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## Pike Hill Copper Mine

*Corinth, Vermont*

*EPA Facility ID: VTD988366720*

*Basin: Waits*

*HUC: 01080103*

### Executive Summary

The Pike Hill Copper Mine site is an abandoned copper mine in a forested rural area of Corinth, Vermont. Investigations conducted by state and federal agencies detected elevated concentrations of metals in surface water, sediment, and soil samples taken from the site, nearby Pike Hill Brook, and the Waits River. Cadmium, copper, and zinc are the primary contaminants of concern to NOAA. Surface water is the primary pathway for the migration of contaminants from the site to NOAA trust resources. The Waits River is the habitat of primary concern to NOAA. The Waits River provides habitat to Atlantic salmon, which is the trust resource of concern to NOAA in the vicinity of the site.

### Site Background

The Pike Hill Copper Mine site (Pike Hill) is an abandoned copper mine in a forested rural area of Corinth, Vermont (Figure 1). The Pike Hill site includes two large mine areas referred to as the Eureka Mine and the Union Mine, as well as a small mine area called the Smith Mine, located to the south of the Eureka and Union mines (Figure 2). The combined area of the three mines is approximately 87 ha (216 acres). Copper was mined at the Pike Hill site from 1847 until 1919. Approximately 18,000 metric tons (20,000 short tons) of waste rock and mine tailings remain in waste piles at the site (Piatak et al. 2006).

Investigations conducted by state and federal agencies detected elevated concentrations of metals in surface water, sediment, and soil samples taken from the site, nearby Pike Hill Brook, and the Waits River (Figure 1). Since 1997, the Vermont Department of Environmental Conservation has been conducting a study of the macroinvertebrate and fish populations in Pike Hill Brook downstream of the site; the study shows that these populations have been significantly impacted by acid mine drainage from the site (Fiske and Langdon 2006; USEPA 2006a). As a result, Pike Hill Brook is listed as an impaired water of the state.

The headwaters of Pike Hill Brook are near the Eureka and Union mines, and surface water runoff from waste piles at these mines drains into the brook. From the Pike Hill site, Pike Hill Brook flows approximately 5.6 km (3.5 mi) before emptying into the Waits River (Figure 1). Surface water runoff from the Smith Mine tailings pile flows into an unnamed stream, a tributary of Cookville Brook. Cookville Brook flows approximately 6 km (4 mi) before emptying into the South Branch Waits River, which flows approximately 6 km (4 mi) before discharging into the Waits River. The Waits River flows for approximately 40 km (25 mi) and ultimately discharges to the Connecticut River. Surface water is the primary pathway for the migration of contaminants from the site to NOAA trust resources.

