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Blackbird Mine

Lemhi County, Idaho
CERCLIS #IDD980725832

Site Exposure Potential

Blackbird Mine is approximately 40 km southwest of Salmon, Idaho, within the Salmon River drainage basin (Figure 1). Bucktail Creek drains the northern part of the site and Blackbird Creek drains the southern portion (Figure 2). Bucktail Creek flows to the northeast and joins with the South Fork of Big Deer Creek, which then flows into Big Deer Creek and, ultimately, Panther Creek. Blackbird Creek flows to the southeast and joins Panther Creek approximately 19 km upstream from the confluence of Big Deer Creek. Panther Creek flows north into the main stem of the Salmon River approximately 20 km downstream from Big Deer Creek. The Salmon River is part of the Snake River drainage system; the Snake River is the largest tributary to the Columbia River.

The Blackbird Mine is one of the largest cobalt deposits in North America. Active mining at the site began in the 1890s. The primary sulfide ores are a cobalt-arsenic sulfide called cobaltite, chalcopyrite, pyrite, and pyrrhotite. Some of the earliest descriptions of the operation, from the 1930s, suggest that all mine tailings were channeled directly into Blackbird Creek during that period (Reiser 1986). Settling ponds and tailing pipelines were subsequently constructed in the 1940s and 1950s. Periodic spills of tailings often

