STREAMLINED RISK ASSESSMENT
RED DEVIL MINE
ALASKA

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Prepared by:

Karl L. Ford, Ph.D.
Bureau of Land Management
National Science and Technology Center
Denver, Colorado

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1.0 INTRODUCTION

Mining activities from the Red Devil Mine tailings have probably influenced Red Devil Creek and the Kuskokwim River since the 1920s. Mine waste generated from mining activity has contributed mercury into water, stream sediments and soils. Besides mining, the area is used for hunting, fishing and recreation. Recreational demands are increasing at the site where exposure to relatively high metal concentrations in tailings, sediments, and surface waters exist.

To address these issues, BLM developed acceptable multi-media risk management criteria (RMC) for the chemicals of concern (COCs) as they relate to human use and wildlife habitat on or near BLM lands. These are published in BLM's Risk Management Criteria for Metals at BLM Mining Sites (Ford, 1999). The primary objective of this section is to perform a streamlined risk assessment for the site and to establish the magnitude of risk to human health and wildlife. RMCs for soil, sediment, fish and water protective of human receptors for the metals of concern were developed using available toxicity data and standard U.S. Environmental Protection Agency (EPA) exposure assumptions. Acceptable soil and sediment concentrations protective of wildlife receptors (ecological RMCs) for the metals of concern were developed using toxicity values and wildlife intake assumptions reported in the current ecotoxicology literature.

The COCs and migration pathways were identified from historical information and site evaluation. The COC selection process utilized chemicals documented to have been released to surface water and observed contamination in soils and tailings at Red Devil Mine. Human and ecological COCs for Red Devil Mine tailings include: antimony, arsenic, mercury, diesel range organic hydrocarbons (DRO) and asbestos. Mercury and arsenic are the principal COCs.

Mercury is present as both the elemental form (liquid mercury) as well as mercury sulfide (cinnabar ore), however neither of these forms is considered to be readily absorbed by ingestion. Methylmercury, an organic form, is more readily absorbed from consuming fish exposed to mercury. Exposure to all types of mercury can permanently damage the brain, kidneys and developing fetus, Attachment 2. Arsenic is classified as a human carcinogen.

Potential receptors, receptor exposure routes, and exposure scenarios were identified from on-site visits and discussions with BLM personnel. Figure 1 shows the site conceptual model. Representative wildlife receptors at risk were chosen using a number of criteria, including likelihood of inhabitation, and availability of data.

1.1 Risk Assessment Scenarios

This risk assessment evaluates two scenarios: (1) the baseline or current risks and, (2) future risks after the selected removal is constructed (post removal). The baseline evaluates existing conditions as of April, 2001 and earlier 1999-2001 sampling data. The future post-remedy condition assumes the site

remedy is completed. This remedy consists of installing an impermeable cap over the contaminated soils and debris on the retort building pad. The cap will include an impermeable landfill grade liner 60 mill HDPE or equivalent. Up-gradient surface drainage will be engineered to flow around the cap, not over it. This approach will not only show the magnitude of risks with the existing condition, but the reduction in risks attributed to the completion of the removal action.

The future post removal condition will also evaluate the effect of the lined repository on groundwater and surface water in Red Devil Creek. The groundwater modeling approach is contained in Attachment 1.

2.0 BASELINE SCENARIO

2.1 Human Health Risk Methodology

The human exposure scenarios were developed to provide realistic estimates of the types and extent of exposure which individuals might experience to the metals of concern in the water, soils, and sediments on BLM property. Such exposures might occur to individuals who use BLM lands for camping, or all-terrain-vehicle (ATV) driving, or individuals who work on BLM lands. Contamination may migrate from the BLM tracts to adjoining property.

The RMC correspond to either a target excess cancer risk level of 1×10^{-5}, or a target noncancer hazard index of 1.0. In the case of metals posing both carcinogenic and noncancer threats to health, the lower (more protective) concentration was selected as the RMC. The concept behind the RMC is that people will not experience adverse health effects from metal contamination on BLM lands in their life-times, while exposure is limited to soil, sediments, and waters with concentrations at or below the RMC. A target excess cancer risk of 1×10^{-5} means that for an individual exposed at these RMC, there is only a one in a hundred thousand chance that he would develop any type of cancer in a lifetime as a result of contact with the COCs. A hazard index of <1.0 means that the dose of noncancer metals assumed to be received at the site by any of the receptors in a medium is lower than the dose that may result in any adverse noncancer health effects. The RMC are protective for exposures to multiple chemicals and media. Lead RMC for the child receptors were determined from EPA's Integrated Exposure Uptake Biokinetic Model (USEPA, 1993) and other EPA regulations and guidance. The human health criteria are found in Attachment 1.

