FINAL HAZARD RANKING SYSTEM PACKAGE

CALLAHAN MINE
BROOKSVILLE, MAINE
CERCLIS ID NO.: MED980524128

Prepared For:

U.S. Environmental Protection Agency
Region I
Office of Site Remediation and Restoration
1 Congress Street, Suite 1100
Boston, MA 02114-2023

CONTRACT NO. 68-W-00-097

TDD NO. 01-05-0161

PCS No. 2660

DC No. A-2045

Prepared by:

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SITE DESCRIPTION

The Callahan Mine site (the "site") (CERCLIS ID No. MED980524128) is located approximately 1,000 feet east-southeast of Harborside Village in the Town of Brooksville, Hancock County, Maine (See Attachment A, Figures 1 and 2) [3; 16, p. 1]. No street address is available for the site. The site is the former location of a zinc/copper open-pit mine [25, p. 2; 34, p. 2]. The mining operations were conducted adjacent to and beneath Goose Pond, a tidal estuary [16, p. 1; 34, p. 2]. The Callahan Mine was reputedly the only intertidal heavy metal mine in the world at the time of its operation [34, p. 2].

The property comprises 150 acres and is located in a coastal, rural setting on the Cape Rosier peninsula [16, p. 1]. The property abuts Goose Pond to the east, and private properties to the west, south, and north (See Attachment A, Figure 2) [3; 16, p. 1]. Site features include large waste piles (waste rock piles), a tailings pond, and mine operations buildings and structures (relic buildings and structures) (See Attachment A, Figure 3) [11, p. 2]. The open pit mine ceased operations in 1972 and was flooded by opening a dam at Goose Falls [6, pp. 6, 7]. The mine is currently under water and is subject to daily tidal exchange in Goose Pond [11, p. 2; 34, p. 2]. Goose Pond is connected to Goose Cove to the north by a reversing falls known as Goose Falls [3; 16, p. 4; 22, pp. 5, Map 15; 34, p. 2]. Goose Cove is located on the southern part of Penobscot Bay [34, p. 2].

The zinc/copper sulfide deposit was discovered in 1880 at low tide by a clam digger [7, p. II-279; 8, p. 182]. The main components of this deposit were sphalerite (ZnS) and chalcopyrite ($CuFeS_2$), accompanied by abundant pyrite (FeS_2) and lesser amounts of pyrrhotite (FeS) [8, p. 182]. The first mine operated until 1887 when a price drop closed this and most other mines in Maine [6, p. 2]. Ore was mined from three shafts [7, pp. II-279, II-280]. Efforts were made to mine the ore sporadically through 1964 [6, pp. 2-3; 7, p. II-280]. Callahan Mining Corporation geologists became interested in the potential of the property in 1964 and subsequently open pit mining operations commenced in 1968 [6, p. 3]. Two dams were constructed at the saltwater inlet and freshwater inlet of Goose Pond. Fresh water which normally flowed into Goose Pond was diverted south to Wier Cove via a drainage ditch. Goose Pond was subsequently drained to allow for the excavation of the mine [6, p. 4].

The open-pit mine was approximately 600 to 1,000 feet (ft) in diameter and 320 ft in depth [6, p. 5; 12, p. 5]. Approximately 5 million tons of non-ore-bearing waste rock and 798,000 to 800,000 tons of ore-bearing rock were removed from the mine [6, p. 5; 25, p. 2]. Waste rock was removed and piled throughout the property, but predominantly in an area south of Dyer Cove [6, p. 5; 11, p. 2]. This area has been referred to as "Callahan Mountain", due to the large volume of waste rock located in this area [6, p. 5]. In addition, a large amount of marine clay (200,000 to 225,000 tons) was dumped on the lower portions of "Callahan Mountain" after a mud slide occurred at the open-pit mine [6, p. 14; 7, p. II-283].

Dyer Cove, currently a small part of the Goose Pond estuary, was a fully enclosed area used to temporarily store water pumped from the open pit mine. Particulates were allowed to settle out prior to pumping the water from this cove to Goose Cove [9, p. 4]. Sediment-laden water from the mine was also pumped through a 16-inch pipe line, discharging directly into Goose Cove, north of Goose Pond [7, p. II-282; 34, Figure 1; 40].

Ore was trucked from the mine to an ore storage area [6, p. 5; 7, p. II-281]. From here, the ore was loaded into a series of crushers and mills which reduced the rock to the consistency of fine sand and silt [6, p. 5]. The small particles containing zinc and copper were then recovered by a process called "flotation." The ore was passed through flotation cells into which chemicals were introduced which caused the minerals to float on bubbles [6, pp. 5, 6]. Chemicals which were used in the flotation process included: dithiophosphate salts, aryl phosphorodithioate, cyclohexanol, and cresol [16, p. 5]. The floatation process creates a "froth" which lifts (through surface tension) the mineral particles and depresses or allows to sink the remaining rock [12, p. 4]. The mineral rich froth was collected, washed, dried, and stockpiled in a portion of the mill where it awaiting transportation to a smelter. [12, p. 4]. The ore was processed in the concentrating mill [25, p. 2]. The average ore grade was 1.30% copper, 4.91% zinc, 0.35% lead, and 0.50 ounces per ton of silver [25, p. 2].

SITE DESCRIPTION (CONCLUDED)

The remaining non-mineral particles and residues of the chemical reagents were discharged to the tailings pond [6, pp. 5, 6; 12, pp. 4, 5]. The approximately 11-acre tailings pond is located in the southern portion of the property, adjacent to Goose Pond [6, pp. 5, 6; 11, p. 2; 16, p. 1]. A series of dams were constructed as material was added to the tailings pond. The final height of the dam is 82 feet [6, p. 10, Figure 2]. Mining operations ceased in June 1972 due to the depletion of the mineral reserve. Milling ceased in July 1972 [25, p. 2].

A study completed by the Maine Department of Marine Resources in 1975 examined bio-accumulation of trace elements in selected marine organisms located in Goose Cove [31]. Levels of cadmium, copper, lead, and zinc were detected at several times to several orders of magnitude higher in Goose Cove biota and sediments than in samples collected from other Maine midcoastal and river locations [31, p. 1].

The most recent sampling event was conducted by the Maine Department of Environmental Protection in October 1999 [18, p. 1]. Twelve soil samples, five tailings pond samples (source samples), three tailings pile samples (source samples), eight waste rock pile samples (source samples), 10 sediment samples, and 10 surface water samples were collected [18, pp. 4 - 6]. One sample from the tailings pond was collected 47 feet below ground surface (bgs); the remaining soil, source, and sediment samples were collected at depths ranging from 0 to 6 inches bgs [18, p. 1 - 2]. Soil samples were collected from the mine entrance and the mine operations areas [18, p. 2]. Sediment samples were collected from Goose Pond, Dyer Cove, and Horseshoe Cove (a background sample location) [18, p. 2]. Samples were submitted to the State of Maine Health and Environmental Testing Laboratory for metals analysis. The data were validated according to EPA New England Regional Functional Guidelines, Modified Tier III requirements [20, p. 1]. The analytical results for these samples are used to associate hazardous substances with the sources and attribute hazardous substances to the site. The sediment samples document Level II actual contamination sensitive environment targets and Level II actual contamination fishery targets in Goose Pond.

HRS DOCUMENTATION RECORD COVER SHEET

Name of Site: Callahan Mine
EPA ID No. MED980524128

<u>Contact Persons</u>

Site Investigation:

	Roy F. Weston, Inc. (WESTON®)/ Superfund Technical Assessment and Response Team (START) (Mr. Thomas A. Campbell)	978-657-5400

Documentation Record:

	EPA New England	
	(Mr. Matthew Audet)	617-918-1449
	(Ms. Nancy Smith)	617-918-1436

<u>Pathways, Components, or Threats Not Scored</u>

The calculation of the HRS site score for the Callahan Mine site is based on threats posed by the site to the surface water migration pathway. After review of the four pathways, it was determined that the ground water migration, soil exposure, and air migration pathways do not contribute significantly to the overall HRS site score. Therefore, these three pathways have not been included in this HRS package.

HRS DOCUMENTATION RECORD

Name of Site: Callahan Mine

EPA Region: Region I

Date Prepared: 16 July 2001

Street Address of Site: Harborside (mine entrance at end of Old Mine Lane Road)

City, County, State: Brooksville (Cape Rosier), Hancock County, Maine

General Location in the State: Coastal, south of Bangor, Maine

Topographic Map: U. S. Geological Survey Cape Rosier, Maine 7 × 15-minute Topographic Map. 1973, photoinspected 1979.

Latitude: 44° 21' 05.9" North

Longitude: 68° 48' 36.5" West

Ref: Latitude and Longitude were measured from the entrance to the property [4]. See Figure 2 in Attachment A for the location of the latitude/longitude measurement point.

Scores	
Air Pathway	NS
Ground Water Pathway	NS
Soil Exposure Pathway	NS
Surface Water Pathway	100
HRS SITE SCORE	**50**

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S		S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	NS		NS
2a.	Surface Water Overland/Flood Migration Component (S_{of}) (from Table 4-1, line 30)	100		10,000
2b.	Ground Water to Surface Water Migration Component (S_{gwsw}) (from Table 4-25, line 28)	NS		NS
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	100		10,000
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	NS		NS
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	NS		NS
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		10,000	
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root		**50**	

NS = Not scored

TABLE 4-1
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

DRINKING WATER THREAT		
Factor Categories and Factors	**Maximum Value**	**Value Assigned**
Likelihood of Release		
1. Observed Release	550	550
2. Potential to Release by Overland Flow		
2a. Containment	10	NS
2b. Runoff	25	NS
2c. Distance to Surface Water	25	NS
2d. Potential to Release by Overland Flow (lines 2a × [2b + 2c])	500	NS
3. Potential to Release by Flood		
3a. Containment (Flood)	10	NS
3b. Flood Frequency	50	NS
3c. Potential to Release by Flood (lines 3a × 3b)	500	NS
4. Potential to Release (lines 2d + 3c, subject to a maximum of 500)	500	NS
5. Likelihood of Release (higher of lines 1 and 4)	550	**550**
Waste Characteristics		
6. Toxicity/Persistence	a	NS
7. Hazardous Waste Quantity	a	NS
8. Waste Characteristics	100	NS
Targets		
9. Nearest Intake	50	NS
10. Population		
10a. Level I Concentrations	b	NS
10b. Level II Concentrations	b	NS
10c. Potential Contamination	b	NS
10d. Population (lines 10a + 10b + 10c)	b	NS
11. Resources	5	NS
12. Targets (lines 9 + 10d + 11)	b	NS
Drinking Water Threat Score		
13. Drinking Water Threat Score ([lines 5 × 8 × 12] ÷ 82,500, subject to a maximum of 100)	100	NS

