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U.S. Army Materials Technology Laboratory

Watertown, Massachusetts
CERCLIS #MA0213820939

Site Exposure Potential

The U.S. Army Materials Technology Laboratory (MTL) covers 19 hectares along the northern bank of the Charles River in Watertown, Massachusetts, a suburb of Boston. The Charles River flows through Boston before discharging into Boston Harbor, approximately 14 km from the site. Boston Harbor is a coastal embayment of Massachusetts Bay, the region in the Atlantic Ocean located north of Cape Cod (Figure 1).

The MTL facility engaged in ammunition and pyrotechnics production, material testing, and experimentation with paint, lubricants, and cartridges from 1816 until World War II. At the height of its activity, the facility encompassed 53 hectares, contained 53 buildings, and employed 10,000 people. The site was also the location of a research nuclear reactor from 1960 until 1970. Today MTL's mission is materials research and development, weapons and ammunition development and production, solid mechanics, testing technology, and lightweight armor development. Sources of contamination are improper handling, storage, and disposal of hazardous materials related to past site activities (no specific activities were addressed in the documents reviewed). Although a portion of the site was allegedly used for landfilling (Site 2, Figure 2), the amount and types of materials

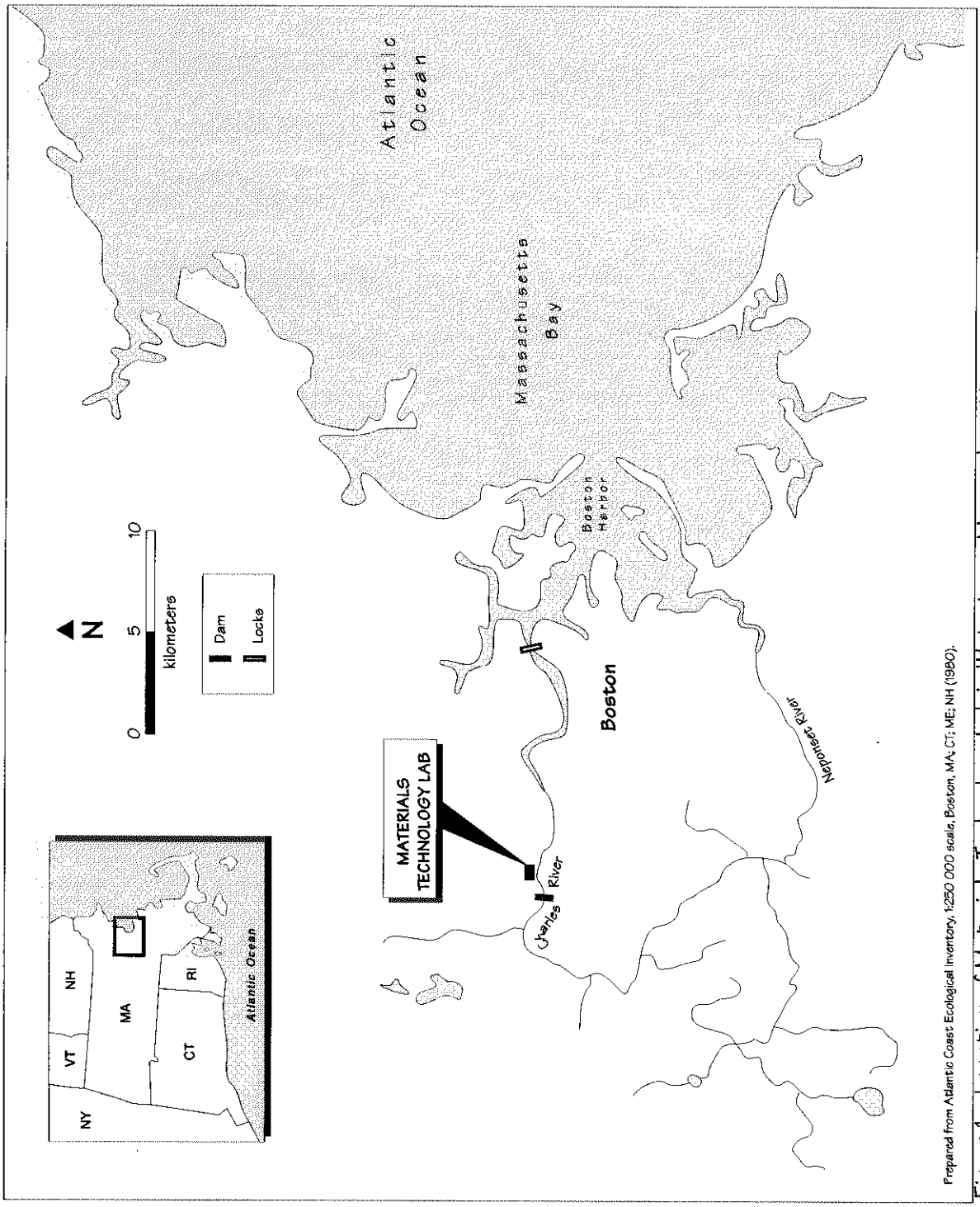

Figure 1. Location of Materials Technology Lab in Watertown, Massachusetts.