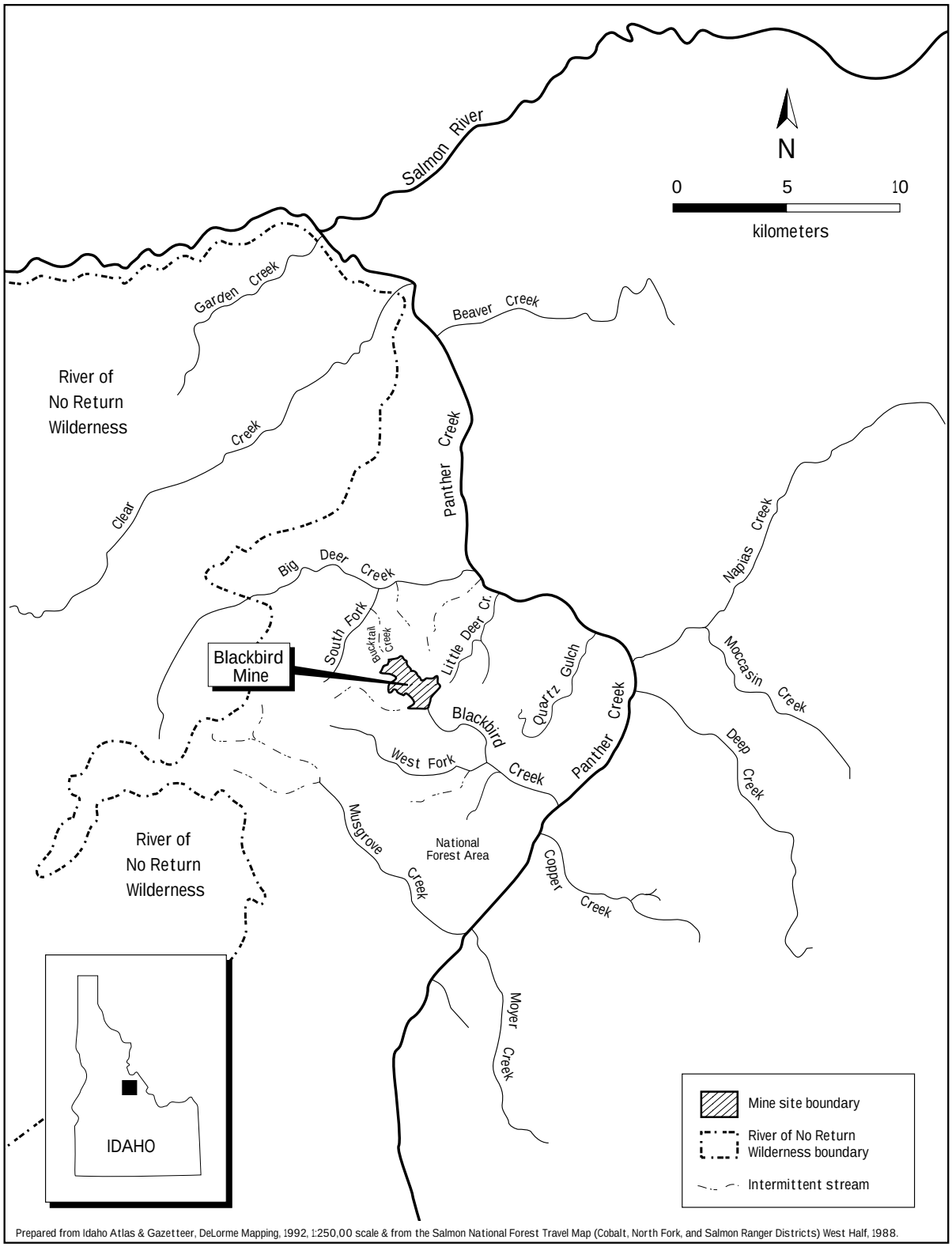

Figure 1. Blackbird Mine study area in the Salmon National Forest, Lemhi County, Idaho.

entered Blackbird Creek due to ineffective containment of tailings, especially during spring runoff (Reiser 1986). When open-pit mining began in the late 1950s, about 3.8 million tons of waste rock near the headwaters of Blackbird and Bucktail creeks were excavated. Numerous waste rock piles are located throughout the mine area (Figure 2). The largest of the waste rock areas is the 5-hectare open pit, which contains over 765,000 m^3 of material. There are about 24 km of underground workings and about 34 hectares of exposed contaminated mine wastes at the site (Bennett 1977; Reiser 1986).

The site is currently owned by Noranda Mining, Inc., but has been inactive since 1982. Noranda planned to reopen the mine and had built a wastewater treatment facility to process water from the main adit as a condition of its 1980 NPDES permit. Noranda implemented several other remedial measures, including debris cleanup in Meadow Creek, and installation of several culverts for directing water around waste rock (Reiser 1986).

Primary pathways of concern are surface runoff, groundwater discharge, and direct discharge of leachate from mine adits. Surface water runoff from the mine enters Blackbird and Bucktail creeks. The surface runoff pathway is most important during the spring, when snow melt increases runoff. During this high-flow period, waste piles and tailings erode, as evidenced by gullies at the base of waste piles (Reiser 1986). Groundwater at the Blackbird Mine occurs in both unconsolidated surficial deposits and in fracture-controlled bedrock systems. Soils are gravelly, silty loams; loams; and sandy loams with moderate permeability and storage capacities. Groundwater in the surficial aquifer is in direct hydraulic contact with streams at the site, and may also migrate vertically into bedrock fractures. Groundwater has been observed to flow toward some of the adits along these fractures, suggesting a potential pathway for groundwater movement of contaminants. The metamorphic bedrock is not very porous; groundwater storage volumes are also expected to be low. There are seeps and springs at the base of several waste piles at the mine (Reiser 1986).

NOAA Trust Habitats and Species

The habitats of concern to NOAA are the surface water and associated bottom substrates of Panther and Blackbird creeks. Two anadromous fish species, chinook salmon and steelhead trout, use habitat in the Panther Creek basin to a very limited extent (Table 1). The only type of chinook salmon found in the Salmon River is classified as the spring / summer race of chinook.

Panther Creek emerges from underground approximately 70 km upstream from its confluence with the Salmon River. Bottom substrates are mixed along the length of the creek, consisting of various combinations of boulders, rubble, coarse gravel, and fine gravel. Habitat type