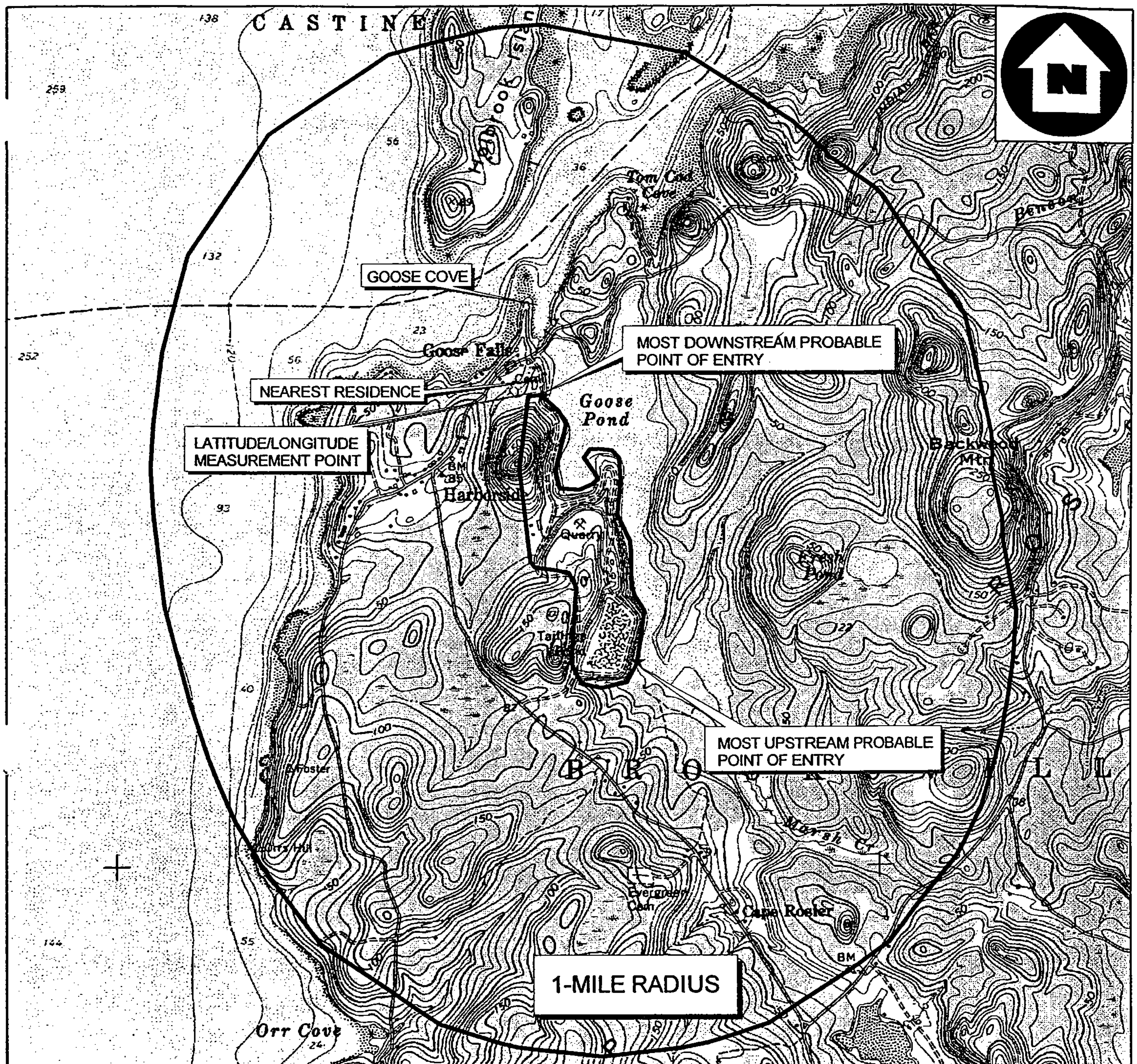
TABLE 4-1 (Continued)
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

HUMAN FOOD CHAIN THREAT		
Factor Categories and Factors	**Maximum Value**	**Value Assigned**
Likelihood of Release		
14. Likelihood of Release (same value as line 5)	550	550
Waste Characteristics		
15. Toxicity/Persistence/Bioaccumulation	a	2×10^8
16. Hazardous Waste Quantity	a	1×10^6
17. Waste Characteristics	1,000	1,000
Targets		
18. Food Chain Individual	50	45
19. Population		
19a. Level I Concentrations	b	0
19b. Level II Concentrations	0.03	0.03
19c. Potential Human Food Chain Contamination	b	0
19d. Population (lines 19a + 19b + 19c)	0.03	0.03
20. Targets (lines 18 + 19d)	b	45.03
Human Food Chain Threat Score		
21. Human Food Chain Threat Score ([lines 14 × 17 × 20] ÷ 82,500, subject to a maximum of 100)	100	**100**

TABLE 4-1 (Concluded)
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

ENVIRONMENTAL THREAT		
Factor Categories and Factors	**Maximum Value**	**Value Assigned**
Likelihood of Release		
22. Likelihood of Release (same value as line 5)	550	550
Waste Characteristics		
23. Ecosystem Toxicity/Persistence/Bioaccumulation	a	2×10^8
24. Hazardous Waste Quantity	a	1×10^6
25. Waste Characteristics	1,000	1,000
Targets		
26. Sensitive Environments		
26a. Level I Concentrations	b	0
26b. Level II Concentrations	b	55
26c. Potential Contamination	b	0
26d. Sensitive Environments (lines 26a + 26b + 26c)	b	55
27. Targets (value from 26d)	b	55
Environmental Threat Score		
28. Environmental Threat Score ([lines 22 × 25 × 27] ÷ 82,500, subject to a maximum of 60)	60	**60**
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE FOR A WATERSHED		
29. Watershed Score[c] (lines 13 + 21 + 28, subject to a maximum of 100)	100	**100**
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE		
30. Component Score (S_{of})[c] (highest score from line 29 for all watersheds evaluated, subject to a maximum of 100)	100	**100**

[a]Maximum= value applies to waste characteristics category.
[b]Maximum value not applicable.
[c]Do not round to nearest integer.



BASE MAP IS A PORTION OF THE FOLLOWING 7.5 X 15' U.S.G.S. QUADRANGLE(S): CAPE ROSIER, MAINE. 1973 REVISED 1979.

Note: only the most downstream and most upstream probable points of entry are depicted for clairity.

1 0 1 2 Kilometers

1 0 1 Miles

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 Feet

QUADRANGLE LOCATION

SITE LOCATION MAP

CALLAHAN MINE
HARBORVIEW
BROOKSVILLE, MAINE

WESTON® MANAGERS DESIGNERS/CONSULTANTS

REGION I SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM

TDD #	DRAWN BY:	DATE:
00-06-0020	CAMPBELL	07/12/2000
FILE NAME: E:\ARC_APRS\START2\CALLAHAN.APR		FIGURE 2

NOTES TO THE READER

All reference citations used to document the HRS score will follow the following conventions:

42	= Reference No. 42 (all references cited by number)
p.	= single page
pp.	= multiple pages (pp. 2-5, 9 or pp. A-1 to A-10)
";"	= next reference

For example:

"Source No. 1 is located in the southern portion of the site at a topographic high (4, Plate 3; 5, pp. 15-21, 23)," means that the information presented is documented in Reference No. 4 on Plate 3 and Reference No. 5 on pages 15 through 21 and page 23.

Referenced text has been either quoted or paraphrased for clarity.

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No. Description of the Reference

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2.2 SOURCE CHARACTERIZATION

2.2.1 SOURCE IDENTIFICATION

Name of source: Waste Rock Piles Number of source: 1

Source Type: Pile

Description and Location of Source (with reference to a map of the site):

The site includes the location of a zinc/copper open-pit mine which was operated by the Callahan Mining Corporation (Callahan) from February 1968 to June 1972 [6, p. 5; 34, pp. 1-2]. The main components of this ore deposit were sphalerite (ZnS), and chalcopyrite ($CuFeS_2$), accompanied by abundant pyrite (FeS_2) and lesser amounts of pyrrhotite (FeS) [6, p. 14; 8, p. 182]. The average ore grade was 1.30% copper, 4.91% zinc, 0.35% lead, and 0.50 ounces per ton of silver [25, p. 2]. At the time of discovery of the ore deposits, surface ore outcrops were entirely below high tide levels [7, p. II-279]. The saltwater entrance to Goose Pond was dammed at the north end of the pond, and the freshwater entrance was dammed at the south end [6, p. 4]. The fresh waters, which normally flowed into Goose Pond, were diverted south through a drainage ditch into Wier Cove on the south side of Cape Rosier [6, p. 4]. Thus, with no new water flowing into Goose Pond, Goose Pond was pumped dry, and open pit mining was undertaken in a normal fashion [6, p. 4].

The open-pit mine was approximately 600 to 1,000 ft in diameter and 320 ft in depth [6, p. 5; 12, p. 5]. Approximately 5 million tons of non-ore-bearing waste rock and 798,000 to 800,000 tons of ore-bearing rock were removed from the mine and processed [6, p. 5; 25, p. 2]. Waste rock was deposited in a waste pile - now "Callahan Mountain" (Waste Rock Pile) - and two adjacent piles (Waste Rock Pile 2 and the Tailings Pile) along the estuary [6, p. 5; 11, pp. 1, 2]. In addition, 200,000 to 225,000 tons of marine clay were deposited on the slopes and first terrace of Waste Rock Pile after a mud slide occurred into the open-pit mine [6, p. 14; 7, p. II-283]. During a 1 June 2000 site reconnaissance conducted by Roy F. Weston, Inc. (WESTON) Superfund Technical Assessment and Response Team (START) personnel, the waste rock material was observed throughout the site [10, pp. 4, 6, 7].

The Waste Rock Piles (Source 1) comprise three piles of waste rock, known as Waste Rock Pile, Waste Rock Pile 2, and the Tailings Pile (see Figure 3 in Attachment A of this document) [11, pp. 1, 2]. This source has been evaluated as a "pile" because the mining process resulted in the deposition of the overlying non-metal- bearing waste rock (dump rock) as waste rock piles [6, pp. 5, 14]. All three piles are composed of the same waste rock: volcanic agglomerate and rhyolite with minor amounts of carbonate, talc and talc-chlorite rock with varying amounts of associated disseminated pyrite [6, p. 14; 10, pp. 8, 13]. Within the waste rock piles, an occasional piece of ore rock can be found, consisting of chalcopyrite and sphalerite within a chloritic or talcose matrix [6, p. 14]. The three waste rock piles will be evaluated as one source because they have similar waste characteristics and containment features.

Waste Rock Pile, also known as "Callahan Mountain," is the largest of the three piles and is located south of Dyer Cove and approximately 200 ft west of Goose Pond (see Figure 3 in Attachment A of this document) [3; 6, p. 5; 11, p. 2]. The area of Waste Rock Pile was determined by the Maine Department of Environmental Protection (ME DEP) to be 980,231 square feet (ft^2) [11, p. 2]. Waste Rock Pile 2 is located southwest and west of Dyer Cove, adjacent to the mine access road, and north of the former mine operations buildings [11, p. 2]. The area of Waste Rock Pile 2 was determined by ME DEP to be 271,597 ft^2 [11, p. 2]. The Tailings Pile, which contains the same waste rock material found in Waste Rock Pile and Waste Rock Pile 2, is located adjacent to and southeast of Waste Rock Pile and approximately 200 ft west of Goose Pond, and was determined by ME DEP to be 74,575 ft^2 [10, p. 10; 11, p. 2; 19, pp. 62, 63, 64].

Mining and milling operations ceased in June 1972, and a reclamation program was begun that included the following components: grading, seeding, and planting of waste dump piles, removal of the freshwater dam, and flooding of the 320-foot deep open pit by opening 18-inch sluice boards at the Goose Falls Dam [6, pp. 6, 7]. Following the mine closure, a hydroseeding firm was hired to hydroseed those areas where some chance of revegetation might occur following regrading [6, pp. 8, 9]. These efforts were only partially successful, as much of the site is still barren of any vegetation [9, p. 1]. Waste Rock Pile is covered with occasional clumps of grasses and young trees [10, p. 8]. Waste Rock Pile 2 is sparsely vegetated with grasses and saplings [10, p. 3]. The Tailings

Pile comprises a waste rock embankment [10, p. 10]. There is no engineered cover, run-on control system, or runoff management system present on Source 1 [10, pp. 4, 8, 13].