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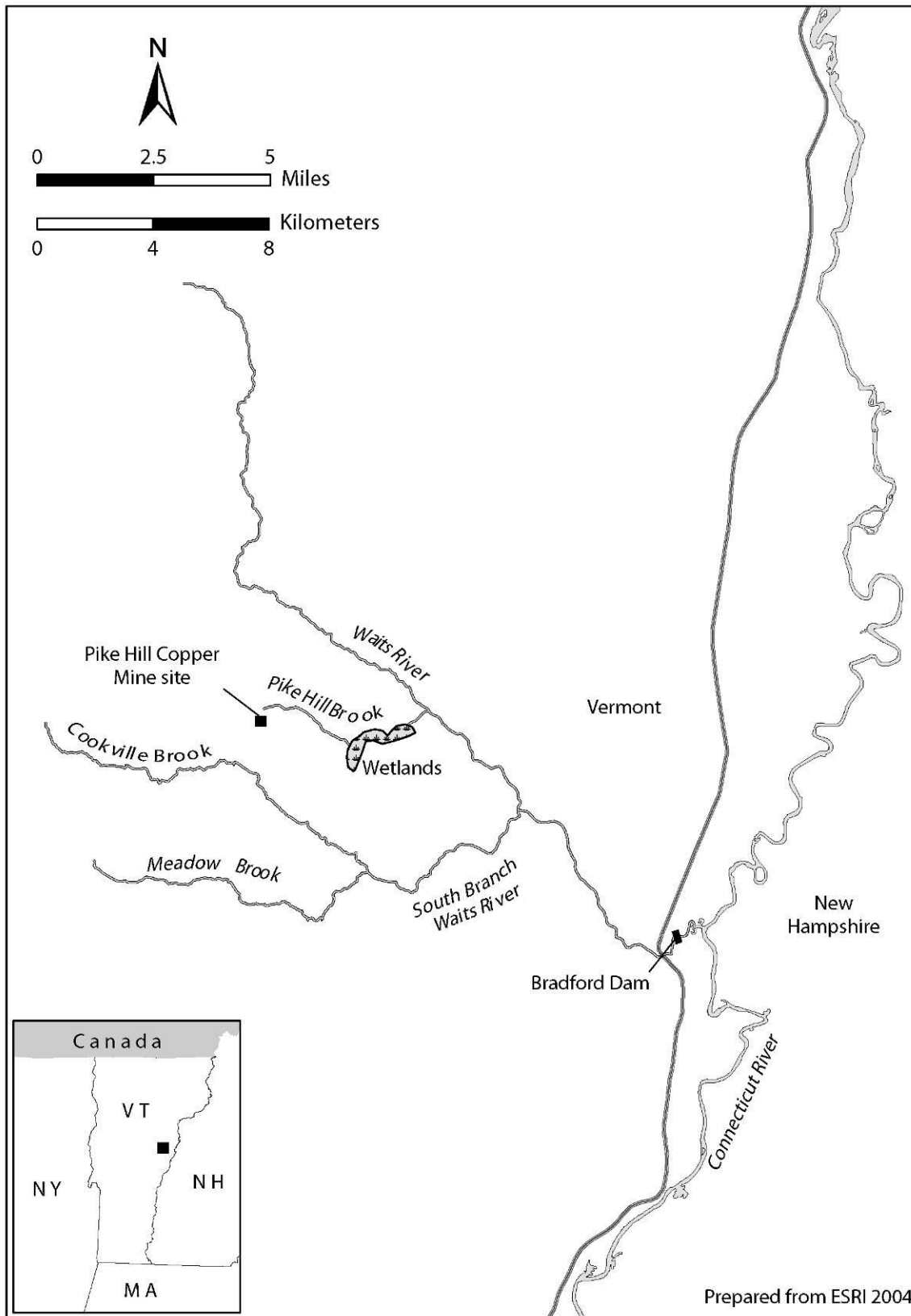


Figure 1. Location of the Pike Hill Copper Mine site, Corinth, Vermont.