Ingestion of mercury via fish consumption may be a concern in Red Devil Creek and Kuskokwim River. The Food and Drug Administration action level for mercury in fish is 1.0 ppm (wet weight; assumes 7 oz. of fish per week) and some states issue health advisories when fish tissue monitoring approaches or exceeds the FDA level. Mercury in fish is almost entirely the more toxic form methylmercury. Risk to consumers of fish uses toxicity factors for methylmercury.

2.2 Ecological Risk Methodology

Wildlife in the Red Devil Mine area may be exposed to metal contamination via several environmental pathways. The potential exposure pathways include soil and sediment ingestion, vegetation ingestion, surface water ingestion, fish consumption, and inhalation of airborne dust. Ecological RMC have been established for metals in soil and sediments. This has been accomplished using the best data available, including: ecotoxicological effects data for the metals of concern, wildlife receptors representative of the Yukon Intermontaine Plateaus Tayga ecosystem (Bailey, 1995), body weights and food intake rates for each receptor, and soil ingestion rates for each receptor.

Typical wildlife of the area includes moose, Dall sheep, caribou, wolf, black and grizzly bear, a wide variety of waterfowl, and many game species of fish. The wildlife receptors evaluated for as surrogates for this area are: deer mouse, mountain cottontail, elk, mallard, Canada goose. These surrogates were chosen in Ford (1999). Differences between the unique Alaskan species and these surrogates are discussed in the uncertainty analysis.

The literature was surveyed for toxicity data relevant to either wildlife receptors at the site or to closely related species. In the absence of available toxicity data for any receptor, data were selected on the basis of phylogenetic similarity between ecological receptors and the test species for which toxicity data were reported. Soil ingestion data for each receptor were obtained from a recent study on dietary soil content of wildlife from the U.S. Fish and Wildlife Service (Beyer, et. al., 1994). Where no dietary soil content data were available for a particular receptor, the soil content was assumed to be equal to that of an animal with similar diets and habits. The amount of soil ingested by each receptor was estimated as a proportion of their daily food intake (Beyer, et. al., 1994). The food intake in grams for each receptor was calculated as a function of body weight (Nagy, 1987).

RMC were calculated for each chemical of concern in soil based upon assumed exposure factors for the selected receptors, and species- and chemical-specific toxicity reference values (TRVs). Essentially, the TRVs represent daily doses of the metals for each wildlife receptor that will not result in any adverse toxic effects. TRVs were computed by metal of concern for each wildlife receptor/metal combination for which toxicity data were available. Phylogenetic and intraspecies differences between test species and ecological receptors have been taken into account by the application of uncertainty factors in derivation of critical toxicity values. These uncertainty factors were applied to protect wildlife receptors which might be more sensitive to the toxic effects of a metal than the test species. The uncertainty factors were applied to the test species toxicity data in accordance with a method developed by BLM. In accordance with this system, a divisor of two (USEPA, 1990) was applied to the toxicity reference dose for each level of phylogenetic difference between the test and wildlife species, i.e. individual, species, genus, and family.

The wildlife RMC for soil and sediment are found in Attachment 1. For aquatic life protection, EPA water quality standards were used.

2.3 Uncertainty Analysis

Toxic doses for each metal were selected from the literature without regard to the chemical speciation that was administered in the toxicity test.

The process of calculating human health RMC, using a target hazard quotient and target excess lifetime carcinogenic risk, has inherent uncertainty. The COCs may have synergistic (or antagonistic) effects on human or wildlife receptors. Cumulative effects were quantitatively dealt with for the human assessment, although not all metals are elevated at each site. Additionally, it is improbable that human receptors would be exposed concurrently via all possible exposure pathways, although this has been assumed for conservatism (Ford, 1996). There is uncertainty in deriving wildlife RMCs due to the lack of toxicity data for these species. A standard uncertainty factor approach was used for interspecies extrapolation (Ford, 1996).

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There are considerable uncertainties in the surface water and fish tissue data. There are no fish tissue data to use in the risk assessment and there are limited surface water data with detection limits low enough to obtain a clear assessment of the extent of mercury and methylmercury concentrations upstream and downstream of the site. Hence maximum detections are used in the risk assessment.

2.4 Risk Assessment Results

Use of RMCs and the results below account for the effects of multiple metals and multiple exposure pathways (e.g. soil, sediment and water ingestion, inhalation and consumption of fish).