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

- Source Samples:

On 4 October 1999, ME DEP collected 11 shallow soil samples (99-WRP-19, 20, 21, 22; 99-WRP2-06, 10, 47, 48; and 99-TPL-16, 17, 18) from Source 1[11, p. 2; 18, pp. 1, 5; 19, pp. 60-64]. The soil samples were collected in accordance with the Quality Assurance Project Plan dated 1 September 1999 [18, p. 1]. The shallow soil samples were collected from depths of 0 to 6 inches [18, p. 1; 19, pp. 60-64]. The soil samples were analyzed by ME DHS HETL for seven metals (cadmium, copper, lead, mercury, silver, selenium, and zinc), percent solids, and grain size [17, p. 3, 15; 18, p. 1; 20]. Analyses were performed in accordance with ME DHS HETL SOP:EVMETALS - Analysis of Trace Metals in Environmental Water, November 1996 and SOP:DW245 - Analysis of Mercury, July 1997 methods [18, p. 3; 20, Attachment A, p. 1]. The seven metal's analytical results were validated at Modified Tier III Level according to EPA New England Regional Functional Guidelines [20, Attachment A, p. 1]. For the purposes of this evaluation, five soil samples (99-WRP-22, 99-WRP2-06, 99-WRP2-10, 99-WRP2-47, and 99-TPL-16) were selected to confirm the presence of hazardous substances contained in Source 1.

Sample ID	Sample Type	Date	Hazardous Substance	Hazardous Substance Concentration	Sample Detection Limit	Reference
99-WRP2-06	Soil	October 4, 1999	Copper	4,000 J mg/kg	5.4 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 17
			Lead	1,600 mg/kg	2 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 17
			Mercury	4.4 J mg/kg	0.1 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 17
			Selenium	46 mg/kg	4 mg/kg	18, p. 1; 20, pp. 5, 7, 8, 11, 17
			Silver	19.0 mg/kg	2.2 mg/kg	18, p. 1; 20, pp. 5, 6, 7, 8, 9, 10, 11, 12, 17
			Zinc	510 mg/kg	8 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 17
99-WRP2-10	Soil	October 4, 1999	Cadmium	32 mg/kg	0.8 mg/kg	18, p. 1; 20, pp. 5, 6, 7, 8, 9, 10, 11, 12, 17
			Copper	1,100 J mg/kg	3.9 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 17
			Lead	790 mg/kg	2 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 17
			Mercury	0.9 J mg/kg	0.10 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 17
			Silver	2.7 mg/kg	1.6 mg/kg	18, p. 1; 20, pp. 5, 6, 7, 8, 9, 10, 11, 12, 17
			Zinc	7,700 mg/kg	8 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 17
99-TPL-17	Soil	October 4, 1999	Copper	520 J mg/kg	5.0 mg/kg	18, p. 1; 20, pp. 6, 9, 11, 20
			Lead	410 mg/kg	2 mg/kg	18, p. 1; 20, pp. 6, 9, 11, 20
			Mercury	1.0 J mg/kg	0.10 mg/kg	18, p. 1; 20, pp. 6, 9, 11, 20
			Selenium	4.9 mg/kg	4 mg/kg	18, p. 1; 20, pp. 6, 7, 9, 11, 20
			Silver	4.0 Mg/kg	2.0 mg/kg	18, p. 1; 20, pp. 6, 7, 9, 10, 11, 12, 20
			Zinc	390 mg/kg	2.0 mg/kg	18, p. 1; 20, pp. 6, 9, 11, 20
99-WRP-22	Soil	October 4, 1999	Cadmium	13 mg/kg	1.0 mg/kg	18, p. 1; 20, pp. 6, 7, 9, 10, 11, 12, 18
			Copper	2,100 J mg/kg	4.9 mg/kg	18, p. 1; 20, pp. 6, 9, 11, 18
			Lead	3,000 mg/kg	2 mg/kg	18, p. 1; 20, pp. 6, 9, 11, 18
			Mercury	0.5 J mg/kg	0.1 mg/kg	18, p. 1; 20, pp. 6, 9, 11, 18
			Silver	2.3 mg/kg	2.0 mg/kg	18, p. 1; 20, pp. 6, 7, 9, 10, 11, 12, 18
			Zinc	7,200 mg/kg	8 mg/kg	18, p. 1; 20, pp. 6, 9, 11, 18

Sample ID	Sample Type	Date	Hazardous Substance	Hazardous Substance Concentration	Sample Detection Limit	Reference
99-WRP2-47	Soil	October 4, 1999	Cadmium	12 mg/kg	0.9 mg/kg	18, p. 1; 20, pp. 5, 6, 7, 8, 9, 10, 11, 12, 18
			Copper	4,000 J mg/kg	4.7 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 18
			Lead	2,100 mg/kg	2 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 18
			Mercury	1.3 J mg/kg	0.1 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 18
			Selenium	11 mg/kg	4 mg/kg	18, p. 1; 20, pp. 5, 7, 8, 11, 18
			Silver	8.3 mg/kg	1.9 mg/kg	18, p. 1; 20, pp. 5, 6, 7, 8, 9, 10, 11, 12, 18
			Zinc	5,800 mg/kg	8 mg/kg	18, p. 1; 20, pp. 5, 6, 8, 11, 18

mg/kg = milligrams/kilograms
ND = Not detected.

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

Containment Description	Containment Factor Value	References
Gas release to air: NS	NS	
Particulate release to air: NS	NS	
Release to groundwater: NS	NS	
Release via overland migration and/or flood: Neither of the following is present: maintained engineered cover or functioning and maintained run-on control system and runoff management system.	10	1, pp. 51595, 51596, Section 3.1.2.1, Table 3-2; 10, pp. 4, 8, 13

Notes:
NS = Not Scored

2.4.2 HAZARDOUS WASTE QUANTITY

The Hazardous Waste Quantity for Source 1 was assigned based on the Hazardous Wastestream Quantity Factor Value [1, p. 51591, Section 2.4.2.1.3, Table 2-5]. The Hazardous Constituent Quantity Value and Volume were not evaluated for Source 1 because insufficient information was available [1, pp. 51590, 51591, Table 2-5, Sections 2.4.2.1.1 and 2.4.2.1.2]. The Hazardous Wastestream Quantity Factor Value is greater than the Area Factor Value, and thus is assigned as the Hazardous Waste Quantity Value for Source 1 [1, p. 51591, Section 2.4.2.1.5].

2.4.2.1.1 Hazardous Constituent Quantity

Description

There is insufficient information to evaluate the source for Hazardous Constituent Quantity.

Hazardous Substance	Constituent Quantity (pounds)	References
NS (Insufficient information)		

Sum (pounds):

Hazardous Constituent Quantity Assigned Value: NS

2.4.2.1.2 Hazardous Wastestream Quantity

Description

About 5 million tons of non-metal-bearing waste rock were mined and deposited in waste piles along the estuary [6, p. 5]. The three piles are composed of the same waste rock materials [10, pp. 8, 13]. The waste rock consists largely of volcanic agglomerate and rhyolite with minor amounts of carbonate, talc and talc-chlorite rock with varying amounts of associated disseminated pyrite [6, p. 14]. Within the waste rock piles, an occasional piece of ore rock can be found, consisting of chalcopyrite and sphalerite within a chloritic or talcose matrix [6, p. 14]. Wastestream quantity calculation equals: 5×10^6 tons $\times$ 2,000 pounds/ton = 1×10^{10} pounds [1, p. 51591, Table 2-5]

Hazardous Wastestream Quantity	Wastestream Quantity (pounds)	References
Waste Rock (containing cadmium, copper, lead, mercury, selenium, silver, and zinc)	1×10^{10}	6, pp. 5, 14; 20, pp. 5, 6

Sum (pounds): 1×10^{10}
Sum of Wastestream Quantity/5,000 (Table 2-5): 2×10^6

Hazardous Wastestream Quantity Assigned Value: 2×10^6

2.4.2.1.3 Volume

Description

There is insufficient information to evaluate the source for volume.

Source Type	Description	Units	References
NS			

Sum (tons):
Equation for Assigning Value (Table 2-5):

Volume Assigned Value: 0

2.4.2.1.4 Area

Description

The areas of the waste rock piles were calculated by ME DEP personnel using a Geographic Positioning System (GPS) unit and ESRI Geographic Information Software (GIS) which calculates area from polygon themes based on the data's spatial location and projected units [11, p. 1].

Source Type	Units (ft^2)	References
Waste Rock Pile	980,231	11, p. 2
Waste Rock Pile 2	271,597	11, p. 2
Tailings Pile	74,575	11, p. 2

Sum (ft^2): 1,326,403 ft^2
Equation for Assigning Value (1, p. 51591, Section 2.4.2.1.1, Table 2-5):
Area of pile ÷ 13; 1,326,403 ft^2 ÷ 13 = 102,031

Area Assigned Value: 102,031

2.4.2.1.5 Source Hazardous Waste Quantity Value

Highest assigned value assigned from Table 2-5: 2×10^6

2.2.1 SOURCE IDENTIFICATION

Name of source: Tailings Pond

Number of source: 2

Source Type: Surface Impoundment

Description and Location of Source (with reference to a map of the site):

The Tailings Pond (Source 2) is located south of Waste Rock Pile and the Tailings Pile, and is adjacent to and west of Goose Pond (see Figure 3 in Attachment A of this document) [11, p. 2]. This source has also been referred to as the "tailings storage pond," "tailings," and "tailings area" in previous investigations [6, pp. 10, 12]. Fine sand and silt-sized pulverized rocks which constitute the unwanted waste from the milling process were deposited into the Tailings Pond [6, pp. 5, 6, 10]. The area of the Tailings Pond was calculated by ME DEP to be 506,908 ft^2 [11, p. 2]. The center of the Tailings Pond contains ponded water and wetland vegetation, while the majority of the Tailings Pond is dry and is consists of a silty powder [10, p. 9].

The milling process at the Callahan Mine began when ore was trucked from the open-pit mine to an ore storage area adjacent to the mill [6, p. 5; 7, II-281]. From this location, the ore was loaded into a series of crushers and mills which reduced the rock to the consistency of fine sand and silt [6, p. 5]. Following mill pulverizing, small particles containing zinc and copper were recovered in the concentrating mill by a process called "flotation" [6, p. 5]. The ore was passed through flotation cells into which chemicals were introduced which caused the mineral particles to float on bubbles [6, p. 6; 12, pp. 3, 4, 5]. Chemicals which were used in the flotation process included: dithiophosphate salts, aryl phosphorodithioate, cyclohexanol, and cresol [16, p. 5]. The floating mineral was then collected and dried to produce the zinc and copper concentrates. The average ore grade was 1.30% copper, 4.91% zinc, 0.35% lead, and 0.50 ounces per ton silver [25, p. 2]. The remaining non-mineral particles and residues of the chemical reagents were discharged to the tailings pond [6, pp. 5, 6]. To the extent possible, the frothing reagents were recycled within the mill. However, certain amounts of these reagents accompanied the tailings to the tailings storage pond (Tailings Pond) [6, p. 6]. Personnel from American Cyanamid, the source of the reagents, stated that they were unaware of any environmental hazards associated with the reagents and that no toxicity problems have been reported [6, p. 11]. A 1972 analysis of the tailings documented the presence of the following hazardous substances: cadmium, copper, lead, silver, and zinc [6, pp. 10-11].

