HRS DOCUMENTATION RECORD COVER SHEET

Name of Site: Microfab Inc (Former) **CERCLIS No.** MAD001409408

Contact Persons:

Site Inspection and Documentation Record:

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Boston, MA 02109-3912

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Region I 8(a)
Superfund Technical Assessment and Response Team (START)

Pathways, Components, or Threats Not Scored:

Ground Water Migration Pathway: The ground water migration pathway will not be scored as part of this Hazard Ranking System (HRS) package [Ref. (1), p. 51570; (2)]. Ground water data is available supporting contaminated ground water; however, there are no identified private or public supply wells and no identified use of ground water within the immediate vicinity of the site resulting in no potential targets [Ref. (3), p. 30].

Soil Exposure Pathway: The soil exposure pathway will not be scored as part of this HRS package [Ref. (1), p. 51570]. Soil data is available for the site, supporting contaminated soil; however the site is vacant and there is currently a limited number of possible targets [Ref. (3), p. 41].

Air Migration Pathway: There is no data to support an observed release from the site to air. The air migration pathway does not affect the site score; therefore it is not included as part of this HRS evaluation [Ref. (1), p. 51570].

These pathways were not included because a release to these media does not significantly affect the overall site score. The surface water migration pathway (overland /flood migration) has been scored for the drinking water threat, the human food chain threat, and the environmental threat. The surface water migration pathway produces a score above the minimum required to qualify for inclusion on the National Priorities List (NPL) and is presented herein.

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HRS DOCUMENTATION RECORD

Name of Site:	SEMS: Microfab Inc (Former)	Date Prepared: September 2016
EPA Region:	1	
Street Address of Site*:	104 Haverhill Road [Ref. (4), p. 1]	
City, County, State, Zip Code:	Amesbury, Essex County, Massachusetts 01913	
General Location in the State:	The site is located in northeastern Massachusetts (**Figure 1** of this HRS Documentation Record).	
Topographic Map:	United States Geological Survey (USGS), 7.5' Newburyport West, Massachusetts Quadrangle [Ref. (5)].	
Latitude:	42^{o} 50' 32.62" North.	
Longitude:	70^{o} 57' 35.43" West.	
Site Reference Point:	The geographic coordinates are measured from the approximate former outfall (Source No. 1) on the property [Ref. (5)].	

*The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, disposed, or placed, or has otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

Site Scoring Summary

Pathway Scores:

Air Migration Pathway	Not Scored
Ground Water Migration Pathway	Not Scored
Soil Exposure Pathway	Not Scored
Surface Water Migration Pathway	100.00
HRS SITE SCORE	**50.00**

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw})	Not Scored	
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	100.0	10000.0
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	Not Scored	
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	100.0	10000.0
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	Not Scored	
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	Not Scored	
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		10000.0
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root	**50.00**	

Surface Water Overland/Flood Migration Component Scoresheet

Factor Categories and Factors	Maximum Value	Value Assigned
Drinking Water Threat		
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 x [2b + 2c])	500	NS
3. Potential to Release by Flood:		NS
3a. Containment (Flood)	10	NS
3b. Flood Frequency	50	NS
3c. Potential to Release by Flood (lines 3a x 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)	10000
7. Hazardous Waste Quantity	(a)	100
8. Waste Characteristics	100	32
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	5.0
12. Targets (lines 9 + 10d + 11)	(b)	5.0

Drinking Water Threat Score:		
13. Drinking Water Threat Score ([lines 5 x 8 x 12]/82,500, subject to a maximum of 100)	100	1.06
Human Food Chain Threat		
Likelihood of Release:		
14. Likelihood of Release (same value as line 5)	550	550
Waste Characteristics:		
15. Toxicity/Persistence/Bioaccumulation	(a)	$5.0x10^8$
16. Hazardous Waste Quantity	(a)	100
17. Waste Characteristics	1,000	320.0

Factor Categories and Factors	Maximum Value	Value Assigned
Targets:		
18. Food Chain Individual	50	20
19. Population:		
19a. Level I Concentrations	(b)	NS
19b. Level II Concentrations	(b)	NS
19c. Potential Human Food Chain Contamination	(b)	0.00000033
19d. Population (lines 19a + 19b + 19c)	(b)	0.00000033
20. Targets (lines 18 + 19d)	(b)	20.00000033
Human Food Chain Threat Score:		
21. Human Food Chain Threat Score ([lines 14 x 17 x 20]/82,500, subject to a maximum of 100)	100	42.66
Environmental Threat		
Likelihood of Release:		
22. Likelihood of Release (same value as line 5)	550	550
23. Ecosystem Toxicity/Persistence/Bioaccumulation	(a)	$2.0x10^8$
24. Hazardous Waste Quantity	(a)	100
25. Waste Characteristics	1,000	320.0
Targets:		
26. Sensitive Environments:		
26a. Level I Concentrations	(b)	0.0
26b. Level II Concentrations	(b)	50
26c. Potential Contamination	(b)	0.012

26d. Sensitive Environments (lines 26a + 26b + 26c)	(b)	50.01
27. Targets (value from 26d)	(b)	50.01
Environmental Threat Score:		
28. Environmental Threat Score ([lines 22 x 25 x 27]/82,500, subject to a maximum of 60)	106.68	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)	103.72	100.00
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	100.00

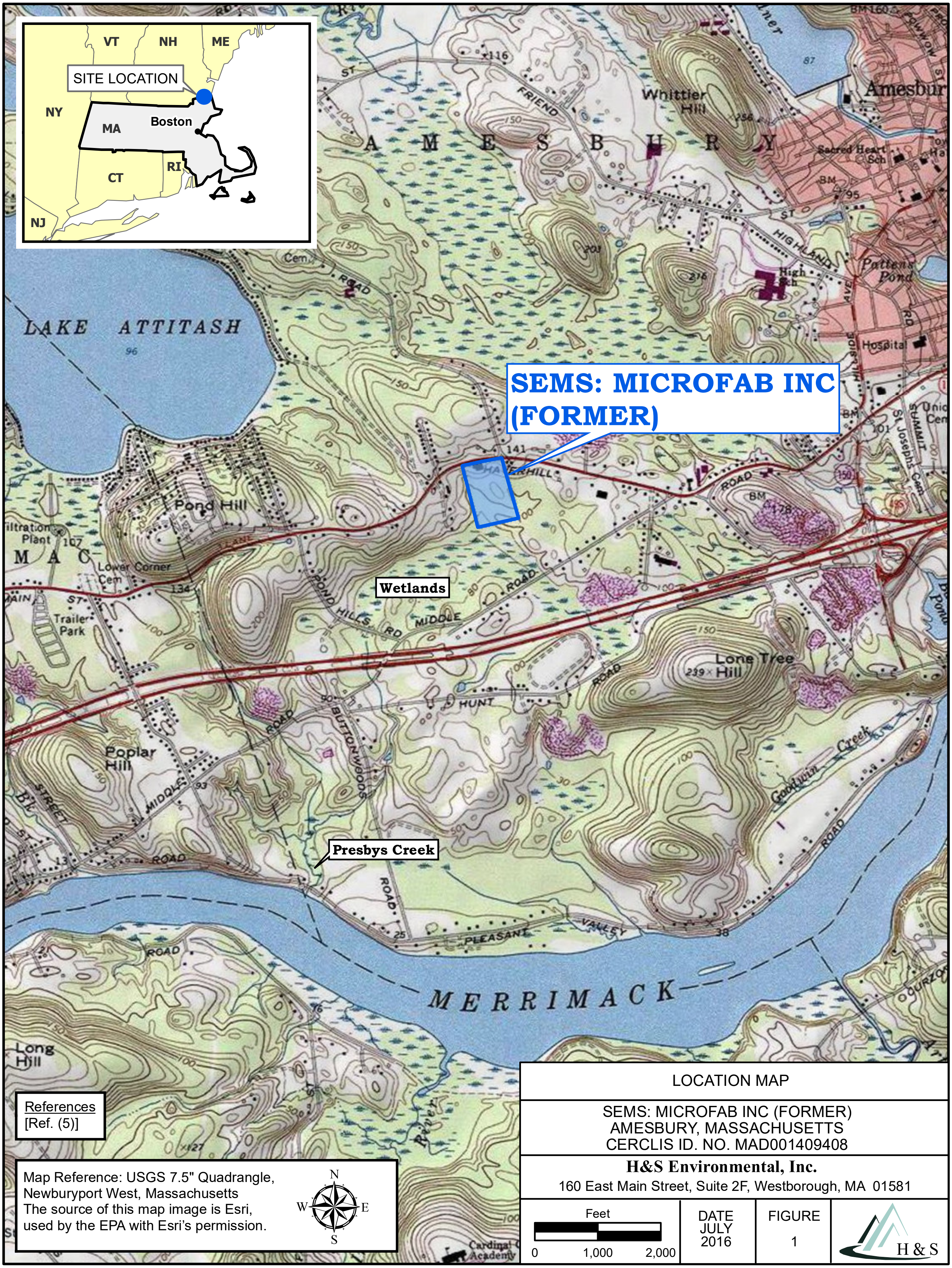
Notes:

[a]Maximum value applies to waste characteristics category.

[b]Maximum value not applicable.

[c]Do not round to nearest integer.

NS: Not Scored.



LOCATION MAP

SEMS: MICROFAB INC (FORMER)
AMESBURY, MASSACHUSETTS
CERCLIS ID. NO. MAD001409408

H&S Environmental, Inc.
160 East Main Street, Suite 2F, Westborough, MA 01581

Feet	DATE	FIGURE	
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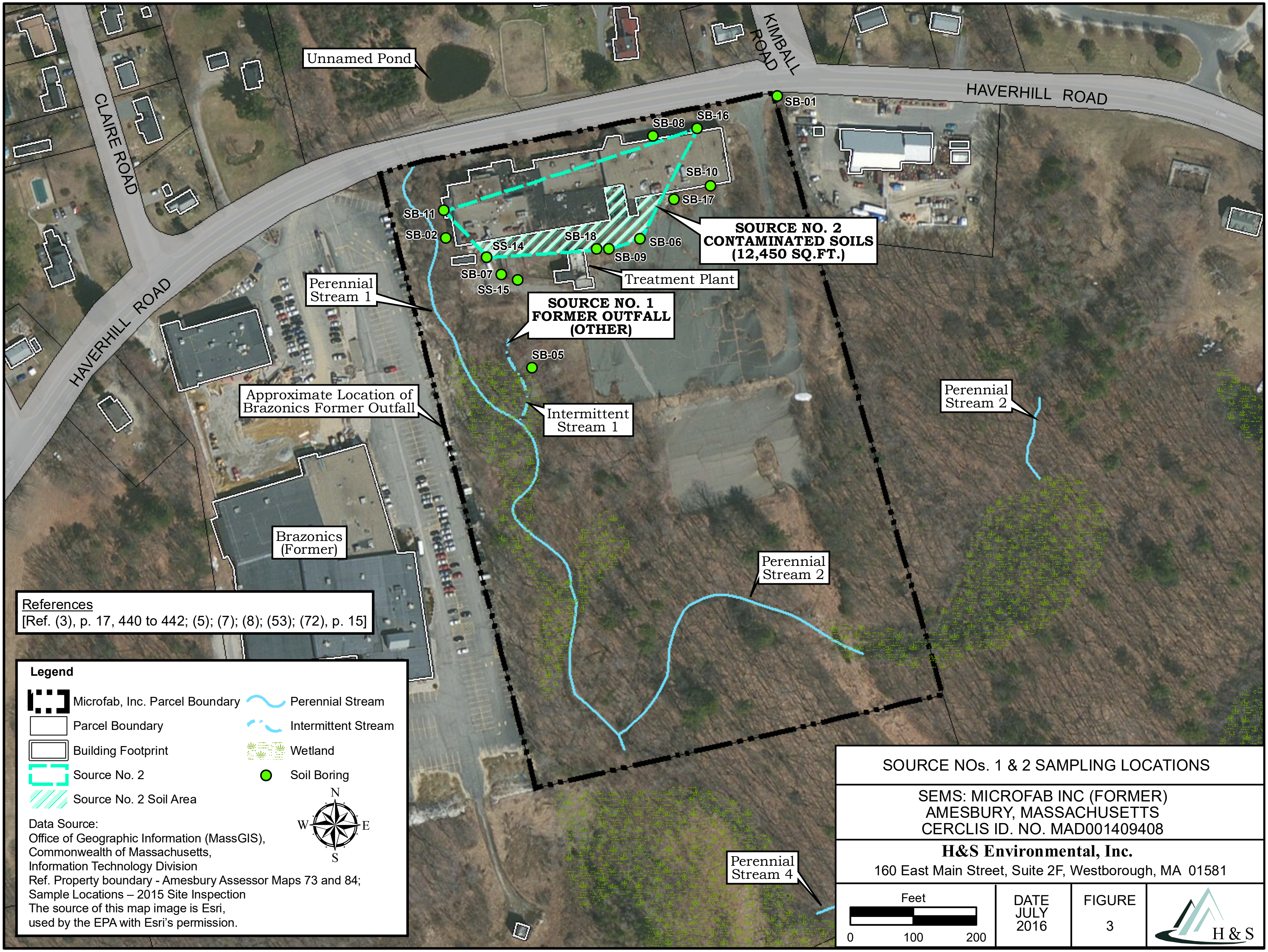
File: Microfab_Figure1_SLM Date:7/22/2016

Document Name: Microfab_Figure2_SiteMap



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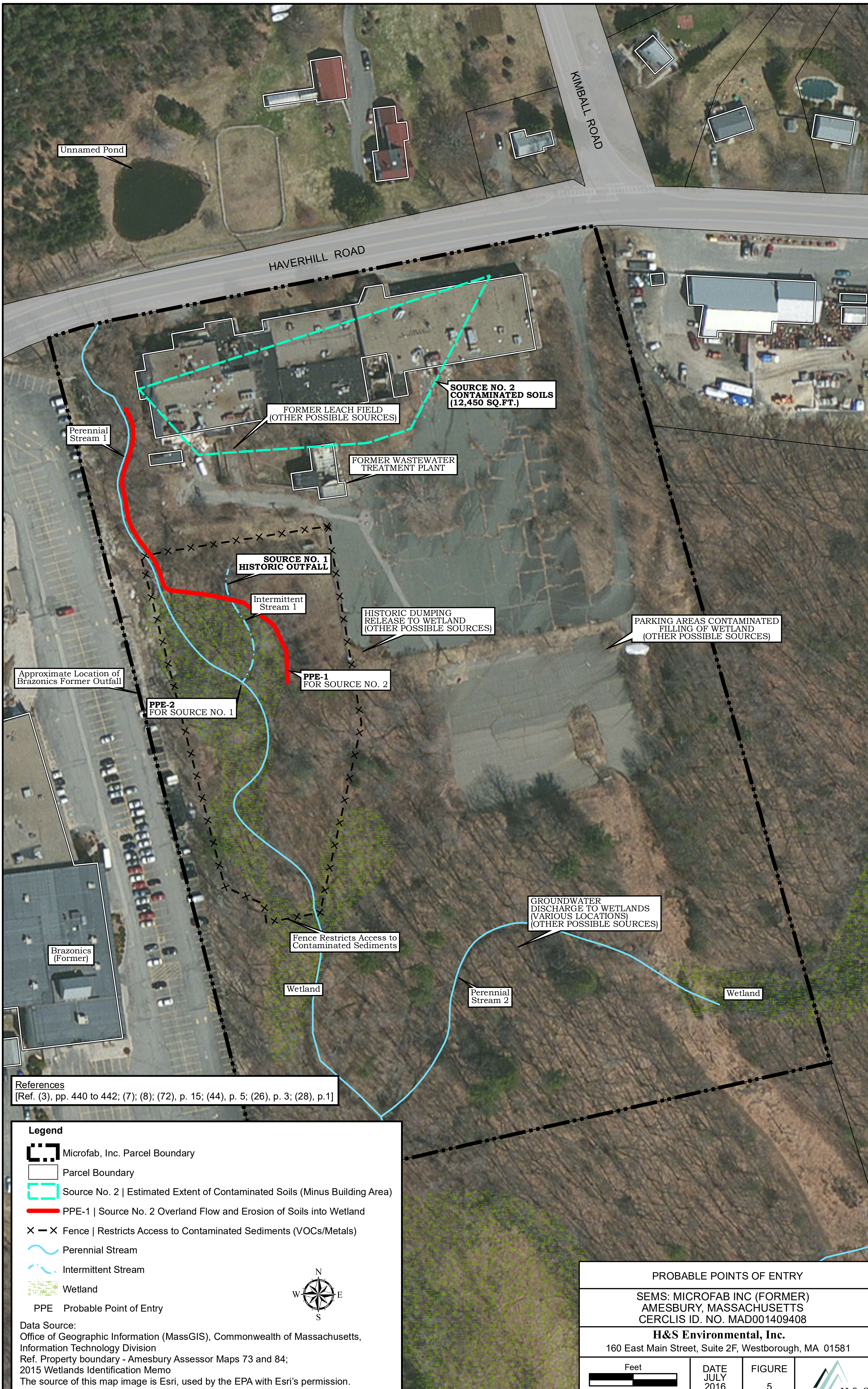

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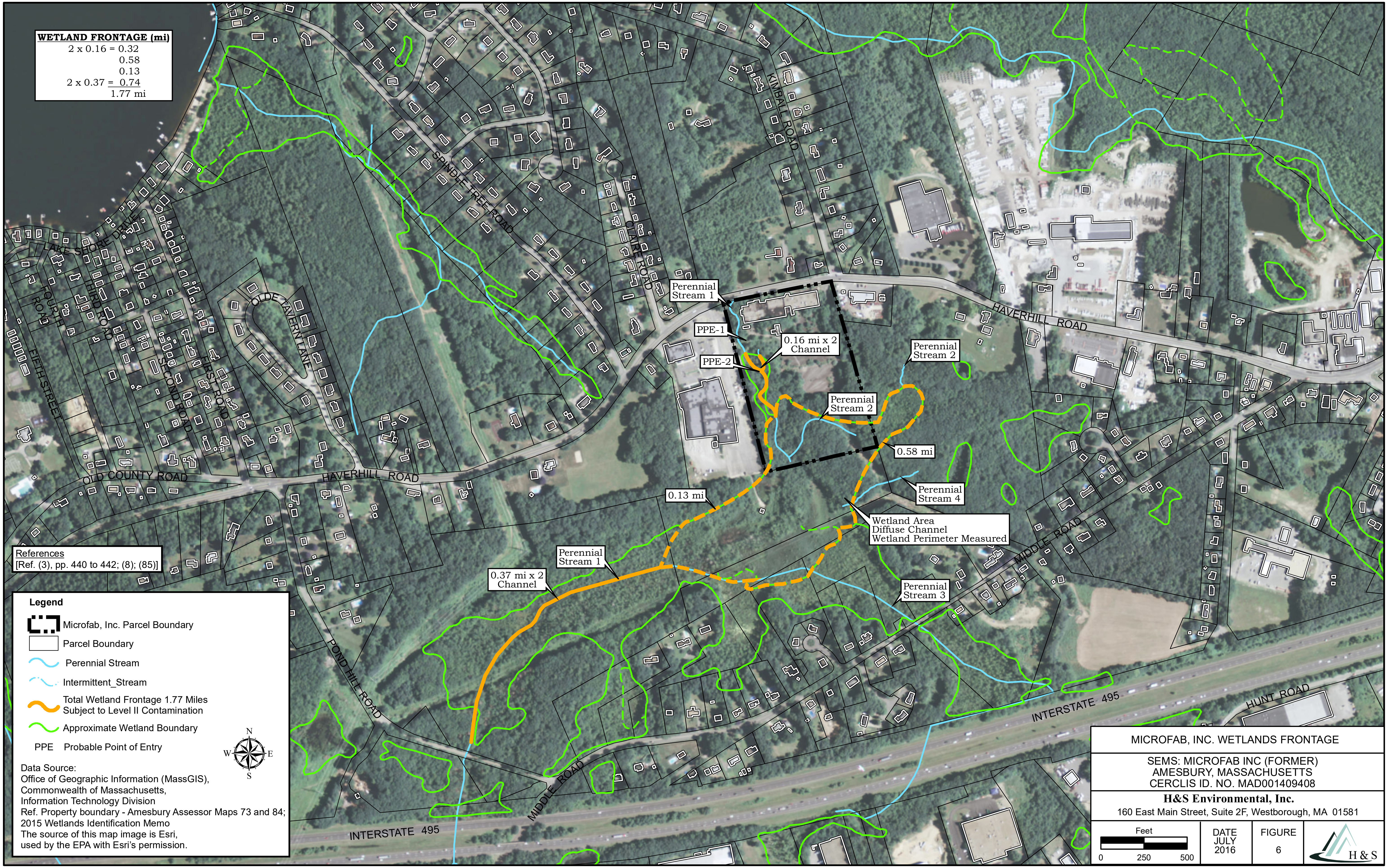
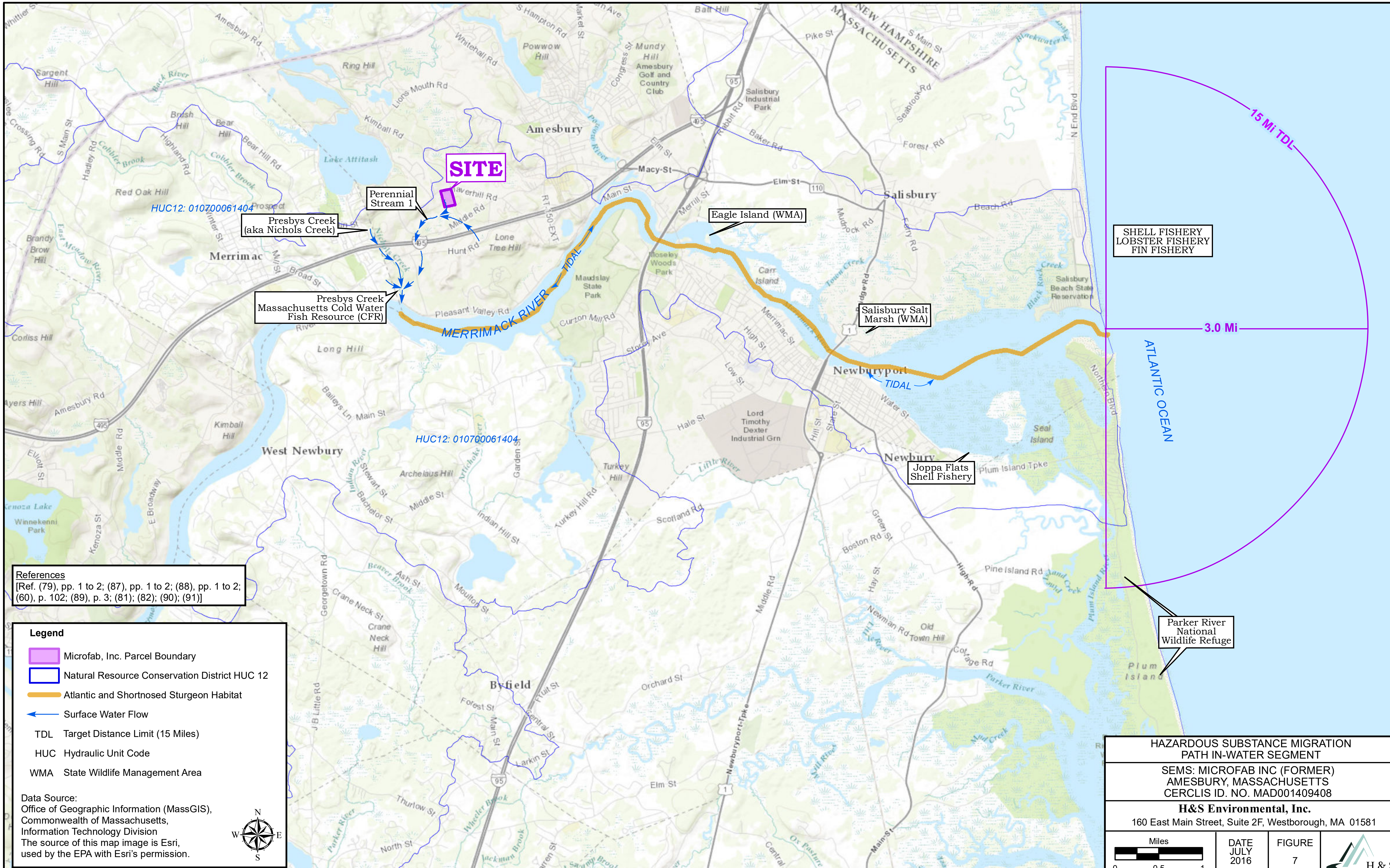


Document Name: Microfab_Figure6_WetlandFrontage



File: Microfab_Figure7_WatershedMap Date:7/28/2016

MICROFAB REFERENCES

Please Note: With the exception of Reference No. 1, HRS Final Rule (citations in this HRS package refer to Federal Register page number), citations in this HRS package refer to the sequential page number in each document. Reference document pages have been renumbered sequentially to include all pages.