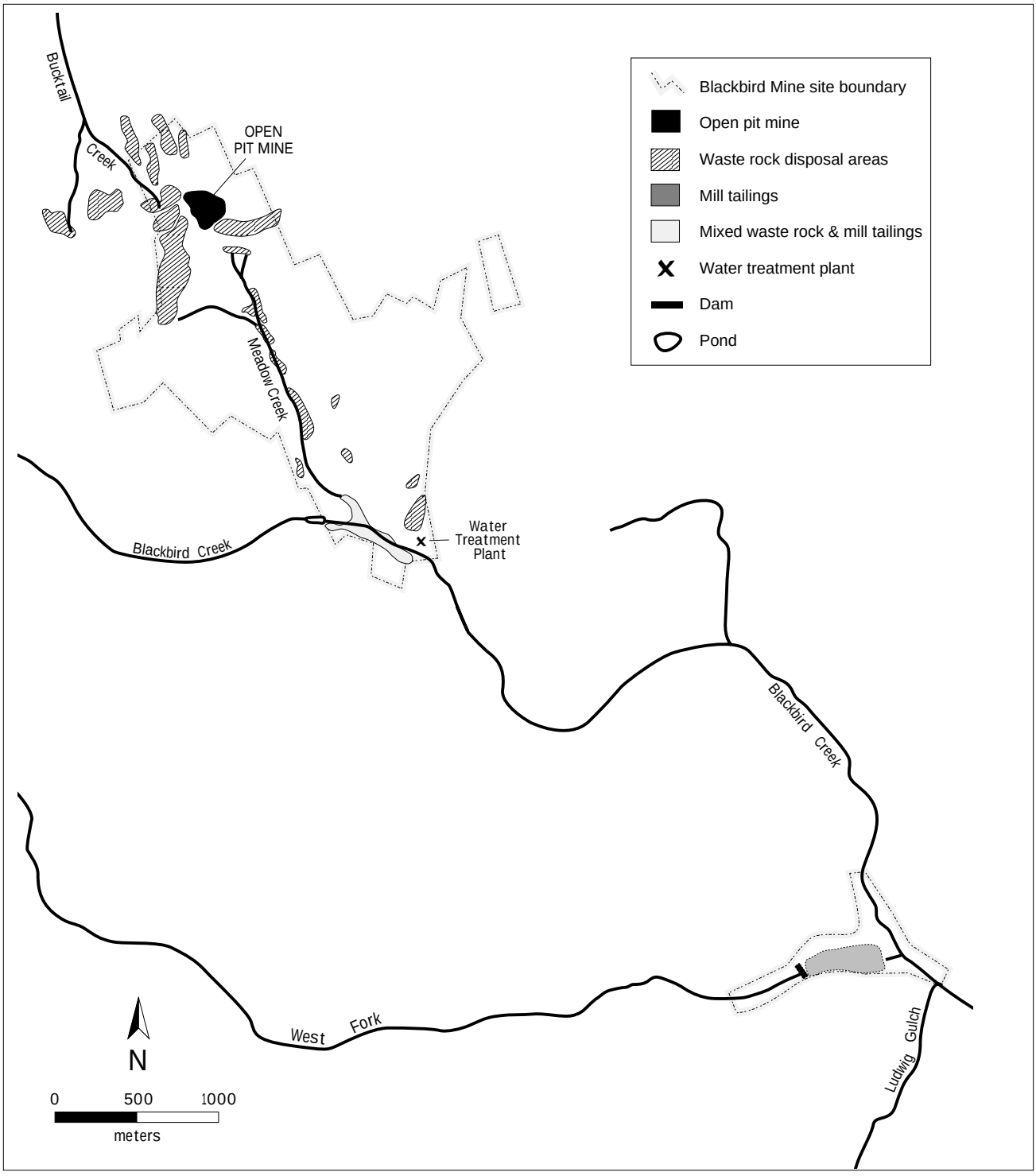

Figure 2. Detail of Blackbird Mine study area (Reiser 1986).

Table 1. NOAA trust resources in the Panther Creek watershed and the Salmon River.

Common Name	Scientific Name	Occurrence Salmon River	Panther Creek	Blackbird Creek
SALMONIDS				
Snake River sockeye salmon (E)	*Oncorhynchus nerka*	♦		
Snake river spring/summer chinook salmon (T)	*Oncorhynchus tshawytscha*	♦	♦	◊
Steelhead trout	*Oncorhynchus mykiss*	♦	♦	◊
OTHER SPECIES				
Pacific lamprey	*Entoaphenus tridentatus*	◊		

♦: Known use - species reported in these habitats
◊ Potential use - physical habitats are suitable for use by these species
E: Endangered species
T: Threatened species

classifications in Panther Creek range from pool / cascade / boulder types to riffle / run types. Stream flow varies, depending on the seasons; lowest flows occur in the winter when precipitation accumulates as snowpack, and the highest flows occur during the spring snowmelt period. Stream flow measured in September 1984 ranged from 7 cfs near the headwaters to 101 cfs towards the mouth of the creek. Suitable spawning habitats for salmon have been identified at a number of locations in the Panther Creek basin (Reiser 1986). Cascades in Big Deer Creek block passage to anadromous fish at about 1 km above the confluence with Panther Creek. Blackbird Creek contains habitat that could potentially support anadromous and resident fish. However, mine effluent makes the creek uninhabitable by most aquatic life below the confluence of Meadow Creek.

