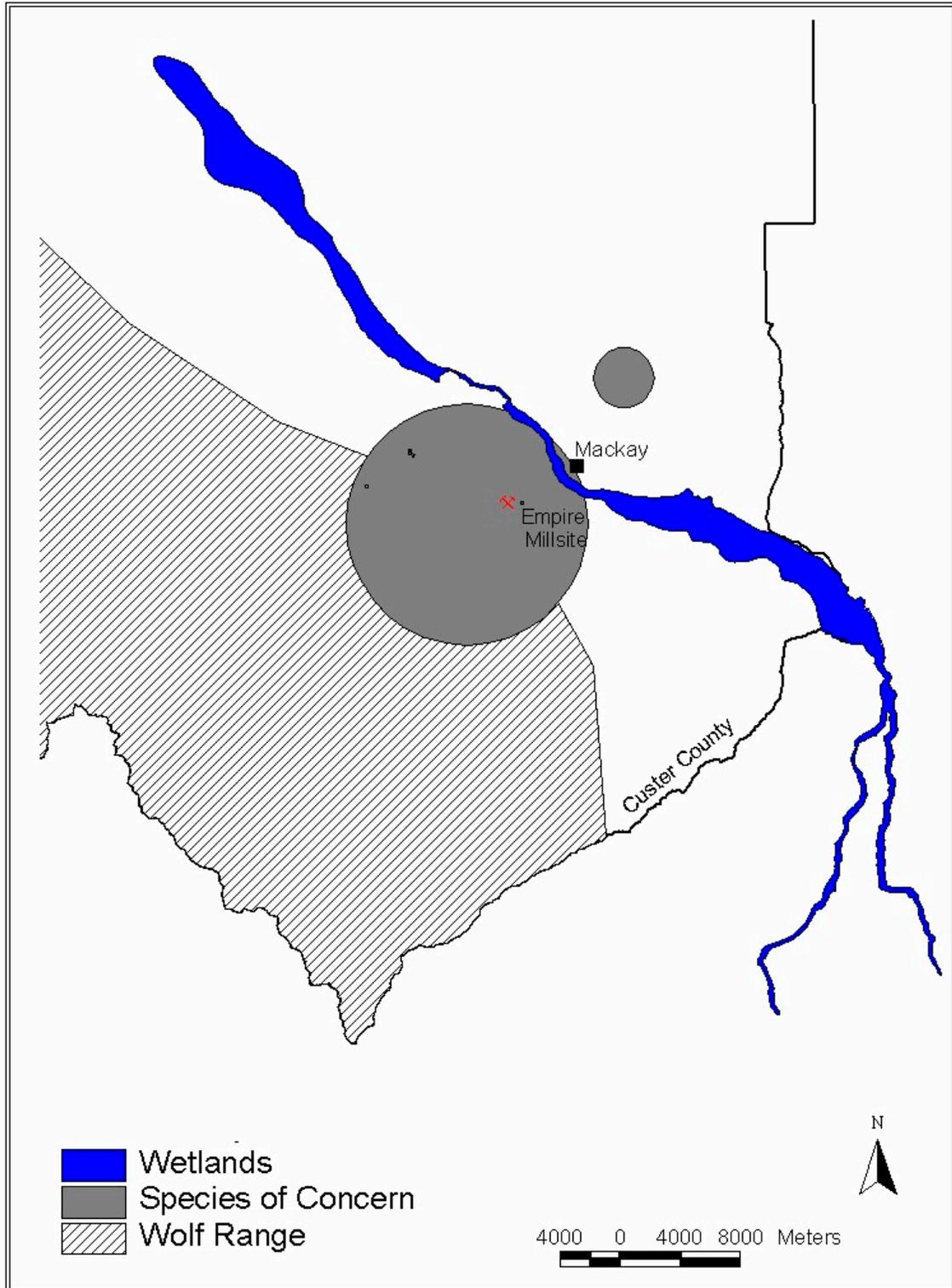


Figure 20. Sensitive environments in the Alder Creek Mining District vicinity.

A compilation of the total estimated volumes of waste rock, ore, and tailings are given in the Table 8. Additional information about these volumes is located in Section 3.2.

Table 8. Total approximated values of tailings and waste rock in the Alder Creek Mining District.

Location	Total Volume of Tailings	Total Volume of Waste Rock and Ore
Cossack Tunnel	10,200 yd ³	5,420 yd ³
Empire Mill	48,249 yd ³	30,000 yd ³
Alberta Tunnel	none	30,000 yd ³
Headhouse	none	3,000 yd ³
Bullion Tunnel	none	9,750 yd ³
Blue Bird	none	8,000 yd ³

Sediment samples were taken from both the Cossack Tunnel and the Empire Millsite. The results for each of these sampling events are presented in Section 3.2. The sites of the primary potential airborne contaminants include the Cossack Tunnel, the Empire Mill site and the Bluebird workings due to the size and exposure of the materials left on site.

Precipitation on the Mine Hill ranges from 17-27 inches per year, the majority of which is snowfall (Figure 21).