As tailings were deposited in the Tailings Pond, a series of dams were constructed along the eastern boundary of the Tailings Pond to contain the tailings waste [6, p. 10, Figure 2; 16, p. 1]. These dams were constructed with an outer layer of coarse rubble and an inner layer of coarse mill tailings and clay [6, Figure 2]. The final height of the dam was 82 ft above the original ground surface [6, p. 10]. The Tailings Pond was also constructed with a decant pipe, which was presumed by START to be designed to drain free liquids in the Tailings Pond to the Goose Pond estuary [6, Figure 2].

In 1972, in order to provide drainage of surface water from the Tailings Pond (tailings), a drainage ditch was excavated from the center to the north end of the Tailings Pond (tailings) [6, p. 12; 7, Figure 3]. START observed a breach area through a waste rock embankment in the north end of the Tailings Pond [10, pp. 9, 10]. Evidence of previous water flow (wash out) was observed by START along the embankment southeast towards Goose Pond [10, p. 12]. At the cessation of mining, Callahan undertook several efforts to restore/reclaim the site, including grading, hydroseeding, and planting trees and shrubs. These efforts were only partially successful as much of the site is still barren of any vegetation [9, p. 1].

The Tailings Pond area, designed to contain mine processing wastes, is leaking slowly at the base in several observed locations. Water seeping from this area and discharging to the Goose Pond estuary contains cadmium and zinc at concentrations above EPA or ME DHS drinking water standards [9, p. 3].

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

- Source Samples:

On 6 October 1999, ME DEP collected shallow soil samples from Source 2 [18, pp. 1, 2, 5; 24, pp. 97, 98]. The soil samples were collected in accordance with the EPA-approved Quality Assurance Project Plan dated 1 September 1999 [17, pp. 3, 9, 12, 15; 18, p. 1; 20; 24, pp. 97, 98]. The shallow soil samples were collected from depths of 0 to 6 inches [18, p. 1; 24, pp. 97, 98]. The soil samples were analyzed by ME DHS HETL for seven metals (cadmium, copper, lead, mercury, silver, selenium, and zinc), grain size, and percent solids [17, p. 3, 15; 18, p. 1]. Analyses were performed inaccordance with ME DHS HETL SOP:EVMETALS - Analysis of Trace Metals in Environmental Water and SOP:DW245 - Analysis of Mercury methods [18, p. 3; 20, Attachment A, p. 1]. The analytical data were validated at Modified Tier III Level according to EPA New England Regional Functional Guidelines [20, Attachment A, p. 1]. For the purposes of this evaluation, one source sample (TPD-12) was selected to confirm the presence of hazardous substances contained in Source 2.

Sample ID	Sample Type	Date	Hazardous Substance	Hazardous Substance Concentration	Sample Detection Limit	Reference*
99-TPD-12	Source	October 6, 1999	Cadmium	25 mg/kg	1.0 mg/kg	18, p. 2; 20, pp. 5, 6, 7, 8, 9, 10, 11, 12, 19
			Copper	1,400 J mg/kg	5.1 mg/kg	18, p. 2; 20, pp. 5, 6, 8, 11, 19
			Lead	990 mg/kg	2 mg/kg	18, p. 2; 20, pp. 5, 6, 8, 11, 19
			Mercury	0.5 J mg/kg	0.1 mg/kg	18, p. 2; 20 pp. 5, 6, 8, 11, 19
			Selenium	9.9 mg/kg	4 mg/kg	18, p. 2; 20, pp. 5, 6, 8, 11, 19
			Silver	4.4 mg/kg	2.1 mg/kg	18, p. 2; 20, pp. 5, 6, 7, 8, 9, 10, 11, 12, 19
			Zinc	5,800 mg/kg	8 mg/kg	18, p. 2; 20, pp. 5, 6, 8, 11, 19

mg/kg = milligrams/kilogram.

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

Containment Description	Containment Factor Value	Reference
Gas release to air: NS	NS	
Particulate release to air: NS	NS	
Release to groundwater: NS	NS	
Release via overland migration and/or flood: Neither of the following is present: maintained engineered cover or functioning and maintained run-on control system and runoff management system.	10	1, p. 51595, 51596, Section 3.1.2.1, Table 3-2; 10, pp. 9, 10, and 12

Notes:
NS = Not Scored

2.4.2 HAZARDOUS WASTE QUANTITY

The Hazardous Waste Quantity for Source 2 was assigned based on the Area Factor Value of surface impoundment [1, pp. 51590, 51591, Section 2.4.2.1.3, Table 2-5]. The Hazardous Constituent Quantity, Hazardous Wastestream Quantity, and Volume Values were not evaluated for Source 2 because insufficient information was available [1, p. 51591, Sections 2.4.2.1.1 and 2.4.2.1.2, Table 2-5].

2.4.2.1.1 Hazardous Constituent Quantity

Description

There is insufficient information to evaluate the source for Hazardous Constituent Quantity.

Hazardous Substance	Constituent Quantity (pounds)	References
NS (Insufficient information)		

Sum (pounds):

Hazardous Constituent Quantity Assigned Value: NS

2.4.2.1.2 Hazardous Wastestream Quantity

Description

There is insufficient information to evaluate the source for Hazardous Wastestream Quantity.

Hazardous Wastestream	Wastestream Quantity (pounds)	References
NS (Insufficient information)		

Sum (pounds):
Sum of Wastestream Quantity/5,000 (Table 2-5):

Hazardous Wastestream Quantity Assigned Value: NS

2.4.2.1.3 Volume

Description

There is insufficient information to evaluate the source for Volume.

Source Type	Description (# drums or dimensions)	Units (yd^3/gal)	References
NS			

Sum (yd^3/gal):
Equation for Assigning Value (Table 2-5):

Volume Assigned Value: 0

2.4.2.1.4 Area

Description

The Tailings Pond occupies an area calculated by ME DEP to be 506,908 ft^2 [11, p. 2].

Source Type	Units (ft^2)	References
Surface Impoundment (filled with tailings containing cadmium, copper, lead, mercury, selenium, silver, and zinc)	506,908	1, p. 51591; 11, p. 2; 20, p. 19

Sum (ft^2): 506,908 ft^2
Equation for Assigning Value (1, p. 51591, Section 2.4.2.1.1, Table 2-5):
Area of Surface Impoundment ÷ 13; 506,908 ft^2 ÷ 13 = 38,992.9

Area Assigned Value: 38,992.9

2.4.2.1.5 Source Hazardous Waste Quantity Value

Highest assigned value assigned from Table 2-5: 38,992.9

SUMMARY OF SOURCE DESCRIPTIONS

Source No.	Source Hazardous Waste Quantity Value	Source Hazardous Constituent Quantity Complete? (Y/N)	Containment Factor Value by Pathway				
			Ground Water (GW) (Table 3-2)	Surface Water (SW)		Air	
				Overland/flood (Table 4-2)	GW to SW (Table 3-2)	Gas (Table 6-3)	Particulate (Table 6-9)
1	2 × 10^6	N	NS	10	NS	NS	NS
2	38,992.9	N	NS	10	NS	NS	NS

Description of Other Potential Sources

Contaminated Soil: The mine (property) entrance area was noted by ME DEP personnel to be a 53,187-ft^2 area at the northern portion of the property [11, p. 2]. The mine operations area, a 17,206-ft^2 area, was noted to include the Pump House, Metal Shop Building, Assay Laboratory, Concentration Mill, and Primary Crusher [11, p. 2; 16, p. 4]. In 1987, four abandoned underground storage tanks were removed from the vicinity of the Metal Shop Building [6, p. 19; 16, p. 4]. In October 1999, ME DEP personnel collected nine surface soil samples from the mine entrance area (mill entrance area) and mine operations area (mill operations area) [11, p. 2; 18, pp. 2, 4]. Hazardous substances detected in the samples included cadmium, copper, lead, mercury, and zinc [11, p. 2; 18, p. 2, 4; 20, p. 6, 7].

This potential source was not evaluated because the Hazardous Waste Quantity Factor Value for the contaminated soil is relatively small compared with the other sources at the site, and therefore, the source would not contribute significantly to the overall site score.

Dyer Cove (former settling pond): Dyer Cove is a shallow cove located within the central-west portion of Goose Pond Estuary [17, p. 4]. During operation the cove was separated from the open pit mine by a causeway [17, p. 4]. Dyer Cove was used as a settling pond for water pumped from the open-pit mine while the mine was operational [17, p. 4]. In 1986 and 1999, elevated levels of cadmium, copper, lead, and zinc were found in the sediments [17, p. 4; 20, p. 7].

This potential source was not evaluated because the Hazardous Waste Quantity Factor Value for the contaminated soil is relatively small compared with the other sources at the site, and therefore, the source would not contribute significantly to the overall site score.

Mine Pit: Located in the northwest corner of Goose Pond, the roughly circular, 600-ft diameter by 320-ft deep, pit was allowed to fill with water after mining operations ceased [6, pp. 5, 7]. Between 1968 and 1972 approximately 5-million tons of non-metal bearing and 798,000 tons of ore-bearing rock were removed from the mine [6, p. 5].

This potential source was not evaluated because of the lack of information regarding hazardous substances associated with the source.

Goose Cove Outfall: A 16-inch effluent discharge pipe from Dyer Cove (the former settling pond) discharged into Goose Cove approximately 450 ft north of Goose Falls dam [6, pp. 15, 16; 40]. Rock "flour" and silt that had not settled out in Dyer Cove were discharged via this pipe [6, p. 16]. This material eventually covered the bottom of Goose Cove to an average thickness of about 8 inches [6, p. 16]. The total quantity of the settled material discharged is about 2,500 cubic yards [6, p. 16]. The average values for heavy metals in the settled materials were 3,200 parts per million (ppm) of copper, 900 ppm of lead, 9,000 ppm of zinc, and 30 ppm of cadmium [6, p. 16]. Cadmium values are approximately the same as in underlying "pre-

Goose Cove Outfall:
(concluded)

mine" sediment; the other values are much higher than in underlying sediment [6, p. 16]. Permits to remove the contaminated sediment by dredging have apparently been denied since 1980 by the Maine Department of Marine Resources [6, p. 16].

This potential source was not evaluated because the association of hazardous substances with the source is not supported by evidence of sufficient quality (a study conducted in 1993 contains data that currently do not provide sufficient laboratory quality assurance documentation), and the source would not add significantly to the overall site score [43].

Trash Piles:

There were two or three domestic trash piles generated and utilized in association with the mine [6, p. 20]. The trash piles contained trash and junk of the type normally accepted by a town dump [6, p. 20]. The trash piles were covered with waste rock during post-mining grading activities [6, p. 20]. According to persons knowledgeable of Callahan Mine operations, no toxic materials were placed in these trash dumps, with the possible exception of paint cans, thinners, etc., which may not have been completely empty [6, p. 20]. Reportedly, no evidence of pollution from the trash dumps has been observed [6, p. 20].

This potential source was not evaluated because the Hazardous Waste Quantity Factor Value for the trash piles is relatively small compared with the other sources at the site, and therefore, the source does not contribute significantly to the overall site score. Further, hazardous substances have not been associated with the source by more than anecdotal evidence.

4.0 SURFACE WATER MIGRATION PATHWAY

4.1 OVERLAND/FLOOD MIGRATION COMPONENT

4.1.1.1 Definition of Hazardous Substance Migration Path for Overland/Flood Component

The Callahan Mine property is located on the Cape Rosier peninsula and is adjacent to Goose Pond Estuary (see Figure 2 in Attachment A of this document) [9, p. 1; 16, p. 1]. The Callahan Mine site is dominated by waste rock piles (Source 1), of which "Callahan Mountain" (Waste Rock Pile) is the largest [6, p. 5; 11, p. 2]. In addition, a Tailing Pond (Source 2) is located on the southern portion of the site [11, p. 2]. Sampling conducted by ME DEP has documented that these sources are contaminated with metals [18, pp. 1-3; 20, pp. 5, 6]. Both sources are located within 200 feet of Goose Pond Estuary [36].