2.4.1 Human Health

The maximum mercury detections in each media are shown in Table 2.1, along with RMCs.
For soils, the maximum mercury detection was found in sample FS021, collected near the retort in 2000, (HLA, 2000). Red Devil Creek sediment results of the USGS (Wang, 1999) were used for sample T-2. This sample had splits that did not agree. Mercury in soil and sediment at Red Devil is

generally ≤1 percent methylmercury (USGS, 1999). The higher concentration of the two split samples is used in Table 2.1 and exceedances of RMC are found for antimony, arsenic and mercury. Surface water samples were used from USGS (1999) for Red Devil Creek (99Eb717) and Kuskokwim River. Groundwater results were obtained from HLA (2001), sample 00RDV03WA, from a monitoring well MW03 located below the Settling Pond.

Table 2.1 compares the maximum media concentrations at the site with the selected appropriate RMCs. The ratio of the environmental media concentration to the RMC is analogous to a hazard quotient of 1.0; that concentration that should present negligible risk. Media concentrations exceeding RMCs for humans or wildlife greater than 1.0 are flagged "+"; these occurrences may pose a chronic threat. Media concentrations exceeding RMCs by more than 10 and 100-fold for humans or wildlife are flagged as "++" and "+++", respectively.

Soils/Wastes: Bioaccessibility and mercury speciation are to be conducted by John Drexler at the University of Colorado. These data are expected to show that only a small percent of arsenic and mercury in soils and tailings is bioavailable, respectively. These data will be confirmed by the percent mercury present as elemental and as mercury sulfide (cinnabar). The mercury sulfide complex is extremely stable and is essentially non-leachable. RMCs may be modified by use of a bioaccessibility factor by dividing the RMC by the percent bioaccessible (Ford, 1999).

Most significant are the ≥100 fold exceedances of antimony, arsenic and mercury in the retort soil (FS021), placing this site in the extremely high risk category according to the RMC (Ford, 1996). [Note these exceedances will change based on the bioaccessibility results]. Another comparison may be made with the use of EPA Soil Screening Levels (SSLs) for mercury: (inhalation) = 10 milligrams per kilogram (mg/kg), ingestion = 23 mg/kg (EPA, 1996). SSLs for arsenic and mercury are shown in Table 2.1. These SSLs are for year-round residential land use and are not as appropriate as the RMC which assumes a camper use (14 days).

Soil contaminated with petroleum hydrocarbons is found around the above-ground storage tanks. Of 22 samples only diesel-range organics (DRO) exceeds Alaska Department of Environmental Quality screening criteria. The maximum concentration detected was 13,500 mg/kg at sample 00RDV19SL. This concentration exceeds the screening concentration of 250 mg/kg by 54 times. The screening criterion is not risk based and there are no toxicity factors for DRO. The higher boiling hydrocarbons such as DRO usually contains benzene and polynuclear aromatic hydrocarbons, but sampling indicates that maximum combined concentrations of benzene and PAHs were less than 0.5 mg/kg, far less than EPA Soil Screening Levels for residential soils.

Surface Water: Ingestion of drinking water is not a concern based on comparison to EPA maximum contaminant levels (MCLs) (Table 2.1). However, due to mercury concentrations, human methylmercury ingestion via fish consumption may be a concern in Red Devil Creek and the Kuskokwim River. However, Red Devil Creek is not known to support a fishery nor anadromous fish

since the flow of Red Devil Creek is small. The respective flows of these water bodies are 0.02 cubic meters/second (cms), and 1,102 cms. As stated previously, methylmercury is bioaccumulated in the aquatic food chain from mercury species in surface water. Higher trophic levels such as fish accumulate the most mercury. A recent 50th percentile bioaccumulation factor (BAF) of 1.6×10^6 at trophic level 3 (EPA, 1997) was used to estimate fish tissue concentration.

Using the Red Devil Creek downgradient of the site as a potential fishery (small species) with a maximum dissolved methylmercury concentration of 0.227 ng/L (USGS), and multiplying times the BAF yields an estimated fish tissue concentration of 0.36 mg/kg (ppm). The FDA action level for allowable amounts of mercury in commercially sold fish is 1 ppm, hence it is unlikely that fish in Red Devil Creek may exceed the FDA fish tissue action level. However, the FDA action level of 7 oz. of fish per week is undoubtedly low for subsistence lifestyles. EPA (Yeardley,1998) uses a methylmercury fish tissue criterion of 0.2 ppm for moderate consumption and 0.05 ppm for heavy fish consumption. The fish RMC for mercury for the camper is .05 ppm. These benchmarks indicate that gamefish (if any) from Red Devil Creek would not be safe for human consumption.