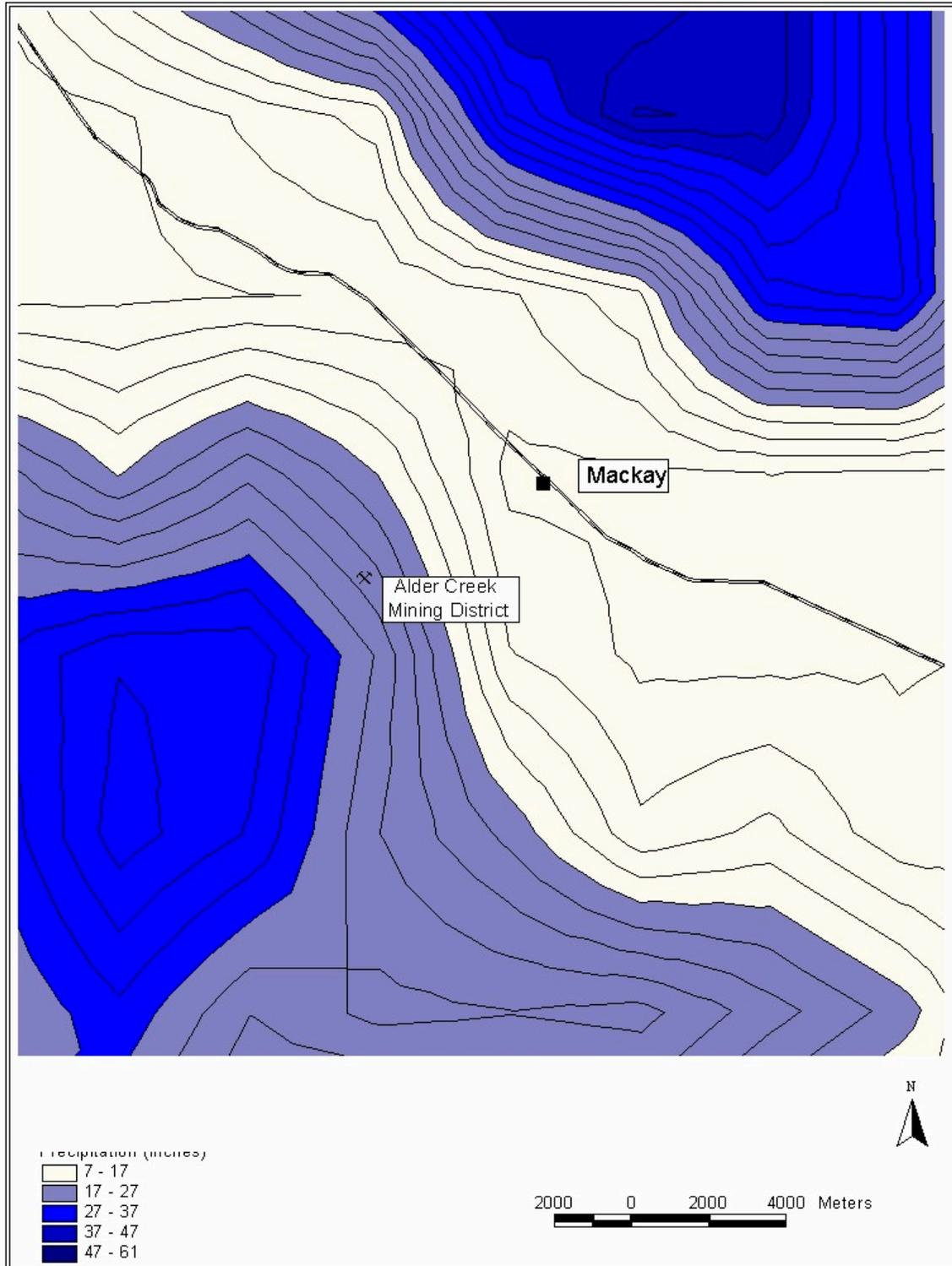


Figure 21. Precipitation in the Alder Creek Mining District.

The primary mobility of the tailings appears to be due to wind erosion. One characteristic of mountainous areas, such as Mine Hill, is the daily (afternoon) occurrence of intense thermally generated winds. These winds, and the very dry

conditions of mill tailings, results in airborne suspension and transportation of metal-bearing dust.

This wind-borne dust is viewed by DEQ as perhaps the most important exposure route for tourists on Mine Hill and residents of Mackay, and it should be closely evaluated for actual risks. During a DEQ site tour to an adjacent mining site on October 27, 2003, DEQ personnel Katy McKinley and Rensay Owen documented tailings being mobilized out of the tailings pond at this site. Again, on August 17, 2005, both Brian Gaber and Katy McKinley were on site performing the PA fieldwork when wind mobilized large amounts of tailings off of the tailings impoundment.



Photo 43. Photo taken by DEQ personnel on 10/27/03 looking up at the front of the tailings impoundment of the Empire Mill as tailings are mobilized by wind.



Photo 44. Photo taken of vegetation on the tailings dam as evidence of aeolian deposition of tailings.

4.3.1 Risk Analysis of Empire Mill Soils

To identify risks to human health from the Empire Mill soils, DEQ performed the following risk evaluation using the DEQ 2004 Risk Evaluation Manual (REM). This analysis is based on exposure to surface soils, and it utilized the following sample data from the tailings pond and the exterior concentrate ore pile: EM1-A, EM2, EM3, and EM-Con. Pile.

4.3.2 Exposure Parameters

It is assumed that recreational visitors have the potential to contact contaminants at the site while hiking and riding mountain bikes or ATVs. Exposure routes, in decreasing order of significance, are incidental soil ingestion, inhalation of particulates, and dermal contact. Several of the residential receptor exposure parameters in the REM software were modified as indicated in Table 9 to estimate exposure more characteristic of a recreational exposure scenario.

Table 9. Modified exposure parameters for recreational scenario.

Receptor	Residential Scenario			Recreational Scenario		
	Exposure Frequency (days/year)	Outdoor Exposure Time (hours/day)	Soil Ingestion Rate (mg/day)	Exposure Frequency (days/year)	Outdoor Exposure Time (hours/day)	Soil Ingestion Rate (mg/day)
Child	350	2	200	15	4	300
Adolescent	350	2	100	15	4	100
Adult	350	2	100	15	4	100

Adjusted exposure parameters are based on professional judgment as well as published literature. For example, the recreational child soil ingestion rate of 300 milligrams per day (mg/day) represents the 90th percentile intake based on a study that measured soil ingestion rates for children at campgrounds (van Wijnen et al., cited in EPA 1997). This intake rate is considered by EPA Region 10 to be an appropriate value for intermittent recreational exposures (EPA 1999).

It is assumed that adolescents and adults will have lower intakes. It is important to understand that changes in any of the exposure parameters can alter risk estimates significantly. For example, an assumption that receptors spend eight rather than four hours per day at the site would result in a doubling of the risk estimate.

4.3.3 Risk Estimates

Both cancer risk and non-cancer risk (hazard index) are shown in Table 10. The age-adjusted receptor represents an individual who visits the site over 30 years, six times as a child, nine times as an adolescent, and fifteen times as an adult. The risk estimates are based on the highest concentration from the samples indicated; sample size was too small to calculate the 95% upper confidence limit.

Table 10. Risk estimates with and without exposure to the exterior concentrate pile.

EM1-A, EM2, EM3, Con Pile				EMI-A, EM2, EM3			
Child		Age-Adjusted		Child		Age-Adjusted	
Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index
4.94E-5	5.02	6.67E-5	1.33	4.94E-5	1.91	6.67E-5	0.512

Note: The preliminary risk estimates are based on exposure only to the Empire Mill tailings pond and concentrate ore pile. A full risk analysis of the Empire Mine would require additional characterization of all tailings and waste rock areas, as well as estimates of background concentration in unexpected areas.

Representative concentrations could then be weighted according to assumed exposure times in the different areas, based on a consideration of the interest different areas would hold for different activities: visitors on a historical tour might be expected to visit different areas than mountain or dirt bikers. The former receptors would be expected to spend some time hiking and exploring structures, and some time in vehicles traveling between different features. Receptors on bikes or ATVs would be attracted to different terrain features and would be expected to have greater exposures to surface soil.

4.3.4 Discussion

Cancer risk at the Empire Mill is driven by arsenic concentrations. Metal concentrations are generally higher in the concentrate pile than in the tailings, but the highest arsenic concentration is sample EM2, so the risk is the same whether or not exposure occurs to the concentrate pile.

Cancer risk for both child and age-adjusted receptors is greater than the acceptable level of $1E-5$ defined by the REM, although less than the upper end of the National Contingency Plan risk range ($1E-4$). Non-cancer hazard is above the acceptable level (a hazard index of one), with exposure to the concentrate pile. When exposure is based on the tailings pond only, non-cancer hazard drops into the acceptable range for the age-adjusted receptor, while it is still greater than one (1) for the child receptor.

The concentrate pile was considered separately due to its lesser volume and because the concentrations of most metals are higher in the pile. The concentrate pile could be addressed separately as a risk management option. When the concentrate pile is removed from the analysis, exposure to several metals, particularly cadmium and zinc, is decreased considerably.

4.3.5 Uncertainty

The risk estimates presented here are based on one area and may not be representative, as it is unlikely receptors would repeatedly spend so much time in this one area over an exposure duration of many years. Concentrations of metals in waste rock piles at the Cossack Tunnel area are lower, with the exception of mercury, which is high enough to warrant further characterization of that area. Concentrations of metals in the Empire Mill tailings are high enough to warrant additional characterization, followed by a more detailed risk analysis.

The analysis presented here assumed that all of the arsenic is 100% bioavailable. It is likely that bioavailability varies in soils throughout this site; 60% arsenic bioavailability has often been assumed for arsenic in soils contaminated with mine waste. Assuming 60% bioavailability would drop the highest risk (for the age-adjusted receptor exposed to tailings and the concentrate pile) from almost $7E-5$ to about $4E-5$.

Moreover, the analysis presented here did not assess risk from lead, as that would require use of the EPA Integrated Exposure Uptake Biokinetic (IEUBK) Model to assess risk of unacceptable blood lead levels in children and the Adult Lead Model to assess unacceptable blood lead in fetuses of adult visitors. At the Empire Mill site, surface lead concentrations ranged up to 2,900 mg/kg in the tailings pond to 7,310 mg/kg in the concentrate ore pile. Depending on exposure variables, concentrations at this level could be associated with unacceptable risk from lead. It is recommended that further characterization of the overall site soils be performed to assess the potential for visitors to experience an unacceptable increase in blood lead concentrations.