Although there are no Snake River sockeye salmon in Panther Creek, this federally endangered species must pass by the mouth of Panther Creek as the fish migrate up the Salmon River to their last remaining spawning grounds in Redfish Lake (NMFS 1991b). Panther Creek historically supported large runs of chinook and steelhead, but these runs gradually declined during the 1940s when extensive mining activities began near Blackbird Creek. The runs were eliminated from the system by the early 1960s. Panther Creek remains largely uninhabited by anadromous fish (Reiser 1986).

The whole Panther Creek watershed is considered critical habitat for the federally threatened Snake River spring / summer chinook run (NMFS 1991a; Rose personal communication 1994). Water quality degradation in Panther Creek from the Blackbird Mine was cited as a factor responsible for the loss of salmon habitat and decline of the species, thereby contributing to the now

threatened status of the Snake River spring/summer chinook (NMFS 1991b). Chinook adults build gravel nests (redds) and spawn in late August to September, whereas steelhead spawn from May to June. More than 95% of the suitable spawning habitats for both species are situated upstream of the confluence with Big Deer Creek, and about 70% of the suitable summer rearing habitats are located below the confluence with Blackbird Creek (Reiser 1986). Therefore, most of the salmon stock must pass through contaminated areas to reach suitable areas for spawning, and juveniles must migrate back downstream through contaminated areas for summer rearing. Juvenile salmonids, if present, would rear in lower Panther Creek for several months. During this time, water quality would need to be good enough to not harm the juvenile salmonids (Reiser 1986).

From the late 1970s to the late 1980s, efforts were conducted to reintroduce chinook and steelhead into Panther Creek. These attempts have been less successful than stocking efforts in other streams in the Salmon River watershed. It has been estimated that before 1945, the Panther Creek drainage basin supported 1,000 redds containing two adults per nest. However, field surveys conducted from 1990 to 1994 revealed only two or less redds in Panther Creek (Smith personal communication 1992; Rose personal communication 1994).

The Idaho Department of Fish and Game (IDFG) maintains a non-sustaining resident rainbow trout sport fishery in Panther Creek through annual "put and take" stocking (IDFG 1993). No restrictions have been placed on recreational fishing of spring/summer chinook or steelhead trout in Panther Creek because these species are generally not found in the basin (Rose personal communication 1994).

Site-Related Contamination

The primary contaminants of concern to NOAA at the Blackbird Mine site are arsenic, cobalt, and copper. Although no studies of contamination at Blackbird Mine have been undertaken as part of the NPL remedial process, a variety of studies have been conducted describing contamination of soil, groundwater, surface water, and sediment (Sauter and Wai 1981; Wai and Mok 1986; McHugh 1987; Mok and Wai 1989; Howell 1992; Hull 1992; Idaho Division of Environmental Quality 1992; RCG/Hagler, Bailly, Inc. 1993; and NOAA 1994).

Soils in the vicinity of Blackbird Mine are naturally enriched with the trace elements arsenic, cobalt, and copper. Concentrations of these trace elements were substantially higher than background concentrations in soil, waste piles, and areas containing mill tailings at the site (Table 2). Groundwater seeps and alluvial groundwater contained copper at maximum concentrations of 650,000 and 1,070,000 µg/l, respectively (Baldwin et al. 1978; Reiser 1986), greatly exceeding the 12 µg/l AWQC for copper. Very high concentrations of cobalt (up to

Table 2. Maximum concentrations (mg/kg) of trace elements of concern detected in surface soil deposits at the Blackbird Mine (RCG/Hagler, Bailly Inc. 1993; Hull 1992) compared with average concentrations in U.S. soil and background concentrations in the vicinity of the site.