Reference

No. **Description of the Reference**

1. U.S. Environmental Protection Agency (EPA). Federal Register Revised Hazard Ranking System (HRS) Final Rule - 55 FR 51532. Federal Register. December 14, 1990. Vol. 55. 136 Pages.

2. U.S. Environmental Protection Agency, (EPA). Superfund Chemical Data Matrix (SCDM). Accessed August 4, 2016. Excerpt from query. 30 Pages. A complete copy of SCDM is available at: https://www.epa.gov/superfund/superfund-chemical-data-matrix-scdm.

3. H&S Environmental, Inc. Final Site Reassessment Report for Microfab, Inc. (Former). December 2015. 442 Pages.

4. Town of Amesbury, Massachusetts. Assessors Card. 2015. 4 Pages.

5. U.S. Geological Survey (USGS). 7.5' Topographic Quadrangle, Newburyport, West, MA-NH, 1:24000. 2015. 1 Map. 1 Page (Sheet).

6. PointMap. Microfab, Inc. (Former). Coordinates Reference Point. 2016. 2 Pages.

7. Amesbury, Town of. Assessors Maps 73 and 84. January 2013. 3 Pages (2 Sheets).

8. Environmental, H&S. Site Assessment Program, Wetlands Identification for Microfab, Inc. (Former), Amesbury, Massachusetts. September 2015. 23 Pages.

9. GEI Consultants, Inc. Phase II Site Investigation, Brazonics Site, Amesbury, Massachusetts. October 15, 1990. 279 Pages.

10. Adams, David C. Senior Sanitary Engineer, Massachusetts Division of Water Pollution Control (DWPC). Memorandum. December 1983. 4 Pages.

11. Essex County, Massachusetts, Registry of Deeds. Deed. Vol. Book 5404, p. 701. 1 Page.

12. Johnson, Stephen. Massachusetts Department of Environmental Quality Engineering (DEQE). Memorandum for the Record. August 31, 1984. 2 Pages.

13. Tarbell, K. A. Amesbury Assistant Sanitary Engineer. Amesbury, Plating Rinse Water Disposal at Micro-Fab, Incorporated. March 6,1967. 3 Pages.

14. Commonwealth of Massachusetts. Department of the Attorney General. Consent Judgement Administrative Consent Order No. 19991. September 7, 1977. 5 Pages.

15. Microfab, Inc. Letter to Massachusetts Water Resources Commission, DWPC. September 14, 1977. 2 Pages.

16. EPA and Commonwealth of Massachusetts. National Pollutant Discharge Elimination System (NPDES), Discharge Permit. 1976. 9 Pages.

MICROFAB REFERENCES

Reference

No. **Description of the Reference**

17. EPA and Commonwealth of Massachusetts. NPDES Permit. 1985. 25 Pages.

18. Semicon, Inc. Letter to Massachusetts Water Resources Commission. December 3, 1976. 2 Pages.

19. Microfab, Inc. Letter to Federal Center Regarding Flash Neutralization System with Leach Bed. June 5, 1972. 3 Pages.

20. United States Bankruptcy Court, District of Massachusetts. Order on the Commonwealth's Motion Requesting Declaration of Exemption from and Relief from Automatic Stay. August 18, 1989. 49 Pages.

21. NPDES. Discharge Report. 1981 to 1986. 5 Pages.

22. Town of Amesbury, Conservation Commission. Letter to EPA Regarding Microfab Mfg., Inc.'s NPDES Permit Application. November 10, 1974. 2 Pages.

23. Commonwealth of Massachusetts, Northern Essex Community College. Letter to Amesbury Conservation Commission. November 11, 1974. 2 Pages.

24. Strutz, Michael D. Water Compliance Section, Enforcement Branch. Enforcement Fact Sheet, Federal Permit MA0002208, State Permit No. 375. Issued December 23,1974, Modified March 25, 1976. 2 Pages.

25. EPA. Letter to Chief of EPA Permits Branch. January 21, 1976. 2 Pages.

26. DEQE. Meeting Notes Interview with Ex-treatment Plant Operator. September 29, 1980. 6 Pages.

27. Commonwealth of Massachusetts, Water Resources Commission, DWPC. Letter to resident Robert Pender, Middle Road, Amesbury, MA. October 21, 1980. 4 Pages.

28. Massachusetts Department of Environmental Protection (MassDEP). Memorandum to File Regarding Interview with Former Microfab Employee. November 27, 2000. 1 Page.

29. Massachusetts, United States District Court for the District of. Civil Action No. 72-1080-M, United States of America v. Microfab, Incorporated. 1972. 6 Pages.

30. EPA. Letter to Semicon, Inc. Rejecting Investigation of Copper on Biological Community. February 11, 1976. 2 Pages.

31. EPA. Letter to Microfab, Inc. Regarding Violations under the Clean Water Act. May 28, 1981. 6 Pages.

32. EPA. Letter Transmitting Administrative Order, 82-1031. January 5, 1982. 12 Pages.

33. EPA. Letter Transmitting Administrative Order, 85-34. July 16, 1985. 12 Pages.

34. Versar, Inc. Inspection and Compliance Sampling, Microfab, Inc. NPDES Permit No. MA0002208. August 1983. 14 Pages.

35. Town of Amesbury Board of Health. Letter to Massachusetts DEQE Regarding Results of Outfall Sampling. October 6, 1982. 3 Pages.

MICROFAB REFERENCES

Reference

No. **Description of the Reference**

36. Commonwealth of Massachusetts. DEQE. Special Analysis, Sediment Unnamed Stream. November 1982. 2 Pages.

37. Johnson, Arthur S. Sanitary Biologist, DWPC. An Investigation of the Microfab, Inc. (Amesbury) Wastewater Discharge and its Impact of the Water Quality of the Unnamed Receiving Stream. October 1984. 17 Pages.

38. EPA and Commonwealth of Massachusetts DWPC. Public Notice of NPDES Application. 1974. 23 Pages.

39. Thorstensen Laboratory, Inc. Analysis of Ground Water Samples Taken Near Microfab, Inc. Amesbury, MASS. 6 January 1976. 3 Pages.

40. Thorstensen Laboratory, Inc. Impact of Discharged Copper on Plants Downstream from Microfab, Inc. Amesbury, MASS. Including Recommended Course of Action. March 29, 1976. 13 Pages.

41. Microfab, Inc. Letter To Massachusetts DWPC Regarding Spilling of Cupric Ammonium Chloride and Exceedance of Permit Limits. October 24, 1979. 1 Page.

42. Adams, David. Massachusetts DEQE. Memorandum to Richard Chalpin Hazardous Wastes Compliance Monitoring. December 22, 1983. 12 Pages.

43. Associates, M. Anthony Lally. Toxicity Testing and Evaluation of Effluent Discharge for NPDES Permit Renewal, Microfab, Inc. October 1984. 252 Pages.

44. Massachusetts DEQE. Potential Hazardous Waste Site - Site Inspection Report (SI). April 18,1984. 14 Pages.

45. Microfab, Inc. Discharge Reports. 1975. 8 Pages.

46. Microfab, Inc. Discharge Report. September 12, 1975. 2 Pages.

47. Lally, Anthony M., Associates. Baseline Monitoring Report. August 1987. 93 Pages.

48. Semicon, Inc. Letter to DWPC Request for Permit Extension and Treatment Measures. November 14, 1975. 2 Pages.

49. H&S/Nobis Environmental JV, LLC. Program Quality Assurance Project Plan (QAPP). November 7, 2011. 2908 Pages.

50. EPA. Quick Reference Fact Sheet. Using Qualified Data to Document an Observed Release and Observed Contamination. November 1996. 18 Pages.

51. Nobis. Nobis DV Data Review Qualification Actions Case 45273. 2016. 4 Pages.

52. Nobis. Laboratory Contract Required Quantitation Limits (CRQLs) and Method Detection Limits (MDLs). 2015. 103 Pages.

53. H&S Environmental, Inc. Microfab, Inc. (Former), Amesbury, MA, Site Investigation Field Notes. 2015. 27 Pages.

54. KAP Technologies, Inc. Laboratory Data Report, A4FT8 Volatile Organics. June 18, 2015. 1601 Pages.

MICROFAB REFERENCES

Reference

No. **Description of the Reference**

55. Nobis. Site Investigation Data and Data Validation. 2015. 383 Pages.

56. Chemtech Consulting Group, Inc. Laboratory Data Report, Metals Analysis, MA4FT0. 2015. 925 Pages.

57. KAP Technologies, Inc. 2015 Laboratory Data Report, A4FY2 Volatile Organics. June 9, 2015. 546 Pages.

58. Chemtech Consulting Group, Inc. Laboratory Data Report Metals Analysis, MA4FY9. 2015. 788 Pages.

59. U.S. Geological Survey. Water Resources of Massachusetts. Water-Resources Investigations Report 90-4144. 1992. 105 Pages.

60. Massachusetts Executive Office of Environmental Affairs (EOEA). Merrimack River, A Comprehensive Watershed Assessment Report. 2001. 149 Pages.

61. MassDEP. Emergency Short Term Measure Approval Form. March 31, 1989. 14 Pages.

62. H&S/Nobis Environmental, JV, LLC. Field Task Work Plan. April 21, 2015. 59 Pages.

63. Chemtech Consulting Group. Laboratory Data Report, MA4FP1, Metals. 2015. 575 Pages.

64. Chemtech Consulting Group, Inc. Laboratory Data Report, MA4FQ5, Metals. 2015. 509 Pages.

65. KAP Technologies. 2015 Laboratory Data Report, A4FT9. Volatile Organics. 2015. 634 Pages.

66. KAP Technologies, Inc. 2015 Laboratory Data Report, A4FP1. Volatile Organics. 2015. 1653 Pages.

67. KAP Technologies, Inc. 2015 Laboratory Report, A4FQ5 Volatile Organics. 2015. 1910 Pages.

68. Lally, Anthony M., Associates. Preliminary Report Pilot System Evaluation of Recommended Wastewater Treatment System Microfab, Inc. December 1985. 89 Pages.

69. MassDEP Reportable Release Lookup, Amesbury, MA. April, 2, 2016. 4 Pages.

70. EPA RCRA Generator Status, Amesbury, MA. FindTheData. April 2016. 9 Pages.

71. Tetra Tech Nus, Inc. Final Site Reassessment Memorandum (Brazonics). October 13, 2005. 12 Pages.

72. GEI Consultants, Inc. Preliminary Environmental Assessment, Brazonics, Haverhill Road, Amesbury, MA. December 1, 1988. 115 Pages.

73. Andronico, Anthony F., Licensed Site Professional (LSP). Downgradient Property Status Opinion. January 31, 2000. 183 Pages.

74. MassDEP. Letter to EPA regarding Brazonics Site Reassessment. January 21, 2003. 2 Pages.

75. Massachusetts EOEA. Salisbury Beach State Reservation. [Online] http://www.mass.gov/eea/agencies/dcr/massparks/region-north/salisbury-beach-state-reservation.html. 2016. 2 Pages.

MICROFAB REFERENCES

Reference

No. **Description of the Reference**

76. The Greater Newburyport Chamber of Commerce and Industry. Plum Island for all Seasons. [Online] http://newburyportchamber.org/pages/PlumIsland. 2016. 6 Pages.

77. Massachusetts Department of Conservation and Recreation, Essex National Heritage Commission. Salisbury Reconnaissance Report. May 2005. 24 Pages.

78. Massachusetts Department of Public Health, Bureau of Environmental Health. Freshwater Fish Consumption Advisory List. August 2013. 6 Pages.

79. Wildlife, Massachusetts Division of Fisheries and. Coldwater Fish Resources List. [Online] http://www.mass.gov/eea/agencies/dfg/dfw/wildlife-habitat-conservation/coldwater-fish-resources-list.html. 2 Pages.

80. Surfland Bait and Tackle, Ms. Kay Moulton. Letter - Fishing at Plum Island and Vicinity. March 23, 2016. 3 Pages.

81. Massachusetts Geographical Information System (MassGIS). Shellfish Growing Areas. 2015. 2 Pages.

82. MassGIS. Lobster Harvest Zones. 1997. 2 Pages.

83. Massachusetts Executive Office of Energy and Environmental Affairs, Division of Marine Fisheries Letter. March 24, 2016. 3 Pages.

84. Plum Island Fishing Guide. On the Water. [Online] 2013. http://www.onthewater.com/plum-island-fishing-guide/. 13 Pages.

85. U.S Government. Code of Federal Regulations (CFR). 40 CFR 230.3. Electronic Code of Federal Regulations. Definitions. Wetlands Definitions. March, 31, 2016. 6 Pages.

86. French,Thomas W., Assistant Director, Massachusetts Division of Fisheries and Wildlife. Letter - Natural Heritage Endangered Species Program Tracking No. 15-34264. 2016. 2 Pages.

87. Natural Heritage and Endangered Species Program. Shortnose Sturgeon. 2015. 2 Pages.

88. Natural Heritage & Endangered Species Program. Atlantic Sturgeon. 2015. 2 Pages.

89. Keiffer, Mica C., Kynard, Boyd. Annual Movements of Shortnose and Atlantic Sturgeons in the Merrimack River, Masschusetts. Transactions of the American Fisheries Society, 122:1088-1103, 1993. 17 Pages.

90. United States Fish and Wildlife Service. Parker River National Wildlife Refuge. Map. 2015. 1 Page.

91. Massachusetts Division of Fisheries and Wildlife. Map - State Wildlife Management Areas. 2016. 2 Pages.

SITE SUMMARY

The Microfab, Inc. (former) (Microfab facility) is located at 104 Haverhill Road, in Amesbury, Essex County, Massachusetts [Ref. (4), p. 1]. For HRS scoring purposes, the Microfab facility (site) is composed of two sources, an outfall pipe (Source No. 1), and contaminated soil in the vicinity of the former facility building (Source No. 2). These sources are associated with observed releases to the Surface Water Migration Pathway [Ref. (3), pp. 15 to 16, (3), p. 34]. The outfall pipe from the treatment plant still exists, however the facility is vacant so process water is no longer discharging. The geographic coordinates, as measured from the approximate location of the pipe at the former outfall, are 42°50'32.62" north latitude and 70°57'35.43" west longitude [Ref. (5); (6), p. 2] (See **Figures 1**, **2** and **3** of this HRS documentation record). The former Microfab facility is located in a mixed commercial, industrial and residential area and is bounded to the north by Haverhill Road with residential properties beyond; to the east by a commercial property; to the southeast by undeveloped property; and to the west by Boston North Technology Park, LLC (Brazonics) [Ref. (7), p. 2 to 3] (**Figures 1 and 2**). Palustrine wetlands are located in the southern portion of the Microfab property and they extend along the unnamed stream to the west [Ref. (8), p. 11] (**Figure 2**). The Microfab property is currently vacant, and is improved with a three-story concrete and cinder block, open floor factory structure reportedly constructed in 1950 [Ref. (4), p. 2]. The building itself is approximately 102,768 square feet (ft^2) [Ref. (4), p. 3]. Paved parking areas totaling approximately 200,000 ft^2 exist south of the Microfab building [Ref. (8), p. 2] (**Figure 2**). A four foot high chain link fence restricts access from Haverhill Road [Ref. (3), p. 4].

A perennial unnamed stream (Perennial Stream 1) is located along the western property boundary. The unnamed stream discharges to the wetlands located south and southwest of Microfab [Ref. (8), pp. 2 to 3] (**Figure 2**). The perennial stream is fed from a small unnamed pond located north of the Microfab property on the opposite side of Haverhill Road (**Figure 2)**. The perennial stream is contained within a culvert beneath Haverhill Road. Storm water runoff from Haverhill Road, the Microfab parking lots, and Boston North Technology Park to the west currently discharge to this perennial stream [Ref. (3), p. 5; (9), p. 5] **(Figure 2)**. An intermittent stream (Intermittent Stream 1) located south of the Microfab building, historically received plant process discharges, which also increased the perennial stream flow [Ref. (10), p. 1] (**Figure 2**). Perennial Stream 1 discharges to a wetland in the southern portion of the Microfab property. A larger wetland is located approximately 0.2 miles south of the Microfab building and extends to the west (**Figure 2**). Perennial Stream 1, fed by this larger wetland, flows beneath Pond Hill Road and Route 495 merging with Presbys Creek (aka Nichols Creek) west of Buttonwoods Road and subsequently discharges to the Merrimack River (**Figure 1**) [Ref. (5), (8)] (**Figures 1 and 4**). Note that Figures 1 through 3 in Reference 8, incorrectly show Perennial Stream 1 as intermittent in the vicinity of the Microfab facility [Ref. (8), pp. 7 to 9]. The MassDEP wetland overlay shown in Reference 8, Figure 4, shows perennial streams feeding the wetlands [Ref. (8), p. 10]. Field observations supporting the perennial character of Perennial Stream 1 include continuity and sinuosity of the channel, in-channel structures and deposits, lack of vegetation in the channel, lack of leaf litter in the channel, and lack of fibrous roots in the channel. Photographs of Perennial Stream 1 are included in the 2015 Site Investigation (SI) Report [Ref. (3), pp. 440 to 442].

The operational history of the facility has included construction of the building in approximately 1950 [Ref. (4), p. 2]. Sigtrans (Signal Transmissions – a machine shop) machined metal parts prior to purchase of the property and occupation by Microfab in 1966 [Ref. (11), p. 1; (12), p. 2]. No information is available regarding property usage before 1950. In 1966, the property was purchased and operated by Microfab, Inc., which engaged in the manufacture of printed circuit boards, electroplating and related operations from May 1967 until October 1987 [Ref. (11), p. 1; (13), p. 2]. Microfab initially discharged untreated wastewater directly to the unnamed stream from 1967 to at least July 1977 [Ref. (13), p. 2; (14), p. 3; (15); p. 1]. National Pollutant Discharge Elimination System (NPDES) permits were obtained in 1976 and 1985 [Ref. (16), pp. 1 to 9; (17), pp. 1 to 25]. Process changes within the building, including discontinuing the use of chromic acid and installation of closed loop rinses for etching machines, were implemented between 1974 and 1976 to improve effluent quality prior to entering the stream [Ref. (18), p. 2]. Prior to 1977, untreated wastewater was discharged directly to the unnamed stream and through a trough to the swamp (wetlands) [Ref. (13); (19); p. 2].

A wastewater treatment plant was not constructed until after July 1977 [Ref. (15), p. 1]. This wastewater treatment plant discharged directly to an intermittent branch (Intermittent Stream 1) of the unnamed stream, located on the west side of the property through a concrete outfall that remains at the site [Ref. (3); p. 435] (**Figure 3**). This intermittent stream received discharge from the treatment plant from 1977 until the company ceased operation due to bankruptcy in 1987 [Ref. (20); p. 4]. NPDES Permit discharge violations were reported between 1977 and 1987 for pollutants including, but not limited to, copper, lead, nickel, tin, and fluoride [Ref. (21), pp. 2 to 5]. Numerous investigations were conducted between 1967 and 2015 performed by the Town of Amesbury, Massachusetts Department of Environmental Quality and Engineering (DEQE)/Department of Environmental Protection (MassDEP) and the U.S. Environmental Protection Agency (EPA). Historical documentation indicates untreated discharges of plating wastes and solvents, spills, complaints, and reported on-site disposal [Ref. (13), pp. 1 to 2; (22), pp. 1 to 2; (23), pp. 1 to 2; (24), pp. 1 to 2; (25), pp.1 to 2; (26), pp.1 to 6; (27), pp.1 to 4; (28) p. 1].

Administrative consent orders, enforcement actions, and findings of violation were issued to Microfab, Inc. as a result of non-compliant discharge to the unnamed stream during the period 1976 to 1987 [Ref. (14); (21), pp. 2 to 5; (29), pp. 1 to 6; (30), pp. 1 to 2 (31), pp. 1 to 6; (32), pp. 1 to 12; (33), pp. 1 to 12].

Flows of up to 178,000 gallons per day were reported from the outfall pipe [Ref. (34), p. 4]. Historical effluent monitoring indicated the process wastestream contained acetone, bis(2ethyl-hexyl)phthalate, chromium, copper, gold, silver, rhodium, ammonium persulfate, ammonium chloride, sulfuric acid, hydrochloric acid, lead, iron, methylene chloride, manganese, nickel, tin, zinc, fluoride, ammonia, organic nitrogen, chloride, phenols, phosphorus, sulfate, surfactants, alkanes, toluene, ethylbenzene, cyanide, chlorinated volatile organic compounds, (CVOCs) and acid/base/neutral extractable compounds (ABNs) [Ref. (10), pp.1 to 4; (13), p. 1; (12), pp. 1 to 2; (34), pp. 1 to 14; (35), pp. 1 to 3; (36), p. 2; (37), pp. 1 to 17; (38), pp. 19 to 23; (39), pp. 1 to 3; (40), pp. 1 to 13; (41), p. 1; (42), p. 1; (43), p. 8; (44), pp. 2 to 6]. **Table 1** provides a summary of historic reports and regulatory history.