This page intentionally left blank for correct double-sided printing.

Section 5: Summary and Conclusions

The Alder Creek Mining District, or “Mine Hill,” comprises many mining sites. The predominant mine workings, and those most frequently visited by the public, were assessed in this preliminary assessment/site inspection (PA/SI). These are the Cossack Tunnel, the Empire Mill, Alberta Tunnel, Tramway “Headhouse,” Bullion Tunnel, and the Blue Bird workings. The easy access to these sites, due to their close vicinity to the town of Mackay, Idaho, as well as the quality of roads to the sites, makes them a favorite local attraction for recreational use.

Through the fieldwork and research presented in the PA/SI, the primary exposure pathways of soils and air have been identified as the main exposure routes for potential receptors. Surface water is a potential receptor during a small portion of the year for human health and terrestrial creatures; however, these ephemeral creeks do not appear to support any type of aquatic life. When flowing, however, it is reasonable to assume that wildlife may use these creeks for drinking water.

Both the local geologic research and the Source Water Assessment (SWA) performed for this area indicate that current residential ground water users are not likely to be exposed from the leaching of mine wastes. Ground water flow appears to move very slowly throughout this area. The abundance of carbonate rock amid the sites has a buffering capacity for most metals. At this time, the data indicate that the ground water pathway is of little concern. However, the potential for exposure increases as residential development expands along the Smelter Road, upward onto Mine Hill.

The primary soil and air exposure routes, in decreasing order of significance, are incidental soil ingestion, inhalation of particulates, and dermal contact. The risk analysis, performed using the DEQ 2004 Risk Evaluation Manual (REM), as described in Section 4.3.1, indicates that exposure to the Empire Mill site for all ages has unacceptable cancer risks under the levels in the REM guidance as well as unacceptable non-cancer risks for all ages, if they are exposed to both the tailings and the concentrate pile.

Under REM, additional site characterization, including determination of concentrations represented in non-impacted areas, can be used to develop exposure time-weighted metals concentrations. The resulting analysis might lead to a conclusion that exposures to metals at this site are not likely to be associated with unacceptable cancer or non-cancer risks or unacceptable increases in blood lead. If site-associated risk is still determined to be unacceptable following the analysis, it is possible that limited remediation of hot-spots could result in overall metals exposure levels that are acceptable.

This page intentionally left blank for correct double-sided printing.

Definitions

Hypogene - Ore deposited from ascending hydrothermal solutions of magmatic origin.

Oxidized ore - The portion of an orebody near the surface that: (1) has been leached by percolating water carrying oxygen, carbon dioxide, or other gases; or (2) in which sulfide minerals have been partially dissolved and re-deposited at depth, the residual portion changing to oxides, carbonates, and sulfates.

Porphyry - An igneous rock of any composition that contains conspicuous phenocrysts in a fine-grained groundmass; a porphyritic igneous rock.

Skarn – see tactite

Stope - An excavation from which ore has been removed in a series of steps. Usually applied to highly inclined or vertical veins.

Supergene enrichment - A mineral deposition process in which near-surface oxidation produces acidic solutions that leach metals, carry them downward, and re-precipitate them, thus enriching sulfide minerals already present.

Tactite - A rock of complex mineralogical composition, formed by contact metamorphism and metasomatism of carbonate rocks. It is typically coarse-grained and rich in garnet, iron-rich pyroxene, epidote, wollastonite, and scapolite. Approximate syn: *skarn*.

TDL – Total Distance Limit is measured 15 miles downstream from the farthest upstream Probable Point of Entry (PPE) of contamination from each site.

This page intentionally left blank for correct double-sided printing.

References

- DEQ, Idaho Department of Environmental Quality. 2003. City of Mackay (PWS 7190032) Source Water Assessment Final Report.
- EPA, U.S. Environmental Protection Agency. 1997. Exposure Factors Handbook. Volumes I-III. An Update to Exposure Factors Handbook EPA/600/8-89/043. March 1989. EPA/600/P-95-002Fa. August, 1997.
- EPA, U.S. Environmental Protection Agency. 1999. Region 10 Supplemental Guidance for Sol Ingestion Rates.
- Farwell, F.W. and R.P. Full. 1944. Geology of the Empire Copper mine near Mackay, Idaho. U.S. Geological Survey open-file report, 22 p.
- Hacettepe University Department of Mining Engineering, Dictionary of Mining, Mineral and Related Terms. Information taken with permission from the U.S. Bureau of Mines Dictionary of Mining, Mineral, and Related Terms, published on CD-ROM in 1996. Available URL: <http://www.maden.hacettepe.edu.tr/dmmrt/index.html>.
- Holzer, Kurt, Lost River Cycling Group Contact. November 21, 2005. Telephone conversation with DEQ employee Brian Gaber.
- Idaho, Inspector of Mines. Annual Report. 1901-1974. Cited in Nielsen, Judith. 1982. The Empire Copper Company, University of Idaho Library, Special Collections, Manuscript Group 143.
- IDFG, Idaho Fish and Game. 2001. Fish Distribution Data-Unpublished report. IDFG StreamNet Data Coordinator.
- Kemp, J. F. and C. G. Gunther. 1908. The White Knob copper-deposits, Mackay Idaho. Am. Inst. Mining Metall. Engineers Trans. V.38, pp. 269-296
- Leland, Frank Milton. Letters contained in the Empire Copper Company papers. Cited in Nielsen, Judith. 1982. The Empire Copper Company, University of Idaho Library, Special Collections, Manuscript Group 143.
- Leland, G. R.. 1957. General geology and mineralization of the Mackay Stock area, University of Idaho, M.S. thesis, 71p.
- Lost River Cycling. 2005. <http://www.lostrivercycling.org/>
- Mackay Action Center. 2005. City Information. Mackay Action Center. <http://mackayidaho.com/city.html>
- Mackay Miner (newspaper) various issues. Cited in Nielsen, Judith. 1982. The Empire Copper Company, University of Idaho Library, Special Collections, Manuscript Group 143.
- Mines Register. New York, Atlas Publishing Company. 1937, 1940, 1942, 1946, 1949, 1952, 1956. Cited in Nielsen, Judith. 1982. The Empire Copper Company, University of Idaho Library, Special Collections, Manuscript Group 143.
- Moye, Falma J. 1995. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 4), Chapter 4, Part D, Section III:

- Properties in the Alder Creek Mining District, Custer County, Idaho. Idaho Geological Survey, pp. 4Diii-5 to 4Diii-12.
- Nelson, W. H. and C. P. Ross. 1969. Geology of the Mackay 30-Minute Quadrangle, Idaho. U.S. Geological Survey, Open-file report.
- Nelson, W. H. and C. P. Ross. 1968. Geology of part of the Alder Creek mining district Custer county, Idaho. U.S. Geological Survey Bull. 1252-A, 30 p.
- Nielsen, Judith. 1982. The Empire Copper Company, University of Idaho Library, Special Collections, Manuscript Group 143.
- Prichard, Terry. 2005. Real Estate Agent in Mackay, Idaho. December 12, 2005. Phone interview with DEQ employee Katy McKinley.
- Scripophily.net (<http://www.scripophily.net/>) - Cited in Nielsen, Judith. 1982. The Empire Copper Company, University of Idaho Library, Special Collections, Manuscript Group 143. The Internet's #1 Buyer and Seller of Old Stock and Bond Certificates - The company's CEO, Bob Kerstein has been featured on CNBC and other media related publications.
- The Copper Handbook. 1903-1909. Compiled and published by Horace J. Stevens. Houghton, Michigan. Cited in Nielsen, Judith. 1982. The Empire Copper Company, University of Idaho Library, Special Collections, Manuscript Group 143.
- The Mines Handbook. New York, H.W. Weed. 1916, 1918, 1926, 1931. Cited in Nielsen, Judith. 1982. The Empire Copper Company, University of Idaho Library, Special Collections, Manuscript Group 143.
- Umpleby, Joseph B. 1917. Geology and ore deposits of the Mackay region, Idaho. U.S. Geol. Survey Prof. Paper 97, 129 p.
- Umpleby, Joseph B. 1917. Geology and ore deposits of the Mackay region, Idaho. Washington, D.C., Government Printing Office, 1917. Cited in Nielsen, Judith. 1982. The Empire Copper Company, University of Idaho Library, Special Collections, Manuscript Group 143.
- Van Angersen, Phil. 2004. Geological Assessment and Exploration Proposal for the Empire Mine Project (Sultana Project). Trio Gold Corp. 12 p.
- vanWijnen, J.H., Clausing, P., and Brunekreef, B. 1990. Estimated soil ingestion by children. Environ. Res. 51:147-162.

Appendix A: Empire Mill RCRA Inspection Report

HWMA/RCRA COMPLIANCE INSPECTION NARRATIVE REPORT

Date of Inspection: August 16, 2005

Facility: Empire Mill

EPA Identification Number:

Address: Location
N 43.89226, W -113.67047
3.5 miles SW of Mackay in Rio Grande Canyon, 0.5 miles from NF Road 496

Owner: Honolulu Copper Co.
Ross Moody
2927 Mokumoa St
Honolulu, Hawaii 96819

Operator: R.M.S. Enterprises, Inc.
Lonnie W. Mullberg, President
P.O. Box 51486
Idaho Falls, Idaho 83405
(208) 528-0019

Report Prepared By: Brian Gaber
Environmental Compliance Officer
Technical Services Division
Idaho Department of Environmental Quality

Inspection Participants: Brian Gaber, DEQ - State Office
Katy McKinley, DEQ – Idaho Falls Regional Office
Lonnie Mullberg, R.M.S. Enterprises, Inc.

Background Information:

The Empire Mill (Mill) is located adjacent to the historic Empire Mine in Rio Grande Canyon on an eastern spur of White Knob Mountain. Constructed in 1961 by R. V. Lloyd & Company, the Mill employed a 175 ton-per-day concentrator with five (5) cell flotation circuits to produce copper concentrates. These concentrates were later shipped to a Utah smelter. The Mill and associated mine patent claims were held by several companies, until final acquisition by the Honolulu Copper Company. The Mill processed mainly copper-bearing ore from the Empire Mine between 1962 and 1977 and lead-zinc ores

from the Horseshoe and Phi Kappa mines in 1973-74 and 1980-1982. According to available records, the Mill has not operated since 1982.

The Empire patents and Mill are currently leased to Mr. Mullberg for a period of 10 years.

Purpose:

The purpose of the August 16, 2005 inspection was to assess the facility's compliance with the Federal Resource Conservation and Recovery Act (RCRA)/Idaho Hazardous Waste Management Act (HWMA), and the Idaho Rules and Standards for Hazardous Waste.

Inspection:

On August 16, 2005, Brian Gaber and Katy McKinley met Mr. Mullberg at the DEQ Regional Office in Idaho Falls and then traveled to Mackay in separate vehicles. Upon arrival at the Mill, I presented my credentials and informed him that we were conducting the inspection based upon previously observed concerns. Mr. Mullberg offered his complete cooperation and accompanied the inspectors throughout the walk-around inspection.

The site consists of a boiler shed, maintenance shed, shop building, "core" shed, "mud" rooms near the 1100 level portal, ore unloading area, conveyor system, main mill building and yard areas. Below the main mill building lie mill tailings, impounded and dewatered. The attached photographic log illustrates the site and highlights issues of concern.

The walk-around inspection began at 9:30 hours commencing at the upper yard adjacent to the Empire Mine's 1100 level portal.

Boiler Building

In the Boiler building, I observed a few 5-gallon containers of grease and/or oil as well as 12-volt (V) lead-acid type batteries stored on the wooden floor. At least one of the containers was open (see Photo 1).

Maintenance Shed

At the northwest corner of the maintenance shed, I observed the storage of six (6) banks of 24-V lead-acid type batteries stored on the ground and two (2) 12-V batteries stored on an external shelf (see Photo 2). Most of the 24-V batteries were broken (see Photo 3). According to Mr. Mullberg, these batteries were used to power the ore cars and had not been used for several decades. When questioned about the storage of these batteries, Mr. Mullberg indicated that he would remove the batteries and store them in the maintenance shed. He mentioned that the Historical Society or BLM might want to acquire these batteries.

Adjacent to the batteries, I observed heavy oil staining, possibly coal oil, on the ground. The impacted area appeared to measure approximately 24 square feet (see Photo 4).

Main Mill Building

At the southeast corner of the building, I observed diesel fuel staining on the ground adjacent to a metal frame (see Photos 5 & 6). According to Mr. Mullberg, this frame once supported the small tank, which was observed on the ground, nearby. The impacted area appeared to measure approximately 100 square feet, though some of the staining appeared to only be surficial.

Mr. Mullberg and I toured the inside of the building, where I observed several containers, varying in size. These appeared to contain oils and grease, though many were not labeled. No photos were taken. The mill is equipped with flotation cells and a ball mill.

Closing Conference

Following the walk-around inspection, a closing conference was held with Mr. Mullberg. A "Preliminary Inspection Findings" form was completed and signed and a copy was provided, after returning to Mackay. I explained the generator requirements to Mr. Mullberg; including the need to identify and characterize all wastes on site, the labeling of hazardous materials, the marking of used oil containers, the management and recycling of batteries, and the cleanup steps to address the minor releases/spills of used oil and diesel fuel to the ground surface. I received affirmation that Mr. Mullberg would address the issues. The closing conference ended at 10:20 hours.

Addendum

Following the inspection, we drove back to Mackay where a copy of the Preliminary Inspection Findings form was obtained for Mr. Mullberg. Mrs. McKinley and I returned to the Empire Mill at 12:30 hours to conduct a Preliminary Assessment (PA) of the site for an EPA-sponsored project. While conducting a second walk-around, measuring and mapping the site, additional RCRA concerns were noted.

Ore Unloading Station

I entered the ore car unloading station situated above the conveyor line to the mill building. Inside the station, I observed an electric-powered engine (see Photo 9) and 24-V battery packs. The battery packs had tipped over off the rail line (see Photos 7 & 8). The stability of the ore station is marginal at best and the battery packs could fall through the structure to the ground beneath, possibly releasing their hazardous contents.

Main Mill Building

While examining the mill machinery, I observed two (2) 55-gallon drums on the North side of the ball mill. These containers were not marked (Photo not included). On the Southeast side of the building, immediately below the waste rock pile, I located a small storage room (see Photo 10). At the base of the waste rock pile I discovered the broken remains of one (1) 12-V battery (see Photos 11 & 12). The storage room was determined to contain milling chemicals, such as flocculent and reagents (see Photos 13, 14 & 15).

Most of the containers were labeled or marked, though the actual contents of the containers were not determined during the inspection.

Summary

Based upon observations by the DEQ, the Empire Mill was inspected as a Conditionally Exempt Small Quantity Generator. The DEQ inspectors identified six (6) potential RCRA violations; failure to perform a waste determination; illegal disposal of hazardous waste (batteries); and failure to perform clean-up of minor releases/spills of used oil/diesel fuel to the ground surface.