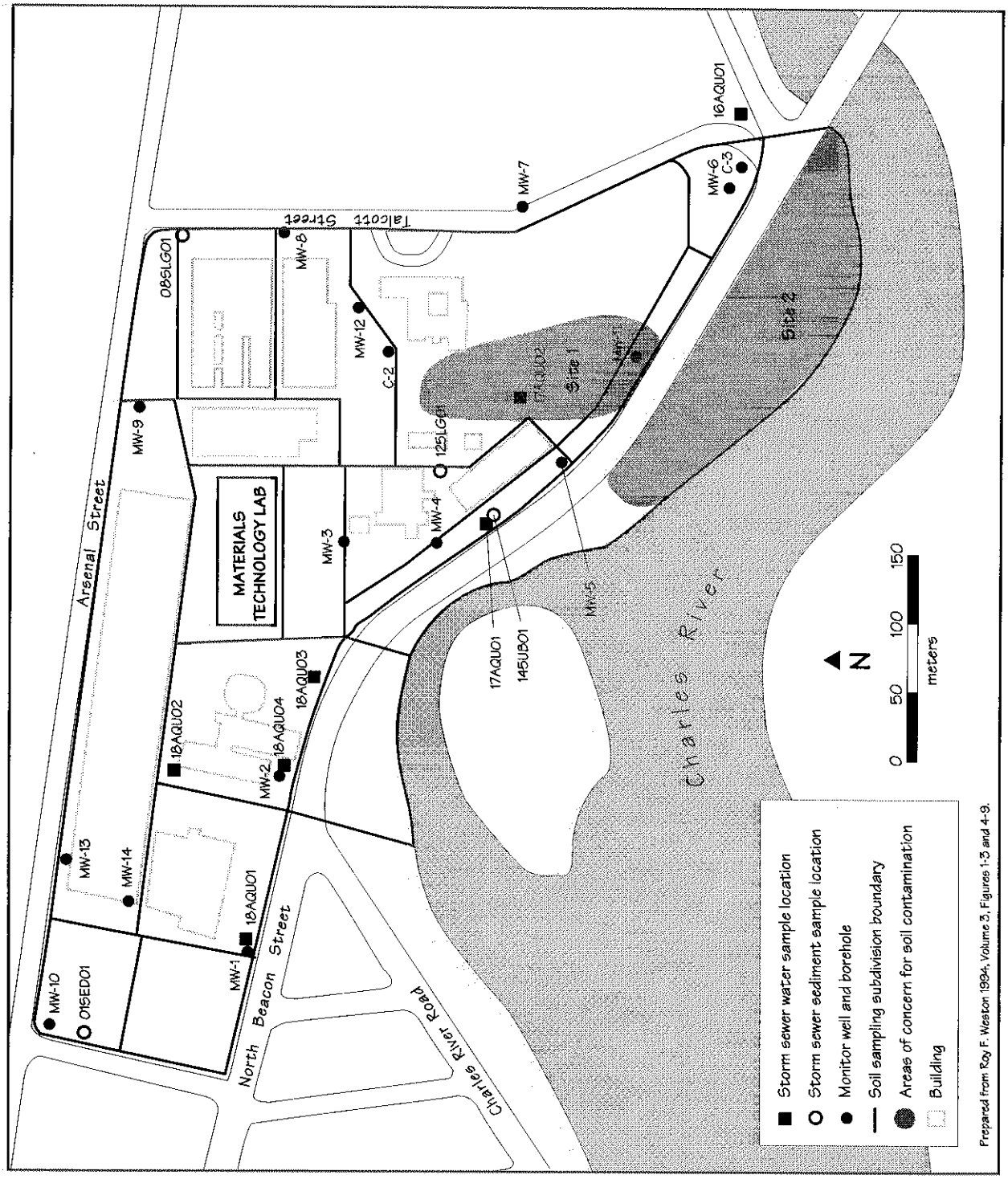

Figure 2. Detail of Materials Technology Lab site.

disposed are unknown (Halliburton NUS Environmental Corporation, 1993). Congress recommended closing the facility in October 1988. Closure procedures (i.e, RI/FS and remedial actions) continue at this time.

Surface water runoff, direct discharge, and groundwater migration are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. Approximately 75 percent of the site is covered with impervious surfaces, and the majority of surface water runoff is directed to an extensive storm sewer system. This on-site storm sewer system discharges directly to the Charles River through several outfalls. Groundwater beneath the site flows generally south and southeast towards the Charles River. Much of the site is overlain by over 3 m of sand and gravel fill, with glacial till deposits and bedrock siltston beneath. The glacial deposits range from 15 m thick on the western boundary to 45 m thick to the east. The current MTL property lies outside the 500-year flood zone, exception for a narrow strip of land along the riverbank (Roy F. Weston, Inc. 1994).

NOAA Trust Habitats and Species

Surface water and associated bottom substrates of the Charles River are habitats of primary concern to NOAA. NOAA trust resources near the site include four anadromous species: blueback herring, rainbow smelt, alewife, and American shad; and the catadromous American eel, which is found throughout the Charles River (Table 1). The surface water near the site is fresh water; the Charles River Dam and Locks 11.5 km downstream, in the lower Charles River basin, restrict the upstream flow of saline water from Boston Harbor. The Watertown Dam, about 2.5 km upstream from the site, is equipped with a functional fish ladder. Immediately below this dam,

Table 1. Major NOAA trust species that use surface water of the Charles River near the Materials Technology Lab site.

