Broad Brook Mill

East Windsor, Connecticut

EPA Facility ID: CT0002055887

Basin: Lower Connecticut

HUC: 01080205

Executive Summary

The Broad Brook Mill site is in East Windsor, Connecticut, next to Broad Brook, a secondary tributary of the Connecticut River. The site has a history of industrial and manufacturing operations — including a grist mill, a saw mill, a tannery, and a wool mill, as well as coal gas, circuit board, and boron filament manufacturing — that dates to before 1835. This long-time use of the site for industrial and manufacturing operations has resulted in contamination; the contaminants of concern are primarily PAHs and other SVOCs, and inorganic compounds (metals). Broad Brook provides important habitat for several NOAA trust resources.

Site Background

The Broad Brook Mill (Broad Brook) site, formerly known as the Millbrook Condominiums site, is in the Broad Brook section of East Windsor, in Hartford County, Connecticut (Figure 1). The Broad Brook site encompasses two lots, identified on East Windsor's Tax Assessor Map 22 as Lots 8 and 8A (Figure 2). A residential condominium building, two garage units, and a former boiler house currently occupy Lot 8, which is approximately 3.5 ha (8.7 acres) in size. Lot 8A, approximately 0.8 ha (1.9 acres) in size, is occupied by a commercial complex and a two-story brick office building. The Broad Brook site is bounded to the north and west by Broad Brook, a tributary of the Scantic River, and to the east and south by named streets. The central area of the site is overgrown with wooded vegetation (USEPA 2000).

Prior to 1835, the property was developed as a grist mill, saw mill, and tannery. Between 1835 and 1954, a wool mill operated on the property. During operation of the wool mill, several primary processes were housed in on-site buildings; these processes included picking, carding, spinning, dressing, weaving, scouring, carbonizing, napping, shearing, and dyeing. Other buildings on the property were used as a machine shop and a coal gas manufacturing plant. From 1954 to 1967, United Technologies Corporation, Hamilton Standard Division (Hamilton), manufactured printed circuit boards on the site. Former Hamilton buildings include a machine shop for the fabrication of small parts needed in the manufacturing process; a parts cleaner station, where chlorinated solvents were used; a wastewater treatment plant to treat electroplating water; a paint spray booth; a boiler house; and a water treatment plant to provide quality water for manufacturing processes (USEPA 2000). From 1968 through 1977, boron filament was manufactured on the property.

Hamilton sold the property and associated mill buildings in 1977 to Broad Brook Center, Inc., James R. Testa, John Bartus, and Broad Brook Center Associates (collectively referred to as BBCI). Hazardous wastes containing methyl ethyl ketone (MEK or 2-butanone), paint liquids, flammable liquids, sodium hydroxide, freon, mercury, waste oil, and activated carbon were shipped off the Broad Brook site in 1984. In January 1986, the property was sold by BBCI to the Connecticut Building