Violation Nos. 1 & 2

Legal Provision Violated: IDAPA 58.01.05.006 Idaho Rules and Standards for Hazardous Waste; [40 CFR § 262.11]

40 CFR § 262.11 states in relevant part:

“A person who generates a solid waste as defined in 40 CFR §261.2, must determine if that waste is a hazardous waste...”

1. At the time of the August 16, 2005 inspection, the Empire Mill failed to perform a hazardous waste determination on the contents of at least twenty-five containers in the Main Mill Building, including the storage room.
2. At the time of the August 16, 2005 inspection, the Empire Mill failed to perform a hazardous waste determination on the contents of at least two (2) containers in the Boiler Building.

Violation No. 3 & 4

Legal Provision Violated: IDAPA 58.01.05.015, Idaho Rules and Standards for Hazardous Waste; 40 CFR § 279.54(g)

40 CFR 279.54(g) states in relevant part:

"Upon detection of a release of used oil to the environment... an owner/operator must perform the following cleanup steps:

- (1) Stop the release;
- (2) Contain the released used oil;
- (3) Clean up and manage properly the released used oil and other materials..."

3. At the time of the August 16, 2005 inspection, the Empire Mill failed to clean-up and manage properly the release of used oil to the ground surface near the maintenance shed.
4. At the time of the August 16, 2005 inspection, the Empire Mill failed to clean up and manage properly the release of diesel fuel to the ground surface near the southeast corner of the Main Mill Building.

Violation Nos. 5 & 6

Legal Provision Violated: IDAPA 58.01.05.011 Idaho Rules and Standards for Hazardous Waste; [40 CFR 268.7(a)(1); §§ 273.2(a)(2) & 273.13(a)(1)]

40 CFR 268.7(a)(1) states in relevant part:

“Requirements for generators: determine if the waste has to be treated before being land disposed...This is done by determining if the hazardous waste meets the treatment standards in 268.40 (Treatment Standards for Hazardous Wastes) or 268.45 (Alternative Treatment Standards for Hazardous Debris)...”

§ 273.2(a)(2) states:

“Spent lead-acid batteries which are not managed under 40 CFR part 266, subpart G, are subject to management under this part.”

§ 273.13(a)(1) states in relevant part:

“A small quantity handler of universal waste must contain any universal waste battery that shows evidence of leakage, spillage, or damage...”

5. At the time of the August 16, 2005 inspection, the Empire Mill failed to determine whether the contents of six (6) 24-volt lead-acid type batteries (D002, D008), observed abandoned near the maintenance shed and one (1) 12-volt lead-acid type battery (D002, D008), observed abandoned near the container storage room, met the Land Disposal Restriction requirements prior to land disposal.
6. At the time of the August 16, 2005 inspection, the Empire Mill failed to contain six (6) universal waste 24-V batteries and one universal waste (1) 12-V battery that showed evidence of leakage and damage.

Brian Gaber
Environmental Compliance Officer
State Technical Services Division
Idaho Department of Environmental Quality

Date

Appendix B: Analytical Data Sheets

This page intentionally left blank for correct double-sided printing.

SVL ANALYTICAL, INC.

One Government Gulch • P.O. Box 925 • Kellogg, Idaho 83837-0925 • Phone: (208)294-1038 • Fax: (208)781-0881

Lab# SVL0019

CLIENT: IDEO IDAHO PALMS R-G. OFFICE	SVL JOB#: 116586
PROJECT:	SAMPLE: 445660
CLIENT SAMPLE ID: MACKAY #1	10/1018
Sample Collected: 4/13/05 12:39	
Sample Receipt: 4/18/05	Matrix: MAF-88
Date of Report: 5/03/05	

Determination	Result	Units	Reference	Method	Analyzed
As	16.0	mg/L		200.7	4/28/05
Barium	22.8	mg CaCO3/L		204.8	4/28/05
Bismuth	1.39	mg/L		200.7	4/28/05
Cadmium	0.0003	mg/L		200.8	4/28/05
Copper	0.0114	mg/L		200.8	4/28/05
Calcium	0.00279	mg/L		200.8	4/28/05
Chromium	0.033	mg/L		200.7	4/28/05
Lead	1.87	mg/L		200.7	4/28/05
Lead	0.017	mg/L	6	200.8	4/28/05
Selenium	<0.003	mg/L		200.8	4/28/05
Zinc	0.051	mg/L		200.7	4/28/05
<hr/>					
D Silver	<0.0011	mg/L		200.8	4/28/05
D Arsenic	0.0050	mg/L		200.8	4/28/05
D Cadmium	<0.0022	mg/L		200.8	4/28/05
D Copper	0.013	mg/L		200.7	4/28/05
D Lead	0.00571	mg/L		200.8	4/28/05
D Selenium	<0.003	mg/L		200.8	4/28/05
D Zinc	0.012	mg/L		200.7	4/28/05

Fill Form Transmittal 445662

Reviewed By: _____



Date

5/3/05

5/3/05 15:22

AZ: 62058 14: 00: 2001 00: 2/ 8/04 1: 0003'9 00: 7/31/01 00: 001

EVL ANALYTICAL, INC.

One Government Gulch • P.O. Box 329 • Kellogg, Idaho 83737-0329 • Phone: (208)784-1258 • Fax: (208)763-0094

Certificate ID: 100079

CLIENT : IDAHO - DEC
 PROJECT : CONTRACT#C170
 CLIENT SAMPLE ID: EMPIRE US
 Sample Collected: 8/26/03 11:10
 Sample Receipt : 9/03/03
 Date of Report : 9/17/03

SVI JOB: 107427
 SAMPLE: 351554
 DIS
 Matrix: WATERS

Determination	Result	Units	Dilution	Method	Analysed
D Silver	<0.0050	mg/L		200.0	9/14/03
D Arsenic	<0.0030	mg/l		200.0	9/14/03
D Beryllium	<0.0020	mg/L		200.0	9/14/03
D Cadmium	<0.0020	mg/L		200.0	9/14/03
D Chromium	<0.0060	mg/L		200.0	9/14/03
D Copper	0.0090	mg/L		200.0	9/14/03
D Mercury	<0.0020	mg/L		245.0	9/11/03
D Nickel	<0.010	mg/L		200.0	9/14/03
D Lead	<0.0030	mg/L		239.0	9/16/03
D Antimony	<0.0050	mg/L		200.0	9/15/03
D Selenium	<0.0030	mg/L		270.0	9/15/03
T Thallium	<0.0020	mg/L		270.0	9/15/03
T Zinc	<0.0050	mg/L		200.0	9/14/03

Reviewed By: _____



Date

9/17/03

9/17/03 15:27

SVL ANALYTICAL, INC.