	Mine Waste Piles	Efflorescent Crust on Waste Piles	Soil and Tailings in Blackbird Creek Floodplain and Along Banks	Mill Tailings	Background Range Near the Site[1]	U.S. Average[2]
Arsenic	5,100	770	6,700	4,500	8-10	5
Cobalt	2,400	2,700	1,100	9,000	6-440	8
Copper	13,000	20,000	1,900	21,000	4-2,400	30

1: Data were compiled and presented by NOAA (1994).
2: Lindsay (1979).

1,470,000 µg/l in alluvial groundwater) have been measured (Baldwin et al. 1978).

Concentrations of copper in both surface water and sediment from creeks downgradient of the site, including Panther Creek, frequently exceeded the screening guidelines, with maximum concentrations generally found in Bucktail Creek (Table 3). Concentrations of cobalt in surface water and sediment were elevated, but screening guidelines were not available for cobalt. Arsenic has been found in sediments of creeks draining the site, including Panther Creek, at concentrations substantially above the ERL for arsenic. Surface water did not contain elevated concentrations of arsenic when compared to the AWQC.

Several types of bioassessment studies have been conducted to determine whether site-related contaminants are causing adverse affects to aquatic biota. Results from bioassays with the amphipod *Hyalella azteca* showed that sediment collected in Panther Creek from two locations just downstream from the outlets of Blackbird and Big Deer creeks was substantially more toxic than sediment from the lab control and from an upstream location (NOAA 1994). *H. azteca* mortaility was positively correlated to concentrations of arsenic, cobalt, and copper in sediment. Results from benthic macroinvertebrate surveys in Panther Creek have consistently shown abundant, diverse populations upstream from the confluence with Blackbird Creek outlet. Downstream from Blackbird Creek, populations were depauperate and were dominated by pollution-tolerant chironomid and simulidae midges (Speyer 1982; Mangum 1985; Smith 1993). The IDFG has conducted in-situ caged fish studies in Panther Creek using juvenile chinook salmon or rainbow trout. Fish tested in Panther Creek just below the confluences of Blackbird and Big Deer creeks have shown substantial mortality relative to the upstream controls in some of the tests. All fish caged in Panther Creek at the mouths of Blackbird and Big Deer creeks

Table 3. Maximum concentrations of trace elements of concern detected in surface water (µg/l; dissolved) and sediment (mg/kg) of creeks draining Blackbird Mine.

	Blackbird Creek	Bucktail Creek	Panther Creek below Blackbird Creek	Panther Creek below Big Deer Creek	Screening Guideline
SURFACE WATER[1]					Freshwater Chronic AWQC[2] (µg/l)
Arsenic	4.6	6.5	6.3	2.6	190
Cobalt	2,800	150,000	120	40	NA
Copper	2,900	310,000	160	60	12+
SEDIMENT[3]					ERL[4] (mg/kg)
Arsenic	3,800	1,100	890	150	8.2
Cobalt	1,600	270	550	550	NA
Copper	9,000	19,000	2,900	1,200	34

1: Data from Wai and Mok 1986; McHugh 1987; IDEQ 1992; and RCG/Hagler, Bailly, Inc. 1993.
2: Ambient water quality criteria for the protection of aquatic organisms (U.S. EPA 1993)
3: Data from Sauter and Wai 1981; Mok and Wai 1989; Howell 1992; Hull 1992; and NOAA 1994.
4: Effects Range-Low; the concentration representing the lowest 10 percentile value for the data in which effects were observed or predicted in studies compiled by Long and McDonald (1992).
+: Hardness-dependent criteria (100 mg/l $CaCO_3$ used).
NA: Not Available

died (Corley 1967; U.S. Department of Energy 1985; Reiser 1986).

Summary

Concentrations of arsenic, cobalt, and copper in surface water, stream sediments, and surface soil deposits in the Blackbird Mine area are substantially higher than background concentrations of those elements. Chinook salmon and steelhead trout were numerous in the Panther Creek watershed before large-scale operation of the Blackbird Mine began in 1945. Since the early 1960s the watershed has been largely uninhabited by those species. Few anadromous fish return to Panther Creek relative to returns to other streams in the region in spite of restocking efforts. The weight of evidence from various bioassessment studies indicates that the aquatic environments of Panther Creek, lower Big Deer Creek, and lower Blackbird Creek continue to be severely stressed by releases from the Blackbird Mine.

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