Table 1 - Historic Reporting and Regulatory History		
Date	**Document Type**	**Observations/Findings/Actions**
1967, March 6	Town of Amesbury Sanitary Engineer Inspection [Ref. (13), pp. 1 to 3]	Proposed discharge of plating wastes containing gold, copper, lead, tin, rhodium, nickel, ammonium persulfate, sulfuric acid, hydrochloric acid, as well as three unidentified substances known as activator, accelerator and catalyst used in circuit board plating to a small brook at the rear of the Microfab property. The report was forwarded to Massachusetts Division of Water Pollution Control (DWPC) on March 22, 1967.
1972, March	Civil Action No. 72-1080_M [Ref. (29), pp. 1 to 6]	Requirements for construction of a treatment plant to meet stipulated discharge criteria.
1977, August 22	Consent Judgement No. 19991 [Ref. (14), pp. 1 to 5]	DWPC v. Microfab, Inc., Consent Judgement for violation of Massachusetts Clean Waters Act.
1982, January 5	Administrative Order No. 82-1031 [Ref. (32), pp. 1 to 12]	U.S. EPA v. Microfab, Violation of Clean Water Act.
1984, April 18	Site Inspection Report (SIR) [Ref. (44), pp. 1 to 14]	DEQE conducted an inspection of Microfab.
1984, October	An Investigation of the Microfab, Inc. Wastewater and its Impact on the Water Quality of the Unnamed Receiving Stream [Ref. (37), p. 5]	The Technical Services Branch of DWPC conducted an investigation of Microfab. Field sampling indicated copper, nickel, sulfate and ammonia nitrogen were present at levels determined to be toxic. Macroinvertebrate community down stream of outfall (Source 1) was "decimated".
1987, October 7	Bankruptcy and plant closure, Chapter 7 Case No. 87-11538-CJK [Ref. (20), p. 4]	Microfab declared bankruptcy and the Commonwealth of Massachusetts filed a Declaration of Exemption from and Relief from Automatic Stay.

The primary source of contamination was the direct discharge of untreated and treated process wastewater from the outfall to the intermittent (Intermittent Stream 1) branch of the unnamed stream located along the western property line. Soils in the vicinity of the building are also contaminated as a result of waste storage, waste handling, waste disposal practices, and facility operations. Soil, sediment and surface water sampling conducted as part of Site Inspection (SI) activities in 2015 provide documentation of contamination [Ref. (3), pp. 18 to 29].

In the spring of 2015, EPA conducted a SI at the site. During the SI, sixteen soil samples, twenty-seven sediment samples and twelve surface water samples were collected for analysis. The information obtained from this 2015 sampling program was used to identify possible sources and to document observed releases at the site. **Figure 3** shows the location of both Source No. 1 and Source No. 2 and the soil sample locations used to characterize Source No. 2 – contaminated soil. **Figure 4** shows sediment and surface water sample locations documenting the observed release of hazardous substances. The samples were submitted to Contract Laboratory Program (CLP) laboratories and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, (target analyte list) TAL metals, polychlorinated biphenyls (PCBs) and cyanide. Site soils contained VOCs, SVOCs, and metals including but not limited to, arsenic, chromium, copper, manganese, nickel, silver and zinc [Ref. (3), pp. 18 to 21]. Sediments at the site were found to contain VOCs, SVOCs, cyanide, and metals including but not limited to, arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc [Ref. (3), pp. 22 to 25]. Analysis of surface water from the unnamed stream and wetland showed CVOCs, and total metals including, but not limited to, arsenic, chromium, copper, lead, nickel and zinc [Ref. (3), pp. 26 to 27]. A fence currently restricts human access to contaminated surface water, sediment and soils located immediately south of the outfall location [Ref. (61), p. 1]

2.2 SOURCE CHARACTERIZATION

2.2.1 SOURCE IDENTIFICATION

Name of source: Former Outfall

Source Type: Other

Description and Location of Source (**Figure 3**):

Source No. 1 is a former outfall from the Microfab building and treatment plant (**Figure 3**). The Source Type is classified as, "Other". Microfab discharged untreated wastewater directly to Perennial Stream 1 from approximately 1967 to 1974 [Ref. (13), p. 1; (19), p. 2]. The specific location of this early untreated discharge to the unnamed stream is not known [Ref. (13), p. 1; (19) pp. 1 to 3]. Minor modification to facility processes including discontinuing use of chromic acid and closed loop rinses for etching were implemented to improve the effluent between 1974 and 1976 [Ref. (18), p. 2]. After July 1977, a treatment plant was constructed that discharged directly from an outfall to the intermittent stream (Intermittent Stream 1) south of the building (**Figure 3**) [Ref. (15), p. 1]. The intermittent stream merges with the perennial unnamed stream (Perennial Stream 1) along the western Microfab property line (**Figure 3**). This outfall still exists, however, the facility is abandoned and no process discharge currently occurs [Ref. (3), p. 435]. This existing outfall is referred to as the, "former outfall" herein.

During installation of the treatment plant, the former outfall was installed to direct treated discharge to the intermittent stream and receiving unnamed stream. The intermittent stream and the perennial unnamed stream received untreated plant discharges and treatment plant effluent from approximately 1966 until 1987 [Ref. (13), p. 2; (20), p. 4]. The volume of wastewater discharged is not known, but reports of up 178,000 gallons per day in 1983 have been identified [Ref. (34), p. 4]. The treatment plant operated on a 16 to 24 hour basis for approximately 10 years [Ref. (34), pp. 2 to 4]. Based on NPDES permit discharge records from April 1981 to January 1987, the average discharge rate during the period was approximately 115,500 gallons per day [Ref. (21), pp. 2 to 5].

Monitoring of the Microfab effluent conducted in 1983 for permitting purposes showed that the wastestream contained aluminum, copper, lead, nickel, tin, zinc, fluoride, ammonia nitrogen, nitrate nitrogen, phosphorus, and chlorinated solvents [Ref. (34), p. 12]. NPDES permit violations continued after installation of the treatment facility [Ref. (21), pp. 2 to 5]. Effluent testing for compliance purposes typically included a short list of analytes including copper, lead, nickel and tin [Ref. (21), pp. 2 to 5]. **Table 2** summarizes the contaminants identified during testing of the wastestream. The substances associated with Source No. 1 are capable of migrating in surface water and are available to the Surface Water Pathway.

Location of the source, with reference to a map of the site:

The former treatment plant outfall is located approximately 150 ft. south of the facility building and 110 ft. southwest of the treatment plant [Ref. (6), p. 2] (**Figure 3**). Based on historic photographs, the pre-1974 outfall was likely located in the same vicinity as the later treatment plant outfall [Ref. (19), pp. 1 to 3].

Source Aggregation: The original outfall (pre-1974) location is not precisely known. However, source aggregation is justified since the two generations of outfalls are of the same source type (other), they affect the same target populations, and the wastestreams were associated with the same company, same processes, and contained the same hazardous substances. In addition, both outfalls lacked any containment, the outfalls were located over the same aquifer system, and were located in the same watershed and floodplain.

Containment: Release to surface water via overland migration/flood.

This former outfall source (Source No. 1) was not contained and discharged directly to an intermittent stream (Intermittent Stream 1) feeding an unnamed stream (Perennial Stream 1) and palustrine wetlands to the south. Discharges (prior to 1977) are reported to have been made directly to the adjacent wetland and may have also involved an earlier outfall area [Ref. (13), pp. 1 to 3]. There is no evidence or documentation suggesting a functioning and maintained run-on control system and runoff management system or maintained engineered cover [Ref. (3), pp. 4 to 10, and p. 435]. Contaminated soils and sediment at the outfall location and sediment in the unnamed stream are subject to mobilization. Surface water and sediment samples collected during the May 2015 SI shows hazardous substances attributable to Source 1 have migrated to the unnamed stream and wetlands [Ref. (3), pp. 22 to 27]. During the SI sampling event, the former outfall contained some water (likely storm water), but not enough sediment to sample [Ref. (3), p. 435]. The containment factor for Source No. 1 is 10 [Ref. (1), HRS Table 4-2].

Waste/Source Sampling: For Source No. 1, the former outfall, the facility is vacant and there is no longer any discharge to sample directly. The results of compliance sampling and wastestream sampling of the outfall performed during the operation of the facility are presented below (**Table 2**).

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

The Microfab facility is vacant and no longer discharging. **Table 2** presents compiled analytical results for samples of the facility wastewater stream prior to discharge from the former outfall. The samples were collected as part of the Microfab facility NPDES permit monitoring or as part of investigations evaluating the quality of the discharge and potential impacts downstream. The limited testing showed that the wastestream contained VOCs, metals, and SVOCs. The table includes only detected CERCLA hazardous substances.

Table 2 – Source Characterization Data

Sample ID	Sample Type	Date	Hazardous Substance	Hazardous Substance Concentration	References
Discharge 4/28/75	Wastestream	4/28/1975	Copper	5.9 mg/l	(45), p. 3
			Lead	0.4 mg/l	(45), p. 3
			Nickel	0.15 mg/l	(45), p. 3
			Total Chromium	0.04 mg/l	(45), p. 3
			Hexavalent Chromium	0.01 mg/l	(45), p. 3
Effluent 5/30/75	Wastestream	5/30/1975	Copper	2.16 mg/l	(45), p. 4
			Lead	0.1 mg/l	(45), p. 4
			Nickel	0.02 mg/l	(45), p. 4
Effluent 6/30/75	Wastestream	6/30/1975	Copper	1.6 mg/l	(45), p. 5
			Lead	0.15 mg/l	(45), p. 5
			Nickel	0.04 mg/l	(45), p. 5
Effluent 001	Wastestream	4/16/1975	Copper	1.29 mg/l	(45), p. 8
			Lead	0.2 mg/l	(45), p. 8
			Nickel	0.38 mg/l	(45), p. 8
			Total Chromium	0.07 mg/l	(45), p. 8
Discharge 8/29/1975	Wastestream	8/29/1975	Copper	3.2 mg/l	(46), p. 2
			Lead	0.05 mg/l	(46), p. 2
			Nickel	0.02 mg/l	(46), p. 2
Sample Taken from Outfall	Wastestream	8/31/1982	Chromium	0.1 mg/l	(35), p. 1
			Copper	2.98 mg/l	(35), p. 1
			Nickel	0.5 mg/l	(35), p. 1
Source A Microfab Inc.	Wastestream	8/31/1982	Copper	3.0 mg/l	(35), p. 3
			Lead	0.78 mg/l	(35), p. 3
			Nickel	0.60 mg/l	(35), p. 3
Plant effluent 007239	Wastestream	9/7/1982	Acetone	120 µg/l	(35), p. 2
			Chloroform	22 µg/l	(35), p. 2
			Methylene Chloride	19 µg/l	(35), p. 2
			Toluene	3.1 µg/l	(35), p. 2
			Ethylbenzene	7.0 µg/l	(35), p. 2
			Xylenes	32 µg/l	(35), p. 2
Discharge	Wastestream	Apr. 1981- Dec. 1981	Dissolved Copper	2.34 mg/l	(21), p. 2
			Total Copper	6.60 mg/l	(21), p. 2
Discharge	Wastestream	Jan. 1982 - Dec. 1982	Dissolved Copper	7.10 mg/l	(21), p. 2
			Total Copper	8.20 mg/l	(21), p. 2
Discharge	Wastestream	Jan. 1983 - Dec. 1983	Dissolved Copper	3.80 mg/l	(21), p. 3
			Total Copper	7.60 mg/l	(21), p. 3
Discharge	Wastestream	Jan. 1984 - Dec. 1984	Dissolved Copper	1.44 mg/l	(21), p. 3
			Total Copper	3.30 mg/l	(21), p. 3

Table 2 – Source Characterization Data					
Sample ID	**Sample Type**	**Date**	**Hazardous Substance**	**Hazardous Substance Concentration**	**References**
Discharge	Wastestream	Jan. 1985 - Dec. 1985	Total Copper	3.50 mg/l	(21), p. 3
			Total Lead	0.270 mg/l	(21), p. 3
			Total Nickel	1.20 mg/l	(21), p. 3
Discharge	Wastestream	Jan. 1986 - Dec. 1986	Total Copper	3.50 mg/l	(21), p. 4
			Total Lead	0.600 mg/l	(21), p. 4
			Total Nickel	4.500 mg/l	(21), p. 4
MF 1 & 2	Wastestream	6/11/1987	Methylene Chloride	77 µg/l	(47), pp. 89 to 91
			Ethylbenzene	8 µg/l	(47), pp. 89 to 91
			Styrene	7 µg/l	(47), pp. 89 to 91
			Xylenes	15 µg/l	(47), pp. 89 to 91
			Bis(2-ethylhexyl)phthalate	130 µg/l	(47), pp. 89 to 91
MF 9	Wastestream	6/11/1987	Copper	1.70 mg/l	(47), pp. 87, 89, 93
			Nickel	0.03 mg/l	(47), pp. 87, 89, 93
			Lead	0.25 mg/l	(47), pp. 87, 89, 93
			Zinc	0.057 mg/l	(47), pp. 87, 89, 93
MF 1 & 2	Wastestream	6/12/1987	Chloroform	9 µg/l	(47), pp. 81, 83, 84
			1,1,1- Trichloroethane	19 µg/l	(47), pp. 81, 83, 84
			PCE	6 µg/l	(47), pp. 81, 83, 84
			Xylenes	15 µg/l	(47), pp. 81, 83, 84
MF 9	Wastestream	6/12/1987	Copper	0.65 mg/l	(47), pp. 81, 83, 85
			Nickel	0.04 mg/l	(47), pp. 81, 83, 85
			Silver	0.010 mg/l	(47), pp. 81, 83, 85
			Zinc	0.034 mg/l	(47), pp. 81, 83, 85
MF 1 & 2	Wastestream	6/18/1987	Methylene Chloride	40 µg/l	(47), pp. 74, 76, 77

Table 2 – Source Characterization Data					
Sample ID	**Sample Type**	**Date**	**Hazardous Substance**	**Hazardous Substance Concentration**	**References**
MF 6	Wastestream	6/18/1987	Bis(2-ethylhexyl)phthalate	81 µg/l	(47), pp. 74, 76, 78
MF 7	Wastestream	6/18/1987	Total Cyanide	0.28 mg/l	(47), pp. 74, 76, 79
MF 9	Wastestream	6/18/1987	Copper	1.0 mg/l	(47), pp. 74, 76, 79
			Silver	0.063 mg/l	(47), pp. 74, 76, 79
			Zinc	0.028 mg/l	(47), pp. 74, 76, 79

Notes:
µg/l: micrograms per liter
mg/l: milligrams per liter
µg/kg: micrograms per kilogram
mg/kg: milligrams per kilogram

List of Hazardous Substances Associated with Source No. 1:

The CERCLA Hazardous Substances listed below (**Table 3**) were found to be present in compliance sampling and discharge sampling of the discharge of the former outfall conducted from approximately 1967 to 1987 [Ref. (13), pp. 1 to 3; (21), pp. 2 to 5; (35), pp. 8 to 12; (48), pp. 1 to 2; (47), pp. 73 to 93]. Compliance sampling and discharge sampling historically included testing for a limited number of analytical parameters (typically copper, lead, nickel, tin, pH, fluoride, suspended solids, and ammonia nitrogen [Ref. (21), pp. 2 to 5].

Table 3 **List of Hazardous Substances Associated with Source No. 1**		
acetone	1,1,1-trichloroethane	copper
chloroform	styrene	lead
ethylbenzene	xylenes	nickel
methylene chloride	bis(2-ethylhexyl)phthalate	silver
toluene	chromium	zinc
tetrachloroethene	hexavalent chromium	cyanide

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

This former outfall source was not contained and discharged directly to an intermittent stream (Intermittent Stream 1) feeding an unnamed stream and wetlands to the south. Discharges (prior to 1977) are reported to have been made directly to the unnamed stream and adjacent wetland and may have also involved an earlier outfall area [Ref. (13), pp. 1 to 3]. There is no evidence or documentation suggesting a functioning and maintained run-on control system and runoff management system or maintained engineered cover [Ref. (3), pp. 4 to 10, and p. 435]. Contaminated soils and sediment at the outfall location and sediment in the unnamed stream are subject to mobilization. Surface water and sediment samples collected during the May 2015 SI shows hazardous substances attributable to Source 1 have migrated to the unnamed stream and wetlands [Ref. (3), pp. 22 to 27]. During the SI sampling event, the former outfall contained some water (likely storm water), but no sediment to sample [Ref. (3), p. 435]. The containment factor for Source No. 1, as summarized in **Table 4** below, is 10 [Ref. (1), HRS Table 4-2].

Table 4
Source No. 1 Containment Factor

Containment Description	Containment Factor Value	References
Gas release to air: The air migration pathway was not scored; therefore, gas release to air containment was not evaluated.	NS	_
Particulate release to air: The air migration pathway was not scored; therefore, particulate release to air containment was not evaluated.	NS	_
Release to ground water: The ground water migration pathway was not scored; therefore, ground water containment was not evaluated.	NS	_
Release via overland migration and/or flood: There is no documentation or evidence to indicate that Source No. 1 has a maintained engineered cover, run-on control system, or runoff management system. There is no evidence of runoff treatment. The containment factor for Source No. 1 is 10.	**10**	[Ref. (3), p. 13; (1), HRS Table 4-2]

Notes:

NS: Not Scored

2.4.2 HAZARDOUS WASTE QUANTITY

2.4.2.1 Source Hazardous Waste Quantity

Insufficient information exists to evaluate Hazardous Constituent Quantity. The hazardous waste quantity value is calculated using Tier C, Volume of contaminated process wastewater [Ref. (1), pp. 51590 to 51591].

2.4.2.1.1 Hazardous Constituent Quantity – Tier A

The hazardous constituent quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all CERCLA hazardous substances in the source and releases from the source are not known and cannot be estimated with reasonable confidence [Ref. (1), pp. 51590 to 51591]. There are insufficient historical and current data [manifests, potentially responsible party (PRP) records, State records, permits, waste concentration data, etc.] available to adequately calculate the total or partial mass of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous constituent quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier B, Hazardous wastestream quantity [Ref. (1), p. 51591].

Hazardous Constituent Quantity Assigned Value: NS

Are the data complete for hazardous constituent quantity for this area? No

2.4.2.1.2. Hazardous Wastestream Quantity – Tier B

The hazardous wastestream quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the mass of all hazardous wastestreams plus the mass of any CERCLA pollutants and contaminants in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. (1), p. 51591, (Section 2.4.2.1.2)]. There are insufficient historical and current data (manifests, PRP records, State records, permits, waste concentration data, etc.) available to adequately calculate the total or partial mass of the wastestream plus the mass of all CERCLA pollutants and contaminants in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous wastestream quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier C, Volume [Ref. (1), p. 51591).

Hazardous Wastestream Quantity Assigned Value: NS

Are the data complete for hazardous constituent quantity for this area? No

2.4.2.1.3. Volume – Tier C

For the migration pathways, the source is assigned a value for volume using the appropriate Tier C equation from Table 2-5 [Ref. (1), p. 51591, (Section 2.4.2.1.3)]. Using NPDES discharge data for the period, April 1981 to January 1987, an average daily discharge from the plant is estimated to have been 115,463 gallons per day (GPD), Using average concentrations of total copper (3.5 mg/l), lead (0.3 mg/l), nickel (0.68 mg/l), chromium (0.07 mg/l) and silver (0.063 mg/l), derived from **Table 2** above, a total metals concentration in the wastestream of 4.6 mg/l (0.00046% or 387,724 gallons over a period of 20 years of discharge) is derived. This value is converted to 1,920 cu. yds. This results in a Source HWQ of 768. The assigned hazardous waste quantity factor value from HRS Table 2-6 is therefore, 100. However, insufficient data are available to accurately or reasonably determine the volume measure. The reasons are as follows: 1). the wastestream was only sampled for a small list of contaminants; 2). data is only available for a small period of the total years of discharge; 3). there is a report of tampering with compliance samples; 4). In addition to copper and other metals, more encompassing analysis of the wastestream, when conducted, detected other hazardous substances. Therefore, the value of > 0 reflects the fact that contaminated source samples are present, and the volume is known to be greater than 0, but the exact amount is unknown.

Volume Assigned Value: unknown, but >0

Are the data complete for volume quantity for this area? No

2.4.2.1.4. Area – Tier D

The area measure (Tier D) is not evaluated for source type "other" [Ref. (1), Table 2-5].

Area Assigned Value: 0

Are the data complete for area quantity for this area? No

2.4.2.1.5. Calculation of Source Hazardous Waste Quantity Value

The source hazardous waste quantity value for Source No. 1 was evaluated based on volume, Tier C. However, insufficient data is available to determine the volume of contaminated process wastewater discharged at Source No. 1. Therefore, the source hazardous waste quantity value for Source No. 1 is unknown, but greater than 0 [Ref. (1), Section 2.4.2.1.5]

Source HWQ Value: unknown, but >0

2.2.1 SOURCE IDENTIFICATION

Name of source: Contaminated Soil — Number of source: 2

Source Type: Contaminated Soil

Description of source (**Figure 3**):

Source No. 2 is an area of contaminated soil located at the rear (south) of the existing facility building (**Figure 3**). Historical spills and poor waste management practices, especially at the rear of the building, resulted in contaminated soils. The Source Type is classified as, "Contaminated Soil". Soil sampling conducted at the Microfab site in May 2015 identified VOCs, SVOCs, metals, and cyanide in near surface soils. May 2015 SI surficial soil sampling was conducted at a depth of 0-1 ft below ground surface (bgs). With the exception of bis(2-ethylhexyl)phthalate, identified in sampling of process wastewater, SVOCs have not been reported as associated with historical process wastestream at the Microfab facility [Ref. (47), pp. 74, 76, 78]. However, the source and quality of fill soils used at the site are not known. SVOCs were identified in 2015 samples of fill material at the property. Therefore, SVOCs are associated with the site based on soil testing results, but a specific origin of the contamination cannot be determined.

Location of the source, with reference to a map of the site:

Contaminated soils are present at the rear of the existing building on-site (**Figure 3**). 2015 SI data was used to define an area of soils with concentrations of contaminants substantially above background concentrations. The area does not include the building footprint (**Figure 3**).

Containment: Release to surface water via overland migration/flood.

Source No. 2 is not contained. Contaminated soils have been identified in areas with no pavement. The site is vegetated and overgrown where not paved. Soils at the site are susceptible to erosion by both wind and runoff. Asphalt pavement at the site is cracked and broken up and may not sufficient to prevent exposure and erosion. Evidence of flow over pavement and erosion/undermining of asphalt pavement are present at the site. This source is not contained. There is reported dumping of solvents at the rear of the building [Ref. (28), p. 1]. Pavement over site soils is deteriorated. There is no evidence or documentation suggesting a functioning and maintained run-on control system and runoff management system or maintained engineered cover. No liners, berms, impoundments or other means of containment have been identified during site visits or during completion of subsurface explorations. There are no runoff control systems maintained at the site. The hazardous substances associated with Source No. 2 are capable of migrating to the Surface Water Pathway. Contaminated soils are subject to mobilization. The containment factor for Source No. 2 is 10 [Ref. (1), Table 4-2; (3), p. 13].

