

October 2011 Fact Sheet

## The Red Devil Mine – An Update

Alaska Department of Environmental Conservation  
Spill Prevention and Response Division  
Contaminated Sites Program

### History

The Red Devil Mine is a historic abandoned mercury mine on the banks of the Kuskokwim River, 250 miles west of Anchorage and 1.5 miles southeast of Red Devil (pop. 23). The mine is on 10 acres of land managed by the Bureau of Land Management and has been selected as a future Native patent by The Kuskokwim Corporation and Calista Corporation.

The Red Devil Mine area has extensive cinnabar deposits that have been mined and retorted (heated) to vaporize and condense the elemental mercury. Mining at the site began in 1933, and the mine operated continuously until 1946 when the mercury market price dropped. Production began again in 1952 and continued until a fire destroyed the mine and mill equipment in 1954. A new retort was built in 1955 on the opposite side of Red Devil Creek, and it operated until 1971.

Open pit mining began in 1969, and by 1970, the Red Devil Mine was Alaska's largest mercury producer and it was one of the largest in the United States. The mine shut down in 1971 when the mercury market dropped and has not operated since. The underground mine itself flooded in 1981. During the mine's lifetime, it produced roughly 35,000 flasks of mercury (76 pounds per flask).

The mine included a housing complex, equipment and chemical storage buildings, a shop pad (laboratory), an engine shop, mine portals, a power plant, a retort building, three settling ponds and five

above-ground petroleum storage tanks. The BLM removed all the buildings in 2001 and the tanks in 2004. Most mining occurred underground in an extensive series of stopes – step-like excavations – and tunnels, but surface strip-mining and exploration were conducted above the retort area.

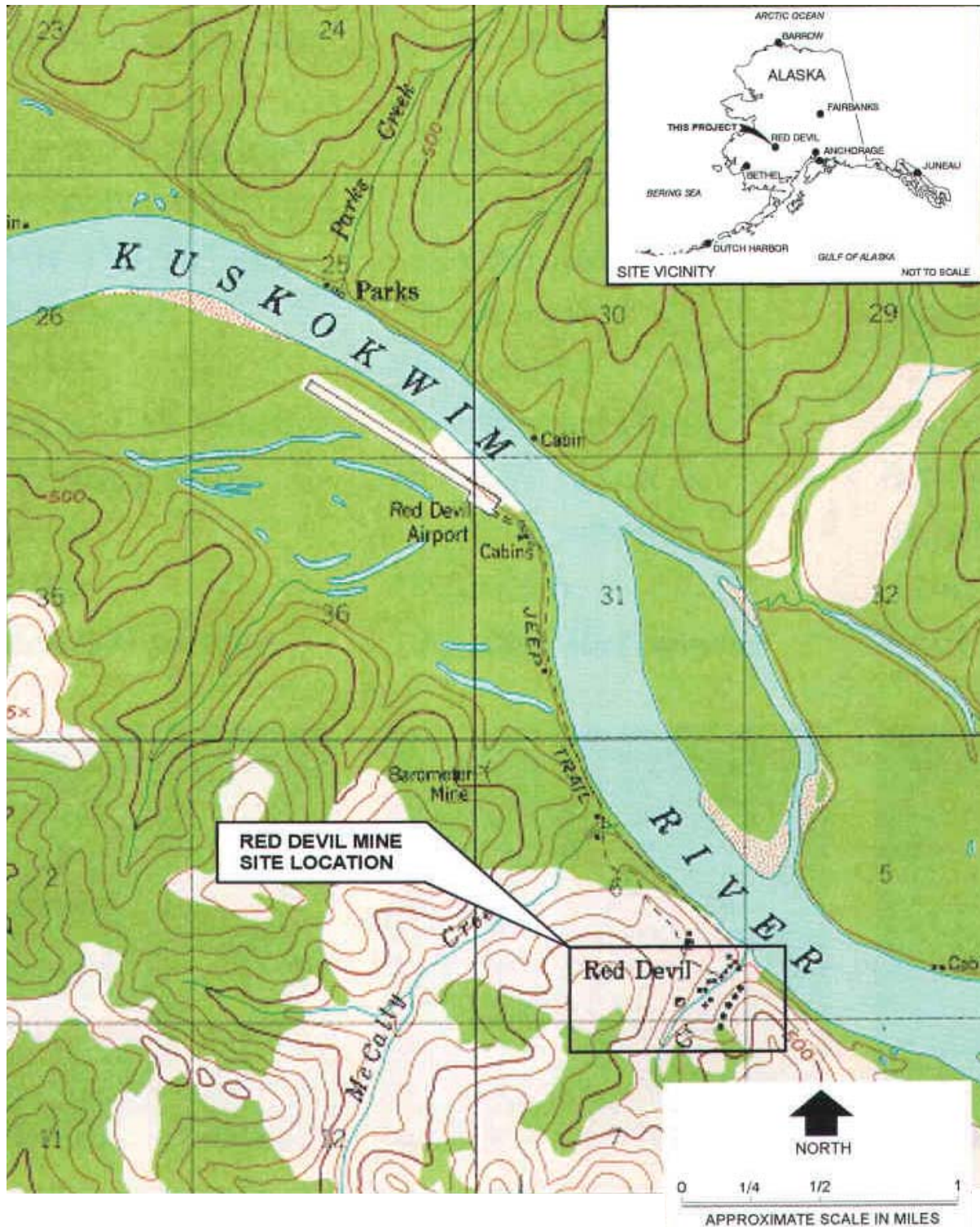
### Contamination

The U.S. Environmental Protection Agency first inspected the site in late 1971 and collected water



Mine tailings shown eroding into Red Devil Creek in August 2011.