One Government Gulch • P.O. Box 925 • Kellogg, Idaho 83842-0925 • Phone: (208)724-1250 • Fax: (208)763-0057

Cell: (208) 763-0059

CLIENT : IDHO
 PROJECT :
 CLIENT SAMPLE ID: TMT-COMPOSITE
 Sample Collected: 8/17/05 11:17
 Sample Receipt : 9/22/05
 Date of Report : 10/24/05

SVL JOB: 113019
 SAMPLE: 471051
 Matrix: SSC1
 Extraction: SP17

Determination	Result	Units	Location	Method	Anal. year
Asbestos	<0.0050	mg/L Ext		6010B	9/30/05
Arsenic	<0.0250	mg/L Ext		6010B	9/30/05
Cadmium	<0.0070	mg/L Ext		6010B	9/30/05
Copper	<0.010	mg/L Ext		6010B	9/30/05
Mercury	<0.0020	mg/L Ext		7470A	10/04/05
Lead	<0.0170	mg/L Ext		6010B	9/30/05
Selenium	<0.040	mg/L Ext		6010B	9/30/05
Zinc	<0.010	mg/L Ext		6010B	9/30/05

Rest: 1052 SCIP YFM13

Reviewed By: _____

[Signature]

Date:

10/4/05

10/24/05 14:10

SVL 9/05/06 CG: NC: 2000 CD: 8/10/04 CG: 030019 SW: 3/2/04 WA: 11268

RECEIVED

DEQ-IDAHO FALLS

TRIO

3213

Sample #10

SVL ANALYTICAL, INC. REPORT OF ANALYTICAL RESULTS
One Government Blvd. P.O. Box 925 Fallsg., Idaho 83637-0929 Phone: (208) 484-1000 Fax: (208) 765-0897

Sample ID	Client Sample ID	Sample Received Date	Report Date	Ag 60100	As 60109	Ba 60114	Cd 60108	Cr 60103	Cu 60124	Pb 60108	Fb 60108
5460861	M-4	8/17/05	8/17/05	20.3mg/kg	120mg/kg	60.7mg/kg	75.3mg/kg	16.5mg/kg	1120mg/kg	3940mg/kg	290mg/kg
5460869	M-4	8/17/05	8/17/05	14.4mg/kg	37mg/kg	24.3mg/kg	44.3mg/kg	11.7mg/kg	1550mg/kg	2160mg/kg	168mg/kg
5460863	M-0	8/17/05	8/17/05	15.8mg/kg	192mg/kg	29.5mg/kg	51.6mg/kg	16.3mg/kg	1300mg/kg	1500mg/kg	128mg/kg
5460864	M-0	8/17/05	8/17/05	17.9mg/kg	105mg/kg	20.5mg/kg	11.4mg/kg	29.3mg/kg	3940mg/kg	2650mg/kg	33mg/kg
5460865	M-0	8/17/05	8/17/05	5.0mg/kg	50.5mg/kg	15.9mg/kg	2.30mg/kg	21.1mg/kg	1550mg/kg	6140mg/kg	83.5mg/kg
5460866	M-0	8/17/05	8/17/05	4.1mg/kg	46.1mg/kg	12.7mg/kg	1.26mg/kg	15.3mg/kg	1370mg/kg	6440mg/kg	156mg/kg
5460867	DH-COMPOST	8/17/05	8/17/05	***	***	***	***	***	***	***	***
5460868	DH-COMPOST	8/17/05	8/17/05	25.4mg/kg	283mg/kg	1.81mg/kg	110mg/kg	4.2mg/kg	780mg/kg	16100mg/kg	731mg/kg
5460869	DH	8/17/05	8/17/05	15.3mg/kg	57mg/kg	15.5mg/kg	79.7mg/kg	15.0mg/kg	150mg/kg	13600mg/kg	84mg/kg
5460870	DH	8/17/05	8/17/05	15.0mg/kg	44.9mg/kg	51.3mg/kg	70.3mg/kg	17.7mg/kg	315mg/kg	15700mg/kg	180mg/kg
5460871	OT-1	8/18/05	8/18/05	22.4mg/kg	140mg/kg	32.1mg/kg	4.37mg/kg	22.3mg/kg	380mg/kg	8520mg/kg	525mg/kg
5460872	OT-2	8/18/05	8/18/05	0.63mg/kg	11.7mg/kg	31.8mg/kg	1.58mg/kg	12.9mg/kg	69mg/kg	2710mg/kg	31.2mg/kg
5460873	OT-3	8/18/05	8/18/05	4.57mg/kg	15.8mg/kg	15.8mg/kg	1.45mg/kg	12.9mg/kg	43mg/kg	10700mg/kg	105mg/kg
5460874	OT-4	8/18/05	8/18/05	<0.50mg/kg	84.4mg/kg	579mg/kg	2.57mg/kg	0.5mg/kg	15.1mg/kg	1480mg/kg	114mg/kg

***: Not Requested

Soil Samples: As Received Basis

Reviewed by: D. HICKMAN

Date: *4/12/05*

RECEIVED
SEP 13 2005
DEQ-IDAHO FALLS

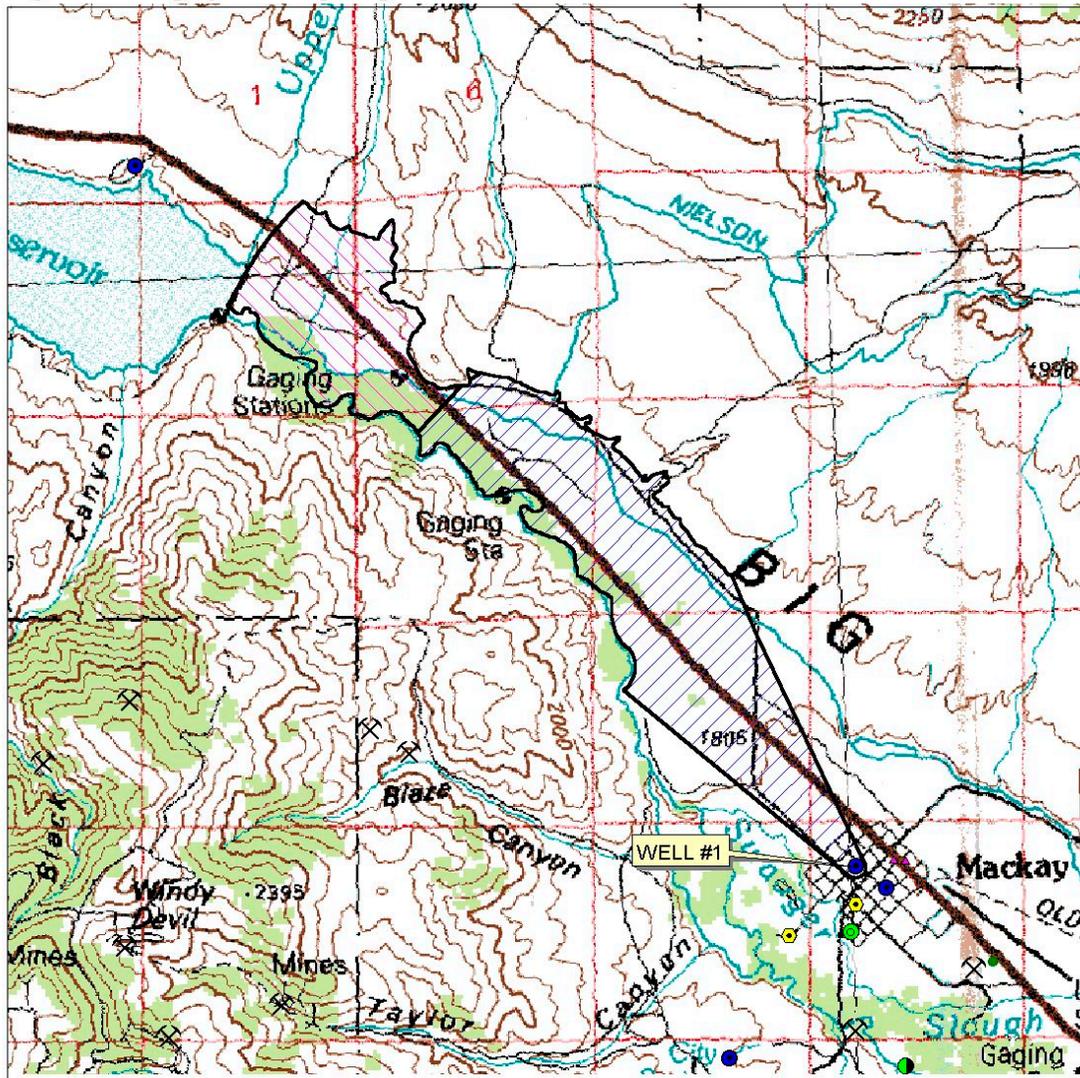
TRIO



This page intentionally left blank for correct double-sided printing.