Waste/Source Sampling: During the period of May 18 through May 27, 2015, sixteen soil samples were collected at the site. **Figure 3** illustrates the soil sample locations used to define the source area and **Tables 5** and **6** indicate the compounds detected during the May 2015 sampling activities. The samples were submitted to CLP laboratories and analyzed for VOCs, SVOCs, pesticides, TAL metals, PCBs and cyanide. Analytical methods for these testing parameters are detailed in the QAPP [Ref. (49), pp. 13 to 14, p. 63, Table 8-2]. A Tier 1 plus data review was completed for the Microfab, facility soil samples collected during the May 2015 sampling event. Samples were analyzed by CLP laboratories using CLP SOWs SOM01.2 and ISM01.3. The data were initially processed through the EPA Electronic Data Exchange and Evaluation System (EXES) for electronic data qualification for laboratory quality control. Additionally, the EXES data qualifications were verified manually, corrected, and other non-automated laboratory quality control and field quality control criteria were evaluated and qualifications were applied to complete the data review process. VOCs including acetone, methylene chloride, tetrachloroethene, and trichloroethylene were detected in the soils. SVOCs including bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, phenanthrene, and pyrene were also detected in site soils. Metals detected in site soils include arsenic, chromium, copper, lead, manganese, nickel, silver, and zinc. Compounds elevated relative to background only are presented in **Tables 5** and **6**.

Soil samples were collected from between 0 and 1 ft bgs, using hand-auger techniques described in the program QAPP Standard Operating Procedure (SOP) ENV-004 [Ref. (49), pp. 23 to 24]. The hand auger contained a plastic sleeve that was decontaminated after each sample, in accordance with SOP FS-004 [Ref. (49), pp. 150 to 153].

A background comparison is not specifically needed for source samples, but because metals are included in Source No. 2, **Table 5** provides background concentrations (derived from soil location SB-01) for individual analytes to show contaminants that are elevated relative to background presented in **Table 6** (**Figure 3**).

For each soil sample representing Source No. 2, a compound is considered to be associated with the source if through documentation it was used or disposed at the facility and the concentrations are elevated relative to the background sample concentrations for site media. For HRS Scoring, soil collected from SB-01 was used to document background soil conditions **(Figure 3).** If the background concentration is not detected or is less than the detection limit, an observed release to soil is established when the sample measurement equals or exceeds the sample quantitation limit (SQL), in accordance with HRS Table 2-3. The SQL is the quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (for example, dilution, and concentration) [Ref. (1), p. 51586]. Although not required by the HRS or 1996 EPA Fact Sheet, qualified data are adjusted in accordance with the fact sheet to demonstrate the relative increase in contamination over background [Ref. (50), pp. 1 to 18; (51), p. 1 to 4].

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

Table 5
Source No. 2 - Contaminated Soil - Background Concentrations

Sample ID	Sample Type/ Depth (ft.)	Date	Hazardous Substance	Concentration	Sample Quantitation Limit (SQL)	References
SB-01/ A4FX5	Soil 0-1 ft.	5/22/2015	Acetone	14 U µg/kg	14 µg/kg	**Figure 3;** (1), p. 51586; (52), p. 8; (49)**,** pp. 13 to 14; (53) p. 16; (54), pp. 15, 81; (55), p. 129
SB-01/ A4FX5	Soil 0-1 ft.	5/22/2015	1,1,1-Trichloroethane	6.9 U µg/kg	6.9 µg/kg	**Figure 3;** (1), p. 51586; (52), p. 8; (49)**,** pp. 13 to 14; (53) p. 16; (54), pp. 15, 81; (55), p. 130
SB-01/ A4FX5	Soil 0-1 ft.	5/22/2015	Trichloroethene	6.9 U µg/kg	6.9 µg/kg	**Figure 3;** (1), p. 51586; (52), p. 8; (49)**,** pp. 13 to 14; (53) p. 16; (54), pp. 15, 81; (55), p. 130
SB-01/ A4FX5	Soil 0-1 ft.	5/22/2015	Tetrachloroethene	6.9 U µg/kg	6.9 µg/kg	**Figure 3;** (1), p. 51586; (52), p. 8; (49)**,** pp. 13 to 14; (53) p. 16; (54), pp. 15, 81; (55), p. 130
SB-01/ A4FX5	Soil 0-1 ft.	5/22/2015	Bis(2-ethylhexyl)phthalate	180 U µg/kg	180 µg/kg	**Figure 3,** (1), p. 51586; (49)**,** pp. 13 to 14; (52), p. 80; (53) p. 16; (54), p. 13, (55), p. 134
SB-01/ A4FX5	Soil 0-1 ft.	5/22/2015	Phenanthrene	180 U µg/kg	180 µg/kg	**Figure 3;** (1), p. 51586; (52), p. 80; (49)**,** pp. 13 to 14; (53) p. 16; (54), pp. 15, 648; (55), p. 135
SB-01 / MA4FX5	Soil 0-1 ft.	5/22/2015	Arsenic	10.7 J mg/kg (10.7 mg/kg) High bias – no adjustment made.	0.2 mg/kg	**Figure 3;** (1), p. 51586; (52), p. 97; (49)**,** pp. 13 to 14; (53) p. 16; (56), pp. 15, 27; (55), p. 316; (50), pp. 8, 18; (51), p. 3

Table 5
Source No. 2 - Contaminated Soil - Background Concentrations

Sample ID	Sample Type/ Depth (ft.)	Date	Hazardous Substance	Concentration	Sample Quantitation Limit (SQL)	References
SB-01 / MA4FX5	Soil 0-1 ft.	5/22/2015	Chromium	58.4 J mg/kg (58.4 mg/kg) High bias – no adjustment made.	0.069 mg/kg	**Figure 3;** (1), p. 51586; (52), p. 97; (49), pp. 13 to 14; (53) p. 16; (56), pp. 15, 27; (55), p. 316; (50), pp. 8, 18; (51), p. 3
SB-01 / MA4FX5	Soil 0-1 ft.	5/22/2015	Copper	59.3 mg/kg	0.32 mg/kg	**Figure 3;** (1), p. 51586; (52), p. 97; (49), pp. 13 to 14; (53) p. 16; (56), pp. 15, 27; (55), p. 316
SB-01 / MA4FX5	Soil 0-1 ft.	5/22/2015	Lead	51.7 J mg/kg (51.7 mg/kg) High bias – no adjustment made.	0.14 mg/kg	**Figure 3;** (1), p. 51586; (52), p. 97; (49), pp. 13 to 14; (53) p. 16; (56), pp. 15, 27; (55), p. 316; (50), pp. 8, 18; (51), p. 3
SB-01 / MA4FX5	Soil 0-1 ft.	5/22/2015	Manganese	138 J mg/kg (138 mg/kg) High bias – no adjustment made.	0.19 mg/kg	**Figure 3**; (1), p. 51586; (52), p. 97; (49), pp. 13 to 14; (53) p. 16; (56), pp. 15, 27; (55), p. 316; (50), pp. 8, 18; (51), p. 3
SB-01 / MA4FX5	Soil 0-1 ft.	5/22/2015	Nickel	15.4 mg/kg	0.22 mg/kg	**Figure 3**; (1), p. 51586; (52), p. 97; (49), pp. 13 to 14; (53) p. 16; (56), pp. 15, 27; (55), p. 316
SB-01 / MA4FX5	Soil 0-1 ft.	5/22/2015	Silver	1.2 mg/kg	0.058 mg/kg	**Figure 3**; (1), p. 51586; (52), p. 97; (49), pp. 13 to 14; (53) p. 16; (56), pp. 15, 27;

Table 5
Source No. 2 - Contaminated Soil - Background Concentrations

Sample ID	Sample Type/ Depth (ft.)	Date	Hazardous Substance	Concentration	Sample Quantitation Limit (SQL)	References
						(55), p. 316
SB-01 / MA4FX5	Soil 0-1 ft.	5/22/2015	Zinc	33.4 mg/kg	1.5 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 97; (49)**,** pp. 13 to 14; (53) p. 16; (56), p. 15, 27; (55), p. 316

Notes:
Sample ID: Field and Lab Designations
U - Not Detected.
µg/l: micrograms per liter
mg/l: milligrams per liter
µg/kg: micrograms per kilogram
mg/kg: milligrams per kilogram.
J: Estimated concentration. Values in parentheses represent adjusted concentration in accordance with Ref. (50), pp. 1 to 18.
SQL: Sample Quantitation Limit - Quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (for example, dilution, concentration) [Ref. (1), p. 51586].

Table 6 - Source No. 2 - Contaminated Soil - Source Concentrations						
Sample ID	**Sample Type/ Depth (ft.)**	**Date**	**Hazardous Substance**	**Hazardous Substance Concentration**	**Sample Quantitation Limit (SQL)**	**References**
SB-05 A4FY1	Soil/ 0 - 1	05/26/15	Acetone	19 µg/kg	4.9 µg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 12; (53), p. 22; (57), p. 16; (55), p. 129
SB-06 MA4FZ1	Soil/ 0 - 1	05/27/15	Chromium	399J mg/kg (309.3 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 84; (53), p. 26; (56), p. 17; (55), p. 355; (58), pp. 13, 17; (50), pp. 8, 18; (51), p. 3
SB-09 A4FX6	Soil 0 - 1	05/22/15	Trichloroethylene	91 µg/kg	1.7 µg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 9; (53), p. 17; (54), pp. 15, 95; (55), p.132
SB-09 / MA4FX6	Soil/ 0 - 1	05/22/15	Nickel	114 mg/kg	0.22 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 98; (53), p. 17; (56), pp. 15, 28; (55), p. 316
SB-09 / MA4FX6	Soil/ 0 - 1	05/22/15	Zinc	277 mg/kg	1.5 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 98; (53), p. 17; (56), p. 15; (55), p. 316
SB-11 / MA4FZ0	Soil/ 0 - 1	05/26/15	Silver	6.1 mg/kg	0.058 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 102; (53), p. 25; (56), pp. 16, 39; (55), p. 316; (58), pp. 12, 16
SS-14 / A4FY4	Soil/ 0 - 1	05/26/15	Acetone	19 µg/kg	4.9 µg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 15; (53), p. 24; (57), p. 16; (55), p. 129
SB-18 / A4FX7	Soil/ 0 - 1	05/22/15	1,1,1-Trichloroethane	71J µg/kg (7.1 µg/kg) High bias. Divide by 10	1.8 µg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 10; (53), p. 18; (54), pp. 15, 110; (55), p. 129; (50), pp. 8, 11; (51), p. 2
			Tetrachloroethene	15 µg/kg	2.7 µg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 11; (53), p. 18; (54), pp. 15, 110; (55), p. 130
SB-18 / A4FX7	Soil/ 0 - 1	05/22/15	Bis(2ethylhexyl)phthalate	260 µg/kg	87 µg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 80; (53), p. 18; (54), pp.

Table 6 - Source No. 2 - Contaminated Soil - Source Concentrations						
Sample ID	**Sample Type/ Depth (ft.)**	**Date**	**Hazardous Substance**	**Hazardous Substance Concentration**	**Sample Quantitation Limit (SQL)**	**References**
						15, 710; (55), p. 134
SB-18 / A4FX7	Soil/ 0 - 1	05/22/15	Phenanthrene	250 µg/kg	120 µg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 80; (53), p. 18; (54), pp. 15, 710; (55), p. 135
SB-18 / MA4FX7	Soil/ 0 - 1	05/22/15	Arsenic	145J mg/kg (83.3 mg/kg) High bias. Divide by 1.74	0.2 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 98; (53), p. 18; (56), pp. 15, 29; (55), p. 316; (50), pp. 8, 18; (51), p. 3
SB-18 / MA4FX7	Soil/ 0 - 1	05/22/15	Chromium	372J mg/kg (288 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 98; (53), p. 18; (56), pp. 15, 29; (55), p. 316; (50), pp. 8, 18; (51), p. 3
SB-18 / MA4FX7	Soil/ 0 - 1	05/22/15	Copper	1000 mg/kg	0.32 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 98; (53), p. 18; (56), pp. 15, 29; (55), p. 316
SB-18 / MA4FX7	Soil/ 0 - 1	05/22/15	Manganese	602J mg/kg (485.4 mg/kg) High bias. Divide by 1.29	0.19 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 98: (53), p. 18; (56), pp. 15, 29; (55), p. 316; (50), pp. 8, 18; (51), p. 3
SB-18 / MA4FX7	Soil/ 0 - 1	05/22/15	Nickel	86.9 mg/kg	0.22 mg/kg	**Figure 3**; (1), p. 51586; (52)**,** p. 98; (53), p. 18; (56), pp. 15, 29; (55), p. 316

Notes:
Sample ID: Field and Lab Designations.
U - Not Detected.
µg/l: micrograms per liter
mg/l: milligrams per liter
µg/kg: micrograms per kilogram
mg/kg: milligrams per kilogram
J: Estimated concentration. Values in parentheses represent adjusted concentration in accordance with Ref. (50), pp. 1 to 18. Qualified actions used to determine bias are provided in Ref. (51).
SQL: Sample Quantitation Limit - Quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (for example, dilution, concentration) [Ref. (1), p. 51586].

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

List of Hazardous Substances Associated with Source No. 2:

The soil samples contained VOCs, SVOCs, and metals with concentrations equal to or greater than their corresponding SQLs [Ref. (3), pp. 18 to 21; **Tables 5** and **6** of this HRS documentation record]. The samples were analyzed for VOCs, SVOCs, metals, PCBs/pesticides, and cyanide (**Table 6**).

The CERCLA Hazardous Substances listed below **(Table 7**) were present in shallow soil samples collected during the 2015 SI and are associated with Source No. 2 – Contaminated Soils [Ref. (3), pp. 18 to 21].

Table 7

List of Hazardous Substances Associated with Source No. 2

acetone	phenanthrene	nickel
tetrachloroethene	copper	silver
trichloroethylene	manganese	zinc
1,1,1-trichloroethane	arsenic	
bis(2-ethylhexyl)phthalate	chromium	

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

Contaminated soils at the site are available to a pathway. Based on 2015 SI data, soils in the near surface (0 - 1 ft). are contaminated (Source No. 2 – **Figure 3**) [Ref. (3), pp. 18 to 21]. Soils are exposed in some areas or are located beneath deteriorating pavement. Exposed soils are subject to erosion by storm water. The containment factor for Source No. 2, as summarized in **Table 8** below, is 10 [Ref. (1), HRS Table 4-2].

Table 8
Source No. 2 Containment Factor

Containment Description	Containment Factor Value	References
Gas release to air: The air migration pathway was not scored; therefore, gas release to air containment was not evaluated.	NS	–
Particulate release to air: The air migration pathway was not scored; therefore, particulate release to air containment was not evaluated.	NS	
Release to ground water: The ground water migration pathway was not scored; therefore, ground water containment was not evaluated.	NS	–
Release via overland migration and/or flood: There is no documentation or evidence to indicate that Source No. 2 has a maintained engineered cover, run-on control system, or runoff management system. There is no evidence of runoff treatment.	**10**	(3), p. 13; (1), Table 4-2

Notes:

NS: Not Scored

2.4.2 HAZARDOUS WASTE QUANTITY

2.4.2.1 Source Hazardous Waste Quantity

The hazardous waste quantity value is calculated using Tier D, Area based on shallow soil sampling results obtained during the 2015 SI [Ref. (1), pp. 51590, 51591; (3), pp. 41 to 43]. Justification for the source 2 hazardous waste quantity is presented below.

2.4.2.1.1 Hazardous Constituent Quantity – Tier A

The hazardous constituent quantity for Source No. 2 could not be adequately determined according to the HRS requirements; that is, the total mass of all CERCLA hazardous substances in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. (1), pp. 51590 to 51591, (Section 2.4.2.1.1)]. There are insufficient historical and current data (manifests, PRP records, state records, permits, waste concentration data, etc.) available to adequately calculate the total or partial mass of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous constituent quantity for Source No. 2 with reasonable confidence. Scoring proceeds to the evaluation of Tier B, Hazardous wastestream quantity [Ref. (1), p. 51591].

Hazardous Constituent Quantity Assigned Value: NS

Are the data complete for hazardous constituent quantity for this area? No

2.4.2.1.2. Hazardous Wastestream Quantity – Tier B

The hazardous wastestream quantity for Source No. 2 could not be adequately determined according to the HRS requirements; that is, the mass of all hazardous wastestreams plus the mass of any CERCLA pollutants and contaminants in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. (1), p. 51591, (Section 2.4.2.1.2)]. There are insufficient historical and current data (manifests, PRP records, state records, permits, waste concentration data, etc.) available to adequately calculate the total or partial mass of the wastestream plus the mass of all CERCLA pollutants and contaminants in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous wastestream quantity for Source No. 2 with reasonable confidence. Scoring proceeds to the evaluation of Tier C, Volume [Ref. (1), p. 51591, Section 2.4.2.1.3].

Hazardous Wastestream Quantity Assigned Value: NS

Are the data complete for hazardous constituent quantity for this area? No

2.4.2.1.3. Volume – Tier C

The hazardous wastestream volume for Source No. 2 could not be adequately determined according to the HRS requirements; that is, the thickness of contaminated soils (Source 2) cannot be adequately determined at this time. Volume is therefore assigned a value of 0. Scoring will proceed to an evaluation of area **[**Ref. (1), p. 51591, Sec. 2.4.2.1.4].

Volume Assigned Value: 0

Are the data complete for volume quantity for this area? No

2.4.2.1.4. Area – Tier D

Shallow soil sampling conducted during the 2015 SI identified contaminated soils within 1 foot of ground surface **(Figure 3**). Paved areas are included herein since the pavement is degraded and soils were observed to be eroding during the 2015 SI. The area measure is evaluated using the area of the source.

Based on this area, assign a value to the area measure as follows: for the migration pathways assign the source a value for the area using the appropriate Tier D equation from Ref. (1), Table 2-5 [Ref. (1), p. 51591]. Using **Figure 3** of this HRS documentation record that depicts the soil sampling locations from May 2015, the estimated area of Source No. 2 was determined. The building footprint was not included. The measuring tool in ESRI ArcMap (GIS) was used to calculate the square footage. The approximate area of Source No. 2 is 12,450 square feet [Ref. (1), p. 51591, Section 2.4.2.1.4] (see **Figure 3** of this HRS documentation record).

Sum (ft^2): 12,450 sq. ft.

Equation for Assigning Value (Table 2-5): Area (A)/34,000

Area Assigned Value: 0.36

2.4.2.1.5. Source Hazardous Waste Quantity Value

The source hazardous waste quantity value for Source No. 2 was evaluated based on area, Tier D. The source hazardous waste quantity (HWQ) value for Source No. 2 is assigned a source HWQ value of 0.36 [Ref. (1), p. 51591, Section 2.4.2.1.5].

Source HWQ Value: 0.36

Highest assigned value assigned from Ref. (1), Table 2-6: 1

SUMMARY OF SOURCE DESCRIPTIONS

Table 9

			Containment Factor Value by Pathway				
				Surface Water (SW)		Air	
Source No.	Source Hazardous Waste Quantity Value (HWQ)	Source Hazardous Constituent Quantity Complete? (Y/N)	Ground Water (GW) [Ref. (1), Table 3-2]	Overland/flood [Ref. (1), Table 4-2]	GW to SW [Ref. (1), Table 3-2]	Gas [Ref. (1), Table 6-3]	Particulate [Ref. (1), Table 6-9]
1	>0	N	NS	10	NS	NS	NS
2	0.36	N	NS	10	NS	NS	NS
Total (Site HWQ)	>0.36						

Notes:

NS: Not Scored.

N: No. Y: Yes.

Description of Other Possible on-Site Sources:

A former leach field existed at the site [Ref. (44), p. 5]. Prior to the wastewater treatment plant being built, process wastewaters were discharged to the leach field [Ref. (44), p. 5]. No samples were collected from the leach field during the 2015 SI.

Significant additional soil contamination may exist beneath the parking lots south of the facility. Interviews with a former employee suggested the possibility of dumping and buried drums [Ref. (26), p. 3; (28), p. 1]. In addition, poor housekeeping and possible disposal of wastes on the ground surface is reported [Ref. (28), p. 1]. Strong solvent odors from excavated soils were reported during construction of the parking lots in 1981 [Ref. (12), p. 1]. Soils beneath the parking lots were not sampled during the 2015 SI.

There is currently insufficient data and information available regarding the leach field and potential soil contamination beneath the parking areas to support these areas as additional sources meeting HRS criteria at the site. The leach field and possible soil contamination beneath the parking lots are not included in the HRS scoring presented herein.

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

Migration Pathway

The nearest surface water body to Source 1 and Source 2 is a perennial unnamed stream (Perennial Stream 1) located on-site and along the western Microfab property line (**Figure 2**). Perennial Stream 1 originates at a small (100 ft. diameter) unnamed pond located 30 ft. north of Haverhill Road (**Figures 2** and **5**). Perennial Stream 1 is classified in the HRS scoresheet as a minimal (less than 10 cfs) fresh water stream.

Surface water flows approximately 375 ft. before an intermittent branch (Intermittent Stream 1) of Perennial Stream 1 enters from the northwest at PPE-2 (**Figures 2** and **5**). Source No. 1 **–** Former Outfall discharged directly to this intermittent branch of Perennial Stream 1. The Microfab facility discharged treated and untreated wastewater directly to this branch of Perennial Stream 1. Intermittent Stream 1 flows south and enters the perennial portion of Perennial Stream 1 approximately 240 ft. south of the outfall location (**Figure 5**).

There is a report that indicates that even during extremely wet periods the natural flow in the unnamed stream (Perennial Stream 1) was well under the flow being discharged by Microfab to the intermittent branch (Intermittent Stream 1) [Ref. (10), p. 1]. Prior to the use of the outfall, earlier operations discharged directly to the wetland in the vicinity of the existing outfall [Ref. (13), pp. 1 to 3; (19), p. 2].

From the point where surface water from Perennial Stream 1 intercepts flow from the Intermittent Stream 1, the unnamed perennial stream (Perennial Stream 1) then flows south for another 250 ft. where a branch (Perennial Stream 2) from wetlands located to the east joins Perennial Stream 1 (**Figures 4** and **5**).

Perennial Stream 1 flows into a large wetland at the southwestern corner of the property (**Figures 2** and **5**). Approximately 1,800 ft from the former outfall, along the stream trace, the Perennial Stream 1 merges with another perennial branch coming from additional wetland areas to the southeast (Perennial Stream 3) (**Figure 4**). Perennial Stream 1 then flows west and southwest, bisecting a larger wetland before flowing under Pond Hill Road and Route 495 **(Figures 4, 5,** and **6)**.