October 2011



Located in a small valley with fairly steep slopes, the Red Devil Mine was bisected by Red Devil Creek, which flows a half mile to the Kuskokwim River.



and sediment samples. Between 1979 and 2008, the EPA, Alaska Department of Environmental Conservation, BLM and U.S. Geological Survey conducted subsequent sampling investigations at the mine and surrounding areas.

Mine tailings had been used as fill across the site. The investigations showed elevated concentrations of metals in the tailings around the two different retort areas, in the sediment and surface water of Red Devil Creek, and in the groundwater on both sides of the creek. Petroleum-contaminated soil was found at several locations along the fuel pipeline and tanks.

From 2000 to 2004, the BLM demolished the buildings and fuel tanks and buried the debris on-site. Due to those BLM ac-

An overview of the Red Devil Mine site (top) shows what the site looked like before the Bureau of Land Management demolished the buildings in 2001 and 2002. BLM contractors removed some chemicals, batteries and waste, but most of the debris, including some hazardous waste, was buried on site. Another aerial photo (bottom) shows what the site looked like in June 2004.



October 2011

tions – operating heavy equipment on-site and moving tailings around – it was unknown if previous sample results were still representative of site conditions.

In January 2008, the EPA and DEC requested that the BLM conduct a comprehensive site characterization, called a Remedial Investigation, to determine the extent of the metals contamination in the soil, sediment, surface water and groundwater, and a Risk Assessment to calculate health risks to humans, plants and animals.

In September 2010, the BLM conducted a limited field sampling effort where its contractors collected soil samples at the ground surface, sediment

and surface water samples from Red Devil Creek, sediment samples from the Kuskokwim River, and groundwater samples from existing wells in order to gather preliminary information to use to design a more extensive field effort in 2011.

The following discussion of site contamination and sample results are solely from the *2010 Limited Sampling Event Report*. The main contaminants of concern at the Red Devil Mine are antimony, arsenic and mercury, but others are present as well. All soil sample results were collected at the ground surface. Groundwater samples were limited to the previously installed wells. This section will be updated with information from the Remedial Investigation when that is available.

### Summary of 2010 Highest Surface Soil and Tailings Sample Results

(in milligrams per kilogram or mg/kg)

Contaminant	West Side Shops	West Side Older Retort	Surface Mined Areas	East Side Tailings and Settling Ponds	East Side Newer Retort	Human Health Screening Level <sup>1</sup>	Ecological Screening Level <sup>2</sup>
Antimony	23,300	2,680	140	16,700	12,100	3.6/41	0.27
Arsenic	5,000	2,880	8,510	6,950	6,670	3.9/4.5	43
Mercury	1,260	172	174	1,620	900	1.4/18	11

<sup>1</sup>State screening levels are from 18 AAC 75.341, Table B1 – Migration to groundwater/direct contact or outdoor inhalation.

<sup>2</sup>Antimony and arsenic values are from EPA's Ecological Soil Screening Levels. The mercury value is from Oregon's cleanup regulations.

### Summary of 2010 Highest Groundwater Sampling Results

(in parts per billion or micrograms per liter – ug/L)

Contaminant	West Side Shops	West Side Older Retort	Gravel Storage Pad	Settling Ponds	Steam Plant	Human Health Screening Level <sup>1</sup>
Antimony	90	250	53	1,250	39	6
Arsenic	245	446	58	515	310	10
Mercury	2	50	29	29	11	2
Lead	8	55	19	25	227	15

<sup>1</sup>Screening levels are from 18 AAC 75.345, Table C – Groundwater cleanup standards.

## Summary of 2010 Highest Sediment and Surface Water Concentrations

(sediment is in milligrams per kilogram, mg/kg, and surface water is in parts per billion or micrograms per liter, ug/L)

Contaminant	RDC: Upstream of Mine	RDC: Below and In Tailings	RDC: Mouth of Creek	Kuskokwim River: Red Devil Delta	Kuskokwim River: Dolly Sluice Delta	Screening Levels <sup>1,2</sup>
<b>Sediment</b>						
Antimony	<10	4,060	1,900	1,280	40	3
Arsenic	50	130,000	1,890	1,790	800	6
Mercury	0.55	63	79	56	13	0.17
<b>Water</b>						
Antimony	1.3	158	170			14
Arsenic	1	903	86			150
Mercury	0.0028	0.23	0.38			0.05

<sup>1</sup>Screening levels for sediment are based on the National Oceanic and Atmospheric Administration Screening Quick Reference Table for Inorganics in Solids – protective of ecological receptors (mortality).