Species		Habitat			Fisheries	
Common Name	Scientific Name	Spawning	Nursery	Adult Forage	Comm.	Recr.
ANADROMOUS SPECIES						
Blueback herring	*Alosa aestivalis*	♦	♦	♦		♦
Alewife	*Alosa pseudoharengus*		♦	♦		
American shad	*Alosa sapidissima*		♦	♦		
Rainbow smelt	*Osmerus mordax*	♦	♦	♦		
CATADROMOUS SPECIES						
American eel	*Anguilla rostrata*		♦	♦		

increased water velocity and a bottom substrate of cobbles and larger rocks form a riffle habitat. The water flow decreases approximately 200 m below the dam, creating a slow-moving, meandering river habitat (Chase personal communication 1994). The Charles River receives runoff from combined sewer overflows and is considered eutrophic. Dissolved oxygen concentrations in the river are low, but remain above 5 mg/l. The river near the site is designated Class B (fishable and swimmable; Life Systems, Inc. 1993; Tisa personal communication 1994).

The blueback herring run on the Charles River is considered one of the largest in Massachusetts; densities of this anadromous species are highest near the site. Both blueback herring and rainbow smelt use the riffle habitat below the Watertown Dam for spawning. Blueback herring also spawn upstream from the Watertown Dam. Limited numbers of rainbow smelt migrate above the dam (Brady personal communication 1994).

Alewife and American shad are found in low numbers in the Charles River. Since the late 1970s the State of Massachusetts has conducted a stocking program to restore American shad in the Charles River. However, only a few returns have been documented above the Watertown Dam, and the program is being re-evaluated to determine the most effective stocking methods (e.g., stocking gravid adults versus juveniles). American shad spawn in slower-moving water upstream from the Watertown Dam, and possibly in the lower Charles River basin above the locks (Brady personal communication 1994).