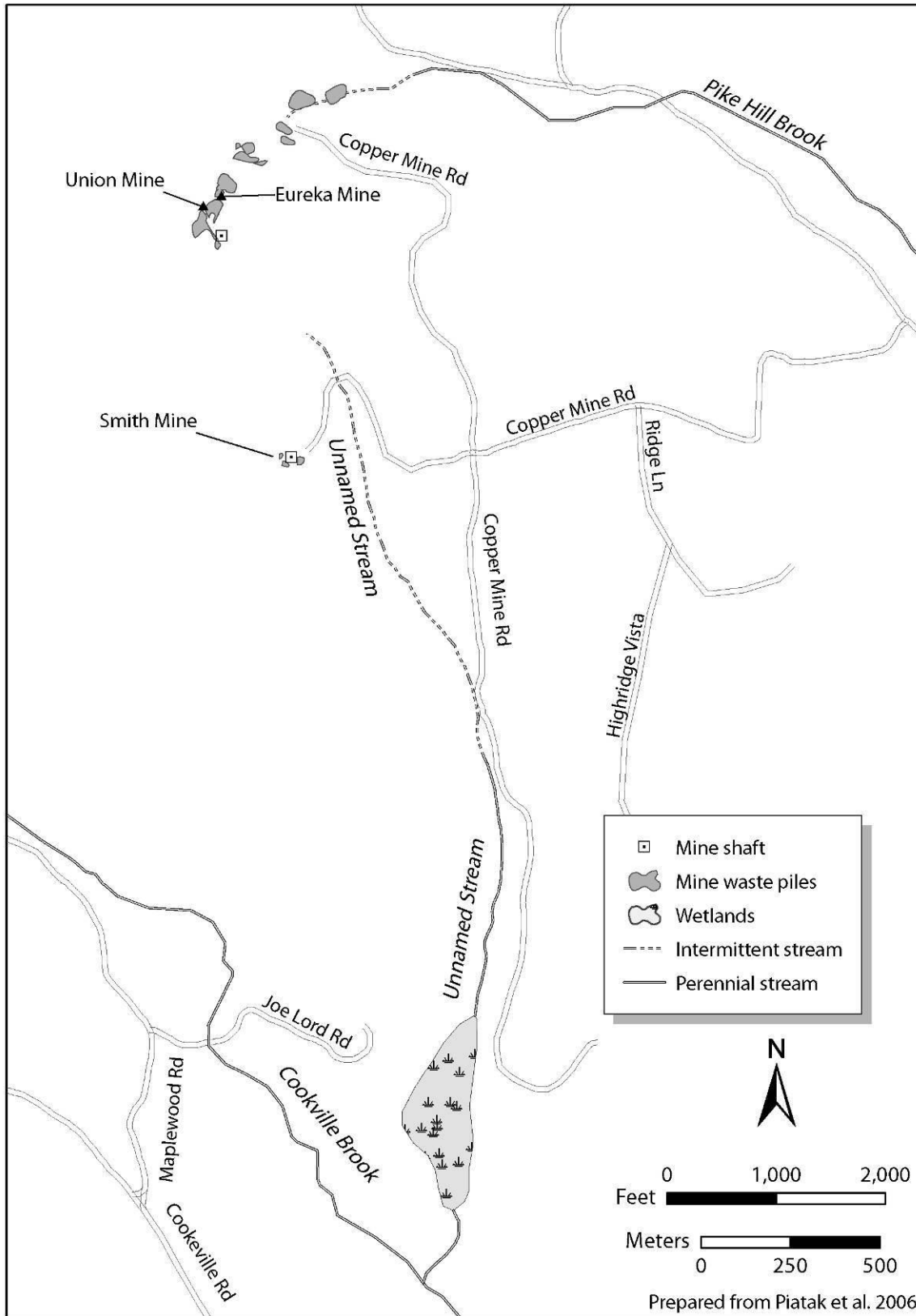


Figure 2. Detail of the Pike Hill Copper Mine property.

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The site was placed on the U.S. Environmental Protection Agency's (USEPA) National Priorities List in July 2004 (USEPA 2007a). During 2004 and 2005, the U.S Geological Survey (USGS) conducted investigations to characterize the mine waste, mine drainage, sediment quality, hydrology, and surface water quality at the Pike Hill site. In 2005, the USEPA initiated a remedial investigation/feasibility study at the site; this investigation is still in progress (USEPA 2007a).

### NOAA Trust Resources

The Waits River is the habitat of primary concern to NOAA. The Waits River provides habitat to Atlantic salmon, a NOAA trust resource. The Waits River is part of the Connecticut River Atlantic Salmon Restoration Program. Stocking in the Waits River has taken place above and below the confluence of Pike Hill Brook (Hunter 2004). The information reviewed for this report did not provide information on the presence or absence of Atlantic salmon in Pike Hill Brook and Cookville Brook, but juvenile Atlantic salmon are stocked in streams throughout the Connecticut River watershed as far north as the Nulhegan River in northern Vermont (USFWS 1998).

Fish passage is in place or planned at all dams on the Connecticut River downstream of the site. The Bradford Dam on the Waits River downstream of the site does not currently have fish passage. Installation of fish passage facilities at the Bradford Dam has been deferred until greater numbers of anadromous fish are present upstream and downstream of the dam (USFWS 1998).

Recreational and commercial fishing of Atlantic salmon has been banned in the Connecticut River and its tributaries, which includes the Waits River, until additional progress on restoring this species has been made (USFWS 2007).

The Vermont Department of Health has issued a general fish consumption advisory for all Vermont waters (VDOH 2007) because of mercury contamination. The advisory recommends that:

- High-risk individuals, which includes women of child-bearing age and children age six and under, should not eat walleye, and the general public should reduce consumption of walleye to one meal per month.
- High-risk individuals should eat no more than one meal per month of American eel, chain pickerel, lake trout, and smallmouth bass, and the general public should eat no more than three meals per month of these species.
- High-risk individuals should eat no more than two meals per month of largemouth bass and northern pike, and the general public should eat no more than six meals per month of these species.
- High-risk individuals should eat no more than three to four meals per month of brook trout, brown trout, rainbow trout, and yellow perch.