Similarly, using a maximum dissolved methylmercury concentration in the Kuskokwim River upgradient of Red Devil Creek of 0.13 ng/L (USGS), and a trophic level 4 (gamefish) BAF of 6.8×10^6, the estimated fish tissue concentration in the River would be 0.88 mg/kg (ppm). The only downgradient surface water data for the Kuskokwim River have an inadequate detection limit of 200 ng/L and mercury was not detected and methylmercury was not analyzed.

Groundwater: MCLs for both arsenic and mercury are exceeded at MW03, however the amount of exceedance is less than twice the MCL.

2.4.2 Ecological Risk Results

Soils: Terrestrial wildlife exposure to antimony, arsenic and mercury in soils and vegetation is greatly exceeds RMCs, by 1,000 fold in some cases (Table 2.1). Lead is only slightly exceeded. The DRO may present a hazard to aquatic life, more so than to human health. However, there is little evidence that DRO has reached surface water and this threat is believed to be low.

Surface Water: Using the downgradient sample with the highest concentration of metals in the surface water at these sites, the sample 99Eb717 (41 ng/L dissolved mercury and 0.227 dissolved methylmercury) exceeds EPA water quality standards for mercury during the 1999 sampling (USGS, 1999). This sample was collected below the tailings piles in Red Devil Creek. The EPA water quality criteria for mercury includes a criterion for (1) protection of aquatic life for chronic exposure (12 ng/L) which is exceeded and for (2) human health which is not exceeded (but close). Arsenic also exceeds water quality criteria in Red Devil Creek (Table 2.1). Much of the methylmercury appears to be coming from upstream sources as sample 99Eb713 contained 0.516 ng/L methylmercury.

Wildlife consuming mercury are likely to get the greatest amount of exposure via bioaccumulation in the aquatic food chain, especially in Red Devil Creek. Species affected would be carnivorous fish, mink, otter, bears, and waterfowl such as herons and osprey. This is somewhat mitigated by the short stream reach (less than 0.5 mile) and low stream flow, hence impact to resources are very limited. Wang (1999) says that Red Devil Creek does not increase mercury in Kuskokwim River (at least measurably). Since there are no fish tissue data from the Kuskokwim River near Red Devil Creek, there is no information to conclude risk except by use of the simple model using BAFs shown above. The model predicts a fish tissue concentration of 0.36 ppm. Some critical values for piscivorous wildlife range from ≤0.1 ppm mercury in fish tissue (Yeardley et al 1998, EPA, 1997) to 0.05 ng/L methylmercury and 0.64 ng/L total mercury in water (EPA, 1997). Both of the latter criteria are exceeded in Red Devil Creek.

In summary, using maximum detections of mercury and other COCs, Table 2.1 identifies significant health risks up to 1,000 times acceptable levels for persons exposed during a 14 day camping and fishing exposure scenario, primarily due to ingestion of soil and inhalation. Although fish tissue data are lacking for Red Devil Creek and Kuskokwim River, models show that fish tissue in the Creek and possibly in the River may be elevated above recommended levels and that much of the methylmercury appears to be coming from upstream sources. In addition, at the Mine site and in Red Devil Creek, significant risks are anticipated for terrestrial wildlife contacting retort soils, and for aquatic species and consumers of fish, such as otter, mink and waterfowl. It is unknown if Red Devil Mine has contributed risk to the Kuskokwim River because of a dearth of downgradient surface water data and fish tissue data. Any effects due to Red Devil would be small relative to the dilution effects of the Kuskokwim River.

Containment of the mine waste will eliminate risks from direct contact and will prevent or reduce release of mercury to Red Devil Creek, help achieve ambient water quality standards and reduce the threat of mercury contamination of fish.

3.0 POST REMOVAL SCENARIO

3.1 Description of the Removal Alternative

An onsite disposal cell is planned. The cell will actually contain two cells, one for debris and one for the more contaminated soils and retort contents (brick and slag). The soil cell waste may be stabilized with agents such as Portland cement or proprietary reagents to prevent leaching. The cells will be capped with an impermeable liner such as 60 mil HDPE, and a clean soil cover. The cap will be graded to shed precipitation and will be revegetated. Run on will be diverted around the cells. This engineered composite cap will prevent nearly all infiltration of precipitation into the waste.

Other features of the planned remedy that have already been taken as interim actions or are planned include: removal of transformer oils, asbestos and diesel fuels from tanks and drain lines. These wastes

were disposed offsite in approved landfills. Any petroleum-contaminated soils exceeding State limits remaining will be disposed in the soil disposal cell. Mining waste soils exceeding the Removal Action limits (Section 4.0) will be placed in the disposal cell.