There is a small recreational fishery for blueback herring, which are caught primarily for bait. The State allows herring to be caught only with a small, hand-held dip net and limits the catch to four days per week to protect the resource. However, it has proven difficult for the State to enforce these restrictions (Brady personal communication 1994). Sportfishing for rainbow smelt is prohibited during the smelt spawning season, from March 15 to June 15. The population of American shad is too small to support a recreational fishery, although some fish are caught incidentally. One of the goals of the American shad restoration program is to develop a sport fishery for shad in the Charles River (Brady personal communication 1994).

Site-Related Contamination

Data collected during the 1992 Phase 2 remedial investigation indicate that soils, groundwater, surface water, and sediments at the MTL facility contain elevated concentrations of site-related contaminants (Roy F. Weston, Inc. 1994). The primary contaminants of concern are trace elements, PAHs, and pesticides. Maximum concentrations of inorganic and organic contaminants are summarized in Tables 2 and 3, along with applicable screening guidelines. Maximum concentrations of radiological compounds detected are presented in Table 4.

Soil sampling was completed in November 1992. A total of 176 surface soil and boring samples were collected for laboratory analysis and used to evaluate the nature and extent of soil contamination at the MTL facility. There are two primary pathways by which soil contamination can migrate to other media: erosion and runoff to storm sewers with discharge to the Charles River, and leaching of contaminants to groundwater. Two portions of the MTL site have been identified as areas with contaminated soils (Halliburton NUS Environmental Corporation 1993). These areas, designated as Sites 1 and 2, are situated in the southeastern part of the MTL site near the Charles River (Figure 2). Soils from both sites contain trace elements at concentrations exceeding average U.S. soil concentrations (Table 3). Pesticides and PAHs were detected at both sites, but screening guidelines are not available for organic compounds in soils.

Groundwater samples were collected from 26 on-site wells and five off-site wells in December 1991 to ascertain the extent of groundwater contamination. Concentrations of cadmium and lead exceeded their respective chronic freshwater AWQC by more than a factor of ten. In addition, the pesticides DDT, heptachlor, and dieldrin were present at concentrations exceeding their chronic freshwater AWQCs, as shown in Table 2 (Roy F. Weston, Inc. 1994).

Table 2. Maximum concentrations (µg/l) in water samples collected for the Phase 2 Remedial Investigation Report, Army Materials Technology Laboratory.

Analyte	Groundwater	Stormwater	Charles River downstream from site	Charles River upstream from site	AWQC[1]
TRACE ELEMENTS					
Cadmium	32	NT	4.8	0.18	1.1+
Chromium	60	NT	19	2.5	11*
Copper	48	580	ND	20	12+
Lead	54	74	4.4	9.5	3.2+
Zinc	97	500	44	49	86
PESTICIDES					
DDT	0.28	ND	ND	ND	0.001
Heptachlor	0.19	ND	ND	ND	0.0038
Lindane	0.17	ND	0.0037	0.0034	0.08
Dieldrin	0.031	ND	ND	ND	0.0019

1: Ambient water quality criteria for the protection of aquatic organisms. The lower value of the marine or freshwater chronic criteria is presented (EPA 1993) because waste sites are located near both marine and freshwater environments.
NT: Not tested
ND: Not detected
+: Value dependent on hardness (100 mg/l $CaCO_3$ used)
*: Value is for Cr $^{+6}$

Table 3. Maximum concentrations (mg/kg) in soil and sediment samples collected for the Phase 2 Remedial Investigation Report, Army Materials Technology Laboratory.