The most upstream probable point of entry (PPE) to the surface water pathway is along Goose Pond at the southeast corner of the Tailings Pond (Source 2) [10, p. 11; 11, p. 2]. Multiple PPEs to the surface water pathway were noted along the Goose Pond shoreline, extending from the most upstream PPE to the surface water pathway to the most downstream PPE to the surface water pathway, located north of the flooded open-pit mine and directly east of the most southerly residence along Old Mine Lane [10, p. 11]. Figure 3 in Attachment A of this document only depicts the most upstream PPE and the most downstream PPE. Three seep areas from Source 2 were investigated by ME DEP personnel [9, p. 3]. According to the ME DEP, in all likelihood, water seeping from the tailings storage pond (Source 2) discharges eventually to the Goose Pond Estuary [9, p. 3]. Water samples collected from two seep areas at the base of Source 2 contained cadmium and zinc [9, p. 3].

Dyer Cove, a shallow cove of Goose Pond, was also impacted by mining operations [6, p. 15; 11, p. 2]. During the mining operations, Dyer Cove was separated from Goose Pond by a causeway (since removed) and utilized as a settling basin for water which was pumped from the open-pit mine [6, p. 15]. As of 1987, Dyer Cove was once again part of the Goose Pond estuary [9, p. 4]. The southwest bank of Dyer Cove abuts portions of Source 1 (Waste Rock Pile and Waste Rock Pile 2), and shows evidence of discolored waste rock material extending to the water's edge of Dyer Cove [10, pp. 3, 13, 14]. START inferred that the discoloration indicated minerals were leaching out of the waste rock material [10, p. 3].

The Penobscot River mouth is located approximately 4 miles south of Bucksport, Maine [15, p. 2]. Beyond this point is the Penobscot Bay, a seawater zone [15, p. 2]. Goose Pond is designated as Estuarine and Marine Class SB by the State of Maine [26, p. 383; 35]. Goose Pond, at the PPEs to the surface water pathway, is considered part of the Penobscot Bay seawater zone [15, pp. 2, 3]. The mean annual flow rate of Goose Pond is not applicable, because an estuary is evaluated as coastal tidal waters [1, pp. 51605, Section 4.0.2, 51613, Table 4-13].

Approximately 1,000 ft downstream of the most downstream PPE, Goose Pond discharges into Goose Cove (see Figure 3 in Attachment A of this document) [34, p. 2]. "Goose Falls," which connects Goose Pond and Goose Cove, is a tidally influenced "reversing falls" [16, p. 4; 22, pp. 5, Map 15]. Goose Cove is connected to the eastern side of Penobscot Bay south of Holbrook Island [3; 34, p. 2]. The remainder of the surface water pathway comprises part of Penobscot Bay. The mean annual flow rate of Penobscot Bay is not applicable, as a bay is evaluated as coastal tidal waters [1, pp. 51605, Section 4.0.2, 51613, Table 4-13]. There are multiple 15-mile downstream termini [38]. The southern terminus of the 15-mile downstream surface water pathway is an arc that extends across Penobscot Bay from 2 miles south of the Ducktrap River in Lincolnville, Maine, across North Haven Island and Deer Isle, to Cape Carter in Brooklin, Maine (see Figure 4 in Attachment A of this document) [38]. The northern terminus is an arc that extends across Penobscot River at the northern end of Verona Island, Maine (see Figure 4 in Attachment A of this document) [38].

4.1.2.1 Likelihood of Release

Observed releases have been documented by chemical analysis [19, pp. 70, 71; 20, pp. 8, 9, 10, 12, 13, 14, 15, 16].

4.1.2.1.1 Observed Release

Chemical Analysis

The following tables summarize analytical results which document an observed release by chemical analysis.

- Background Concentrations:

On October 5 and 6, 1999, ME DEP personnel conducted sediment sampling at the Callahan Mine site [18, pp. 2-6]. Background samples included three sediment samples (99-BKSD-23, 99-BKSD-24, and 99-BKSD-25) collected from Horseshoe Cove, located approximately 1.5 miles east of the site (see Figure 5 in Attachment A of this document) [5, Attachment 2, p. 1; 18, pp. 2, 6]. Because of the natural variability of metals in sediments, three background sediment samples were collected [18, p. 6]. The sediment samples were collected in accordance with the EPA-approved Quality Assurance Project Plan dated 1 September 1999 [17; 18, pp. 1-6]. The sediment samples were analyzed by ME DHS HETL for seven metals (cadmium, copper, lead, mercury, silver, selenium, and zinc), sieve [grain] size, and percent solids [17, pp. 3, 16]. Analyses were performed in accordance with ME DHS HETL SOP:EVMETALS - Analysis of Trace Metals in Environmental Water, November 1996 and SOP:DW245 - Analysis of Mercury, July 1997 methods [18, pp. 1-3; 20, Attachment A, p. 1]. The analytical data were validated at Modified Tier III Level according to EPA New England Regional Functional Guidelines [20, p. 1]. Following data review, positive mercury results were estimated (J) and non-detected mercury results were rejected (R) due to low mercury spike matrix recovery and exceedance of mercury analysis holding time [20, pp. 3, 5, 6]. In addition, some modifications to the analytical data were conducted by WESTON to meet the criteria of the EPA Headquarters guidelines for using qualified data to document an observed release and observed contamination [20, p. 1].

Background samples were collected from locations that represent similar depositional environments from where samples were collected in Goose Pond [5, p. 1]. Grain size analysis was conducted to determine if any geologic variability existed between background and downstream sediment samples [5, p. 1]. The background sediment samples collected from Horseshoe Cove were described as undifferentiated silt and clay with an average of 19% sand [5, p. 1].

Sample ID	Sample Medium	Sample Location	Depth	Date	Reference
99-BKSD-23	sediment	Horseshoe Cove	0 to 6 inches	October 6, 1999	18, pp. 2, 6; 19, p. 71
99-BKSD-24	sediment	Horseshoe Cove	0 to 6 inches	October 6, 1999	18, pp. 2, 4; 19, p. 71
99-BKSD-25	sediment	Horseshoe Cove	0 to 6 inches	October 6, 1999	18, pp. 2, 4; 19, p. 71

The background sediment samples were used to document background concentrations of hazardous substances in sediments in the vicinity of Goose Pond [18, p. 6]. The following table summarizes the analytical results for the background sediment samples collected from Horseshoe Cove; values in bold type were selected as the background concentrations for the listed hazardous substance.

Sample ID	Hazardous Substance	Concentration	Adjusted Concentration	Sample Detection Limit	Reference
99-BKSD-23	Cadmium	ND mg/kg		**1.0 mg/kg**	20, p. 5, 8, 12
	Copper	14 J mg/kg	(17) mg/kg[a]	5.1 mg/kg	20, p. 5, 8, 12
	Lead	10 mg/kg		2 mg/kg	20, p. 5, 8, 12
	Selenium	ND mg/kg		**4 mg/kg**	20, p. 5, 8, 12
	Zinc	49 mg/kg		8 mg/kg	20, p. 5, 8, 12

Sample ID	Hazardous Substance	Concentration	Adjusted Concentration	Sample Detection Limit	Reference
99-BKSD-24	Cadmium	ND mg/kg		**1.0 mg/kg**	20, p. 5, 8, 13
	Copper	18 J mg/kg	**(22) mg/kg[a]**	4.9 mg/kg	20, p. 5, 8, 13
	Lead	**11 mg/kg**		2 mg/kg	20, p. 5, 8, 13
	Selenium	ND mg/kg		**4 mg/kg**	20, p. 5, 8, 13
	Zinc	**64 mg/kg**		8 mg/kg	20, p. 5, 8, 13
99-BKSD-25	Cadmium	ND mg/kg		**1.0 mg/kg**	20, p. 6, 9, 13
	Copper	14 J mg/kg	(17) mg/kg[a]	4.9 mg/kg	20, p. 6, 9, 13
	Lead	10 mg/kg		2 mg/kg	20, p. 6, 9, 13
	Selenium	ND mg/kg		**4 mg/kg**	20, p. 6, 9, 13
	Zinc	52 mg/kg		8 mg/kg	20, p. 6, 9, 13

ND = Not detected.
mg/kg = milligrams/kilogram.
[a] = Copper result was estimated following data review. Copper result had an unknown bias, and has been adjusted by multiplying by an adjustment factor of 1.22 [20, pp. 12, 13].
( ) = Adjusted value.
Note: EPA Quick Reference Fact Sheet Using Qualified Data to Document an Observed Release and Observed Contamination was used to adjust the original concentration values [20, Attachment D].

- Contaminated Samples:

On October 5, 1999, ME DEP personnel collected sediment samples 99-SD-29, 99-SD-31, 99-SD-33, 99-SD-35, 99-SD-37(d), and 99-SD-39(d) from Goose Pond and Dyer Cove [18, pp. 1, 2, 6; 19, p. 65, 66, 67, 70]. All of the sediment samples were collected from a depth of 0 to 6 inches[18, p. 2]. Samples 99-SD-29, 99-SD-31, 99-SD-37(d) and 99-SD-39(d) were described as dark grey, fine silt and clay, with organic matter [19, p. 65, 70]. Sample 99-SD-33 was described as light brown, fine sand and silt, with black organic rich lenses at 1 inch [19, p. 66]. Sample 99-SD-35 was described as brown silt and clay with few fine sand [19, p. 66]. The samples were collected in accordance with the EPA-approved Quality Assurance Project Plan dated 1 September 1999 [17; 18, p. 1]. The sediment samples were analyzed by ME DHS HETL for seven metals (cadmium, copper, lead, mercury, silver, selenium, and zinc), sieve [grain] size, and percent solids [17, pp. 3, 16]. Analyses were performed in accordance with ME DHS HETL SOP:EVMETALS - Analysis of Trace Metals in Environmental Water, November 1996 and SOP:DW245 - Analysis of Mercury, July 1997 methods [18, pp. 1-3; 20, Attachment A, p. 1]. The analytical data were validated at Modified Tier III Level according to EPA New England Regional Functional Guidelines [20, p. 1]. In addition, some modifications to the analytical data were conducted by WESTON to meet the criteria of the EPA Headquarters guidelines for using qualified data to document an observed release and observed contamination [20, p. 1].

Grain size analysis was conducted to determine if any geologic variability existed between background and downstream sediment samples [5, p. 1]. The background sediment samples collected from Horseshoe Cove were described as undifferentiated silt and clay with an average of 19% sand [5, p. 1]. The sediment samples (99-SD-29, 99-SD-31, 99SD-33, and 99-SD-35) collected from Goose Pond were described as undifferentiated silt and clay with varying amounts of sand [5, p. 1]. The sand content in 99-SD-29, 99-SD-31, and 99-SD-33 ranges from 2 to 9%. Sample 99-SD-35 contains a higher percentage of sands, 35%. The sieve analysis indicate that the samples are similar in composition. They are predominately silts and clay. Because of silts and clay's strong affinity for metals, if inorganic contaminants were transported to Goose Pond from Callahan Mine, the analytical results should reflect this impact [5, pp. 1, 2].