The final land use of the site dictates the level of cleanup needed for the site. A recreational land use has been identified as the future land use. Removal of all contaminated soils and debris as described above will restore the site to acceptable levels of contaminants based on risk to camping and recreation. This is a more conservative land use scenario than that allowed for industrial land use.

By virtue of the removal of all contaminated soil and debris, only the groundwater pathway and possibly the surface water pathway (as it may be affected by groundwater) are exposure pathways of concern. Currently, there is no use of groundwater at the site. However, it has been assumed for the risk assessment that groundwater may discharge to Red Devil Creek. Therefore, modeling has been employed to estimate future maximum groundwater concentrations of mercury and arsenic after the disposal cell is complete. Modeling is also employed to estimate maximum surface water concentrations.

3.2 Description of the Models and Assumptions Used

This section describes the findings of the modeling simulations run to estimate the concentration of arsenic and mercury in groundwater over time after completion of future remedial activities at the Red Devil Mine (i.e., excavation, consolidation, and cap placement). Attachment 1 provides the modeling results. A separate simulation was run to model the effects of limited remedial activities (i.e., no capping). The modeling approach was based on scarce hydrogeological and analytical data contained in the *Red Devil Mine Source Area Removal and Investigation*, prepared jointly by Harding Lawson Associates and Wilder Construction Company (HLA/Wilder); and dated March 2001. The data included the dimensions of the source area, distances between well points, and physical properties of the indigenous soils (i.e., bore logs). The soil properties provided in the HLS/Wilder boring and well logs were used to estimate the values of conductivity and permeability. The following general assumptions and steps were the basis of this modeling exercise:

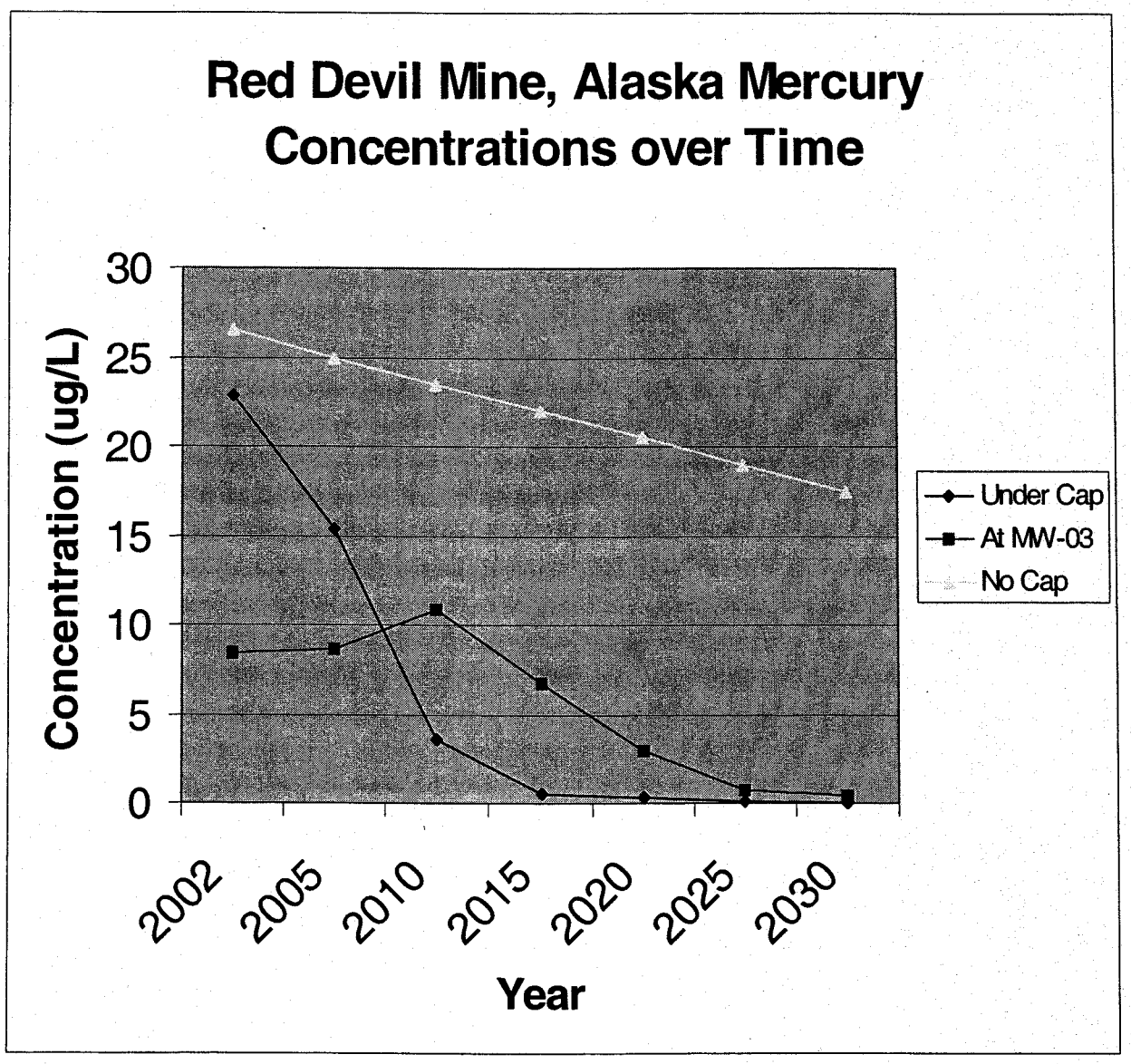
- Groundwater modeling is being used as an evaluation tool in the development and design of a capping system for the main source area at the site; that is, the area surrounding the Retort Building.

