Ely Copper Mine

Vershire, Vermont

EPA Facility ID: VTD988366571

Basin: Waits

HUC: 01080103

Executive Summary

The Ely Copper Mine site is an abandoned mine located next to the Ompompanoosuc River in Vershire, Vermont. Activities at the mine ceased in 1920; left behind were ore dumps and tailings piles that contain approximately 90,700 metric tons (100,000 tons) of ore materials. The contaminants of concern at the Ely Copper Mine site are metals found in the site's surface water, groundwater, sediment, and soil. Contaminants from the Ely Copper Mine site are considered a threat to Atlantic salmon, a NOAA trust resource. The NOAA habitat of concern is the surface waters of the Ompompanoosuc River; the river and its tributaries are part of the Connecticut River Atlantic Salmon Restoration Program. Atlantic salmon are stocked along the Ompompanoosuc River as far north as Vershire, near the Ely Copper Mine site.

Site Background

The Ely Copper Mine site in rural Vershire, Vermont, encompasses approximately 728 ha (1,800 acres) (Figure 1). Copper mining activities occurred on approximately 142 ha (350 acres) of the site. These activities ceased in 1920, with the exception that dump-ore was removed from the property between 1949 and 1950 (USEPA 2001). Numerous ore dumps, including a mine tailing and slag pile, remain on the property. These dumps are estimated to contain approximately 90,700 metric tons (100,000 tons) of ore material (VDEC 1992). The area where mining activities occurred is barren of vegetation except near the entrance of the mine, flue, and adits. Ely Mine Forest, Inc., the current property owner, manages portions of the property as commercial timberland (USEPA 2001).

The Ely Copper Mine site extends from Ely Brook, a small tributary of the Ompompanoosuc River, along the top of a long ridge at elevations ranging from approximately 270 m (900 ft) above mean sea level (MSL) to approximately 400 m (1,300 ft) MSL (VDEC 1992). Two intermittent mine drainage streams, Stream A and Stream B, drain the property (Figure 2). Stream A flows adjacent to the west side of the tailings pile, while Stream B flows over the tailings pile. The tailings are rich in metals and sulfides. As water passes over and through the tailings, sulfuric acid is produced. The sulfuric acid dissolves and mobilizes the metals, causing acid mine drainage (Tetra Tech 2001). The acid mine drainage has stained the two drainage streams, which are orange, brown, and reddish in color (Tetra Tech 2001).

Stream A and Stream B join to form the Mine Drainage Stream, which flows southeast approximately 0.8 km (0.5 mi) to Ely Brook (Figure 2). From the confluence of the Mine Drainage Stream with Ely Brook, it is approximately 1.6 km (1 mi) to the confluence of Ely Brook and the Ompompanoosuc River, which is approximately 23 km (14 mi) upstream of the confluence of the Ompompanoosuc River and the Connecticut River (VDEC 1992) (Figure 1).