The sediment samples [99-SD-37(d) and 99-SD-39(d)] collected from Dyer Cove were described as poorly sorted sand, silt, and clay, with some gravel [5, p. 2]. In comparison to the background sediment samples, the sediment samples collected from Dyer Cove were much coarser [5, p. 2]. As a result, any elevated concentrations of metals detected in the Dyer Cove sediment sample are particularly significant, considering the tendency for finer-grained background sediment samples to be naturally higher in metals [5, p. 2].

Sample ID	Sample Medium	Sample Location	Distance from Upstream PPE	Depth	Date	Reference
99-SD-29	sediment	Goose Pond	0 feet	0 to 6 inches	October 5, 1999	3; 18, pp. 2, 6; 19, p. 65; 44
99-SD-31	sediment	Goose Pond	700 feet	0 to 6 inches	October 5, 1999	3; 18, pp. 2, 6; 19, p. 65; 44
99-SD-33	sediment	Goose Pond	1,475 feet	0 to 6 inches	October 5, 1999	3; 18, pp. 2, 6; 19, p. 66; 44
99-SD-35	sediment	Goose Pond	2,208 feet	0 to 6 inches	October 5, 1999	3; 18, pp. 2, 6; 19, p. 66; 44
99-SD-37(d)	sediment	Dyer Cove (Goose Pond)	3,960 feet	0 to 6 inches	October 5, 1999	3; 18, pp. 2, 6; 19, p. 70; 36
99-SD-39(d)	sediment	Dyer Cove (Goose Pond)	3,960 feet	0 to 6 inches	October 5, 1999	3; 18, pp. 2, 6; 19, p. 70; 36

The following table compares the highest concentrations of hazardous substances detected in sediment samples 99-SD-29, 99-SD-31, 99-SD-33, 99-SD-35, 99-SD-37(d) and 99-SD-39(d) with the highest background concentrations established by review of the highest background sediment sample analytical results [1, p. 51589, Table 2-3]. A review of analytical results of hazardous substances detected in sediment samples 99-SD-29, 99-SD-31, 99-SD-33, 99-SD-35, 99-SD-37(d), and 99-SD-39(d) indicated that all sediment samples contained concentrations of hazardous substances which meet observed release criteria. Mercury results for all three background sediment samples were rejected; therefore, since no background concentration are available for comparison, mercury results are not used to establish an observed release [20, pp. 12-14].

Sample ID	Hazardous Substance	Concentration	Adjusted Concentration	Sample Detection Limit	Reference
99-SD-29	Cadmium	33 mg/kg		1.0 mg/kg	20, p. 5, 8, 14
	Copper	1,800 J mg/kg[a]	(1,500) mg/kg[a]	5 mg/kg	20, p. 5, 8, 14
	Lead	770 mg/kg		2 mg/kg	20, p. 5, 8, 14
	Selenium	6.9 mg/kg		4 mg/kg	20, p. 5, 8, 14
	Silver	4.6 mg/kg		2 mg/kg	20, p. 5, 8, 14
	Zinc	6,900 mg/kg		8 mg/kg	20, p. 5, 8, 14
99-SD-31	Cadmium	27 mg/kg		1.0 mg/kg	20, p. 7, 10, 14
	Copper	1,200 J mg/kg[a]	(990) mg/kg[a]	5.2 mg/kg	20, p. 7, 10, 14
	Lead	590 mg/kg		2 mg/kg	20, p. 7, 10, 14
	Selenium	5.7 mg/kg		4 mg/kg	20, p. 7, 10, 14
	Silver	3.2 mg/kg		2.1 mg/kg	20, p. 7, 10, 14
	Zinc	5,400 mg/kg		8 mg/kg	20, p. 7, 10, 14
99-SD-33	Cadmium	5.2 mg/kg		1.0 mg/kg	20, p. 7, 10, 15
	Copper	1,900 J mg/kg[a]	(1,600) mg/kg[a]	4.9 mg/kg	20, p. 7, 10, 15
	Lead	210 mg/kg		2 mg/kg	20, p. 7, 10, 15
	Selenium	ND mg/kg		4 mg/kg	20, p. 7, 10, 15
	Silver	ND mg/kg		1.9 mg/kg	20, p. 7, 10, 15
	Zinc	3,100 mg/kg		8 mg/kg	20, p. 7, 10, 15

Sample ID	Hazardous Substance	Concentration	Adjusted Concentration	Sample Detection Limit	Reference
99-SD-35	Cadmium	3.9 mg/kg		1.1 mg/kg	20, p. 7, 10, 15
	Copper	170 J mg/kg[a]	(140) mg/kg[a]	5.5 mg/kg	20, p. 7, 10, 15
	Lead	52 mg/kg		2 mg/kg	20, p. 7, 10, 15
	Selenium	ND mg/kg		4 mg/kg	20, p. 7, 10, 15
	Silver	ND mg/kg		2.2 mg/kg	20, p. 7, 10, 15
	Zinc	840 mg/kg		8 mg/kg	20, p. 7, 10, 15
99-SD-37(d)	Cadmium	5.5 mg/kg		1.0 mg/kg	20, p. 7, 10, 16
	Copper	190 J mg/kg[a]	(160) mg/kg[a]	5.1 mg/kg	20, p. 7, 10, 16
	Lead	120 mg/kg		2 mg/kg	20, p. 7, 10, 16
	Selenium	ND mg/kg		4 mg/kg	20, p. 7, 10, 16
	Silver	ND mg/kg		2 mg/kg	20, p. 7, 10, 16
	Zinc	1,400 mg/kg		8 mg/kg	20, p. 7, 10, 16
99-SD-39(d)	Cadmium	7.3 mg/kg		1.0 mg/kg	20, p. 7, 10, 16
	Copper	350 J mg/kg[a]	(290) mg/kg[a]	5.1 mg/kg	20, p. 7, 10, 16
	Lead	150 mg/kg		2 mg/kg	20, p. 7, 10, 16
	Selenium	ND mg/kg		4 mg/kg	20, p. 7, 10, 16
	Silver	ND mg/kg		2 mg/kg	20, p. 7, 10, 16
	Zinc	1,700 mg/kg		8 mg/kg	20, p. 7, 10, 16

Notes:

mg/kg = milligram/kilogram.
ND = Not detected.
U = Substance not detected at the indicated SDL.
[a] = Copper result was estimated following data review. Copper result had an unknown bias, and has been adjusted by dividing by an adjustment factor of 1.22 [20, pp. 14, 15, 16].
() = Adjusted value.

Note: EPA Quick Reference Fact Sheet Using Qualified Data to Document an Observed Release and Observed Contamination was used to adjust the original concentration values [20, Attachment D].

Attribution

Attribution of hazardous substances in the surface water at the site is based on historical information and chemical analysis. Historically, the site includes the location of a zinc/copper open-pit mine which was operated by the Callahan Mining Company from February 1968 to June 1972 [6, p. 5; 34, pp. 1-2]. During this period Callahan excavated a total of about 5 million tons of non-metal-bearing waste rock (Source 1) and 798,000 to 800,000 tons of metal bearing "ore" rock [6, p. 5]. For every ton of ore extracted, six tons of waste had to be removed and deposited in waste piles [6, p. 5]. The main components of this ore deposit were sphalerite (ZnS) and chalcopyrite ($CuFeS_2$), accompanied by abundant pyrite (FeS_2) and lesser amounts of pyrrhotite (FeS) [6, p. 14; 8, p. 182]. The average ore grade was 1.30% copper, 4.91% zinc, 0.35% lead, and 0.50 ounces per ton of silver [25, p. 2]. Mining and milling operations ceased in June 1972, and a reclamation program was begun that included removal of the freshwater dam, and flooding of the 320-foot deep open pit by opening 18-inch sluice boards at the Goose Falls Dam [6, pp. 6, 7]. Within the waste rock piles (Source 1), an occasional piece of ore rock can be found, consisting of chalcopyrite and sphalerite within a chloritic or talcose matrix [6, p. 14]. Within the Tailings Pond (Source 2), the unwanted components of the floatation process (which separated ore from non-ore) were accumulated [6, pp. 5, 6]. Cadmium is usually present in small amounts in sphalerite [32, p. 250]. Galena (PbS), a lead sulfide mineral, is commonly found with sphalerite and has been collected from the tailings piles at the site [32, pp. 250-251; 34, p. 5]. Clausthalite (PbSe), lead selenide, is very similar to galena [45, p. 1]. Acanthite is a silver sulfide associated with galena and aguilarite is another silver sulifide which also contains selenium [33; 39]. In addition, selenium is found as a trace element in many copper sulfide minerals especially pyrite and coal [45, p. 1]. Therefore, the hazardous substances cadmium, copper, lead, selenium, silver, and zinc are attributable to the site based on their association with the ore deposit wastes mined at the site.

Areas in Mid-Coastal Maine have been mined for copper and zinc since the later part of the 1800's [34, p. 1]. A second mine in the area, now abandoned, was the Kerramerica (Blue Hill) mine located approximately 10 miles northeast of the Callahan Mine [8, p. 171; 34, p. 1]. Blue Hill's distance from Callahan Mine makes it unlikely it contributed to the contamination detected at the Callahan Mine site. The Blue Hill mine is not located along Callahan Mine's 15-mile downstream surface water pathway [38]. The two mines are located in the same major watershed, Maine Coastal [46].

On 4 and 6 October 1999, ME DEP collected shallow soil samples from Source 1 and 2 [11, p. 2; 18, pp. 1, 2, 5; 19, pp. 60-64; 24, pp. 97, 98]. The soil samples were collected in accordance with the Quality Assurance Project Plan dated 1 September 1999 [18]. The soil samples were analyzed by ME DHS HETL for seven metals (cadmium, copper, lead, mercury, silver, selenium, and zinc), percent solids, and grain size [17, p. 3]. Analyses were performed in accordance with ME DHS HETL SOP:EVMETALS - Analysis of Trace Metals in Environmental Water, November 1996 and SOP:DW245 - Analysis of Mercury, July 1997 methods [18, p. 3; 20, Attachment A, p. 1]. The seven metal's analytical results were validated at Modified Tier III Level according to EPA New England Regional Functional Guidelines [20, Attachment A, p. 1]. The hazardous substances detected in Source 1 and Source 2 included cadmium, copper, lead, mercury, selenium, silver, and zinc [20, pp. 17-20].

On October 5, 1999, ME DEP personnel collected sediment samples 99-SD-29, 99-SD-31, 99-SD-33, 99-SD-35, 99-SD-37(d), and 99-SD-39(d) from Goose Pond and Dyer Cove [18, pp. 1, 2; 19, p. 65, 66, 67, 70]. The samples were collected in accordance with the EPA-approved Quality Assurance Project Plan dated 1 September 1999 [17, pp. 3, 13, 16, 18-22; 18, p. 2; 19, p. 70]. The samples were analyzed by ME DHS HETL for seven metals (cadmium, copper, lead, mercury, silver, selenium, and zinc), grain size, and percent solids by ME DHS HETL SOP:EVMETALS - Analysis of Trace Metals in Environmental Water and SOP:DW245 - Analysis of Mercury methods [20, Attachment A, p. 1]. The data were validated at Modified Tier III Level according to EPA New England Regional Functional Guidelines [20, Attachment A, p. 1]. Hazardous substances detected in sediment samples included cadmium, copper, lead, selenium, silver, and zinc [20, pp. 14, 15, 16]. These hazardous substances (cadmium, copper, lead, selenium, silver, and zinc) are attributable to the site based on their detection in samples collected from the Source 1 and Source 2.