Approximately 1.7 miles downstream from the outfall on Intermittent Stream 1, Perennial Stream 1 merges with Presbys Creek (aka Nichols Creek) **(Figure 7)**. The combined flow reaches the Merrimack River in another 0.3 miles. In total, the perennial stream (in combination with Presby's Creek) flows approximately 2 miles before discharging into the Merrimack River (**Figure 7**).

Presbys Creek discharges into a tidal estuary within the Merrimack River. The Merrimack River in turn is classified in HRS as a large stream to river (1,000 to 10,000 cfs) with an average discharge upstream at Lowell, Massachusetts of 7,562 cfs [Ref. (59), p. 34]. The Merrimack River is tidal to a point approximately 22 miles upstream from the mouth of the river (Haverhill, MA) [Ref. (60), p. 5]. The distance from the point of entry of Presbys Creek to the discharge point of the Merrimack in the Atlantic Ocean at Newburyport, MA is approximately 10 miles (**Figure 7)**. The Target Distance Limit (TDL) of 15 Miles therefore extends into the Atlantic Ocean (approximately 3 miles). The TDL within the Atlantic is represented by an arc with a radius of approximately 3 miles **(Figure 7)**.

Sources and Probably Points of Entry (PPEs)

PPE-1

Source No. 2 - Contaminated Soils. Site soils were contaminated through improper waste disposal practices, washing of drums at the rear of the facility onto the ground surface and possibly through discharge of waste directly to the ground surface [Ref. (28), p. 1]. The Probable Point of Entry (PPE) for source 2 is a line along the Perennial Stream 1 and the associated wetland adjacent to the building and filled areas of the property to the south and southwest of the building (PPE-1) **(Figure 5)**. Surface soils may be mobilized through overland flow and erosion.

Storm water runs off and across unpaved areas and deteriorated pavement and over the contaminated soil. The runoff and soil burden enters the unnamed perennial stream and the associated wetland along the perennially stream bank approximately 60 ft. southwest of the building [Ref. (3), p. 13] (**Figure 5**). Once the contaminated soils are mobilized and enter at PPE-1, the contaminated soils are then incorporated in the Migration Pathway described above.

PPE-2

Source No. 1 – Historic Outfall. PPE-2 is located at a point where Intermittent Stream 1 enters Perennial Stream 1 (**Figure 5**). Intermittent Stream 1 received the process wastewaters discharged through the historic outfall. The intermittent stream and Perennial Stream 1 received untreated discharge and treatment plant discharge from approximately 1966 until 1987 [Ref. (13), p. 2; (20), p. 4]. The volume of wastewater discharged is not known, but reports of up 178,000 gallons per day in 1983 have been identified [Ref. (34), p. 4]. The plant operated on a 16 to 24 hour basis for approximately 10 years (1977 – 1987) [Ref. (34), pp. 2 to 4]. Based on NPDES permit discharge records from April 1981 to January 1987, the average discharge rate during the period was approximately 115,500 gallons per day [Ref. (21), pp. 2 to 5]. Once the discharge entered Intermittent Stream 1 and the associated wetlands, it was incorporated in the Migration Pathway described above.

Surface water containing runoff from Source No. 2, which enters Perennial Stream 1 at PPE-1, joins runoff from Source No. 1 at location PPE-2. Impacted soils and sediments associated with the former outfall, stream channel and adjacent wetland continue to migrate with overland flow. (**Figure 5**). Site investigations have indicated that the historic discharge of wastewaters has resulted in elevated concentrations of metals found in surface water and sediments southwest of the facility and in surface water and sediments downstream from the location [Ref. (3), pp. 22 to 27]. The contaminated sediments identified during the May 2015 SI extend for at least 0.75 miles from the former outfall location, to sediment sample location SED-25, as shown on **Figure 4** of this HRS Documentation Record [Ref. (3), pp. 22 to 27].

4.1.2.1 Likelihood of Release

4.1.2.1.1 Observed Release

Direct Observation

An observed release by direct observation is not being scored.

Chemical Analysis

Establishing an observed release by chemical analysis generally requires documenting that the concentration of at least one hazardous substance in a release sample is elevated relative to its associated background level, and that the substance detected in the release can be attributed to the site [Ref. (1), p. 51859, (Table 2-3)]. When the background level is greater than or equal to its detection limit, to meet the HRS observed release criteria, the concentration in the release sample must be three times greater than the background level. If the background level is below its associated detection limit, an observed release is established if the concentration in the release sample is greater than or equal to the SQL. J-flagged qualified data showing bias has been adjusted, if necessary, in accordance with the EPA Fact Sheet [Ref. (50), pp.1 to 18; (51), pp. 1 to 4]. Descriptions of background samples are provided in **Table 10** and background sediment and surface water sample data is provided in **Table 11**.

SI activities conducted in May 2015 involved collection of soil, sediment and surface water from the site [Ref. (3); p. 15]. Sampling activities were conducted in accordance with a Field Task Work Plan, dated April 21, 2015 [Ref. (62), pp. 38 to 45] and the Standard Operating Procedures (SOP) in the Quality Assurance Project Plan (QAPP) [Ref. (49), p. 79 to 1087 (Appendix A)]. The samples were analyzed for VOCs, SVOCs, metals, cyanide and PCBs/pesticides [Ref. (55); pp. 4 to 15]. During SI activities conducted during the period of May 18 through May 27, 2015, twenty-seven sediment samples and twelve surface water samples were collected for analysis. **Table 12** provides descriptions of sediment and surface water samples. **Figures 3** and **4** illustrate the sample locations used to compile this HRS documentation record and **Tables 13** and **14** indicate compounds in sediment and surface water identified during the May 2015 sampling activities that meet observed release criteria. The samples were submitted to Contract Laboratory Program (CLP) laboratories and analyzed for VOCs, SVOCs, pesticides, TAL metals, polychlorinated biphenyls (PCBs/pesticides) and cyanide. Analytical methods for these testing parameters are detailed in the QAPP [Ref. (49), pp. 13 to 14, Table 8-2, p. 63].

Observed releases by chemical analysis have been documented during the 2015 SI for Source No. 1 and Source No. 2 in sediment and surface water (**Tables 13** and **14**). Sediment samples were collected from the bottom of the water body to a depth below the stream bottom of less than 2 ft. Sediment contamination associated with Source No. 1 is documented between sediment sample SED-04, collected proximal to the former outfall, and SED-25, collected approximately 0.66 miles from the outfall, near Pond Hill Road (**Figure 4**). Surface water contamination attributable to Source No. 1 has been identified near the outfall (SW-03), as far south as SW-11 and as far west as location SW-09 (**Figure 4**). In addition, contamination identified at SED-02 is unrelated to the outfall at Source No. 1, but is attributable to releases near the west side of the building (Source No. 2) and upgradient of the outfall location at Source No. 1 (**Figure 4**). This contamination is attributable to overland flow.

Observed releases by chemical analysis of VOCs, SVOCs, metals and cyanide have been documented for sediment. Observe releases by chemical analysis of VOCs, and metals have been documented for surface water. These observed releases are documented in the following sections by comparing hazardous substance concentrations in similar background and similar contaminated sediment and surface water samples.

<u>Background Samples:</u>

Because of historic waste handling and disposal practices, as well as a long history of contaminant discharges to the adjacent wetland, much of the Microfab property has been impacted with contamination sourced from the facility. A number of locations were selected during the 2015 SI to attempt to get samples of media that were representative of background conditions. However, since the site is heavily impacted, contaminants attributable to the Microfab facility were identified in most media samples. As a result, and based on review of the data and sample locations, only one sample each of soil, sediment, and surface water was selected as representative of background conditions for these specific media. These media samples are sufficient to establish background concentrations based on the following factors:

- Site contamination is widespread;
- Migration routes are simple – there is only one watershed and a limited number of overland segments;
- The selected background samples were collected within the last year, so the background data is current. Historical data for this site is comparatively old (> 5 years);
- The selected background samples were collected over a period of a few days and under similar meteorological conditions;
- Background samples, source samples, and release samples were all collected and analyzed in a similar manner during the 2015 SI;
- Concentrations of attributable contaminants in sources and release areas are high and widespread allowing differentiation between impacted areas and areas of the property that were not impacted;
- Background samples were collected upstream from potentially contaminated areas;
- PPEs are located on the same stream (Perennial Stream 1); and
- Environmental media across the property is similar – a single overburden and bedrock aquifer is present, similar soils and sediments are present, and similar depositional environments (small streams and wetlands) are present on the facility and in the vicinity of the facility.

Background samples of media were collected at a location in the unnamed stream (Perennial Stream 1) which was upstream of runoff from the Microfab property and at locations which were unlikely to be impacted by facility operations. Sediment collected near the upstream limit of the unnamed stream on the property (location SED-01) and above outfalls on the property or adjacent properties is considered to represent background for sediments (**Figure 4**) [Ref. (53), p. 9]. Surface water collected at the same location (SW-01) is considered to represent background for surface water (**Figure 4**) [Ref. (53), p. 1].

Background samples for sediment and surface water were collected in accordance with the procedures stipulated in the Field Task Work Plan and SOPs presented in the QAPP [Ref. (62), pp. 43 to 44; (49), Appendix A, pp. 79 to 1087]. Background and release samples were collected from similar media types. Sediment sample locations were collected using techniques described in the program QAPP Standard Operating Procedure (SOP) ENV-004 and ENV-008 [Ref. (49), pp. 86 to 90; (49), pp. 96 to 102]. Surface water samples were collected according to SOP 011 [Ref. (49), pp. 315 to 323].

Sediment samples were collected using a disposable plastic sampling device and preserved sample containers (SOP 008) [Ref. (49), pp. 96 to 102]. A Tee Handle hand auger was used to collect sediment samples from beneath plants (SOP 004) [Ref. (49), pp. 86 to 90]. Sediment samples were collected from 0-2 ft below the bottom of the stream bed. Surface water samples were collected with minimum disturbance and aeration. Surface water samples were collected by immersing the mouth of the container upstream at a 45 degree angle from vertical, allowing the mouth to be submerged half way. The depth of collection was from the water surface to a depth of approximately 0.5 ft. Unpreserved sample containers were used for collection and the sample was gently decanted into the appropriately preserved laboratory bottle ware.

The field logbook contains sampling information and the coordinates for each sample collected [Ref. (53)]. Samples were delivered to the contract laboratory under chain-of-custody (COC) documentation. The samples were submitted to the CLP laboratories and analyzed for VOCs, SVOCs, pesticides, TAL metals, PCBs and cyanide. Analytical methods for these testing parameters are detailed in the QAPP [Ref. (49), pp. 13 to 14, Table 8-2, p. 63]. COCs are included with the laboratory data reports [Ref. (63), pp. 10 to 14; (64), pp. 11 to 14; (56), pp. 14 to 17; (58), pp. 12, 13; (65), pp. 13 to 14; (54), pp. 14 to 19; (66), pp. 14 to 21; (57), pp. 16 to 17; (67) pp. 14 to 18].

Release samples were compared to background samples. Release samples showing concentrations three times background or concentrations greater than or equal to the SQL when background is below the detection limit are representative of an observed release.

Table 10
Background Samples

Sample ID/Location	Sample Medium	Depth (ft.)	Date Sampled	Description	References
SED-01	Sediment	0 - 2 ft. (below bottom of stream bed)	5/20/2015	Sediment collected from unnamed stream, south of Haverhill Road and inside property line.	**Figure 4**, (53), p. 9
SW-01	Surface Water	0 - 0.5 ft. (below water surface)	5/18/2015	Surface water collected south of Haverhill Road and inside property line.	**Figure 4**, (53), p. 4.

Notes:
ft: feet.
NA: Not Applicable.
SED: Sediment.
SW: Surface Water.

<u>Background Levels</u>

One sediment and one surface water sample (SED-01 and SW-01) were collected during the May 2015 SI, near the upstream, on-property limit, of the unnamed stream in order to establish background concentrations of hazardous substances detected on the site (**Figure 4**). The location of the sample collection point is upstream of known outfalls and PPE's identified along the unnamed stream [Ref. (53), p. 9]. The samples were submitted to Contract Laboratory Program (CLP) laboratories and analyzed for VOCs, SVOCs, pesticides, TAL metals, PCBs and cyanide [Ref. (62), pp. 43 to 44]. Analytical methods for these testing parameters are detailed in the QAPP [Ref. (49), pp. 13 to 14; Table 8-2, p. 63]. The EPA Region 1 laboratory reviewed the data and data review checklists are included in the laboratory data reports [Ref. (66), pp. 1 to 7; (67), pp. 1 to 7; (57), pp. 1 to 7; (65), pp. 1 to 7; (63), pp. 1 to 2; (64), pp. 1 to 2; (56), pp. 1 to 2; (58), pp. 1 to 2]. The SQL is the quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (for example, dilution, and concentration) [Ref. (1), p. 51586]. H&S/Nobis Environmental LLC, JV

(H&S/Nobis) performed a Tier 1 Plus data review of the analytical data packages [Ref. (55); (49), pp. 35 to 37]. Samples were analyzed by CLP laboratories using CLP SOWs SOM01.2 and ISM01.3. The data were initially processed through the EPA Electronic Data Exchange and Evaluation System (EXES) for electronic data qualification for laboratory quality control. Additionally, the EXES data qualifications were verified manually, corrected, and other non-automated laboratory quality control and field quality control criteria were evaluated and qualifications were applied to complete the data review process [Ref. (55); (49), pp. 35 to 37; (51), pp. 1 to 4].

The results for sediment sample SED-01 and surface water sample SW-01 are presented in **Table 11** below. These results were used as background concentrations for sediment and surface water during the preparation of this HRS document record. J-flagged qualified data showing bias has been adjusted, if necessary, in accordance with the 1996 EPA Fact Sheet [Ref. (50), pp. 1 to 18; (51), p. 1 to 4].

Table 11
Background Concentrations – Sediment and Surface Water Samples

Sample ID	**Hazardous Substance**	**Sample Concentration**	**Sample Quantitation Limit (SQL)**	**References**
Sediment				
SED-01 / A4FR4	Acetone	13 U µg/kg	13 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 62; (67), p. 171 to 173
	Chloroform	6.6 U µg/kg	6.6 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 62; (67), p. 171 to 173
	Ethylbenzene	6.6 U µg/kg	6.6 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 63; (67), p. 171 to 173
	Methylene chloride	6.6 U µg/kg	6.6 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 63; (67), p. 171 to 173
	Tetrachloroethene	6.6 U µg/kg	6.6 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 63; (67), p. 171 to 173
	Toluene	6.6 U µg/kg	6.6 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 63; (67), p. 171 to 173
SED-01 / A4FR4	1,1,1-Trichloroethane	6.6 U µg/kg	6.6 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 63; (67), p. 171 to 173

Table 11 Background Concentrations – Sediment and Surface Water Samples				
Sample ID	**Hazardous Substance**	**Sample Concentration**	**Sample Quantitation Limit (SQL)**	**References**
	Trichloroethene	6.6 U µg/kg	6.6 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 63; (67), p. 171 to 173
	m,p-Xylene	6.6 U µg/kg	6.6 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 63; (67), p. 171 to 173
	o-Xylene	6.6 U µg/kg	6.6 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 45; (53), p. 9; (67), p. 15; (55), p. 63; (67), p. 171 to 173
SED-01 / A4FR4/MA4FR4	Bis(2-ethylhexyl)phthalate	150 J µg/kg (150 µg/kg) No bias. Use concentration.	87 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 67; (53), p. 9; (67), p. 15; (55), p. 67; (67), p. 1056; (50), pp. 8, 14; (51), p. 2
	Phenanthrene	240 U µg/kg	240 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 67; (53), p. 9; (67), p.15; (55), p. 68; (67), p. 1056; (50), pp. 8, 15
	Arsenic	12.3 mg/kg	0.2 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 74; (53), p. 9; (63), p. 12; (55), p. 288; (64), p. 26
	Chromium	32 J mg/kg (32 mg/kg) High bias. Use concentration.	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 74; (53), p. 9; (63), p. 12; (55), p. 288; (64), p. 26; (50), pp. 8, 18; (51), p. 3
	Copper	15.8 J mg/kg (15.8 mg/kg) High bias. Use concentration.	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 74; (53), p. 9; (63), p. 12; (55), p. 288; (64), p. 26; (50), pp. 8, 18; (51), p. 3
	Lead	49.8 J mg/kg (49.8 mg/kg) High bias. Use concentration.	0.14 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 74 (53), p. 9; (63), p. 12; (55), p. 288; (64), p. 26; (50), pp. 8, 18

Table 11 Background Concentrations – Sediment and Surface Water Samples				
Sample ID	**Hazardous Substance**	**Sample Concentration**	**Sample Quantitation Limit (SQL)**	**References**
SED-01 /MA4FR4	Manganese	145 mg/kg	0.19 mg/kg	**Figure 4**; (1), p. 51586; (52)**,** p. 74; (53), p. 9; (63), p. 12; (55), p. 288; (64), p. 26
	Nickel	18.9 J mg/kg (25.5 mg/kg) Unknown bias. Multiply by 1.35	0.22 mg/kg	**Figure 4**; (1), p. 51586; (52)**,** p. 74**;** (53), p. 9; (63), p. 12; (55), p. 288; (64), p. 26; (50), pp. 8, 18; (51), p. 3
	Silver	1.2 mg/kg	0.058 mg/kg	**Figure 4**; (1), p. 51586; (52)**,** p. 74**;** (53), p. 9; (63), p. 12; (55), p. 288; (64), p. 26
	Zinc	58.0 mg/kg	1.5 mg/kg	**Figure 4**; (1), p. 51586; (1), p. 51586; (52), p. 74**;** (53)**,** p. 9; (63), p. 12; (55), p. 288; (64), p. 26
	Cyanide	0.20 J mg/kg No bias. Use concentration	0.13 mg/kg	**Figure 4**; (1), p. 51586; (52)**,** p. 74**;** (53), p. 9; (63), p. 12; (55), p. 290; (64), p. 26; (50), pp. 8, 18; (51), p. 3
Surface Water				
SW-01 / A4FP1	Acetone	10 U µg/l	10 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44
	Chloroform	5 U µg/l	5 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44
	Ethylbenzene	5 U µg/l	5 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44
	Methylene chloride	5 U µg/l	5 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44
	Tetrachloroethene	5 U µg/l	5 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44

Table 11 Background Concentrations – Sediment and Surface Water Samples				
Sample ID	**Hazardous Substance**	**Sample Concentration**	**Sample Quantitation Limit (SQL)**	**References**
SW-01 / A4FP1	Toluene	5 U µg/l	5 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44
	1,1,1-Trichloroethane	5 U µg/l	5 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44
	Trichloroethene	5 U µg/l	5 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44
	m,p-Xylene	5 U µg/l	5 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44
	o-Xylene	5 U µg/l	5 µg/l	**Figure 4;** (1), p. 51586; (52), p. 2; (53) p. 4; (66), p. 14, (55), p. 4; (66), p. 44
	Bis(2-ethylhexyl)phthalate	6.3 U µg/l	6.3 µg/l	**Figure 4;** (1), p. 51586; (52), p. 59; (53) p.4; (66), p. 14, (55), p. 9; (66), p. 710
	Phenanthrene	6.3 U µg/l	6.3 µg/l	**Figure 4;** (1), p. 51586; (52), p. 59; (53) p. 4; (66), p. 14, (55), p. 9; (66), p. 710
SW-01 / MA4FP1	Arsenic	2.4 J µg/l (2.4 µg/l) No bias. Use concentration	2.1 µg/l	**Figure 4;** (1), p. 51586; (52), p. 60; (53) p. 4; (63), p. 10; (55), p. 255; (63), p. 17; (50), pp. 8, 18; (51), p. 3
	Chromium	1.4 J µg/l (1.4 µg/l) No bias. Use concentration.	1.1 µg/l	**Figure 4;** (1), p. 51586; (52), p. 60; (53) p. 4; (63), p. 10; (55), p. 255; (63), p. 17; (50), pp. 8, 18; (51), p. 3
	Copper	7.9 J µg/l(7.9 µg/l) No bias. Use concentration.	3.4 µg/l	**Figure 4;** (1), p. 51586; (52), p. 60; (53) p. 4; (63), p. 10; (55), p. 255; (63), p. 17; (50), pp. 8, 18; (51), p. 3

Table 11 Background Concentrations – Sediment and Surface Water Samples				
Sample ID	**Hazardous Substance**	**Sample Concentration**	**Sample Quantitation Limit (SQL)**	**References**
	Lead	9.2 J µg/l (9.2 µg/l) No bias. Use concentration.	2.3 µg/l	**Figure 4;** (1), p. 51586; (52), p. 60; (53) p. 4; (63), p. 10; (55), p. 255; (63), p. 17; (50), pp. 8, 18; (51), p. 3
SW-01 / MA4FP	Manganese	125 µg/l	1.4 µg/l	**Figure 4;** (1), p. 51586; (52), p. 60; (53) p. 4; (63), p. 10; (55), p. 255; (63), p. 17
	Nickel	4 J µg/l (4 µg/l) No bias. Use concentration.	2.9 µg/l	**Figure 4;** (1), p. 51586; (52), p. 60; (53) p. 4; (63), p. 10; (55), p. 255; (63), p. 17 (51), p. 3
	Silver	10 U µg/l	1.1 µg/l	**Figure 4;** (1), p. 51586; (52), p. 60; (53) p. 4; (63), p. 10; (55), p. 255; (63), p. 17
	Zinc	91 µg/l	8.3 µg/l	**Figure 4;** (1), p. 51586; (52), p. 60; (53) p. 4; (63), p. 10; (55), p. 255; (63), p. 17
	Cyanide	4 J µg/l (4µg/l) No bias. Use concentration.	1.8 µg/l	**Figure 4;** (1), p. 51586; (52), p. 60; (53) p. 4; (63), p. 10; (55), p. 257; (63), p. 17; (50), pp. 8, 18; (51), p. 3

Notes:
Background Sample SED-01 showed high bias for chromium, copper and lead. No adjustment was made [Ref. (51), p. 3; (50), p. 8].
U: Not Detected. µg/l: micrograms per liter. mg/l: milligrams per liter. mg/kg: milligrams per kilogram
µg/kg: micrograms per kilogram
Sample ID: Field and Lab Designations.
J: Estimated Concentration. Concentrations in parentheses are the adjusted concentrations in accordance with Ref. (50), pp. 1 to 18.
SQL: Sample Quantitation Limit - Quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (for example, dilution, concentration) [Ref. (1), p. 51586].