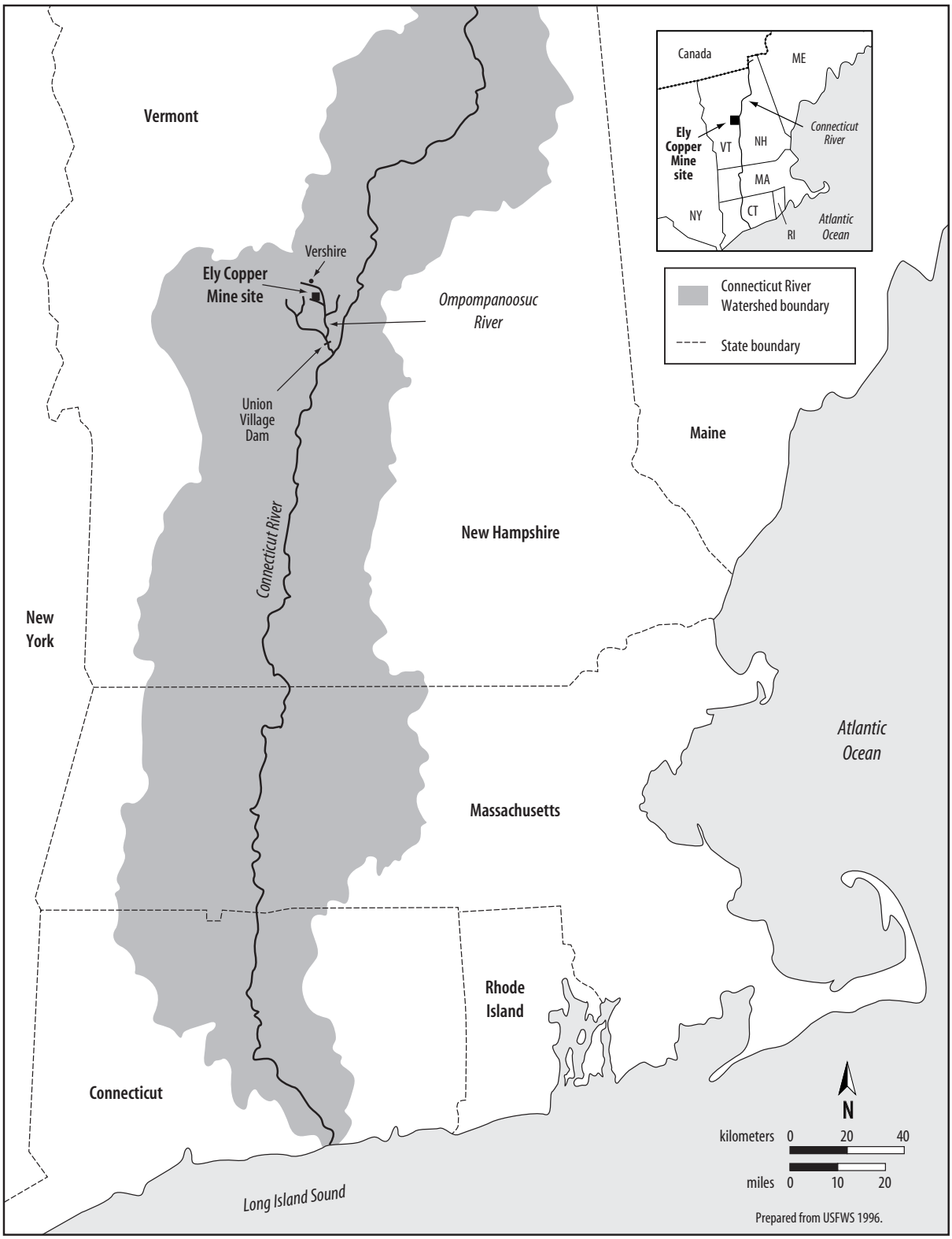

Figure 1. Location of Ely Copper Mine site, Vershire, Vermont.