Hazardous Substances Released

Based on the analytical results of sediment samples 99-SD-29, 99-SD-31, 99-SD-33, 99-SD-35, 99-SD-37(d) and 99-SD-39(d), the following hazardous substances attributed to the site have been released to the surface water pathway: cadmium, copper, lead, selenium, silver, and zinc [20, pp. 12, 13, 14, 15, 16]. The analytical data which documents an observed release to the surface water pathway is evidence of hazardous substance migration from the source areas; a Containment Factor Value of 10 is assigned to such sources [1, pp. 51609, 51610, Table 4-1]. Since Source 1 and Source 2 have containment factors greater than 0, all hazardous substances (cadmium, copper, lead, mercury, selenium, silver, and zinc) associated with Source 1 and Source 2 will be used to evaluate the Waste Characteristics Factor Category for the surface water pathway [1, pp. 51611, Section 4.1.2.2].

Surface Water Observed Release Factor Value: 550

4.1.3.2 Human Food Chain Threat Waste Characteristics

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

The following substances are attributed to the site by documented waste disposal history and chemical analysis. Hazardous substances attributed to the site are considered associated with both sources based on waste disposal history and chemical analysis.

The Toxicity Factor Value, the Persistence Factor Value, and the Bioaccumulation Factor Value are assigned to the hazardous substances associated with the sources and releases at the site based on the values presented in Superfund Chemical Data Matrix (SCDM) [2, pp. B-4, B-6, B-13, B-20]. Because all of the downstream hazardous substance migration pathway comprises saltwater bodies, bioaccumulation factor values for saltwater are used.

Hazardous Substance	Source Number	Toxicity Factor Value	Persistence Factor Value*	Bioaccumulation Value**	Toxicity/ Persistence/ Bioaccumulation Factor Value (Table 4-16)	Reference
Cadmium	1, 2	10,000	1	5,000	5×10^7	2, p. B-4
Copper	1, 2	NL	1	50,000	NA	2, p. B-6
Lead	1, 2	10,000	1	5,000	5×10^7	2, p. B-13
Mercury	1, 2	10,000	0.4	50,000	2×10^8	2, p. B-13
Selenium	1, 2	100	1	50	5,000	2, p. B-17
Silver	1, 2	100	1	50	5,000	2, p. B-17
Zinc	1, 2	10	1	50,000	5×10^5	2, p. B-20

NL = Not listed in SCDM JUN96.
NA = Not available.
* = Persistence value for Rivers.
** = Bioaccumulation factor value for Salt.

A Toxicity Factor Value of 10,000 and a Persistence Factor Value of 0.4 are assigned a Toxicity/Persistence Factor Value of 4,000 [1, p. 51613, Table 4-12]. A Toxicity/Persistence Factor Value of 4,000 and a Bioaccumulation Potential Factor Value of 50,000 are assigned a Toxicity/Persistence/Bioaccumulation Factor Value of 2×10^8 [1, pp. 51618, 51619, Table 4-16]. The hazardous substances with the highest Toxicity/Persistence/Bioaccumulation Factor Value (mercury) was used to assign the Toxicity/Persistence/Bioaccumulation Factor Value for the watershed [1, pp. 51618, Section 4.1.3.2.1.4]

Toxicity/Persistence/Bioaccumulation Factor Value: 2×10^8

4.1.3.2.2 Hazardous Waste Quantity

Source No.	Source Type	Source Hazardous Waste Quantity
1	Tailings Pile	2×10^6
2	Surface Impoundment	38,992.9

Sum of Values: 2.04×10^6

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity Factor Value [1, p. 51591, Section 2.4.2.2]. A Hazardous Waste Quantity Factor Value of 1×10^6 is assigned to a site when the sum of the hazardous waste quantity values is greater than 1×10^6 [1, p. 51591, Table 2-6].

Hazardous Waste Quantity Factor Value: 1×10^6

4.1.3.2.3 Waste Characteristics Factor Category Value

The Toxicity/Persistence Factor Value for mercury (4,000) is multiplied by the Hazardous Waste Quantity Factor Value for the watershed (1×10^6) in order to determine the Waste Characteristics Product. This product is subject to a maximum value of 1×10^8 [1, pp. 51620, 51624]. $(4{,}000) \times (1 \times 10^6) = 4 \times 10^9$.

Toxicity/Persistence Factor Value × Hazardous Waste Quantity Factor Value: 4×10^9

The product of this Toxicity/Persistence Factor Value × Hazardous Waste Quantity Factor Value is subject to a maximum product of 1×10^8 and therefore the maximum value of 1×10^8 is assigned to this calculation [1, p. 51620].

The product of the Toxicity/Persistence Factor Value and Hazardous Waste Quantity Factor Value for the watershed is multiplied by the Bioaccumulation Potential Factor Value for mercury (50,000), subject to a maximum value of 1×10^{12} [1, Table 2-7]. $(1 \times 10^8) \times (50{,}000) = 5 \times 10^{12}$.

(Toxicity/Persistence Factor Value × Hazardous Waste Quantity Factor Value) × Bioaccumulation Potential Factor Value: 5×10^{12}

The product of this (Toxicity/Persistence Factor Value × Hazardous Waste Quantity Factor Value) × Bioaccumulation Potential Factor Value is subject to a maximum product of 1×10^{12} and therefore the maximum value of 1×10^{12} is assigned to this calculation [1, p. 51592].

From HRS Table 2-7, a Waste Characteristics Product 1×10^{12} is assigned a Waste Characteristics Factor Category Value of 1,000 [1, p. 51592].

Waste Characteristics Factor Category Value: 1,000

4.1.3.3 Human Food Chain Threat Targets

Goose Pond and Goose Cove are designated closed shellfish fisheries and Penobscot Bay is a designated finfish and shellfish fishery by the Maine Department of Marine Resources [13; 14; 21]. Species harvested include lobster, sea urchins, scallops, mackerel, and striped bass [13]. START personnel observed lobster pot buoys in Goose Cove during the on-site reconnaissance, providing further evidence of a lobster fishery in Goose Cove [10, p. 5]. Annual harvest information for the above species was not available to START. Maine Department of Marine Resources personnel indicated that the shellfish fisheries in Goose Pond and Goose Cove have been closed due to high fecal bacteria counts and heavy metal concentrations [14]. Species affected by this closure include mussels, surf clams, hard shell clams, and oysters [14]. Lobsters are not affected in this closure because they are not filter feeders [41]. In addition, START personnel observed signs placed by Maine Marine Patrol prohibiting the harvesting of shellfish in Goose Pond and indicating that the Goose Pond shellfish fishery was closed due to heavy metal contamination from Callahan Mine [10, p. 5, 14; 14]. For the purposes of this evaluation, Goose Pond will be evaluated as a fishery subject to actual human food chain contamination. Goose Pond fishery satisfies the following HRS criteria: the fishery is closed and a hazardous substance for which the fishery has been closed has been documented in an observed release [1, p. 51620, Section 4.1.3.3].

Actual Human Food Chain Contamination

Sediment Samples

On 5 October 1999, ME DEP personnel collected sediment samples 99-SD-29, 99-SD-31, 99-SD-33, 99-SD-35, 99-SD-37(d) and 99-SD-39(d) from Goose Pond and Dyer Cove [18, pp. 1, 2, 6; 19, p. 65, 66, 67, 70]. Analytical results indicate the observed release of cadmium, copper, lead, selenium, silver, and zinc above background sediment sample concentrations in accordance with Section 2.3, Table 2-3 of the HRS [1, p. 51589, Section 2.3, Table 2-3; 20, pp. 5-10, 12-16].

Sample ID	Sample Medium	Distance from PPE	Hazardous Substance	Bioaccumulation Factor Value*	References
99-SD-29	sediment	0 feet	Cadmium	5,000	2, p. B-4; 3; 18, pp. 2, 6; 19, p. 65; 44
			Copper	50,000	2, p. B-6; 3; 18, pp. 2, 6; 19, p. 65; 44
			Lead	5,000	2, p. B-13; 3; 18, pp. 2, 6; 19, p. 65; 44
			Selenium	50	2, p. B-17; 3; 18, pp. 2, 6; 19, p. 65; 44
			Silver	50	2, p. B-17; 3; 18, pp. 2, 6; 19, p. 65; 44
			Zinc	50,000	2, p. B-20; 3; 18, pp. 2, 6; 19, p. 65; 44
99-SD-31	sediment	700 feet	Cadmium	5,000	2, p. B-4; 3; 18, pp. 2, 6; 19, p. 65; 44
			Copper	50,000	2, p. B-6; 3; 18, pp. 2, 6; 19, p. 65; 44
			Lead	5,000	2, p. B-13; 3; 18, pp. 2, 6; 19, p. 65; 44
			Selenium	50	2, p. B-17; 3; 18, pp. 2, 6; 19, p. 65; 44
			Silver	50	2, p. B-17; 3; 18, pp. 2, 6; 19, p. 65; 44
			Zinc	50,000	2, p. B-20; 3; 18, pp. 2, 6; 19, p. 65; 44
99-SD-33	sediment	1,475 feet	Cadmium	5,000	2, p. B-4; 3; 18, pp. 2, 6; 19, p. 66; 44
			Copper	50,000	2, p. B-6; 3; 18, pp. 2, 6; 19, p. 66; 44
			Lead	5,000	2, p. B-13; 3; 18, pp. 2, 6; 19, p. 66; 44
			Zinc	50,000	2, p. B-20; 3; 18, pp. 2, 6; 19, p. 66; 44

Sample ID	Sample Medium	Distance from PPE	Hazardous Substance	Bioaccumulation Factor Value*	References
99-SD-35	sediment	2,208 feet	Cadmium	5,000	2, p. B-4; 3; 18, pp. 2, 6; 19, p. 66; 44
			Copper	50,000	2, p. B-6; 3; 18, pp. 2, 6; 19, p. 66; 44
			Lead	5,000	2, p. B-13; 3; 18, pp. 2, 6; 19, p. 66; 44
			Zinc	50,000	2, p. B-20; 3; 18, pp. 2, 6; 19, p. 66; 44
99-SD-37(d)	sediment	3,960 feet	Cadmium	5,000	2, p. B-4; 3; 18, pp. 2, 6; 19, p. 70; 36
			Copper	50,000	2, p. B-6; 3; 18, pp. 2, 6; 19, p. 70; 36
			Lead	5,000	2, p. B-13; 3; 18, pp. 2, 6; 19, p. 70; 36
			Zinc	50,000	2, p. B-20; 3; 18, pp. 2, 6; 19, p. 70; 36
99-SD-39(d)	sediment	3,960 feet	Cadmium	5,000	2, p. B-4; 3; 18, pp. 2, 6; 19, p. 70; 36
			Copper	50,000	2, p. B-6; 3; 18, pp. 2, 6; 19, p. 70; 36
			Lead	5,000	2, p. B-13; 3; 18, pp. 2, 6; 19, p. 70; 36
			Zinc	50,000	2, p. B-20; 3; 18, pp. 2, 6; 19, p. 70; 36

* Saltwater Bioaccumulation Factor used.

- Closed Fisheries:

Shellfish fisheries in Goose Pond are closed due to high fecal bacteria counts and heavy metal concentrations [14]. Sediment samples 99-SD-37(d) and 99-SD-39(d) were collected 3,960 ft downstream from the most upstream PPE, located north of Waste Pile 1 and east of Waste Pile 2 [3; 11, p. 2; 36].

Identity of Fishery	Sample ID	Distance from PPE	Hazardous Substance	References
Goose Pond	99-SD-37(d) 99-SD-39(d)	3,960 feet	Cadmium, copper, lead, zinc	10, p. 5; 14; 20, pp. 5-10, 12-14; 36

NA = not applicable.