- Two different models that describe advection-dispersion transport in groundwater and the vadose zone were used to simulate metal transport in the subsurface. The use of comprehensive geochemical models, which require more site specific data than is currently available at this time, were not used.

- Analytical data provided in the HLA/Wilder report were used to estimate aquifer parameters,

by performing calibration runs of contaminated groundwater flow along the following line of wells: MW07, MW01, and MW04. The aquifer parameters were estimated using a one-dimensional analytical solution model (SOLUTE). The aquifer parameters were necessary to run the more complex 3-D groundwater modeling simulations.

- The 3-D model "SWMS_3D" was used to complete the modeling efforts; that is, to estimate the concentration of arsenic and mercury over distance and time from the source area (Retort Building) to Red Devil Creek.


Red Devil Mine, Alaska Mercury Concentrations over Time
Concentration (ug/L)
30
25
20
15
10
5
0
2002
2005
2010
2015
2020
2025
2030
Year
Under Cap
At MW-03
No Cap

3.3 Risk Assessment Results

Table 3.3 shows a comparison of Risk Management Criteria for surface and ground water for the post-removal scenario.

3.3.1 Human Health Risk

Tables 5 and 6 from Attachment 1 show the mercury results of the 3D ground water model through the year 2030. Figure 1 below compares year 2000 to year 2030 mercury results, with and without a cap. Concentrations of mercury decline much faster with the cap, reaching the MCL of 2 ug/L at all locations out to 90 meters by 2020.

Table 4 of the Attachment shows the arsenic results. Arsenic declines out to about 50 meters by the year 2006. Concentrations at MW-03 are approximately equal to the arsenic MCL. Because of attaining MCLs, the modeling was not carried further out into the future, but with a cap, concentrations will decline about 5-10% per year.

3.3.2 Ecological Risk

It may be assumed that some of the site groundwater discharges to Red Devil Creek. At MW-03, which is longitudinally downgradient, at the probable point of entry near Red Devil Creek, the mercury concentration is projected to be about 0.4 ug/L in 2030. The EPA ambient water quality criterion for mercury for human health consumption of water and fish is 0.05 ug/L. Although Red Devil Creek has no fish of a size likely to be consumed by humans, the projected 0.4 ug/L concentration exceeds the mercury ambient water quality criterion. However, mixing with uncontaminated water upstream is expected to enable attainment of ambient water quality criteria by 2030.

The arsenic chronic exposure water quality criterion for protection of aquatic life is 150 ug/L. As indicated above, groundwater in the vicinity of MW-03 is about 50 ug/L, so it less than the criterion and should not be a threat to aquatic life.

4.0 REMOVAL ACTION CRITERIA

The camper RMC shown in Table 2.1 are proposed to be the removal action criteria for waste materials and soil. It has been shown that mining waste is migrating into the stream below the Red Devil site. Since the risk criteria are based on ingestion and inhalation, mean surficial concentrations of soil exceeding these criteria will be removed or covered. The RMC have not yet been evaluated using

bioaccessibility. This work is planned for 2001 and may result in modification of the RMC. Correction of the release of the contaminated soil will enhance water and sediment quality in Red Devil Creek and reduce fish accumulation of mercury.