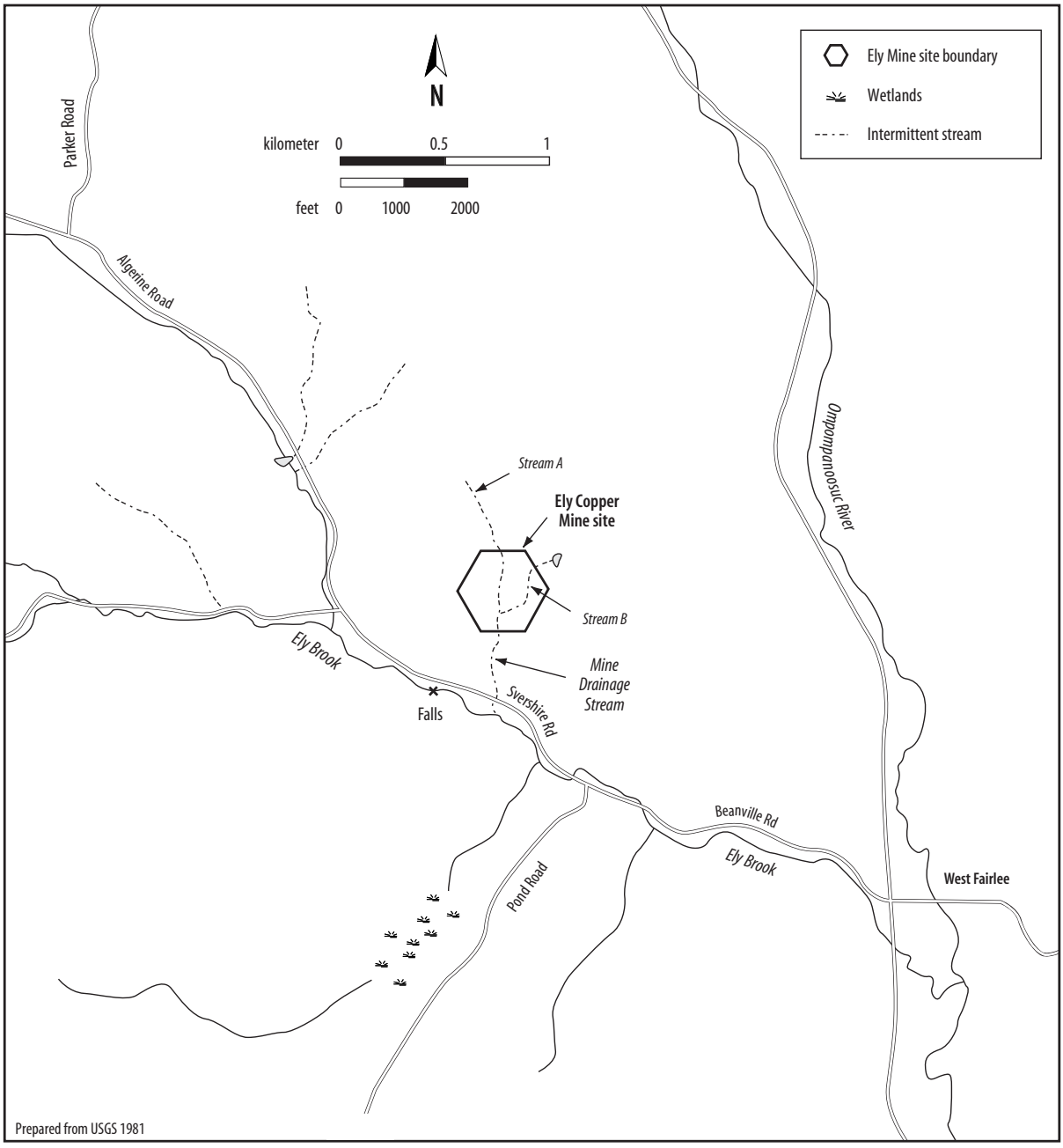

Figure 2. Detail of Ely Copper Mine site.

In July 1988, the Vermont Agency of Natural Resources collected water samples from Ely Brook and inventoried fish species found in the brook. Only one freshwater fish species was found below the confluence of the Mine Drainage Stream and Ely Brook, while five freshwater fish species were found above the confluence (VDEC 1992). In 1991, the Vermont Department of Environmental Conservation concluded that copper had impacted the macroinvertebrate community of Ely Brook downstream of its confluence with the Mine Drainage Stream. In 1995, the Bureau of Mines undertook a study to determine the impact of the discharge from the Ely Copper Mine site and concluded that mine drainage had impacted Ely Brook's water quality as demonstrated by physical and biological factors (Tetra Tech 2001). The U.S. Environmental Protection Agency placed the Ely Copper Mine site on the National Priorities List in September 2001.

NOAA Trust Resources

The NOAA trust resource of concern at the Ely Copper Mine site is Atlantic salmon. The NOAA trust habitat of concern is the surface waters of the Ompompanoosuc River; the river and its tributaries are part of the Connecticut River Atlantic Salmon Restoration Program.