Most Distant Level II Sample

The Goose Pond fishery is subject to actual contamination, based on the release of hazardous substances (copper, cadmium, lead, and zinc) to the fishery indicated by chemical analyses of sediment samples 99-SD-37(d) and 99-SD-39(d) [1, p. 51620, Section 4.1.3.3; 20, pp. 5, 6, 8, 9, 10 ,12, 13, 14]. An observed release of attributable hazardous substances (cadmium, copper, lead, and zinc) each having a Bioaccumulation Factor Value of 500 or greater (5,000; 50,000; 5,000; and 50,000; respectively) to the in-water segment for the watershed containing fisheries has been established [1, p. 51589, Section 2.3; 2, pp. B-4, B-6, B-20; 11, p. 2; 20, pp. 5, 6, 8, 9, 10, 12, 13, 14]. Fisheries determined to meet actual contamination target criteria based on the chemical analysis of sediment samples are evaluated as subject to Level II contamination, since no health-based benchmarks are available for sediment samples [1, p. 51592, Section 2.5].

Sample ID: 99-SD-37(d) and 99-SD-39(d)
Distance from the probable point of entry: 3,960 feet
Reference: [11, p. 2; 36]

Level II Fisheries

Identity of Fishery	Extent of Level II Fishery (Relative to PPE or Level I Fishery)	References
Goose Pond Fishery	3,960 feet	11, p. 2; 14; 36

4.1.3.3.1 Food Chain Individual

The Goose Pond fishery is subject to actual contamination, based on the release of hazardous substances (copper, cadmium, lead, selenium, silver, and zinc) to the fishery indicated by chemical analyses of sediment samples 99-SD-29, 99-SD-31, 99-SD-33, 99-SD-35, 99-SD-37(d) and 99-SD-39(d) [1, p. 51620, Section 4.1.3.3; 14; 20, pp. 5, 6, 8, 9, 10 ,12, 13, 14]. An observed release of attributable hazardous substances (cadmium, copper, lead, and zinc) each having a Bioaccumulation Factor Value of 500 or greater (5,000; 50,000; 5,000; and 50,000; respectively) to the in-water segment for the watershed containing fisheries has been established [1, p. 51589, Section 2.3; 2, pp. B-4, B-6, B-20; 11, p. 2; 14; 20, pp. 5, 6, 8, 9, 10, 12, 13, 14]. Fisheries determined to meet actual contamination target criteria based on the chemical analysis of sediment samples are evaluated as subject to Level II contamination, since no health-based benchmarks are established for sediment samples [1, p. 51592, Section 2.5]. Therefore, a Food Chain Individual Factor Value of 45 is assigned [1, p. 51620, Section 4.1.3.3.1].

Sample ID: 99-SD-29, 99-SD-31, 99-SD-33, 99-SD-35, 99-SD-37(d), and 99-SD-39(d)
Level I/Level II/or Potential: Level II
Hazardous Substances: Cadmium; Copper; Lead; Zinc
Bioaccumulation Potential: 5,000; 50,000; 5,000; 50,000

Identity of Fishery	Type of Surface Water Body	Dilution Weight (Table 4-13)	References
Goose Pond Fishery	Coastal Tidal Waters	0.0001	1, p. 51613, Table 4-3; 14; 15

Food Chain Individual Factor Value: 45

4.1.3.3.2 Population

4.1.3.3.2.2 Level II Concentrations

Goose Pond is a closed shellfish fishery [14]. Annual harvest (production) when the fishery was open is unknown; for the purposes of this evaluation, annual production will be considered to have been greater than 0 pounds [13]

Identity of Fishery	Annual Production (pounds)	References	Human Food Chain Population Value (Table 4-18)
Goose Pond Fishery	>0	1, p. 51621; 13	0.03

Sum of Level II Human Food Chain Population Values: 0.03

Level II Concentrations Factor Value: 0.03

4.1.4.2 Environmental Threat Waste Characteristics

4.1.4.2.1 Ecosystem Toxicity/Persistence/Bioaccumulation

The following substances are attributed to the site by documented waste disposal history and chemical analysis. Hazardous substances attributed to the site are considered associated with both sources based on waste disposal history and chemical analysis.

The Ecosystem Toxicity Factor Value, the Persistence Factor Value, and the Ecosystem Bioaccumulation Factor Value are assigned to the hazardous substances associated with the sources and releases at the site based on the values presented in Superfund Chemical Data Matrix (SCDM) [2, pp. B-4, B-6, B-13, B-20]. Because all of the downstream hazardous substance migration pathway comprises saltwater bodies, bioaccumulation factor values for saltwater are used.

Hazardous Substance	Source Number	Ecosystem Toxicity Factor Value	Persistence Factor Value*	Ecosystem Bioaccu-mulation Value**	Ecosystem Toxicity/ Persistence/ Bioaccumulation Factor Value (Table 4-21)	References
Cadmium	1, 2	1,000	1	5,000	5×10^6	2, p. B-4
Copper	1, 2	100	1	50,000	5×10^6	2, p. B-6
Lead	1, 2	1,000	1	5,000	5×10^6	2, p. B-13
Mercury	1, 2	10,000	0.4	50,000	2×10^8	2, p. B-13
Selenium	1, 2	100	1	50	5,000	2. p. B-17
Silver	1, 2	10,000	1	50	5×10^5	2, p. B-17
Zinc	1, 2	100	1	50,000	5×10^6	2, p. B-20

Notes:

* Persistence value for Rivers.

** Bioaccumulation factor value for Salt.

An Ecosystem Toxicity Factor Value of 10,000 and a Persistence Factor Value of 0.4 are assigned an Ecosystem Toxicity/Persistence Factor Value of 4,000 [1, p. 51622, Table 4-20]. An Ecosystem Toxicity/Persistence Factor Value of 4,000 and an Ecosystem Bioaccumulation Potential Factor Value of 50,000 are assigned an Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value of 2×10^8 [1, pp. 51622, 51623, Table 4-21]. The hazardous substances with the highest Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value (mercury) was used to assign the Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value for the watershed [1, pp. 51622, Section 4.1.4.2.1.4]

Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value: 2×10^8

4.1.4.2.2. Hazardous Waste Quantity

Source Number	Source Type	Source Hazardous Waste Quantity
1	Waste Pile	2×10^6
2	Surface Impoundment	38,992.9

Sum of Values: 2.04×10^6

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity Factor Value [1, p. 51591, Section 2.4.2.2]. A Hazardous Waste Quantity Factor Value of 1×10^6 is assigned to a site when the sum of the hazardous waste quantity values is greater than 1×10^6 [1, p. 51591, Table 2-6].

Hazardous Waste Quantity Factor Value: 1×10^6

4.1.4.2.3 Waste Characteristics Factor Category Value

The Ecosystem Toxicity/Persistence Factor Value for mercury (4,000) is multiplied by the Hazardous Waste Quantity Factor Value for the watershed (1×10^6) in order to determine the Waste Characteristics Product. This product is subject to a maximum value of 1×10^8 [1, pp. 51624]. $(4{,}000) \times (1 \times 10^6) = 4 \times 10^9$.

Ecosystem Toxicity/Persistence Factor Value × Hazardous Waste Quantity Factor Value: 4×10^9

The product of this Ecosystem Toxicity/Persistence Factor Value × Hazardous Waste Quantity Factor Value is subject to a maximum product of 1×10^8 and therefore the maximum value of 1×10^8 is assigned to this calculation [1, p. 51624].

The product of the Ecosystem Toxicity/Persistence Factor Value and Hazardous Waste Quantity Factor Value for the watershed is multiplied by the Ecosystem Bioaccumulation Potential Factor Value for mercury (50,000), subject to a maximum value of 1×10^{12} [1, p. 51624]. $(1 \times 10^8) \times (50{,}000) = 5 \times 10^{12}$.

(Ecosystem Toxicity/Persistence Factor Value × Hazardous Waste Quantity Factor Value) × Ecosystem Bioaccumulation Potential Factor Value: 5×10^{12}

The product of this (Ecosystem Toxicity/Persistence Factor Value × Hazardous Waste Quantity Factor Value) × Ecosystem Bioaccumulation Potential Factor Value is subject to a maximum product of 1×10^{12} and therefore the maximum value of 1×10^{12} is assigned to this calculation [1, p. 51624].

From HRS Table 2-7, a Waste Characteristics Product 1×10^{12} is assigned a Waste Characteristics Factor Category Value of 1,000 [1, p. 51592].

Waste Characteristics Factor Category Value: 1,000

4.1.4.3 Environmental Threat Targets

Goose Pond is designated as Estuarine and Marine Class SB by the State of Maine [35]. Class SB waters as designated by the state are "... suitable for the designated uses of recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish, industrial process and cooling water supply, hydroelectric power generation and navigation and as habitat for fish and other estuarine and marine life" [26, p. 357]. The Maine standards of classification of water bodies offer protection under the U.S. Clean Water Act statutes [35].

The Holbrook Island Sanctuary, a state park, borders Goose Pond to the east of the Callahan Mine site [11, p. 2; 27, p. 2 of 4]. The sanctuary is a scenic natural area containing a diverse set of ecosystems which provides habitat for numerous species of wildlife and plant life [27, pp. 1 - 4].

A wetlands delineation was conducted by a ME DEP specialist on 1 June 2000 [28, p. 1]. Wetlands were identified by vegetative type and hydrologic setting and located using a GPS unit. U.S. Fish and Wildlife Service wetland classifications types were identified from the Cape Rosier, Maine National Wetlands Inventory Map [29]. Wetlands present adjacent to Goose Pond include palustrine emergent and palustrine scrub-shrub wetlands [29]. Approximately 0.77 miles of wetlands frontage exists downstream of the most upstream PPE along Goose Pond [28; 36].

<u>Most Distant Level II Sample</u>

On 6 October 1999, ME DEP personnel collected sediment samples 99-SD-37(d) and 99-SD-39(d) in Dyer Cove (Goose Pond) [18, pp. 2, 6]. Sediment samples 99-SD-37(d) and 99-SD-39(d) were collected 3,960 ft downstream of the most upstream PPE to surface water from the site, located at the southeast corner of the tailings pond (Source 2) (see Figure 3 in Attachment A of this document) [11, p. 2; 10, p. 11; 36]. Analytical results of samples 99-SD-37(d) and 99-SD-39(d) indicate the detection of cadmium, copper, lead, and zinc at concentrations greater than the background concentrations of the same hazardous substances [20, pp. 5, 6, 8, 9, 10, 12, 13, 14].

Sample ID: 99-SD-37(d) and 99-SD-39(d)
Distance from the probable point of entry: 3,960 ft
Reference: [11, p. 2; 36]

4.1.4.3.1 Sensitive Environments

4.1.4.3.1.2. Level II Concentrations

<u>Sensitive Environments</u>

Sensitive Environment	Distance from PPE to Nearest Sensitive Environment	References	Sensitive Environment Value (Table 4-23)
State designated Natural Area-Holbrook Island Sanctuary-State Park	300 feet	1, p. 51624, Table 4-23; 11, p. 2; 27	25
State designated areas for the protection and maintenance of aquatic life under the Clean Water Act -Goose Pond	0	1, p. 51624, Table 4-23; 3; 11, p. 2; 35	5

Sum of Level II Sensitive Environments Value: 30

Wetlands

Wetland	Wetland Frontage (miles)	References
Goose Pond	0.77	28; 36

Sum of Level II Wetland Frontages: 0.77
Wetlands Value (1, p. 51625, Table 4-24): 25

Sum of Level II Sensitive Environments Value + Wetlands Value: 30 + 25 = 55

Level II Concentrations Factor Value: 55