	Soil		Sediment			
Analyte	Soil	Average U.S. soil[1]	Stormdrain	Charles River downstream from site	Charles River upstream from site	ERL[2]
TRACE ELEMENTS						
Cadmium	13	0.06	6.2	25	13	1.2
Chromium	380	100	450	160	120	81
Copper	1400	30	15,000	1000	280	34
Lead	7200	10	560	1,900	780	47
Mercury	4.50	0.03	15	2.2	1.7	0.15
Nickel	1800	40	230	55	39	21
Zinc	1400	50	1000	890	690	150
ORGANIC COMPOUNDS						
Acenaphthene	75	NA	NT	4.7	0.454	0.016
Anthracene	120	NA	NT	10.1	NT	0.085
Benzo(a)anthracene	340	NA	16.3	23	10	0.26
Benzo(a)pyrene	120	NA	NT	29	17	0.430
Chrysene	280	NA	18	22	3.0	0.38
Dibenz(a,h)anthracene	47	NA	NT	4.3	NT	0.063
Fluoranthene	120	NA	26	31	13	0.60
Fluorene	170	NA	1.3	5.6	0.89	0.035
2-Methylnaphthalene	72	NA	NT	1.1	0.53	0.065
Phenanthrene	240	NA	22.5	80	8.9	0.24
Pyrene	120	NA	32	58	22	0.67
PESTICIDES						
DDD	3.5	NA	NT	0.62	0.25	0.002
DDE	6.3	NA	NT	0.38	0.18	0.002
DDT	9.6	NA	NT	0.7	0.31	0.001
Heptachlor	0.032	NA	NT	ND	NT	NA
Lindane	0.26	NA	NT	0.001	NT	NA
Dieldrin	4.0	NA	NT	0.48	1.9	0.00002
Endrin	0.34	NA	NT	0.05	NT	0.00002

1 Lindsay (1979).
2: Effects range low; the concentration representing the lowest 10-percentile value for the data in which effects were observed or predicted in studies compiled by Long and MacDonald (1992).
NT: Not tested
ND: Not detected
NA: Not available

Fourteen river water samples were collected; nine samples were collected downstream of the site and five samples were collected upstream to provide background data for comparison. Five more water samples were collected from on-site storm sewers that drain directly to the Charles River (Roy F. Weston, Inc. 1994). Cadmium, chromium, and lead were detected at concentrations exceeding chronic freshwater AWQC (Table 2) in the Charles River below the site.

Table 4. Maximum concentrations (pCi/g) for radioactive analytes detected in samples from Army Materials Technology Laboratory.

	Water			Soil	Sediment	
Radioactive Analyte	Charles River	Storm Sewer	Groundwater	On-site	Charles River	Storm Sewer
Alpha gross	2	3	24	38	35	110
Beta gross	10	5	110	39	38	120
Uranium-234	0.9	0.2	1.3	2.4	1.4	7.9
Uranium-235	NT	NT	0.1	0.3	0.2	0.9
Uranium-238	0.5	0.1	1.2	3.4	1.5	55

NT: Not tested

Copper and lead in river water collected upstream of the site exceeded chronic freshwater AWQC (Table 2). Copper, lead, and zinc concentrations in stormwater draining the site also exceeded chronic freshwater AWQC (Table 2).

Sediment samples were collected from the Charles River at 13 locations downstream from the MTL site, five locations upstream, and from four storm sewers located on the site (Roy F. Weston, Inc. 1994). Trace elements, PAHs, and pesticides were found in sediments at concentrations that pose a threat to NOAA trust resources. Sediments sampled from the Charles River (downstream and upstream) and stormdrains draining the site exceeded ERL guidelines for seven trace elements: cadmium, chromium, copper, lead, mercury, nickel, and zinc. Several pesticides and PAH compounds were also detected in sediments at concentrations exceeding screening guidelines (Table 3).

Radiological compounds were detected in surface water, groundwater, soil, and sediment samples (Table 4). Although detected radionuclides at the site exceeded upstream concentrations in both surface water and sediment, the consultant to the U.S. Army advised EPA that remediation of radiological contamination in the environment at MTL was not needed (Roy F. Weston, Inc. 1994). No screening guidelines are available to assess the potential radiological threat to NOAA trust resources. All buildings known or suspected to be contaminated were decontaminated in May 1993 (Roy F. Weston, Inc. 1994).

Summary

Trace element and pesticide concentrations detected in the Army MTL site's groundwater, surface water, soil, and sediments exceeded screening guidelines. PAHs were also detected in soils and sediments. PAH concentrations in sediment exceeded ERL screening guidelines. NOAA trust resources near the site include four anadromous species: blueback herring, rainbow smelt, alewife, and American shad; and the catadromous American eel. The blueback herring

run is one of the largest in Massachusetts, with densities highest near the site. Site-related contamination could affect these NOAA trust resources near the site as well as habitat in the Charles River and Boston Harbor downstream from the site.

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