The confluence of Ely Brook and the Ompompanoosuc River is approximately 15 km (9.5 mi) upstream of Union Village Dam (Figure 1). The dam has no upstream fish passage facilities, which limits fish migration from the Connecticut River to the Ompompanoosuc River to the first 5.6 km (3.5 mi) of the Ompompanoosuc River below the dam (Kirn 2002).

Although no Atlantic salmon were found among fish samples recently collected from below Union Village Dam, Atlantic salmon fry are stocked above and below the dam (Kirn 2002; Langdon 2002). Salmon fry are stocked above the dam as far north as Vershire for smolt production. In the Ompompanoosuc River, the majority of the habitat suitable for Atlantic salmon smolts is upstream of the Union Village Dam (Kirn 2002, 2003). Because Union Village Dam is used only for flood control, it is left open year-round. Juvenile salmon are able to pass through the dam, moving with the flow of the water, but the dam forms an impassable barrier to the upstream migration of returning adult salmon (McMenemy 2002). Restoration plans to allow upstream fish passage around Union Village Dam have been deferred until the numbers of adult salmon returning to the river basin increase (Covington 2002; Kirn 2003).

Ely Brook was stocked with Atlantic salmon on an experimental basis for one year. Because of extremely poor survival and growth of the fish, likely due to acid mine drainage, it was not restocked (McMenemy 2001). Stocking could be attempted again should the brook provide suitable habitat for fry in the future (Kirn 2002).

There is no commercial or recreational fishing of Atlantic salmon in the Ompompanoosuc River. A fish consumption advisory, which recommends reduced fish consumption, is currently in effect for all Vermont waters. The advisory is for resident fish species, including chain pickerel, lake trout, largemouth bass, northern pike, smallmouth bass, and walleye (VDH 2000).

Site-Related Contamination

Inorganic compounds, metals in particular, are the primary contaminants of concern at the Ely Copper Mine site. During a screening site inspection conducted by the Vermont Department of Environmental Conservation, seven surface water samples, three groundwater samples, seven sediment samples, and seven soil samples were collected. All samples were analyzed for vola-

tile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals (arsenic, cadmium, chromium [assumed to represent hexavalent chromium], copper, lead, mercury, nickel, selenium, and zinc). Analytical results for the inorganic compounds are presented in Table 1. VOCs or SVOCs were not detected in any of the media sampled, but it is noted that detection limits were not available for comparison at the time of this report.

Table 1. Maximum concentrations of contaminants of concern to NOAA at the Ely Copper Mine site (VDEC 1992).

	Soil (mg/kg)		Water (µg/L)			Sediment (mg/kg)	
Contaminant	Soils	Mean U.S.[a] Soil	Ground-water	Surface Water	AWQC[b]	Sediment	TEL[c]
INORGANIC COMPOUNDS							
Arsenic	21	5.2	59	15	150	11	5.9
Cadmium	1	0.06	3	7	2.2[d]	<0.10	0.596
Chromium[f]	35	37	36	17	11	73	37.3
Copper	5600	17	1400	5800	9[d]	5500	35.7
Lead	304	16	<10	<10	2.5[d]	17	35
Mercury	1	0.058	<0.2	<0.2	0.77[e]	<0.070	0.174
Nickel	35	13	180	73	52[d]	26	18
Selenium	56	0.26	<5	<5	5.0[e]	28	NA
Zinc	1200	48	25000	1300	120[d]	160	123.1

a: Shacklette and Boerngen (1984), except for cadmium, which represents average concentrations in the Earth's crust from Lindsay (1979).

b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 1993, 1999). Freshwater chronic criteria presented.

c: Threshold effects level (TEL) is the geometric mean of the 15th percentile of the effects data and the 50th percentile of the no-effects data. The TEL is intended to represent the concentration below which adverse biological effects rarely occurred (Smith et al. 1996).

d: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.

e: Criterion expressed as total recoverable metal.

f: Screening guidelines represent concentrations for $Cr.^{+6}$

NA: Screening guidelines not available.