Contaminated Samples – Description

Contaminated sediment and surface water samples were collected by H&S Environmental in accordance with the procedures stipulated in the EPA approved Work Plan [Ref. (62), pp. 43 to 44] in May 2015. Background and contaminated samples were collected from similar soil and surface water types. The field log book contains sampling information and the coordinates for each sample collected [Ref. (53)]. Sediment sample locations were collected using techniques described in the program QAPP Standard Operating Procedure (SOP) ENV-008 [Ref. (49), pp. 96 to 102]. Surface water samples were collected according to SOP 011 [Ref. (49), pp. 315 to 323]. Samples were delivered to the contract laboratory under chain-of-custody (COC) documentation. Analytical methods for these testing parameters are detailed in the QAPP [Ref. (49), pp. 13 to 14, Table 8-2, p. 63]. COCs are included with the laboratory data reports [Ref. (63), pp. 10 to 14; (64), pp. 11 to 14; (56), pp. 14 to 17; (58), p. 13; (65), pp. 13 to 14; (54), pp. 14 to 19; (66), pp. 14 to 21; (57), pp. 16 to 17; (67) p. 14 to 18].

Table 12

Contaminated Sediment and Surface Water Samples – May 2015

Sample ID	Sample Medium	Sample Location	Source No.	Distance from PPE (ft.)	Depth (ft. below stream bottom)	Date Sampled	References
SED-02	Sediment	SED-02	2	0 ft. PPE-1	0-2 ft.	05/20/15	**Figures 4** and **5**; (53), p. 9
SED-03	Sediment	SED-03	1	At outfall 240 ft. to PPE-2	0-2 ft.	05/20/15	**Figures 4** and **5**; (53), p. 8
SED-04	Sediment	SED-04	1	Below outfall - 230 ft. to PPE-2	0-2 ft.	05/20/15	**Figures 4** and **5**; (53), p. 8
SED-05	Sediment	SED-05	1	Below outfall - 120 ft. to PPE-2	0-2 ft.	05/20/15	**Figures 4** and **5**; (53), p. 7
SED-06	Sediment	SED-06	1	40 ft. PPE-2	0-2 ft.	05/19/15	**Figures 4** and **5**; (53), p. 6
SED-07	Sediment	SED-07	2	175 ft. PPE-1	0-2 ft.	05/20/15	**Figures 4** and **5**; (53), p. 7
SED-08	Sediment	SED-08	2	260 ft. E. of PPE-2	0-2 ft.	05/19/15	**Figures 4** and **5**; (53), p. 5
SED-09	Sediment	SED-09	1	0 ft. PPE-2	0-2 ft.	05/19/15	**Figures 4** and **5**; (53), p. 6
SED-10	Sediment	SED-10	1	535 ft. PPE-2	0-2 ft.	05/21/15	**Figures 4** and **5**; (53), p. 14
SED-11	Sediment	SED-11	1	560 ft. PPE-2	0-2 ft.	05/21/15	**Figures 4** and **5**; (53), p. 14
SED-12	Sediment	SED-12	1	400 ft. PPE-2	0-2 ft.	05/21/15	**Figures 4** and **5**; (53), p. 13
SED-13	Sediment	SED-13	1	450 ft. PPE-2	0-2 ft.	05/21/15	**Figures 4** and **5**; (53), p. 13

Table 12

Contaminated Sediment and Surface Water Samples – May 2015

Sample ID	Sample Medium	Sample Location	Source No.	Distance from PPE (ft.)	Depth (ft. below stream bottom)	Date Sampled	References
SED-14	Sediment	SED-14	1	590 ft. PPE-2	0-2 ft.	05/21/15	**Figures 4** and **5**; (53), p. 15
SED-15	Sediment	SED-15	1	1,560 ft. PPE-2	0-2 ft.	05/21/15	**Figures 4** and **5**; (53), p. 11
SED-16	Sediment	SED-16	1	985 ft. PPE-2	0-2 ft.	05/21/15	**Figures 4** and **5**; (53), p. 12
SED-17	Sediment	SED-17	1	1,250 ft. PPE-2	0-2 ft.	05/21/15	**Figures 4** and **5**; (53), p. 11
SED-18	Sediment	SED-18	1	1,810 ft. PPE-2	0-2 ft.	05/27/15	**Figures 4** and **5**; (53), p. 18
SED-19	Sediment	SED-19	1	1,660 ft. PPE-2	0-2 ft.	05/27/15	**Figures 4** and **5**; (53), p. 26
SED-20	Sediment	SED-20	1	1,235 ft. PPE-2	0-2 ft.	05/27/15	**Figures 4** and **5**; (53), p. 7
SED-22	Sediment	SED-22	1	1,960 ft. PPE-2	0-2 ft.	05/27/15	**Figures 4** and **5**; (53), p. 26
SED-23	Sediment	SED-23	1	3260 ft. PPE-2	0-2 ft.	05/27/15	**Figures 4** and **5**; (53), p. 26
SED-24	Sediment	SED-24	1	3360 ft. PPE-2	0-2 ft.	05/27/15	**Figures 4** and **5**; (53), p. 26
SED-25	Sediment	SED-25	1	3495 ft. PPE-2	0-2 ft.	05/27/15	**Figures 4** and **5**; (53), p. 26
SW-03	Surface Water	SW-03	1	Below Outfall - 120 ft. to PPE-2	0 - 0.5 ft. (water depth)	05/19/15	**Figures 4** and **5**; (53), p. 4
SW-04	Surface Water	SW-04	1	50 ft. PPE-2	0 - 0.5 ft. (water depth)	05/18/15	**Figures 4** and **5**; (53), p. 4
SW-05	Surface Water	SW-05	2	175 ft. PPE-1	0 - 0.5 ft. (water depth)	05/19/15	**Figures 4** and **5**; (53), p. 4
SW-06	Surface Water	SW-06	1	240 ft. PPE-2	0 - 0.5 ft.	05/18/15	**Figures 4** and **5**; (53),

Table 12 Contaminated Sediment and Surface Water Samples – May 2015							
Sample ID	**Sample Medium**	**Sample Location**	**Source No.**	**Distance from PPE (ft.)**	**Depth (ft. below stream bottom)**	**Date Sampled**	**References**
					(water depth)		p. 4
SW-07	Surface Water	SW-07	1	590 ft. PPE-2	0 - 0.5ft. (water depth)	05/18/15	**Figures 4** and **5**; (53), p. 4
SW-08	Surface Water	SW-08	1	985 PPE-2	0 - 0.5 ft. (water depth)	05/18/15	**Figures 4** and **5**; (53), p. 4
SW-09	Surface Water	SW-09	1	1560 ft. PPE-2	0 - 0.5 ft. (water depth)	05/18/15	**Figures 4** and **5**; (53), p. 3
SW-10	Surface Water	SW-10	1	1250 ft. PPE-2	0 - 0.5 ft. (water depth)	05/18/15	**Figures 4** and **5**; (53), p. 3
SW-11	Surface Water	SW-11	1	1235 PPE-2	0 - 0.5 ft. (water depth)	05/18/15	**Figures 4** and **5**; (53), p. 3

Notes:
ft: feet.
SED: Sediment Sample
SW: Surface Water Sample
PPE: Probable Point of Entry. See **Figure 5** for sources and PPEs.

Contaminated Samples Concentrations

The contaminated sediment and surface water samples were submitted to CLP laboratories and analyzed for VOCs, SVOCs, TAL metals, pesticides, PCBs and cyanide. The EPA Region 1 laboratory reviewed the data and data review checklists are included in the laboratory data reports. The SQL is the quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (for example, dilution, and concentration) [Ref. (1), p. 51586]. H&S/Nobis Environmental LLC, JV (H&S/Nobis) performed a Tier 1 Plus data review as specified by EPA New England Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures on all submitted samples [Ref. (55)]. Samples were analyzed by CLP laboratories using CLP SOWs SOM01.2 and ISM01.3. Analytical methods for these testing parameters are detailed in the QAPP [Ref. (49), pp. 13 to 14, Table 8-2, p. 63]. The data were initially processed through the EPA Electronic Data Exchange and Evaluation System (EXES) for electronic data qualification for laboratory quality control. Additionally, the EXES data qualifications were verified manually, corrected, and other non-automated laboratory quality control and field quality control criteria were evaluated and qualifications were applied to complete the data review process [Ref. (55); (49), pp. 35 to 37].

The results for contaminated sediment samples and contaminated surface water samples are presented in **Tables 13** and **14** below. All samples listed in the tables below meet observed release criteria [Ref. (1), Table 2-3].

Table 13 Contaminated Samples - Sediment				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References.**
SED-02 /A4FR3	Phenanthrene	430 µg/kg	120 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 67; (53), p. 9; (67), p. 15; (55), p. 68; (67), p. 1004
SED-02 / MA4FR3	Copper	376 J mg/kg (308 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 74; (53), p. 9; (64), p. 12; (55), p. 288; (64), p. 25; (50), pp. 8, 18; (51), p. 3
	Silver	9.6 mg/kg	0.058 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 74; (53), p. 9; (64), p. 12; (55), p. 288; (64), p. 25
SED-03 / A4FR0	Phenanthrene	1700 µg/kg	120 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 66; (53), p. 8; (67), p. 15; (55), p. 68; (67), p. 853; (50), pp. 8, 18
SED-03 / MA4FR0	Copper	197 J mg/kg (161 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 72; (53), p. 8; (64), p. 11; (63), p.11; (55), p. 288; (64), p. 22; (50), pp. 8, 18; (51), p. 3
	Manganese	499 mg/kg	0.19 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 72; (53), p. 8; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 22
	Silver	3.9 mg/kg	0.058 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 72; (53), p. 8; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 22
	Zinc	469 mg/kg	1.5 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 72; (53), p. 8; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 22
SED-04 / MA4FR2	Chromium	202 J mg/kg (157 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 73; (53), p. 8; (63), p. 12; (64), p. 12; (55), p. 288; (64), p. 24; (50), pp. 8, 18; (51), p. 3
	Copper	96.7 J mg/kg (79.3 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 73; (53), p. 8; (63), p. 12; (64), p. 12; (55), p. 288; (50), pp. 8, 18; (51), p. 3
SED-05 / MAFQ8	Arsenic	421 J mg/kg (241.9 mg/kg) Unknown bias.	0.2 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 71; (53), p. 7; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 20; (50), pp. 8, 18; (51), p. 3
		Divide by 1.74		
	Chromium	452 J mg/kg (350 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 71; (53), p. 7; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 20; (50), pp. 8, 18; (51), p. 3

Table 13 Contaminated Samples - Sediment				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References.**
	Copper	158 J mg/kg (130 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 71; (53), p. 7; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 20; (50), pp. 8, 18; (51), p. 3
	Manganese	1670 J mg/kg (1346 mg/kg) High bias. Divide by 1.24	0.19 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 71; (53), p. 7; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 20; (50), pp. 8, 18; (51), p. 3
	Silver	14.1 J mg/kg (8.1 mg/kg) High bias. Divide by 1.74.	0.058 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 71; (53), p. 7; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 20; (50), pp. 8, 18; (51), p. 3
SED-06 / MA4FQ5	Arsenic	46.9 mg/kg	0.2 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 70; (53), p. 6; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 17
	Chromium	937 J mg/kg (726 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 70; (53), p. 6; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 17; (50), pp. 8, 18; (51), p. 3
SED-06 / MA4FQ5	Copper	627 J mg/kg (514 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 70; (53), p. 6; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 17; (50), pp. 8, 18; (51), p. 3
SED-07 / MA4FQ9	Arsenic	93.1 mg/kg	0.2 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 72; (53) p. 7; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 21
	Chromium	6190 J mg/kg (4798 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 72; (53) p. 7; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 21; (50), pp. 8, 18; (51), p. 3
	Copper	3970 J mg/kg (3254 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 72; (53) p. 7; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 21; (50), pp. 8, 18; (51), p. 3
	Lead		0.14 mg/kg	**Figure 4**; (1), p. 51586; (52), p.
		351 J mg/kg (244 mg/kg) High bias. Divide by 1.44		72; (53) p. 7; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 21; (50), pp. 8, 18; (51), p. 3
	Manganese	939 mg/kg	0.19 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 72; (53) p. 7; (64), p. 11; (63),

Table 13 Contaminated Samples - Sediment				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References.**
				p. 11; (55), p. 288; (64), p. 21
SED-08 / MA4FQ6	Chromium	229 J mg/kg (178 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 70; (53), p. 5; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 18; (50), pp. 8, 18; (51), p. 3
SED-09 / MA4FQ7	Arsenic	87.4 mg/kg	0.2 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 70; (53), p. 6; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 19
	Chromium	3640 J mg/kg (2821 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 71; (53), p. 6; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 19; (50), pp. 8, 18; (51), p. 3
	Copper	934 J mg/kg (766 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 71; (53), p. 6; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 19; (50), pp. 8, 18; (51), p. 3
	Silver	4.4 mg/kg	0.058 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 71; (53), p. 6; (64), p. 11; (63), p. 11; (55), p. 288; (64), p. 19
SED-10 / MA4FW4	Arsenic	41.5 mg/kg	0.2 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 75; (53), p. 13; (63), p. 13; (55), p. 288; (64), p. 29
	Chromium	287 J mg/kg (223 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 76; (53), p. 13; (63), p. 13; (55), p. 288; (64), p. 29; (50), pp. 8, 18; (51), p. 3
	Copper	100 J mg/kg (82 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 76; (53), p. 13; (63), p. 13; (55), p. 288; (64), p. 29; (50), pp. 8, 18; (51), p. 3
SED-11 / A4FW5	Methylene chloride	25 µg/kg	1.3 µg/kg	**Figure 4;** (1), p. 51586; (52), p. 50; (53), p. 13; (67), p. 17; (55), p. 63; (67), p. 258
	Trichloroethene	17 µg/kg	1.7 µg/kg	**Figure 4;** (1), p. 51586; (52), p. 51; (53), p. 13; (67), p. 17; (55), p. 63; (67), p. 258
	Chromium		0.069 mg/kg	**Figure 4;** (1), p. 51586; (52), p.
SED-11 / MA4FW5		637 J mg/kg (494 mg/kg) High bias. Divide by 1.29		76; (53), p. 13; (64), p. 13; (63), p. 13; (55), p. 288; (64), p. 30; (50), pp. 8, 18; (51), p. 3

Table 13 Contaminated Samples - Sediment				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References.**
	Copper	393 J mg/kg (322 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 76; (53), p. 12; (64), p. 13; (63), p. 13; (55), p. 288; (64), p. 30; (50), pp. 8, 18; (51), p. 3
SED-11 / MA4FW5	Manganese	520 mg/kg	0.19 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 76; (53), p. 13; (64), p. 13; (63), p. 13; (55), p. 288; (64), p. 30
SED-12 / A4FW6	Trichloroethene	420 µg/kg	1.7 µg/kg	**Figure 4;** (1), p. 51586; (52), p. 52; (53), p. 20; (54), pp. 14; (65), p. 13; (55), p. 63; (67), p. 17; (67), p. 274
	Phenanthrene	300 J µg/kg (300 µg/kg) No bias. Use concentration.	120 µg/kg	**Figure 4;** (1), p. 51586; (52), p. 68; (53), p. 20; (54), p. 14; (65), p. 13; (55), p. 68; (67), p. 1273; (50), pp. 8, 15; (51), p. 1
SED-12 / MA4FW6	Arsenic	48.5 mg/kg	0.2 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 76; (53), p. 20; (56), pp. 14,; (64), p. 13; p. 288; (64), p. 31
	Chromium	2170 J mg/kg (1682 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 77; (53), p. 11; (56), p. 14; (64), p. 13; p. 288; (64), p. 31; (50), pp. 8, 18; (51), p. 3
	Copper	559 J mg/kg (458 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 77; (53), p. 20; (56), p. 14; (64), p. 13; p. 288; (64), p. 31; (50), pp. 8, 18; (51), p. 3
	Manganese	938 mg/kg	0.19 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 77; (53), p. 20; (56), p. 14; (64), p. 13; p. 288; (64), p. 31
	Cyanide	1.2 mg/kg	0.13 mg/kg	**Figure 4;** (1), p. 51586; (52), p. 77; (53), p. 20; (56), p. 14; (64), p. 13; p. 290; (64), p. 31
SED-13 / MA4FW7	Arsenic	41.9 mg/kg	0.2 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 77; (53), p. 20; (56), p. 14; (64), p. 13; (55), p. 63; (64), p. 32
SED-13 / MA4FW7	Chromium	156 J mg/kg (121 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 77; (53), p. 20; (56), p. 14; (64), p. 13; (55), p. 63; (64), p. 32; (50), pp. 8, 18
	Copper	83.4 J mg/kg (68.4 mg/kg) High bias.	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 77; (53), p. 20; (56), p. 14; (64), p. 13; (55), p. 63; (64), p. 32; (50), pp. 8, 18

Table 13 Contaminated Samples - Sediment				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References.**
		Divide by 1.22		
	Manganese	960 mg/kg	0.19 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 77; (53), p. 20; (56), p. 14; (64), p. 13; (55), p. 63; (64), p. 32
SED-14 / MA4FW8	Chromium	931 J mg/kg (722 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 78; (53), p. 15; (64) p. 13; (63); p. 13; (55), p. 289; (64), p. 33; (50), pp. 8, 18; (51), p. 3
	Copper	191 J mg/kg (157 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 78; (53), p. 15; (64) p. 13; (63), p. 13; (55), p. 289; (64), p. 33; (50), pp. 8, 18; (51), p. 3
SED-15 / MA4FW9	Copper	66.6 J mg/kg (55 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 78; (53), p. 11; (56), p. 14; (64), p. 13; (55), p. 289; (64), p. 34; (50), pp. 8, 18; (51), p. 3
SED-16 / A4FX0	Methylene chloride	120 J µg/kg (120 µg/kg) No bias. Use concentration	1.3 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 56; (53), p. 14; (67), p. 18; (66), p. 18; (55), p. 65; (67), p. 332; (50), pp. 8, 12; (51), p. 1
SED-16 / MA4FX0	Chromium	2050 J mg/kg (1589 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 79; (53), p. 14; (64), p. 4; (63), p. 14; (55), p. 289; (64), p. 35; (50), pp. 8, 18; (51), p. 3
SED-16 / MA4FX0	Copper	2080 J mg/kg (1705 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 79; (53), p. 14; (64), p. 4; (63), p. 14; (55), p. 289; (64), p. 35; (50), pp. 8, 18; (51), p. 3
	Nickel	128 J mg/kg (95 mg/kg) High bias. Divide by 1.35	0.22 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 79; (53), p. 14; (64), p. 4; (63), p. 14; (55), p. 289; (64), p. 35; (50), pp. 8, 18; (51), p. 3
SED-17 / MA4FX1	Chromium	239 J mg/kg (185 mg/kg) High bias. Divide by 1.29	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 79; (53), p. 11; (64), p. 14; (63); p. 14; p. 289; (64), p. 36; (50), pp. 8, 18; (51), p. 3
	Copper	129 J mg/kg (106 mg/kg) High bias. Divide by 1.22	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 79; (53), p. 11; (64), p. 14; (63); p. 14; p. 289; (64), p. 36; (50), pp. 8, 18; (51), p. 3

Table 13 Contaminated Samples - Sediment				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References.**
SED-18 / MA4FZ5	Copper	96.5 mg/kg	0.32 µg/kg	**Figure 4**; (1), p. 51586; (52), p. 86; (53), p. 26; (58); p. 13; (56); p. 17; (55), p. 355; (58), p. 21
SED-19 / MA4FZ6	Chromium	107 mg/kg	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 86; (53), p. 26; (58), p. 13; (56), p. 17; (58), p. 22
	Copper	55.1 mg/kg	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 86; (53), p. 26; (58), p. 13; (56), p. 17; (58), p. 22
SED-20 / MA4FZ7	Chromium	322 mg/kg	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 87; (53), p. 26; (58), p. 13; (56),p. 17; (55), p. 355; (58), p. 23
	Copper	299 mg/kg	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 87; (53), p. 26; (58), p. 13; (56),p. 17; (55), p. 355; (58), p. 23
SED-22 / MA4FZ9	Chromium	848 mg/kg	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 88; (53), (58), p. 13; (56), p 17; (55), p. 355; (58), p. 25
	Copper	475 mg/kg	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 88; (53), p. 26; (58), p. 13; (56), p 17; (55), p. 355; (58), p. 25
SED-23 / MA4FZ4	Copper	83.9 mg/kg	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 85; (53), p. 26; (58), p. 13; (56), p. 17; (55), p. 355; (58), p. 20
SED-24 / MA4FZ3	Chromium	293 mg/kg	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 85; (53), p. 26; (58), p. 13; (56), p. 85; (55), p. 355; (58), p. 19
	Copper	386 mg/kg	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 85; (53), p. 26; (58), p. 13; (56), p. 17; (55), p. 355; (58), p. 19
SED-25 / MA4FZ2	Chromium	479 mg/kg	0.069 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 84; (53), p. 26; (58), p. 13; (56),p. 17; (55), p. 355; (58), p. 18
	Copper	261 mg/kg	0.32 mg/kg	**Figure 4**; (1), p. 51586; (52), p. 84; (53), p. 26; (58), p. 13; (56), p. 17; (55), p. 355; (58), p. 18

Notes:
Sample ID: Field and Lab Designations.
J: Estimated Concentration. Concentrations in parentheses are adjusted concentrations in accordance with Reference (50), pp. 1 to 18.
SQL: Sample Quantitation Limit - Quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (for example, dilution, concentration) [Ref. (1), p. 51586].
U: Not Detected.