In addition to the mercury hazard at the site, the potential physical hazards associated with the steep slopes, partially collapsed adit, antiquated mining equipment, and related debris at the site must be considered as well when evaluating future site activities. The site is characterized by a relatively large amount of mining equipment and structures which were extremely large, heavy, and precariously balanced. The proximity of these structures to the river increases the likelihood of visitors to the site, and the poor condition of the equipment, the steep slopes, and open adit present numerous opportunities for injury. In order to be protective of human health, it is recommended that the mining equipment be removed, or stabilized as soon as possible.

Table 2.1 Red Devil Mine Comparison of Analytical Results and Risk Management Criteria Mine Waste, Surface Water, and Groundwater

Soils, Mine Wastes, Sediment (mg/kg)					
ANALYTE	**Retort Soil FS021**	**Red Devil Creek Sediment (T2)**	**Wildlife Median RMC**	**EPA SSLs**	**Camper RMC**
Antimony	6,100+++	6,680+++	NA	31	50
Arsenic	7,190+++	5,150+++	274	0.4*	20
Lead	94	21	125	400	1000
Mercury	73,300+++	250+++	8	23	40
Diesel range organics (DRO)	13,600++			250†	
Dissolved Surface Water					
ANALYTE	**99Eb717 Red Devil Creek**	**99SWRDMK01 Kuskokwim River**	**EPA Chronic WQC**	**EPA Wildlife 1997**	**MCL**
Arsenic (ug/l)	220+	<5.6	150	NA	50
Mercury (ng/l)	41+++	<200	50	0.64	2,000
Methylmercury (ng/l)	0.227+	NA		0.05	
Groundwater (ug/L)					
ANALYTE	**00RDV02WA**				**MCL**
Arsenic	129+				50
Mercury	5.3+				2

+Exceeds RMC by <10
++Exceeds RMC by 10-100 fold
+++Exceeds RMC by >100 fold
*Based on cancer risk of 1 in 1,000,000
†Alaska Department of Environmental Quality Screening Level

Table 3.3 Red Devil Mine Post-Removal Comparison of Analytical Results and Risk Management Criteria Surface Water, and Groundwater, Year 2030 unless otherwise noted.

Dissolved Surface Water (ug/l)					
ANALYTE	**At Red Devil Creek**		**EPA Chronic WQC**	**EPA Wildlife 1997**	**MCL**
Arsenic	54*		150	NA	50
Mercury	0.4		0.05	0.64	2
Groundwater (ug/L)					
ANALYTE	**Under Cap**				**MCL**
Arsenic	74*				50
Mercury	0.07				2

*Year 2006

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Fact Sheet
Health Effects of Mercury:

Types of Mercury: Mercury exists as inorganic mercury salts, metallic mercury (quicksilver) and organic methylmercury (in fish tissue). Exposure to high enough levels of all forms of merrcury can permanently damage the brain, kidneys, and developing fetus. Not all forms of mercury are equally able to affect the nervous system. For example, breathing in large amounts of mercury vapors and breathing in or swallowing large amounts of methylmercury are more likely to cause nervous system effects than swallowing large amounts of inorganic mercury salts.

People who have eaten fish containing large amounts of methylmercury have had permanent damage to the brain, kidneys, and the growing fetus. The amounts of organic mercury that cause these effects are much higher than the amounts to which the general population is exposed daily. FDA limits the amount of methymercury in commercial fish at 1 ppm assuming 7 ounce portions/day, but EPA has more stringent guidelines, recommending only 4 ounces/month at 1 ppm. EPA and states (including Oregon) have fish advisories recommending people, especially pregnant women, limit their consumption of fish from areas with higher mercury levels.

Following are the principal health effects of mercury:

- **Brain:** The changes that mercury causes in the brain are not specific for one type of brain function. Therefore, a variety of effects may occur. These effects include personality changes (irritability, shyness, nervousness), tremors, changes in vision or hearing, and difficulties with memory. Exposure to methylmercury may cause brain damage in the developing fetus. This is because relatively more methylmercury passes into the brains of young children than adults, and interferes with brain development.