Appendix C: Source Water Assessment Figures

Figure 2. City of Mackay Map and Potential Contaminant Source Locations



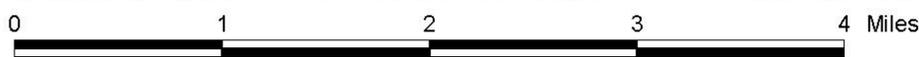
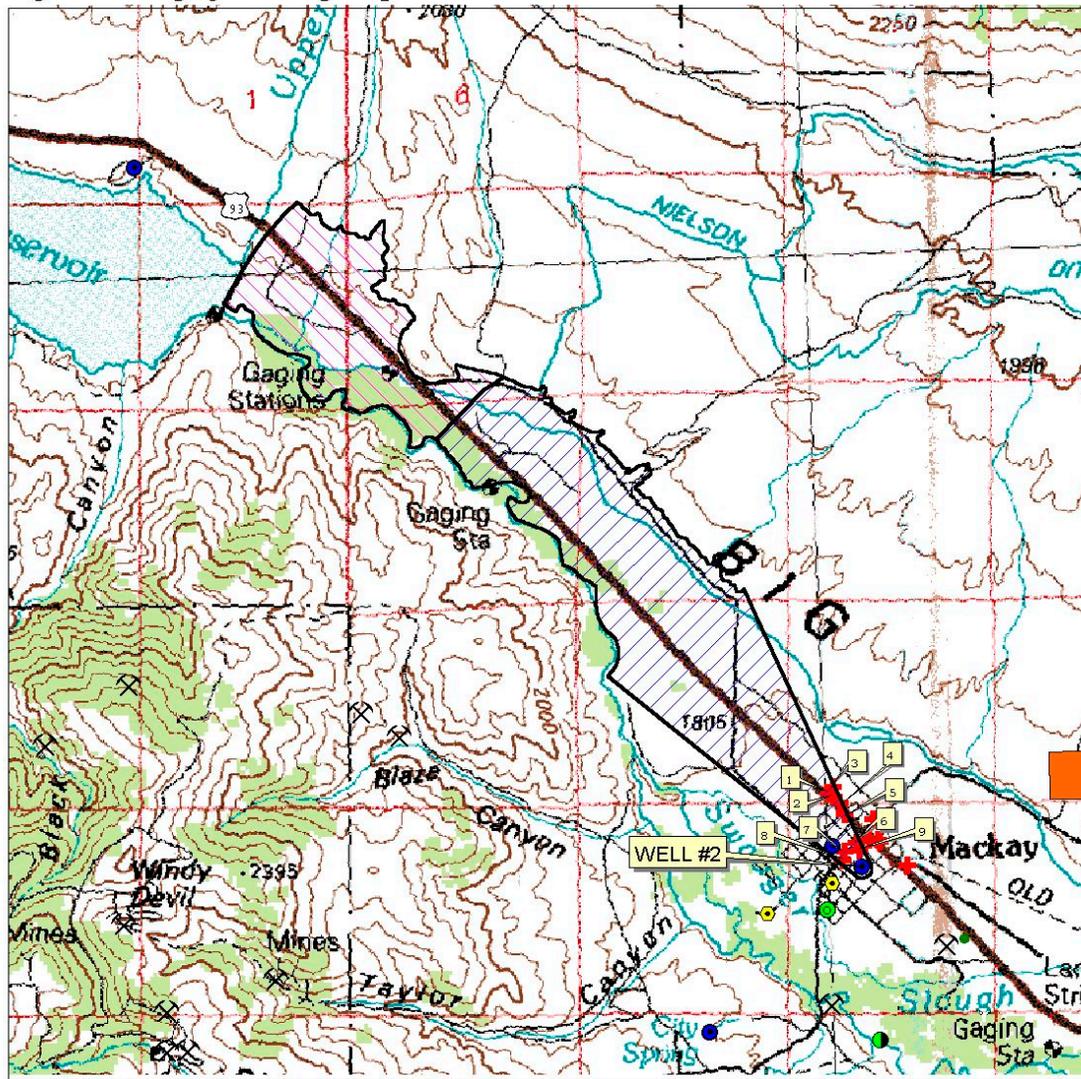
0 1 2 3 4 Miles

LEGEND		
18 (3 yr TOT)	★ Dairy	Toxic Release Inventory
2 (6 yr TOT)	● LUST Site	● SARA Title III Site (EPCRA)
3 (10 yr TOT)	▲ Closed UST Site	● Recharge Point
● Wellhead	▲ Open UST Site	● Injection Well
+ Enhanced Inventory	● Business Mailing List	● Group 1 Site
● CERCLIS Site	● NPDES Site	● Cyanide Site
● RICRIS Site	⌵ Mine	■ Landfill
	● AST	■ Wastewater Land App. Site