µg/l: microgram per liter
mg/l: milligram per liter
µg/kg: microgram per kilogram
mg/kg: milligram per kilogram

Table 14 Contaminated Samples - Surface Water				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References**
SW-03/A4FP3 SW-03 / MA4FP3	Chloroform	17 µg/l	4.4 µg/l	**Figure 4**; (1), p. 51586; (52), p. 4; (53), p. 4; (66), p. 14; (55), p. 4; (66), p. 69
	Arsenic	414 J+ µg/l (307 µg/) High bias. Divide by 1.35	2.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 60; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 21; (50), pp. 8, 18; (51), p. 3
	Chromium	200 J µg/l (155 µg/l) Unknown bias. Divide by 1.30	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 60; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 21; (50), pp. 8, 18; (51), p. 2
	Copper	279 µg/l	3.4 µg/l	**Figure 4**; (1), p. 51586; (52), p. 60; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 21
	Manganese	9450 µg/l	1.4 µg/l	**Figure 4**; (1), p. 51586; (52), p. 60; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 21
	Nickel	180 µg/l	2.9 µg/l	**Figure 4**; (1), p. 51586; (52), p. 61; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 21
	Silver	17 J+ µg/l (12 µg/l) High bias. Divide by 1.42	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 61; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 21; (50), pp. 8, 18; (51), p. 3
SW-04 / A4FP4 SW-04 / MA4FP4	1,1,1-Trichloroethane	75 µg/l	4.0 µg/l	**Figure 4**; (1), p. 51586; (52), p. 59; (53), p. 4; (66), p. 14; (55), p. 4; (66), p. 99
	Arsenic	10.1 µg/l	2.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 61; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 23
	Chromium	37.5 J µg/l (29.1 µg/l) Unknown bias.	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 61; (53), p. 4; (63), p. 10;

Table 14 Contaminated Samples - Surface Water				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References**
		Divide by 1.30		(55), p. 255; (63), p. 23; (50), pp. 8, 18; (51), p. 2
	Manganese	952 µg/l	1.4 µg/l	**Figure 4**; (1), p. 51586; (52), p. 61; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 23
SW-05 / A4FP5	1,1,1-Trichloroethane	95 µg/l	4.0 µg/l	**Figure 4**; (1), p. 51586; (52), p. 59; (53), p. 4; (66), p. 14; (55), p. 4; (66), p. 116
SW-05 / MA4FP5	Manganese	1010 µg/l	1.4 µg/l	**Figure 4**; (1), p. 51586; (52), p. 61; (53), p. 4; (63), p. 10, (55), 255; (63), p. 25
SW-06 / A4FP6 SW-06 / MA4FP6	Trichloroethene	1400 J µg/l (843 µg/l) Unknown bias. Divide by 1.66	3.8 µg/l	**Figure 4**; (1), p. 51586; (52), p. 59; (53), p. 4; (66), p. 14; (55), p. 4; (66), p. 134; (50), pp. 8, 12; (51), p. 1
	Arsenic	18.6 J+ µg/l (13.8 µg/l) High bias. Divide by 1.35	2.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 61; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 27; (50), pp. 8, 18; (51), p. 3
	Chromium	106 J µg/l (81.5 µg/l) Unknown bias. Divide by 1.30	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 27; (50), pp. 8, 18; (51), p. 3
	Copper	71.7 µg/l	3.4 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 27
	Manganese	2350 µg/l	1.4 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 4; (63), p. 10; (55), p. 255; (63), p. 27
SW-07 / A4FP9	Trichloroethene	460 µg/l	3.8 µg/l	**Figure 4**; (1), p. 51586; (52), p. 59; (53), p. 4; (66), p. 14; (55), p.4; (66), p. 199
SW-07 / MA4FP9	Chromium	5.9 J µg/l (4.5 µg/l)	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 63;

Table 14 Contaminated Samples - Surface Water				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References**
		Unknown bias. Divide by 1.30		(53), p. 4; (63), p. 10; (55), p. 255; (63), p. 33; (50), pp. 8, 18; (51), p. 2
SW-08 / MA4FP8	Arsenic	72.6 J+ µg/l (53.8 µg/l) High bias. Divide by 1.35	2.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 3; (63), p. 10; (55), p. 255; (63), p. 31; (50), pp. 8, 18
	Chromium	790 J µg/l (608 µg/l) Unknown bias. Divide by 1.30	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 3; (63), p. 10; (55), p. 255; (63), p. 31; (50), pp. 8, 18; (51), p. 2
	Copper	530 µg/l	3.4 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 3; (63), p. 10; (55), p. 255; (63), p. 31
	Lead	65.5 µg/l	2.3 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 3; (63), p. 10; (55), p. 255; (63), p. 31
	Manganese	12400 µg/l	1.4 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 3; (63), p. 10; (55), p. 255; (63), p. 31
	Nickel	136 µg/l	2.9 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 3; (63), p. 10; (55), p. 255; (63), p. 31
SW-08 / MA4FP8	Silver	16.8 J+ µg/l (11.8 µg/l) High bias. Divide by 1.42	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 62; (53), p. 3; (63), p. 10; (55), p. 255; (63), p. 31; (50), pp. 8, 18; (51), p. 3
	Zinc	369 J+ µg/l (286.0 µg/l) High bias. Divide by 1.29	8.3 µg/l	**Figure 4**; (1), p. 51586; (52), p. 63; (53), p. 3; (63), p. 10; (55), p. 255; (63), p. 31; (50), pp. 8, 18; (51), p. 3
SW-09 / MA4FQ0	Chromium	23.7 J µg/l (18.4 µg/l) Unknown bias. Divide by 1.30	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 63; (53), p. 3; (63), p. 10; (55), p. 255; (63), p.

Table 14 Contaminated Samples - Surface Water				
Sample ID	**Hazardous Substance**	**Concentration**	**Sample Quantitation Limits (SQL)**	**References**
				35; (50), pp. 8, 18; (51), p. 2
	Lead	38.8 µg/l	2.3 µg/l	**Figure 4**; (1), p. 51586; (52), p. 63; (53), p. 3; (63), p. 10; (55), p. 255; (63), p. 35
SW-10 / A4FQ1	Trichloroethene	14 µg/l	3.8 µg/l	**Figure 4**; (1), p. 51586; (52), p. 1; (53), p. 3; (66), p. 15; (55), p. 4; (66), p. 240
SW-10 / MA4FQ1	Chromium	22.2 J µg/l (17.2 µg/l) Unknown bias. Divide by 1.30	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 63; (53), p. 3; (63), p. 11; (55), p. 255; (63), p. 37; (50), pp. 8, 18; (51), p. 2
SW-11 / MAFQ2	Chromium	11.4 J µg/l (8.8 µg/l) Unknown bias. Divide by 1.30	1.1 µg/l	**Figure 4**; (1), p. 51586; (52), p. 64; (53), p. 3; (63), p. 11; (55), p. 255; (63), p. 39; (50), pp. 8, 18; (51), p. 2

Notes:
Sample ID: Field and Lab Designations.
J: Estimated Concentration. Concentrations in parentheses are adjusted concentrations in accordance with Reference (50), pp. 1 to 18.
SQL: Sample Quantitation Limit - Quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (for example, dilution, concentration) [Ref. (1), p. 51586].

U: Not Detected.
µg/l: micrograms per liter
mg/l: milligrams per liter
µg/kg: micrograms per kilogram
mg/kg: milligrams per kilogram

Attribution:

The former Microfab facility is a vacant and abandoned manufacturing operation [Ref. (3), p. 4]. The facility engaged in the manufacture of printed circuit boards, electroplating and related operations from May 1967 until October 1987. Wastes generated included waste solvents, process water, and plating wastes [Ref. (44), pp. 2, 5]. Prior to 1977, process wastewater was discharged to an intermittent branch (Intermittent Stream 1) of an unnamed stream (Perennial Stream 1). A treatment plant was constructed in 1977, however, wastewater treatment often failed to meet NPDES permit requirements resulting in discharge violations [Ref. (21); pp. 2 to 5].

The printed circuit board manufacturing process resulted in generation of a significant quantity of wastewater containing metals including copper, lead, nickel and tin, as well as ammonia and fluoride [Ref. (68), p. 8]. By 1985 there were two methods of wastewater disposal in use at Microfab. Plating contact wastewaters which contained metals were treated on-site in the wastewater treatment facility. The effluent from the treatment facility was discharged to Intermittent Stream 1 (**Figure 3**) [Ref. (68), p. 8]. The non-metal bearing wastewaters included cleaners, strippers, developers, and rinses. This wastestream was pumped to the municipal sewer under a discharge permit in the amount of 100,000 gallons per day which was issued to Microfab in 1982 [Ref. (68), p. 8]. Prior to 1982, a leach field was used for on-site subsurface disposal of the sanitary stream [Ref. (44), p. 5]. Two deep on-site wells were used as a source of cooling water. In 1980, these wells were found to be heavily contaminated with trichloroethylene and other chlorinated solvents [Ref. (44), p. 2]. The source of TCE is attributed to on-site disposal. Hazardous substances observed by chemical analysis in surface water and sediment are attributable to Sources No. 1 and No. 2 and the historical operation of the Microfab facility.

A review of EPA and MassDEP databases was conducted to evaluate the potential for additional sources in the vicinity of the site. The following facilities were within a one mile radius of the site reference point coordinates [Ref. (6), p. 2].

Table 15

EPA and MassDEP Listed Facilities

Facility Name	**Facility ID**	**Address**	**Classification**	**MassDEP listed Release Site [Ref.** (69) **]**	**Location Relative to Facility**
MacLellan/New England Concrete Company	387676 (MassDEP) 110015756635 (EPA)	91 Haverhill Road	RCRA Large Quantity Toxic User – No violations [Ref. (70), p. 7].	No	1,700 ft. East. Cross-gradient.
Shaheen Brothers	110043255447	95 Haverhill Road	Compliance Activity	No	1,150 ft. NE. Cross-gradient.
Merrows Inc.	MAD019147701	100 Haverhill Road	RCRA Small Quantity Generator – No violations [Ref. (70), p. 7].	No	700 ft. E. Abutter. Cross-gradient.
Brazonics	3-02073 (MassDEP), 3-019220 (MassDEP) MAD985307420	110 Haverhill Road	Pending No Further Action RCRA Unspecified – No violations [Ref (70), p. 3].	Yes	150 ft. W. Abutter. Cross-gradient.
MA/COM	MAD099187197	110	RCRA	Yes	150 ft. W.

Table 15 EPA and MassDEP Listed Facilities					
Facility Name	**Facility ID**	**Address**	**Classification**	**MassDEP listed Release Site [Ref.** (69) **]**	**Location Relative to Facility**
Antenna & Cable Division		Haverhill Road	Unspecified [Ref. (70), p. 6].		Abutter. Cross-gradient
Dirtglue Enterprises, LLC	MAD000200	83 Middle Road	Unpermitted Facility, NPDES violation.	No	2,700 ft. SW. Downgradient
Waste Management Hunt Road Landfill	SL0007.001 (MassDEP)	26 South Hunt Road	Closed Municipal Lined Landfill – No RCRA violations [Ref. (70), p. 9].	No	3,600 ft. SE. Downgradient
Applied Graphics, Inc.	MAD982755746	61 South Hunt Road	RCRA Small Quantity Generator - No violations [Ref. (70), p. 2].	No	3,500 ft. SW. Downgradient
CSI Environmental Services	MAD985278274 MAC300014412	63 Hunt Road	RCRA Unspecified	No	3,450 ft. SW. Downgradient

With the possible exception of the former Brazonics operation at 110 Haverhill Road, there is no identified documentation suggesting that these nearby facilities historically impacted or are currently impacting current site conditions or downgradient conditions within the TDL. There is no surface water near these facilities with the potential to impact site conditions. There are no identified permit violations or releases of hazardous substances at the remaining facilities listed on **Table 15** above and the facilities are generally located in a cross-gradient or downgradient location relative to the site coordinates. Brazonics did discharge treated wastewater to the wetlands associated with Perennial Stream 1 on the Microfab property under an NPDES permit from 1974 to 1979 [Ref. (9), p. 5].

The adjacent property to the west at 110 Haverhill Road was formerly occupied by a high temperature brazing facility referred to as, "Brazonics". Brazonics occupied the adjacent property from approximately 1960 to 1989 [Ref. (71), p. 2]. A second division was added in 1981 (Antenna & Microwave Division – A&M) [Ref. (71), p. 2]. Brazonics manufactured brazed machined aluminum parts. Operations included forming and tooling of aluminum [Ref. (72), p. 19]. The metal brazing and tooling operations utilized sodium fluoride salts, acids, acid cleaning baths, 1,1,1-trichloroethane, and acetone. A chrome coating conversion process utilizing chromic acid was also used in the process. Brazonics was a generator of waste oil, solvents and chromic acid [Ref. (72), p. 20]. TCE was reportedly not used at Brazonics [Ref. (73), p. 2]. A&M reportedly used small quantities of cleaning solvents, including TCA, methyl ethyl ketone (2-butanone), and acetone [Ref. (72), p. 20]. Prior to 1971, untreated wastewater from the brazing operation was discharged to the ground surface approximately 100 ft from the building on the east side of the building. This area of the Brazonics property was later filled and a parking area constructed on it. A wastewater treatment facility was installed in 1971 to treat the discharge under an NPDES permit (MA0002623) issued in 1974 [Ref. (9), p. 5; (72), p. 18]. The treated wastewater was discharged to the wetland associated with the unnamed stream (Perennial Stream 1) on the Microfab property. Sanitary sewage was discharged to two leach fields on the Brazonics property. Both discharges ended in 1979 when the facility was tied to the town of Amesbury sewage system [Ref. (9), p. 5].

Chlorinated VOCs were detected in ground water samples collected from the Brazonics site in 1988-1989 and dissolved metals in ground water samples collected in 1990 [Ref. (9), p. 19]. This identified ground water contamination resulted in Brazonics being placed on CERCLIS on 30 March 1990. MassDEP conducted a Preliminary Assessment and Site Inspection in 1990 and 1993, respectively. The site is currently listed within the MassDEP Bureau of Waste Site Cleanup and assigned Release Tracking Numbers (RTNs) 3-0002073 and 3-0019220. In a letter from MassDEP to EPA dated January 21, 2003, MassDEP indicated that the contaminated ground water plume from Microfab extends onto adjacent properties and that it would be "extremely difficult to differentiate and/or quantify any contamination coming from the Brazonics facility". The letter concludes, "the Department does not have any substantive concerns relative to the Brazonics Site" [Ref. (74), p. 2)]. The current compliance status for these RTNs is Pending No Further Action (PENNFA) and Downgradient Property Status, respectively [Ref. (73), pp. 24 to 34].

The approximate location of the former Brazonics outfall is shown on **Figure 5** [Ref. (72), p. 21]. The wastewater generating process for the original Brazonics facility consisted of continuous overflow from a clean water rinse tank [Ref. (72), p. 21]. Prior to 1971, the volumes of effluent released from Brazonics to the area east of their facility was less than 2,000 gpd, which is much less than the tens of thousands of gallons per day released from the Microfab facility [Ref. (72), p. 18]. The wastestreams generated by the two facilities were also different in that that the Brazonics wastestream was associated with a clean water rinse of parts and part protective coating processes, while the Microfab discharge was a result of electroplating, cleaning, stripping, rinsing and etching [Ref. (68), p. 8].

The former Brazonics outfall is located downstream of Sources No. 1 and No. 2 on the Microfab property (**Figures 4 and 5**). The former Brazonics outfall was located downstream of Microfab PPE-1 and approximately cross-gradient to PPE-2 identified in this HRS documentation record (**Figure 5**). The former Brazonics outfall was also at a location that is downstream from the sediment and surface water background location (SED-01 and SW-01) located at the northwestern corner of the Microfab property (**Figure 4**).

Samples of sediment and surface water presented in the HRS documentation record with contamination meeting observed release criteria for metals were collected at locations upstream of the former Brazonics outfall location (SED-02, SED-03, SED-04, SED-05, SED-07, SW-03, and SW-05) (**Tables 13** and **14**). Sediment sample SED-09 is located approximately cross-gradient to the former Brazonics outfall. The contaminants in sediment and surface water samples documenting the observed releases below the former Brazonics outfall are consistent with the observed releases above the former Brazonics outfall. The chemical characteristics of the Brazonics treated discharge are not known. Comingling of the Microfab and Brazonics discharges downstream from the Brazonics outfall is likely, however the Brazonics treated discharge was associated with a different process (clean water rinsing of aluminum parts, brazing, and coating), the discharge was shorter in duration (6 years) and the daily discharge volume was at least an order of magnitude less than the process waters originating at the Microfab facility. A comparison of the two facilities in provided in **Table 16** below.

Table 16 - Facility Comparison

Facility	**Brazonics**	**Microfab**
Plant Processes:	Clean water rinsing of parts, brazing of aluminum parts, and coating of parts.	Electroplating, cleaning, stripping, rinsing and etching.

Table 16 - Facility Comparison		
Hazardous substances used/found in sources: (substance common to both operations are presented in bold).	**Acetone, 1,1,1-TCA**, MEK, chromic acid.	**Acetone, 1,1,1-TCA**, chloroform, ethylbenzene, methylene chloride, toluene, PCE, TCE, styrene, bis2-ethylhexyl phthalate, phenanthrene, chromium, copper, lead, manganese, nickel, silver, zinc, and cyanide.

Brazonics and Microfab both used 1,1,1-TCA, however, the 2015 SI only detected 1,1,1-TCA in two surface water samples. One of the samples (SW-05) was collected upstream of the historic Brazonics discharge point (**Figure 4**). The second sample (SW-4) was collected downstream from the historic Brazonics discharge point, but it was also downstream from both Microfab PPE's. The presence of 1,1,1-TCA as a volatile organic compound currently in surface water points to groundwater seeps in the wetland as a source. Remaining released hazardous substances identified in the surface water pathway are attributable to electroplating and process operations conducted by Microfab over a 20 year history.

Background samples presented in this HRS documentation record were collected at a point upstream from the former Brazonics outfall and the identified Microfab sources. No other potential sources have been identified upstream of the site background collection point. This supports the assertion that the increase in hazardous substances in the observed release is attributable to the Microfab site and not to other sites (**Table 17**). The sources contain the same contaminants as identified in the surface water pathway.

CERCLA Hazardous Substances Released

Table 17		
chloroform	arsenic	manganese
methylene chloride	chromium	nickel
1,1,1-trichloroethane	copper	silver
trichloroethylene	lead	zinc
phenanthrene	cyanide	

Surface Water Observed Release Factor Value: **550**

4.1.2.2 Drinking Water Threat

Drinking Water Threat

There are no identified surface water intakes for drinking water within the surface water pathway to the 15-mile target distance limit (TDL). The Merrimack River, including beaches within the 15-Mile TDL, is a major recreation area. Recreational areas include Salisbury Beach State Reservation where activities include swimming, boating, sport fishing, and hunting [Ref. (75), p. 1]. Plum Island is located at the mouth of the Merrimack River and offers swimming, boating, and sport fishing **(Figure 7**) [Ref. (76), pp. 1 to 6]. The Drinking Water Threat is scored considering these recreational resources.

4.1.2.2 Drinking Water Threat Waste Characteristics

4.1.2.2.1 Toxicity/Persistence

The toxicity and persistence factor values for contaminants detected in Source No. 1 and Source No. 2 with containment factor values greater than 0 are summarized in **Table 18** below. Toxicity/persistence factor values are assigned in accordance with Ref. (1), p. 51574, Section 4.1.2.2.1.3.

Table 18 - Toxicity and Persistence

Hazardous Substance	**Source No.**	**Toxicity Factor Value**	**River Persistence Factor Value**	**Toxicity/ Persistence Factor Value [Ref. (1), Table 4-12]**	**References**
Chloroform	1	100	0.07	7	(2), pp. 3, 4
Methylene chloride	1	100	0.07	7	(2), pp. 17, 18
Trichloroethylene	2	1000	0.07	70	(2), pp. 27, 28
1,1,1-Trichloroethane	1	1	0.07	0.07	(2), pp. 25, 26
Phenanthrene	2	1	0.4	0.4	(2), pp. 21, 22
Arsenic	2	10000	1	10000	(2), pp. 1, 2
Chromium	1, 2	10000	1	10000	(2), pp. 5 to 8
Copper	1, 2	100	1	100	(2), pp. 9, 10
Lead	1	10000	1	10000	(2), pp. 13, 14
Manganese	2	10000	1	10000	(2), pp. 15, 16
Nickel	1, 2	10000	1	10000	(2), pp. 19, 20
Silver	1, 2	100	1	100	(2), pp. 23, 24
Zinc	2	10	1	10	(2), pp. 29, 30
Cyanide	1	10000	0.4	4000	(2), pp. 11, 12

For the drinking water threat, arsenic, chromium, lead, manganese and nickel all have toxicity/persistence factor values of 10,000, which is the highest factor value.

Toxicity/Persistence Factor Value: 10,000

[Ref. (1), Section 4.1.2.2.1.3]

4.1.2.2.2 Hazardous Waste Quantity

Table 19			
Source No.	**Source Type**	**Source Hazardous Waste Quantity**	**Source Hazardous Constituent Quantity Complete?**
1	Other	>0	No
2	Contaminated Soil	0.36	No

Sum of Values: 0.36

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity factor value [Ref. (1), Sec. 2.4.2.2]. If the pathway HWQ total is between 1 and 100, a HWQ Score of 1 is assigned (HRS Table 2-6 [Ref. (1), Sec. 2.4.2.2].

In accordance with HRS Section 2.4.2.2, because the hazardous constituent quantity is not determined for one or more sources, and a target in the surface water pathway is subject to Level II contamination (wetlands) a hazardous waste quantity factor value of 100 is assigned.

HWQ Factor Value for the Surface Water Migration Pathway: 100

[Ref. (1), Table 2-6]

4.1.2.2.3 Calculation of the Drinking Water Threat Waste Characteristics Factor Category Value

For the drinking water threat, arsenic, chromium, lead, manganese and nickel all have Toxicity/Persistence Factor values of 10,000, which is the highest factor value. The waste characteristics factor category value is obtained by multiplying the toxicity/persistence factor value by the HWQ factor value. Based on this product, a value is assigned in accordance with Ref. (1), Table 2-7.

Toxicity/Persistence Factor Value: 10,000

Hazardous Waste Quantity Factor Value: 100

Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value: 1×10^{6}

Waste Characteristics Factor Category Value: 32

[Ref. (1), Table 2-7]

4.1.2.3 Drinking Water Threat Targets

4.1.2.3.2.2 Level I Concentrations

There are no Level I concentrations established because there are no known surface water intakes within the TDL that are impacted by the site [Ref. (1), 4.1.2.3.2.2].

Not Scored.

4.1.2.3.2.3 Level II Concentrations

There are no Level II concentrations established because there are no known surface water intakes within the TDL that are impacted by the site [Ref. (1), 4.1.2.3.2.3].

Not Scored.

4.1.2.3.2.4 Potential Contamination

There are no surface water intakes subject to Potential Contamination within the Target Distance Limit [Ref. (1), 4.1.2.3.2.4].

Not Scored.

4.1.2.3.3 Resources

Table 20

Surface Water Body	Resource Use	References
Merrimack River and Estuary	Major or designated water recreation area, excluding drinking water use (Salisbury Beach State Reservation).	(1), Section 4.1.2.3.3; (76), p. 2; (77), p. 22

Resources Factor Value: 5

The Drinking Water Threat score is calculated by multiplying the drinking water threat factor category values for likelihood of release, waste characteristics, and targets for the watershed.

Likelihood of Release (550) x Waste Characteristics (32) x Targets (5) = 88,000 (rounded to the nearest integer). This product is then divided by 82,500:

88,000 ÷ 82,500 = 1.06

The resulting value, subject to a maximum of 100, is assigned as the Drinking Water Treat Score.

Drinking Water Threat Score= 1.06

4.1.3.2 Human Food Chain Threat Waste Characteristics

Human Food Chain Threat

An observed release of hazardous substances having a bioaccumulation factor value of 500 or greater is documented in perennial surface waters at the site with fisheries located downstream within the 15-mile TDL (**Figure 7**). Approximately 1.5 miles from the former outfall (Source No. 1), Perennial Stream 1 merges with Presbys Creek (aka Nichols Creek) (**Figure 7**). The combined flow reaches the Merrimack River in another 0.25 miles. The Merrimack River is tidal to a point approximately 22 miles upstream from the mouth of the river (Haverhill, MA) [Ref. (60), p. 5]. The distance from the point of entry of Presbys Creek to the discharge point of the Merrimack into the Atlantic Ocean at Newburyport, MA is approximately 9.75 miles (**Figure 7**). The Target Distance Limit (TDL) of 15 Miles therefore extends in the Atlantic Ocean (approximately 3 miles) (**Figure 7**).