Three of the seven surface water samples were collected from Ely Brook above, below, and downstream of its confluence with the drainage streams; three were collected at various locations within the mining operations area; and a background sample was collected upgradient of the site. Maximum concentrations of cadmium, chromium, copper, nickel, and zinc in surface water samples from the mining operations area exceeded ambient water quality criteria (AWQC) screening guidelines. The maximum concentration of copper exceeded the AWQC by more than two orders of magnitude. The maximum concentration of zinc exceeded the AWQC by one order of magnitude. The maximum concentrations of cadmium, chromium, and nickel exceeded the AWQC by factors of approximately three or less. Arsenic was detected, but at a maximum concentration below the AWQC; lead, mercury, and selenium were not detected. All maximum concentrations of metals were detected in a surface water sample taken from Stream A approximately 122 m (400 ft)

upstream of the confluence of Streams A and B. Analysis of the surface water samples collected from Ely Brook showed copper (95 µg/L) to be the only metal detected at a maximum concentration above the AWQC.

Groundwater samples for metals analyses were taken from two of three well points; a sample could not be collected from the third well because the well did not recharge after other sampling. Maximum concentrations of cadmium, chromium, copper, nickel, and zinc all exceeded the AWQC. The maximum concentrations of copper and zinc exceeded the AWQC by two orders of magnitude. The maximum concentrations of cadmium, chromium, and nickel exceeded the AWQC by factors of approximately three or less. Arsenic was detected, but at a maximum concentration below the AWQC; lead, mercury, and selenium were not detected. The maximum concentrations of cadmium, copper, and zinc were detected in a sample collected from a well point in Stream A; the maximum concentrations of arsenic, chromium, and nickel were found in a sample collected from a well point in Stream B (VDEC 1992).

Analysis of sediment samples taken from the mining operations area showed that maximum concentrations of arsenic, chromium, copper, nickel, and zinc exceeded the threshold effects level (TEL) screening guidelines. The maximum concentration of copper exceeded the TEL by two orders of magnitude. The maximum concentrations of arsenic, chromium, nickel, and zinc exceeded TELs by factors of approximately two or less. Lead was detected, but at a maximum concentration below the TEL. Selenium was detected in sediment samples but there is no TEL available for comparison. Cadmium and mercury were not detected. The maximum concentrations of arsenic, chromium, and nickel were detected in a sample collected from an area of ponded water near an air shaft on the mine property. The maximum concentration of lead was detected in a sample collected from Stream B, while the maximum concentrations of copper, selenium, and zinc were found in a sample from Stream A (VDEC 1992). In sediment samples collected from Ely Brook, only copper (246 mg/kg) was detected at a maximum concentration above the TEL. All other maximum concentrations of metals in sediment from Ely Brook did not exceed the TEL screening guidelines (excepting a 0.6 mg/kg concentration of selenium, for which there is no TEL) (VDEC 1992).

Five of the seven soil samples were taken from waste material at the site; one was a background sample; and one was a sample of native soil. The soil samples were collected at depths ranging from approximately 0.15 m to 0.3 m (0.5 ft to 1.0 ft) (VDEC 1992). Maximum concentrations of arsenic, cadmium, copper, lead, mercury, nickel, selenium, and zinc in soil samples from the Ely Copper Mine site all exceeded the average concentrations found in U.S. soil (mean U.S. soil concentrations). The maximum concentrations of copper and selenium exceeded the mean U.S. soil concentrations by two orders of magnitude. The maximum concentrations of cadmium, lead, mercury, and zinc exceeded the mean U.S. soil concentrations by one order of magnitude. Maximum concentrations of arsenic and nickel exceeded the mean U.S. soil concentrations by factors of approximately four or less; chromium was detected, but at a concentration below the mean U.S. soil guideline. The maximum concentrations of cadmium, copper, and zinc were detected in a sample taken from an ash pile. The maximum concentrations of lead and mercury were detected in samples taken from slag piles, while the maximum concentration of selenium was found near some old roasting beds. Copper ore was roasted in the roasting beds to reduce the sulfur content and other impurities before it was smelted. (VDEC 1992).

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