PWS# 7190032
WELL #1

Figure 3. City of Mackay Map and Potential Contaminant Source Locations

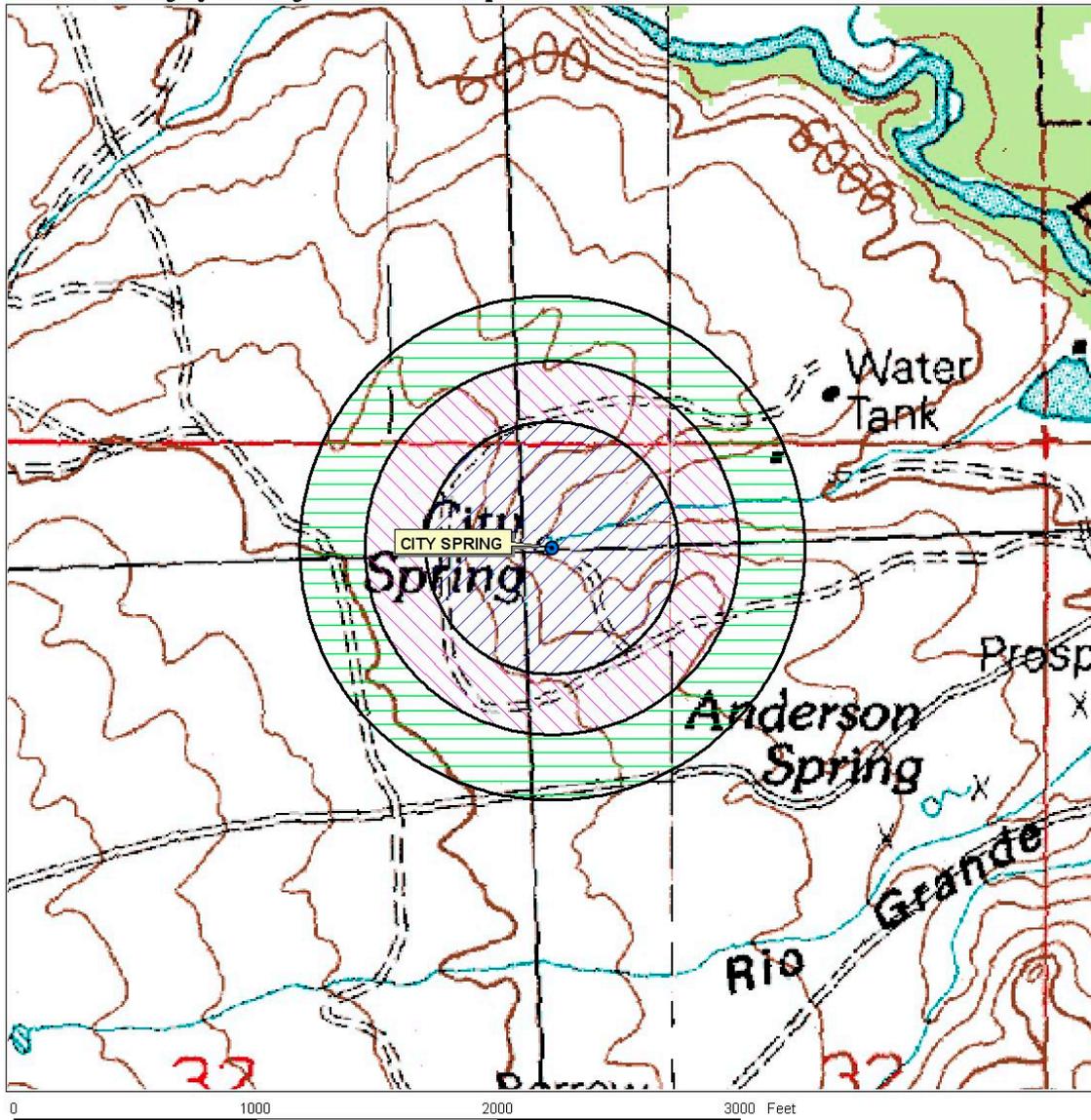


LEGEND		
19 (3 yr TOT)	★ Dairy	Toxic Release Inventory
2 (6 yr TOT)	● LUST Site	● SARA Title III Site (EPCRA)
3 (10 yr TOT)	▲ Closed UST Site	● Recharge Point
● Wellhead	▲ Open UST Site	● Injection Well
● Enhanced Inventory	● Business Mailing List	● Group I Site
● CERCLIS Site	● NPDES Site	● Cyanide Site
● RICRIS Site	⊗ Mine	■ Landfill
	● AST	■ Wastewater Land App. Site



PWS# 7190032
WELL #2

FIGURE 4. City of Mackay Delineation Map and Potential Contaminant Source Locations



LEGEND			
1B (3 yr TOT)	Dairy	Toxic Release Inventory	SARA Title III Site (EPCRA)
2 (6 yr TOT)	LUST Site	Recharge Point	Injection Well
3 (10 yr TOT)	Closed UST Site	Group I Site	Cyanide Site
Wellhead	Open UST Site	Group I Site	Cyanide Site
Enhanced Inventory	Business Mailing List	Group I Site	Cyanide Site
CERCLIS Site	NPDES Site	Group I Site	Cyanide Site
RICIS Site	Mine	Landfill	Wastewater Land App. Site
	AST		



**PWS# 7190032
 CITY SPRING**

Report Index

“Mine Hill”	1	Empire Mill 2, 7, 8, 9, 10, 13, 22, 23, 24,	
“time of travel” (TOT) zones	61	27, 29, 30, 60, 62, 68, 69, 72, 74, 75,	
Abandoned and Inactive Mine Program		76, 77, 79, 85, 87, 88, 89	
USFS	7	Exxon Minerals	14
airborne contaminants		faults.....	57
potential.....	72	future mining.....	10
Alberta Tunnel . 2, 18, 30, 31, 36, 38, 62,		future uses	10
72, 79		gold	11, 14, 50
All Terrain Vehicle (ATV)	8	granite	18, 31, 32, 47, 50, 57
andesite porphyry.....	57	grey limestone.....	18
aplite.....	57	hazardous waste	
arsenic	77	release of	24
ATV	8, 9, 23	Headhouse... 2, 34, 43, 45, 47, 62, 72, 79	
ATVs.....	75	historical information.....	11
Big Lost River 1, 7, 9, 10, 43, 61, 62, 64,		Honolulu Copper Company	7, 8, 85
65, 68, 70		Idaho Default Target Limits (IDTL)... 19	
Blue Bird.....	2, 50, 72, 79	Idaho Geological Survey (IGS)	7, 50
Blue Bird workings.....	2, 50, 79	<i>Idaho Hazardous Waste management</i>	
Bullion Tunnel	2, 46, 47, 48, 72, 79	<i>Act (HWMA)</i>	7
Bullion Tunnels.....	47	Idaho National Laboratory (INL).....	68
Bureau of Mines Project 1406	13, 14	<i>Idaho Rules and Standards for</i>	
Cambior Exploration USA, Inc.....	14	<i>Hazardous Waste</i>	7, 86, 88, 89
cancer risk.....	76	John W. Taber.....	13, 14
capture zones.....	61	land	
channel morphology.....	61	value	10
chemicals.....	22, 87	lead... 2, 7, 14, 18, 19, 22, 24, 50, 77, 79,	
concentrate (Cons) piles.....	22	85, 86, 89	
conveyor system.....	22, 86	lead-acid batteries	24
copper.....	2, 11, 12, 14, 50, 83, 85	lead-zinc deposits.....	2
Copper Bullion.....	47	Lonnie Mollberg	7, 13
Cossack Tunnel.. 2, 8, 12, 13, 14, 15, 16,		Mackay... 1, 2, 3, 8, 9, 11, 12, 13, 30, 50,	
18, 20, 21, 22, 50, 58, 62, 64, 72, 77,		57, 58, 60, 61, 68, 74, 79, 83, 84, 85,	
79		86, 87	
Custer County	1, 8, 13, 84	mercury	77
daycare facilities	68	metal-bearing dust.....	74
deer.....	68	Mick Halverson.....	7
dermal exposure.....	7	mill building.....	15, 22, 24, 25, 86, 87
dikes	57	mining activity	2, 22, 61, 68
diorite	57	mountain bike race.....	9
Easlie Group.....	50	Myko, Inc.....	13, 22
		non-cancer risk.....	76

ore tonnage.....	14	stratified samples	24
Paleozoic White Knob Limestone	57	sulphide ore.....	14
Phi Kappa.....	13, 22, 86	Sun Valley.....	68
precipitation	72	Synthetic Precipitation Leaching	
Preliminary Assessment Program.....	1	Procedur(SPLP).....	19
probable point of entry (PPE)	61	tailings 7, 8, 9, 10, 14, 18, 19, 22, 23, 24,	
quartz monzonite.....	57	25, 68, 69, 72, 73, 74, 75, 76, 77, 79,	
R.V. Lloyd & Co.....	22	86	
red altered limestone	18	Tertiary granitic complex.....	57
REM.....	19, 27, 75, 77, 79	Total Maximum Daily Loads (TMDLs)	
residential development	10, 61, 79	64
<i>Resource Conservation and Recovery</i>		Tramway “Headhouse”	2
<i>Act (RCRA)</i>	7, 86	tungsten	14
Rio Grande Canyon.....	17, 18, 61, 62, 85	U.S. Forest Service	7, 50, 83
riparian vegetation	62	violations.....	7, 24, 88
Risk Evaluation Manual (REM)	75	visitors.....	23
Ross Moody	13, 85	annual	9
schools.....	68	Warning Letter	
sediment	72	issuance of.....	8
Shay railroad track	30	waste rock ..	7, 10, 14, 18, 19, 22, 23, 30,
shear zones	58	36, 37, 41, 43, 47, 50, 53, 72, 76, 77,	
silver.....	11, 14, 22, 50	87	
skarn	18, 57, 81	wells	60, 61
Smelter Road.....	10, 14, 65, 68, 69, 79	windborne contaminants	7
snowfall.....	72	working populations.....	68
soil ingestion	75, 76, 79, 84	zinc	2, 14, 19, 50, 77, 85
species of concern.....	70		