There is no identified fishing ban on this reach of the Merrimack River [Ref. (78), p. 3]. The section of the river from the discharge point of the unnamed brook/Presbys Creek to the Atlantic Ocean is not included on the Massachusetts Department of Public Health Freshwater Fish Consumption Advisory List [Ref. (78), p. 3]. Presbys Creek is listed with the Massachusetts Division of Fisheries and Wildlife as Coldwater Fish Resource [Ref. (79), pp. 1 to 2]. Merrimack River fish species include Atlantic salmon, shad, Atlantic sturgeon, shortnose sturgeon, bluegill, bullhead, catfish, carp, northern pike, striped bass, and largemouth bass [Ref. (60), p. 106]. Sport fishing occurs at Salisbury Beach and Plum Island [Ref. (75), p. 1; (76), pp. 1 to 6; (80), pp. 1 to 3]. Commercial shell fishing occurs at the mouth of the Merrimack (Joppa Flats) and lobster fishing occurs off shore within the TDL [Ref. (81), p. 2; (82), p. 2; (80), p. 1; (83), p. 1]. Salt water species harvested for consumption include, but are not limited to, flounder, striped bass, mackerel, pollock, bluefish, herring, black sea bass, tautog, shad, lobster, clams, and sea scallops [Ref. (80), p. 1; (83), p. 1]. Sport and commercial fishing occur within the TDL in the Atlantic Ocean (**Figure 7**) [Ref. (84), pp. 1 to 13; (80), p. 1; (83), p. 1].

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

The toxicity, persistence, and bioaccumulation factor values for contaminants detected in Source No. 1 and Source No. 2 with containment factor values of greater than 0 are summarized in **Table 21** below. The combined toxicity, persistence, and bioaccumulation factor values are assigned in accordance with Ref. (1), Section 4.1.3.2.1.

Table 21

Toxicity, Persistence and Bioaccumulation Factor Values

Hazardous Substance	Source No.	Toxicity Factor Value	River Persistence Factor Value*	Salt Water Food Chain Bio-accumulation Value**	Toxicity/ Persistence/ Bioaccumulation Factor Value [Ref. (1), Table 4-16]	References
Chloroform	1	100	0.07	5	35	(2), pp. 3, 4
Methylene chloride	1	100	0.07	5	35	(2), pp. 17, 18
Trichloroethylene	2	1000	0.07	50	$3.5x10^3$	(2), pp. 27, 28
1,1,1-Trichloroethane	1,2	1	0.07	5	0.35	(2), pp. 25, 26

Table 21 Toxicity, Persistence and Bioaccumulation Factor Values						
Hazardous Substance	**Source No.**	**Toxicity Factor Value**	**River Persistence Factor Value***	**Salt Water Food Chain Bio-accumulation Value****	**Toxicity/ Persistence/ Bioaccumulation Factor Value [Ref. (1), Table 4-16]**	**References**
Phenanthrene	2	1	0.4	5000	2000	(2), pp. 21, 22
Arsenic	2	10000	1	500	$5x10^6$	(2), pp. 1, 2
Chromium	1, 2	10000	1	500	$5x10^6$	(2), pp. 5 to 8
Copper	1, 2	100	1	50000	$5x10^6$	(2), pp. 9, 10
Lead	1	10000	1	5000	$5x10^7$	(2), pp. 13, 14
Manganese	2	10000	1	50000	$5x10^8$	(2), pp. 15, 16
Nickel	1, 2	10000	1	5	$5x10^4$	(2), pp. 19, 20
Silver	1, 2	100	1	50000	$5x10^6$	(2), pp. 23, 24
Zinc	1, 2	10	1	50000	$5x10^5$	(2), pp. 29, 30
Cyanide	1	10000	0.4	0.5	2000	(2), pp. 11, 12

Notes:

* Persistence value for Rivers. ** Bioaccumulation factor value for Salt Water.

Manganese is the hazardous substance with the highest toxicity/persistence/bioaccumulation factor value of $5x10^8$.

Toxicity/Persistence/Bioaccumulation Factor Value: $5x10^8$

4.1.3.2.2 Hazardous Waste Quantity

Table 22			
Source No.	**Source Type**	**Source Hazardous Waste Quantity**	**Source Hazardous Constituent Quantity Complete?**
1	Other	>0	No
2	Contaminated Soil	0.36	No

Sum of Values: >0.36

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity factor value [Ref. (1), Sec. 2.4.2.2]. If the pathway HWQ total is between 1 and 100, a HWQ Score of 1 is assigned (HRS Table 2-6) [Ref. (1), Sec. 2.4.2.2].

In accordance with HRS Section 2.4.2.2, because the hazardous constituent quantity is not determined for one or more sources, and a target in the surface water pathway is subject to Level II contamination (wetlands) a hazardous waste quantity factor value of 100 is assigned.

HWQ Factor Value for the Surface Water Migration Pathway: 100

[Ref. (1), Table 2-6]

4.1.3.2.3 Waste Characteristics Factor Category Value

For the human food chain threat, the hazardous substance with the highest Toxicity/Persistence/Bioaccumulation factor value for the watershed is manganese ($5x10^8$) [Ref. (1), Section 4.1.3.2.3]. This contaminant is evaluated for the waste characteristics. The waste characteristics factor category value is obtained by multiplying the toxicity, persistence, and hazardous waste quantity (HWQ) factor values, subject to a maximum product of $1x10^8$. Then this product is multiplied by the human food chain bioaccumulation potential factor value, subject to a maximum product of $1x10^{12}$. Based on this product, a value is assigned in accordance with Ref. (1), Table 2-7.

Toxicity/Persistence Factor Value: 10,000

Hazardous Waste Quantity Factor Value: 100

Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value: $1x10^6$

Bioaccumulation Value: 50,000

(Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value) x Bioaccumulation Factor Value: $(1x10^6) x (50,000) = 5x10^{10}$

Waste Characteristics Factor Category Value: 320

[Ref. (1), Table 2-7]

4.1.3.3 Human Food Chain Threat Targets

4.1.3.3.1 Food Chain Individual

An observed release of hazardous substances having a bioaccumulation factor value of 500 or greater is documented in perennial surface waters at the site with fisheries located downstream within the 15-mile TDL (**Figure 7**). Sport fishing and commercial fishing are documented to occur in this HRS documentation record at least from the crossing of Route 495 to approximately 3 miles beyond the mouth of the Merrimack River (**Figure 7**) [Ref. (84), p. 3 to 9; (80), p 1; (83), p. 1]. Sport and commercial fishing occur within the TDL in the Atlantic Ocean (**Figure 7**) [Ref. (84), pp. 1 to 13; (80), p. 1; (83), p. 1]. Salt water species harvested for consumption within the TDL include but are not limited to flounder, striped bass, mackerel, pollock, bluefish, herring, black sea bass, tautaug, shad, lobster and clams [Ref. (80), p. 1; (83), p. 1].

A food chain individual factor value of 20 is assigned based on an observed release of manganese by chemical analyses with a Bioaccumulation Factor Value of 500 or greater to sediments within the surface water target distance limit, and due to the fisheries present in the mouth of the Merrimack River and in the waters of the Atlantic within the TDL (**Figure 7**) [Ref. (82), p. 2; (76), p. 2; (81), p. 2; (75), p. 1; (84), pp. 1 to 13; (80), p. 1; (83), p. 1].

Food Chain Individual Factor Value: 20

[Ref. (1), Section 4.1.3.3.1]

4.1.3.3.2 Population

4.1.3.3.2.1 Level I Concentrations

There are no Level I concentrations established because no tissue samples have been collected.

4.1.3.3.2.2 Level II Concentrations

No Level II concentrations have been established within a fishery.

4.1.3.3.2.3 Potential Human Food Chain Contamination

Potential Population Targets

Commercial shell fishing is documented for the mouth of the Merrimack River [Ref. (80), p. 1; (83), p. 1]. Commercial lobster, shell fish and fin fishing as well as sport fishing for consumption occur in the Atlantic Ocean within the TDL (**Figure 7**) [Ref. (82), p. 2; (76), p. 2; (81), p. 2; (75), p. 1; (84), pp. 1 to 13; (80), p. 1; (83), p. 1]. Although the annual pounds of fish consumed are not known or documented, since some fish are consumed, the annual pounds consumed are conservatively assumed to be greater than zero (> 0) and less than 100 pounds per year.

Table 23 Summary of Fisheries in the 15-Mile Target Distance Limit (TDL)							
Identity of Fishery	**Annual Production (pounds)**	**Type of Surface Water Body**	**Average Annual Flow (cfs)**	**References**	**Population Value (P_i) [Ref. (1), Table 4-18]**	**Dilution Weight (D_i) [Ref. (1), Table 4-13]**	**P_i x D_i**
Mouth of Merrimack River, Plum Island, Salisbury Beach, and Joppa Flats	> 0	Coastal Tidal Waters	Not Applicable, depth not applicable	[Ref. (1), Table 4-13; (82), p. 2; (76), p. 2; (81), p. 2; (75), p. 1; (84), pp. 1 to 13]	0.03	0.0001	$3x10^{-6}$
Atlantic Ocean Area 1	> 0	Moderate Ocean Zone	Flow Not Applicable, depth 20 – 200 ft.	[Ref. (1), Table 4-13; (82), p. 2; (76), p. 2; (81), p. 2; (75), p. 1; (84), pp. 1 to 13]	0.03	0.00001	$3x10^{-7}$

Notes:
cfs: cubic feet per second.
Sum of P_i x D_i: $3.3x10^{-6}$
(Sum of P_i x D_i)/10: $3.3x10^{-7}$

Potential Human Food Chain Factor Value: $3.3x10^{-7}$

[Ref. (1), Section 4.1.3.3.2.3]

The Human Food Chain Threat score is calculated by multiplying the human food chain threat factor category values for likelihood of release, waste characteristics, and targets for the watershed.

Likelihood of Release (550) x Waste Characteristics (320) x Targets (20.00000033) = 3,520,000 (rounded to the nearest integer).

This product is then divided by 82,500:

3,520,000 ÷ 82,500 = 42.66

The resulting value, subject to a maximum of 100, is assigned as the Human Food Chain Threat Score.

Human Food Chain Threat Score= 42.66

4.1.4.2 Environmental Threat Waste Characteristics

4.1.4.2.1 Ecosystem Toxicity/Persistence/Bioaccumulation

The ecosystem toxicity, persistence, and bioaccumulation factor values for contaminants detected in Source No. 1 and Source No. 2, with containment factor values of greater than 0, are summarized below in **Table 24**. The combined ecosystem toxicity, persistence, and bioaccumulation factor values are assigned in accordance with Ref. (1), Section 4.1.4.2.1.

Table 24

Ecosystem Toxicity/Persistence/Bioaccumulation Factor Values

Hazardous Substance	Source No.	Fresh Water Ecosystem Toxicity Factor Value	River Persistence Factor Value	Fresh Water Ecosystem Bio-accumulation Value	Ecosystem Toxicity/ Persistence/ Ecosystem Bioaccumulation Factor Value [Ref. (1), Table 4-21]	References
Chloroform	1	1000	0.07	500	3.5×10^4	(2), pp. 3, 4
Methylene chloride	1	1	0.07	500	35	(2), pp. 17, 18
Trichloroethylene	2	100	0.07	50	350	(2), pp. 27, 28
1,1,1-Trichloroethane	1, 2	10	0.07	5	3.5	(2), pp. 25, 26
Phenanthrene	2	10000	0.4	50000	$2x10^8$	(2), pp. 21, 22
Arsenic	2	10	1	50000	$5x10^5$	(2), pp. 1, 2
Chromium	1, 2	10000	1	500	$5x10^6$	(2), pp. 5 to 8
Copper	1, 2	1000	1	50000	$5x10^7$	(2), pp. 9, 10
Lead	2	1000	1	50000	$5x10^7$	(2), pp. 13, 14
Manganese	2	100	1	50000	$5x10^6$	(2), pp. 15, 16
Nickel	1, 2	100	1	50000	$5x10^6$	(2), pp. 19, 20
Silver	1, 2	10000	1	50	$5x10^5$	(2), pp. 23, 24

Table 24 **Ecosystem Toxicity/Persistence/Bioaccumulation Factor Values**						
Hazardous Substance	**Source No.**	**Fresh Water Ecosystem Toxicity Factor Value**	**River Persistence Factor Value**	**Fresh Water Ecosystem Bio-accumulation Value**	**Ecosystem Toxicity/ Persistence/ Ecosystem Bioaccumulation Factor Value [Ref. (1), Table 4-21]**	**References**
Zinc	2	10	1	50000	5×10^5	(2), pp. 29, 30
Cyanide	1	1000	0.4	0.5	200	(2), pp. 11, 12

The contaminant with the highest Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value is phenanthrene.

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

4.1.4.2.2. Hazardous Waste Quantity

Table 25			
Source No.	**Source Type**	**Source Hazardous Waste Quantity**	**Source Hazardous Constituent Quantity Complete?**
1	Other	>0	No
2	Contaminated Soil	0.36	No

Sum of Values: > 0.36

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity factor value [Ref. (1), Sec. 2.4.2.2]. If the pathway HWQ total is between 1 and 100, a HWQ Score of 1 is assigned (HRS Table 2-6 [Ref. (1), Sec. 2.4.2.2]).

In accordance with HRS Section 2.4.2.2, because the hazardous constituent quantity is not determined for one or more sources, and a target in the surface water pathway is subject to Level II contamination (wetlands) a hazardous waste quantity factor value of 100 is assigned.

HWQ Factor Value for the Surface Water Migration Pathway: 100

[Ref. (1), Table 2-6]

4.1.4.2.3. Calculation of the Environmental Threat Waste Characteristics Factor Category Value

For the environmental threat, phenanthrene is evaluated for the waste characteristics. The waste characteristics factor category value is obtained by multiplying the ecosystem toxicity, persistence, and HWQ factor values, subject to a maximum product of $1x10^8$. Then this product is multiplied by the environmental bioaccumulation potential factor value, subject to a maximum product of $1x10^{12}$. Based on this product, a value is assigned in accordance with Ref. (1), Table 2-7.

Ecosystem Toxicity/Persistence Factor Value: 4,000

Hazardous Waste Quantity Factor Value: 100

Ecosystem Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value: $4x10^5$

Bioaccumulation value: 50,000

(Ecosystem Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value) x Environmental Bioaccumulation Factor Value (50,000): $2x10^{10}$

Waste Characteristics Factor Category Value: 320

[Ref. (1), HRS Table 2-7]

4.1.4.3 Environmental Threat Targets

A large (estimated 50 acres) palustrine wetland is associated with the unnamed stream (**Figure 6**). Historical documents indicated that contaminants were discharged directly to the unnamed stream and the wetland. Surface water and sediment data from the stream and wetland confirm the presence of contaminants attributable to the Site [Ref. (3), pp. 22 to 27]. The observed release to the wetland is documented herein with chemical analysis.

A wetlands investigation was completed for the adjacent wetlands as part of SI activities **(Figure 6).** Wetlands were documented with respect to the definition in 40 CFR 230, Subpart A – General, Section 230.3 [Ref. (85), p. 6]. The wetlands on the Microfab property and south and west of the property are referred to as palustrine forested or palustrine scrub – shrub [Ref. (8), p. 3]. The wetlands are temporarily flooded, seasonally flooded, or seasonally flooded/saturated [Ref. (8), p. 3]. The wetlands investigation indicated that the areas south and west of Microfab areas contained vegetation and aquatic species prevalent in wetland environments [Ref. (8), p. 4]. The areas observed were confirmed to contain emergent plants that are persistent in standing water, standing water was observed and saturated soils were noted throughout the areas delineated [Ref. (8), p. 4].

The wetlands frontage is estimated to be 1.77 miles (**Figure 6**). The wetland areas on the Microfab property and within the site to the south and east are designated by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) as Priority Habitat of Rare Species (PH664) and Estimated Habitat of Rare Wildlife (EH 590) [Ref. (86), p. 1]. The Merrimack River within the TDL is habitat known to be used by Federal designated or proposed endangered or threatened species. The river is habitat for the short-nosed and Atlantic sturgeon [Ref. (87), pp. 1 to 2; (88), pp. 1 to 2; (60), p. 106]. Studies have shown that the shortnose sturgeon used freshwater reaches of the river, while Atlantic sturgeon occupied the saline reaches of the river. Maximum salt penetration is in the vicinity of the outlet of Presbys Creek [Ref. (89), p. 3]. Shortnose sturgeon migrate to the head of the tide near Haverhill to spawn [Ref. (89), p. 3]. Additionally, sturgeon are known to winter near the outlet of Presby's Creek, and the Artichoke River within the TDL [Ref. (89), p. 10]. Sturgeon populations are also known near the lower islands and flats of the Merrimack within the TDL [Ref. (89), p. 11]. The Parker River National Wildlife Refuge is within the TDL and located just south of the mouth of the Merrimack River (**Figure 7**) [Ref. (90), p. 1]. Finally, two state designated wildlife management areas (Eagle Island WMA and Salisbury Marsh WMA) are located near the mouth of the Merrimack River [Ref. (91), p. 2].

4.1.4.3.1 Sensitive Environments

4.1.4.3.1.1. Level I Concentrations

No sensitive environments subject to Level I Concentrations have been documented.

Level I Concentrations Factor Value: 0

4.1.4.3.1.2. Level II Concentrations

Sensitive Environments

Wetlands

A wetland survey was conducted as part of the 2015 SI [Ref. (8); pp. 1 to 23]. Wetlands that meet the criteria presented in 40 CFR 230.3 are located on site, and are contiguous with the unnamed stream to the south and west of the site (**Figure 6**) [Ref. (85), p. 6; (8), p. 4]. The wetlands are referred to as palustrine forested, or palustrine scrub-shrub and are temporarily flooded, seasonally flooded or seasonally flooded/saturated [Ref. (8), p. 3]. The wetlands considered in this HRS documentation record contained emergent plants that are persistent and standing water and saturated soils were noted throughout the delineated areas [Ref. (8), p. 4]. The wetlands frontage subject to Level II contamination is shown on **Figure 6.** The unnamed stream (Perennial Stream 1) flows from PPE-1 within a channel for approximately 0.16 miles before becoming diffuse within a wetland south and west of the Microfab property **(Figure 6)**. Perennial Stream 1 then leaves the large wetland and travels approximately 0.37 miles to Pond Hill Road

(Figure 6). Both sides of the channel are included in the frontage calculation. The perimeter of the wetland from the point in Perennial stream 1 where there is no defined channel to the point where the stream falls within a channel again is included in the frontage calculation **(Figure 6)**. A lobe of the wetland to the east is not isolated but is contiguous with the large wetland to the southwest. Perennial stream 2 connects the wetland areas. A total amount of wetlands (frontage and perimeter) of 1.77 miles is present **(Figure 6)**. From HRS Table 4-24, a value of 50 is assigned.

Most Distant Level II Sample:

Investigation: 2015 Site Inspection

Sample ID: SED-25

Sample Medium: Sediment

Hazardous Substances: Methylene chloride, chromium, and copper.

Location: 3,495 ft. downstream from PPE-2. (Approximately, 120 ft upstream from Pond Hill Road) (**Figure 4**).

References [Ref. (3), pp. 17, 24, 25, 180, 181, 185, 186, 187, 404; (53), p. 24]

Table 26 Level II Wetland Frontage		
Wetland	**Wetland Frontage (miles)**	**References**
Unnamed Stream - Palustrine Wetlands	1.77 miles	[Ref. (8), p. 4; **Figure 6** of this HRS Documentation Record]

The total wetland frontage is based on the frontage along both sides of the perennial unnamed stream when a discernable channel is present and the wetland perimeter when no discernable channel is observed (**Figure 6**).

Sum of Level II Wetland Frontages: 1.77 miles.

The wetland ratings value from Ref. (1), Table 4-24: > 1 to 2 Miles is an assigned value of 50.

Wetland value: 50 x 1 = 50

Level II Concentrations Factor Value: 50

[Ref. (1), Section 4.1.4.3.1.1]

4.1.4.3.1.3 Potential Contamination

The Merrimack River within the TDL is documented habitat for the Atlantic and shortnosed sturgeon [Ref. (60), p. 106; (88), p. 1; (87), p. 1; (89), p. 2]. Therefore, it is habitat known to be used by Federal designated endangered species [Ref. (88), p. 1; (87) p. 1; (89), p. 2]. In addition, the Parker River National Wildlife Refuge in part falls within the TDL (**Figure 7**) [Ref. (90), p. 1]. Two state wildlife management areas (Eagle Island and Salisbury Salt Marsh WMAs) are located in and adjacent to the Merrimack River within the TDL [Ref. (91), p. 2].

Table 27

Type of Surface Water Body	Sensitive Environment	References	Sensitive Environment Value [Ref. 1, Table 4-23]
Merrimack River	Eagle Island State Wildlife Management Area (WMA).	**Figure 7**; (91), p. 2.	25
Merrimack River	Salisbury Salt Marsh Wildlife Management Area (WMA).	**Figure 7**; (91), p. 2.	25
Merrimack River	Habitat known to be used by Federal designated or proposed endangered or threatened species.	**Figure 7;** (1), Table 4-23; (88), pp. 1 to 2; (87), pp. 1 to 2.	75
Atlantic Ocean	Parker River National Wildlife Refuge	**Figure 7;** (1), Table 4-23; (90).	75

Potential Wetland Frontages

About 8 miles of additional wetland frontage is located along the Merrimack River and the estuary at the mouth (**Figure 7**). However, these wetlands were not mapped during the SI and will not significantly affect the score, so these tidal wetlands are not scored herein.

Table 28

Surface Water Body	**Type of Surface Water Body [Ref. (1), Table 4-13]**	**Sum of Sensitive Environments Values (S_j)**	**Wetland Frontage Value (W_j)**	**Dilution Weight (D_j) [Ref. (1), Table 4-13]**	**$D_j(W_j + S_j)$**
Merrimack River	Large stream to river – Greater than 1,000 to 10,000 cfs.	125	NS	0.001	0.125
Atlantic Ocean	Moderate depth ocean zone – Flow not applicable, depth 20 to 200 ft.	75	NS	0.00001	0.00075

Notes:
NS: Not Scored
Sum of $D_j(W_j + S_j)$: 0.12575
(Sum of $D_j(W_j + S_j)$)/10: 0.012575

Potential Contamination Factor Value: 0.012575

The Environmental Threat score is calculated by multiplying the environmental threat factor category values for likelihood of release, waste characteristics, and targets for the watershed.

Likelihood of Release (550) x Waste Characteristics (320) x Targets (50.01) = 8,801,760 (rounded to the nearest integer).

This product is then divided by 82,500:

8,801,760 ÷ 82,500 = 106.68

The resulting value, subject to a maximum of 60, is assigned as the Environmental Threat Score.

Environmental Threat Score = 60