## Site-Related Contamination

During 2004 and 2005, 44 surface water, 11 sediment, and four soil samples were collected at the site by the USGS (Kiah et al. 2007; Piatak et al. 2006). All of the samples were analyzed for metals. In 2006, toxicity tests were conducted by exposing the freshwater cladoceran species *Ceriodaphnia dubia* and fathead minnow *Pimephales promelas* to surface water collected from Pike Hill Brook downstream of the Pike Hill Copper Mine site. The results of the toxicity tests indicate that Pike Hill Brook is being impacted from acid drainage from the mine (TechLaw 2006). Based on the analytical and toxicity results, cadmium, copper, and zinc are the primary contaminants of concern to NOAA at the Pike Hill Copper Mine site.

Table 1 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. In the absence of such guidance, the screening guidelines for surface water are the ambient water quality criteria (AWQC; USEPA 2006b); the screening guidelines for sediment in a freshwater environment are the probable effects concentrations (PECs; MacDonald et al. 2000); and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2008). Exceptions to these screening guidelines, if any, are noted on Table 1. Only maximum concentrations that equaled or exceeded relevant screening guidelines, or for which screening guidelines are not currently available, are discussed below. When known, the general sampling locations are also provided for maximum concentrations that exceeded screening guidelines or do not have screening guidelines.

### Surface Water

Six metals were detected in surface water samples collected from the Pike Hill site at maximum concentrations that exceeded the AWQC (Table 1). The maximum concentrations of cadmium and copper were detected in a sample collected from Pike Hill Brook approximately 240 m (800 ft) downstream of the Eureka Mine and Union Mine waste piles (Figure 2). The maximum concentration of copper exceeded the AWQC by three orders of magnitude. The maximum concentration of cadmium exceeded the AWQC by two orders of magnitude. The maximum concentrations of lead and zinc were detected in a sample collected from a pool in the Eureka Mine shaft. The maximum concentration of zinc exceeded the AWQC by one order of magnitude while lead exceeded the AWQC by a factor of approximately two. Chromium and nickel were detected at maximum concentrations that slightly exceeded the AWQCs in a surface water sample collected from an unnamed stream, a tributary to Cookville Brook near the Smith Mine.

### Sediment

Three metals were detected in sediment samples taken from Pike Hill Brook at maximum concentrations that exceeded the PECs, and selenium was also detected for which no screening guideline is currently available (Table 1). Maximum concentrations of cadmium, copper, selenium, and zinc were detected in a sample collected from Pike Hill Brook approximately 240 m (800 ft) downstream of the Eureka Mine and Union Mine waste piles (Figure 2). The maximum concentration of copper exceeded the PEC by one order of magnitude; zinc concentrations exceeded the PEC by a factor of two, and cadmium

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concentrations slightly exceeded the PEC. No screening guideline is currently available for comparison to the maximum concentration of selenium detected in the sediment samples.

### Soil

Five metals were detected in soil samples taken from the Pike Hill site down-slope of the southernmost Smith Mine waste pile (Figure 2) at maximum concentrations that exceeded screening guidelines (Table 1). Maximum concentrations of chromium, selenium, and zinc exceeded the ORNL-PRGs by one order of magnitude. The maximum concentration of copper exceeded the USEPA's ecological soil screening guideline by one order of magnitude. The maximum concentration of cadmium slightly exceeded the USEPA's ecological soil screening guideline.

Table 1. Maximum concentrations of contaminants of concern to NOAA at the Pike Hill Copper Mine site (Piatak et al. 2006; Kiah et al. 2007). Contaminant values in bold exceed or are equal to screening guidelines.

Contaminant	Soil (mg/kg)		Surface Water (µg/L)		Sediment (mg/kg)	
	Soil	ORNL-PRG <sup>a</sup>	Surface Water	AWQC <sup>b</sup>	Sediment	PEC <sup>c</sup>
<b>METALS/INORGANICS</b>						
Arsenic	0.6	9.9	3	150	23	33
Cadmium	<b>0.49</b>	0.36 <sup>d</sup>	<b>93</b>	0.25 <sup>e</sup>	<b>5.8</b>	4.98
Chromium	<b>39</b>	0.4	<b>12</b>	11 <sup>f</sup>	75	111
Copper	<b>1,100</b>	28 <sup>d</sup>	<b>31,000</b>	9 <sup>e</sup>	<b>8,100</b>	149
Lead	22	40.5	<b>4.2</b>	2.5 <sup>e</sup>	62	128
Nickel	25	30	<b>62</b>	52 <sup>e</sup>	32	48.6
Selenium	<b>2.1</b>	0.21	2.9	5.0 <sup>g</sup>	52	NA
Zinc	<b>520</b>	8.5	<b>7,400</b>	120 <sup>e</sup>	<b>1,100</b>	459

- a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
- b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006b). Freshwater chronic criteria presented.
- c: Probable Effects Concentration (PEC). Concentration above which adverse effects are likely to be frequently observed (MacDonald et al. 2000).
- d: Ecological soil screening guideline (USEPA 2008).
- e: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L CaCO<sub>3</sub>.
- f: Screening guideline represents concentration for Cr.<sup>+6</sup>
- g: Criterion expressed as total recoverable metal.
- NA: Screening guideline not available.