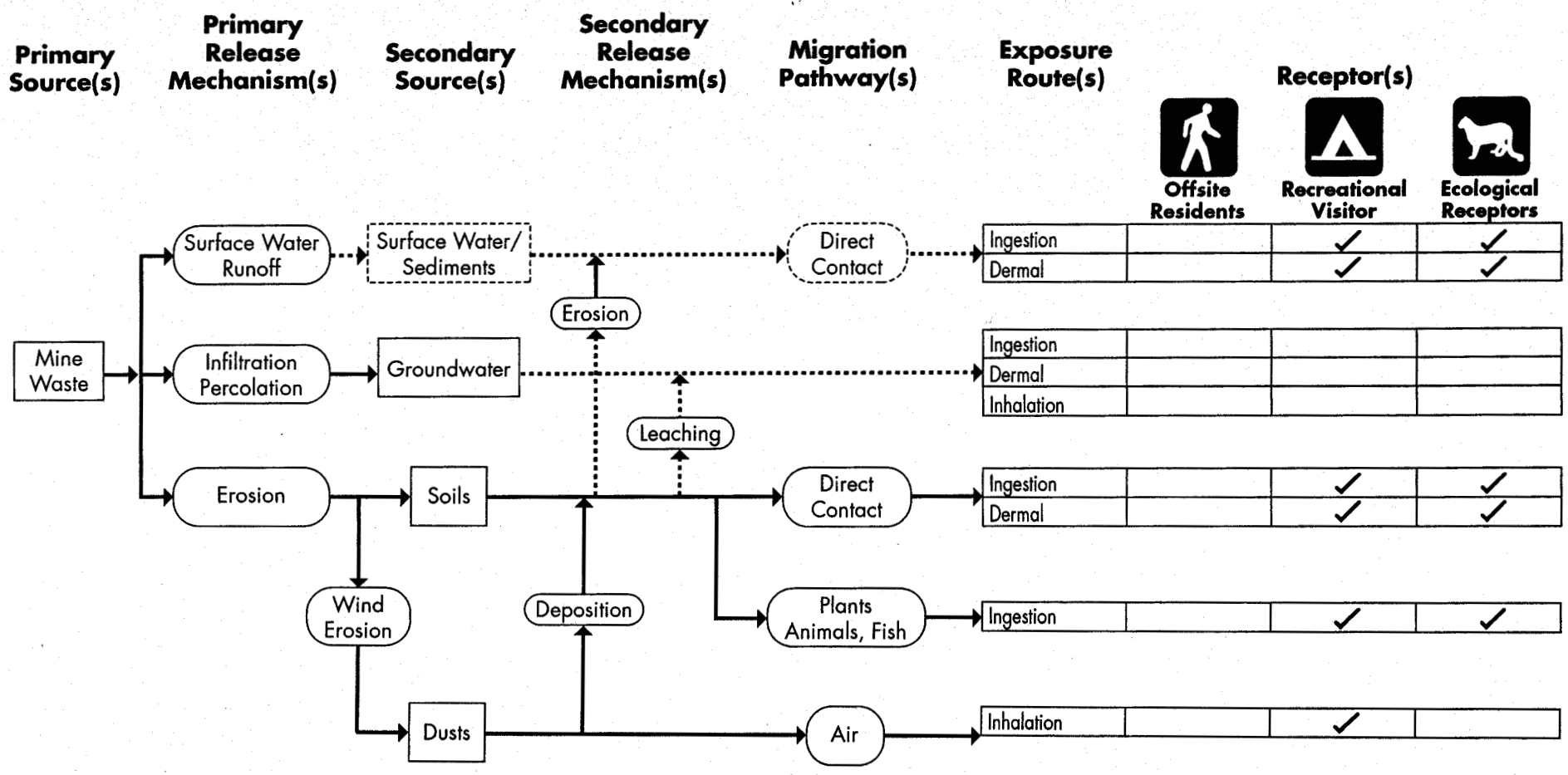
- **Kidney**: The kidney is also very sensitive to mercury. All forms of mercury are able to cause kidney damage if large enough amounts enter the body. Recovery from the kidney effects of mercury is likely, once the body clears itself of the contamination.

- **Other Effects:** In addition to the effects described above, short-term exposure to high levels of metallic mercury vapor in the air can damage the lungs, cause nausea, vomiting, or diarrhea, cause increases in blood pressure or heart rate, and cause skin rashes or eye irritation. Long-term exposure of workers in several industries to metallic mercury has been shown to cause similar effects. Skin contact with the metal mercury causes allergic reactions (skin rashes) in some people.

- **Reproduction**: Results of studies in humans showed that there were no effects on the ability to have children after breathing metallic mercury for a long time, however, methylmercury is dangerous to the fetus.

- **Cancer:** There is no information to show that mercury causes cancer in humans. The Department of Health and Human Services (DHHS), EPA, and the International Agency for Research on Cancer (IARC) have not classified mercury as to its human carcinogenicity.

Mine Waste Conceptual Site Model for Human and Ecological



Potentially complete pathway

Potentially incomplete pathway

✓ Potentially exposure route