<sup>2</sup>Screening levels for water are based on Alaska Water Quality Standards – antimony and mercury: protective of human health and aquatic organisms; arsenic: protective of aquatic organisms only.

### BLM Building Removal Actions

In 1999, the BLM identified various types of wastes and removed from the site roughly 100 batteries, mercury-contaminated retort slag, mineral processing chemicals and liquid wastes (petroleum products and solvents).

In 2002, the BLM submitted a plan to DEC to place building debris and other solid waste into two buried landfills on the site. One of the “monofills” – a landfill that has debris from one location – would contain all of the hazardous waste from the site. The monofills did not comply with Alaska Solid Waste guidelines for buried landfills and were partially placed on top of the most highly contaminated areas without addressing the contamination first. Due to these and other technical reasons, DEC did not concur with this action. The BLM, however, conducted the work over DEC’s objections. The following monofills are present at the site:

- Monofill No. 1 (4,400 cubic yards) holds building debris, concrete, wood, scrap

metal, crushed drums, three vehicles, 23 drained non-PCB transformers, and Category 1 and II asbestos-containing materials.

- Monofill No. 2 (930 cubic yards) contains the retort bricks and retort slag (hazardous waste treated with arsenic and mercury encapsulant to prevent leaching); retort building debris and general building debris. A 60-mil geomembrane liner was placed on top of the retort building concrete pad and some surrounding contaminated soils. The retort bricks, slag and debris were placed on top of the liner, covered with tailings and then another liner. Tailings were placed on top of the liner as a cap. Appropriate quality control sampling of the encapsulation was not conducted, therefore, it is unknown if it was effective.
- A third monofill was created in 2003 to dispose of the metal from the above-ground fuel tanks and ore hopper.

## **Petroleum Removal Actions**

In 2005, the BLM began removing petroleum-contaminated soil from the area of the five above-ground storage tanks and the fueling pipeline, in accordance with a DEC-approved work plan. Very little characterization work had been performed prior to the start of the removal action. Contractors discovered a larger volume of contaminated soil than anticipated, and not all the contamination could be excavated in 2005. Additional contaminated soil was excavated in 2006, however, due to funding and timing constraints, not all the contamination could be removed. The remaining soil was sampled in 2010 and sample results showed that the cleanup levels were met. Roughly 2,000 cubic yards of contaminated soil were stockpiled on-site awaiting treatment.

In 2010, in accordance with a DEC-approved work plan, the petroleum-contaminated soil was moved to a cleared area and landspread on the ground surface to encourage naturally occurring microbes to break down the petroleum. Soil samples were collected to establish a baseline concentration and the soil was seeded to reduce possible erosion. The BLM is required to conduct annual sampling, and if the contaminant concentrations have not reduced significantly within the next several years, the BLM may be required to conduct additional actions, such as tilling, to accelerate the petroleum breakdown.

## **Current Status**

The DEC has been working with the EPA to oversee the BLM's Remedial Investigation work. Field work for the Remedial Investigation and Risk As-



Mine tailings are shown adjacent to the settling pond in an August 2009 photo.

assessment were conducted to a limited extent in 2010 and more extensively in 2011. The purposes of the Remedial Investigation are to determine:

- If the tailings and soil at the site exceed state screening levels, and if so, where and at what concentrations.
- If the sediment and surface water in Red Devil Creek exceed federal and/or state screening levels for metals, and if so, where and at what concentrations.
- If the groundwater at the site exceeds federal and state cleanup levels, and if so, where and at what concentrations.
- If the sediment in the Kuskokwim River exceeds federal screening levels, and if so, where and at what concentrations.
- If free-phase mercury is present outside the hazardous waste monofill and if the monofill is an appropriate long-term solution to the storage of that material.
- The concentrations of naturally occurring metals in the background media.
- How the contaminants migrate through the soil and groundwater to Red Devil Creek and the Kuskokwim River.

The BLM will also conduct both a Human Health and Ecological Risk Assessment to calculate the risk from the contamination at the site to humans,

animals (terrestrial, avian and aquatic) and plants. Both the Remedial Investigation and Risk Assessment Report are scheduled to be finalized in the summer of 2012. The BLM plans to prepare a Feasibility Study in late 2012 that will evaluate different cleanup options. The DEC and EPA will be working with the BLM to select appropriate cleanup alternatives to evaluate.

### **Contacts**

For more information about this site, contact:

Anne Marie Palmieri, Project Manager  
[AnneMarie.Palmieri@alaska.gov](mailto:AnneMarie.Palmieri@alaska.gov)  
(907) 766-3184

Jennifer Roberts, Section Manager  
[Jennifer.Roberts@alaska.gov](mailto:Jennifer.Roberts@alaska.gov)  
(907) 269-7553