### References

Efroymson, R.A., G.W. Suter II, B.E. Sample, and D.S. Jones. 1997. Preliminary remediation goals for ecological endpoints. August 1997. Prepared for U.S. Department of Energy, Oak Ridge, TN. Available at: Environmental Services Division, Oak Ridge National Laboratory, <http://www.esd.ornl.gov/programs/ecorisk/documents/tm162r2.pdf> (accessed August 2, 2007).

- Environmental Systems Research Institute, Inc. (ESRI). 2004. ESRI data & maps 2004. Redlands, California.
- Fiske, S., and R. Langdon. 2006. Memorandum to the record regarding: Interpretation of biological assessment data collected by VTDEC and USGS below the Pike Hill mine site through 2005. Vermont Department of Environmental Conservation. July 12, 2006.
- Hunter, A. Fisheries biologist for the Vermont Department of Fish and Wildlife, Roxbury, VT. Personal communication March 30, 2004.
- Kiah, R.G., J.R. Deacon, N.M. Piatak, R.R. Seal, J.F. Coles, and J.M. Hammarstrom. 2007. Surface-water hydrology and quality at the Pike Hill Superfund Site. U.S. Geological Survey Scientific Investigation Report 2007-5003.
- MacDonald, D., C. Ingersoll, and T. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Archives of Environmental Contamination and Toxicology* 39:20-31.
- Piatak, N.M., R.R. Seal, J.M. Hammarstrom, R.G. Kiah, J.R. Deacon, M. Adams, M. W. Anthony, P.H. Briggs, and J.C. Jackson. 2006. Geochemical characterization of mine waste, mine drainage, and stream sediments at the Pike Hill Copper Mine Superfund site. U.S. Geological Survey Scientific Investigation Report 2006-5303.
- TechLaw. 2006. Surface water toxicity testing report for the Pike Hill Mine in Corinth, VT and the Ely Mine in Vershire, VT. August.
- U.S. Environmental Protection Agency (USEPA). 2006a. NPL site narrative at listing for Pike Hill Copper Mine. Available at: USEPA National Priorities List, <http://www.epa.gov/superfund/sites/npl/nar1718.htm> (accessed August 2, 2007).
- U.S. Environmental Protection Agency (USEPA). 2006b. National recommended water quality criteria: U.S. Environmental Protection Agency, Office of Water.
- U.S. Environmental Protection Agency (USEPA). 2007a. Pike Hill Copper Mine fact sheet. Available at: USEPA Waste Site Cleanup & Reuse in New England, <http://www.epa.gov/region1/superfund/sites/pikehill> (accessed August 16, 2007).
- U.S. Environmental Protection Agency (USEPA). 2008. Ecological soil screening guidelines. May 2008. Available: <http://www.epa.gov/ecotox/ecossl/> (accessed September 2008).
- U.S. Fish and Wildlife Service (USFWS). 1998. Strategic plan for the restoration of Atlantic salmon to the Connecticut River. Connecticut River Atlantic Salmon Commission. Available at: USFWS Connecticut River Coordinators Office, <http://www.fws.gov/r5crc/stuff/stplan.html> (accessed August 16, 2007).
- U.S. Fish and Wildlife Service (USFWS). 2007. Fishing rules and regulations. Available at: USFWS Connecticut River Coordinators Office, [http://www.fws.gov/r5crc/fishing\\_regulations.htm](http://www.fws.gov/r5crc/fishing_regulations.htm) (accessed August 16, 2007).
- Vermont Department of Health (VDOH). 2007. Fish alert. Available at: VDOH Health Advisories and Alerts, [http://healthvermont.gov/enviro/fish\\_alert/fish\\_alert.aspx](http://healthvermont.gov/enviro/fish_alert/fish_alert.aspx) (accessed August 29, 2007).