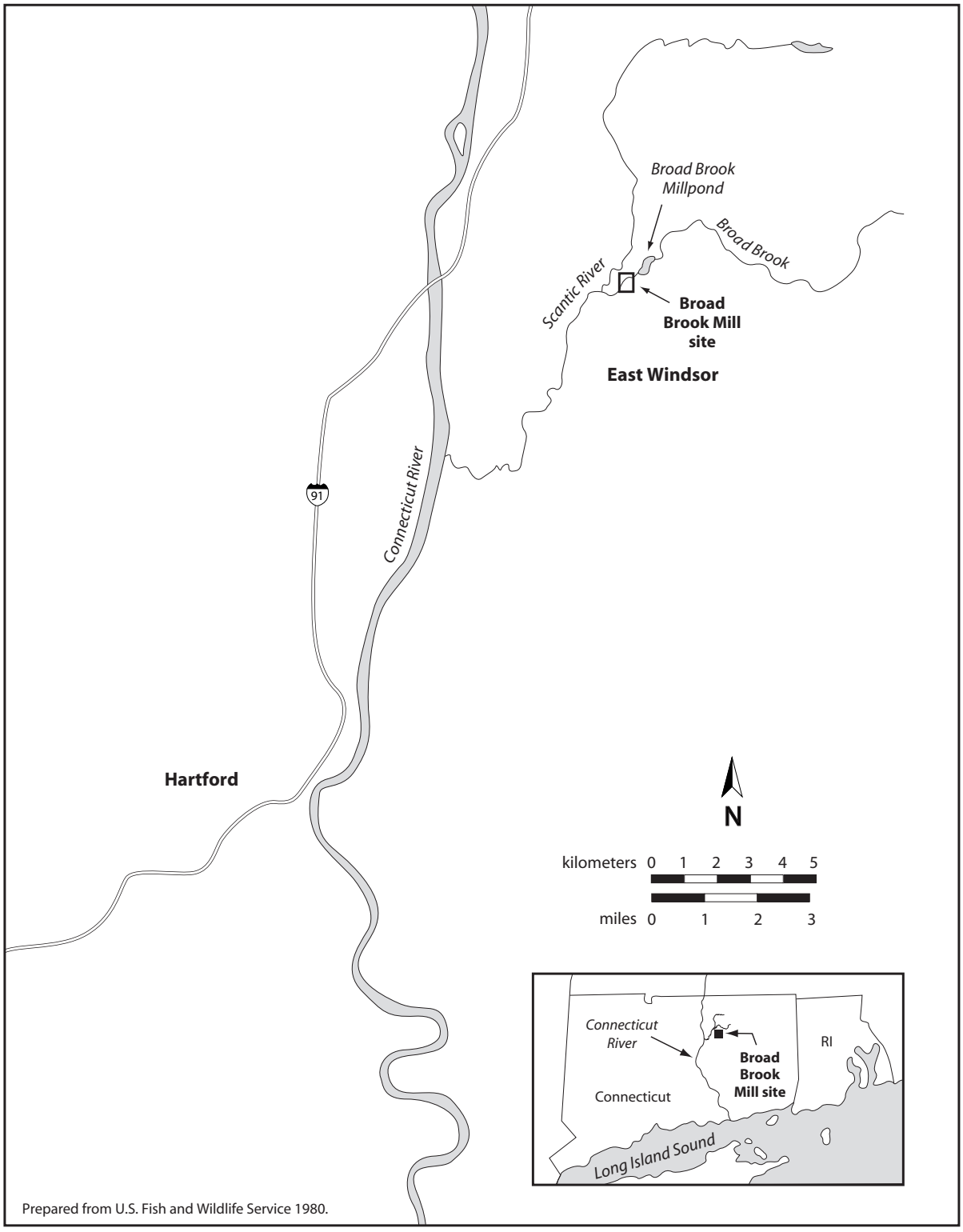

Figure 1. Location of Broad Brook Mill site, East Windsor, Connecticut.

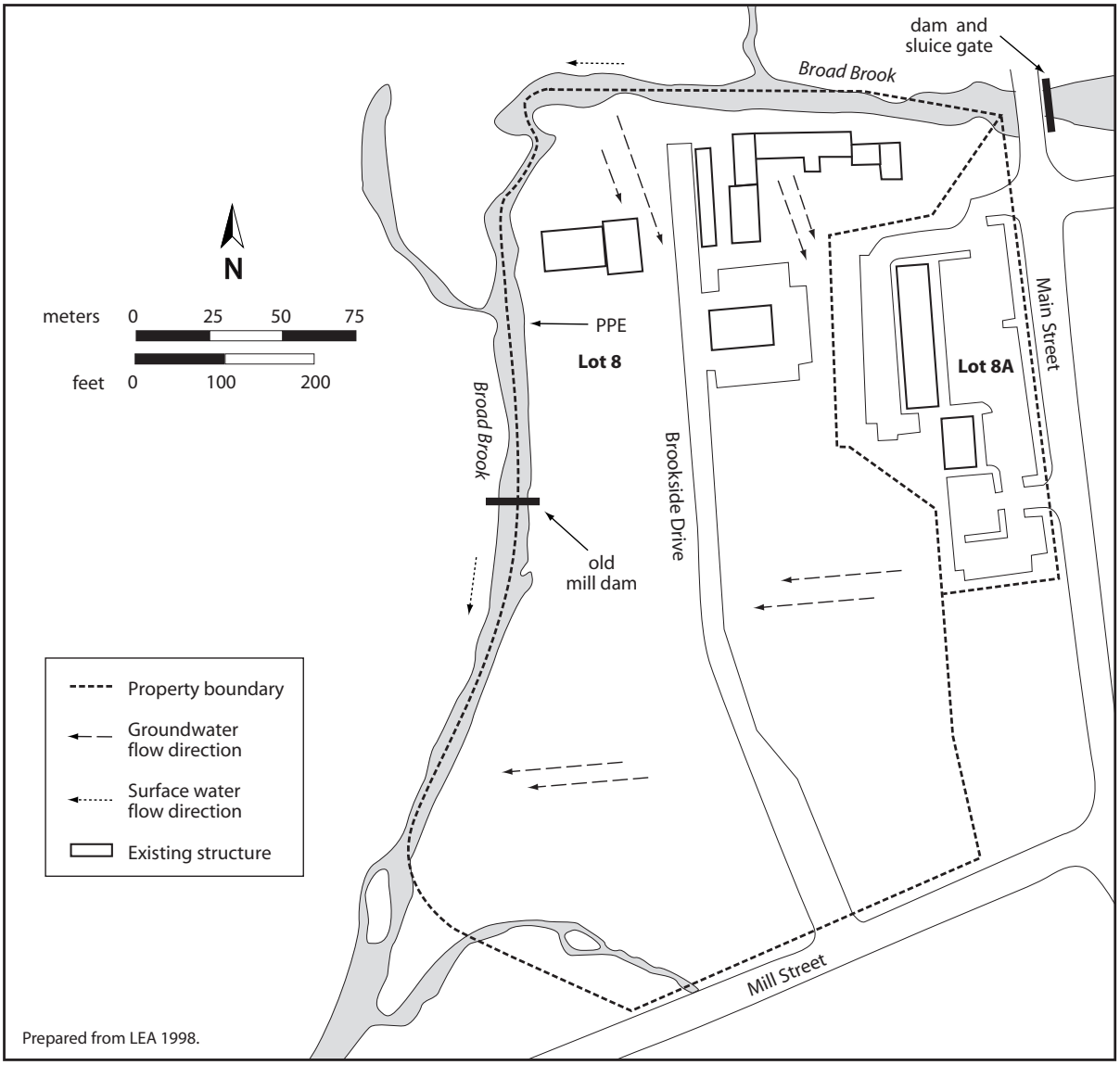

Figure 2. Detail of Broad Brook Mill site.

Corporation. In May of that year, a fire destroyed many of the mill buildings. In 1989, a commercial complex was developed from a former mill building that had survived the fire on Lot 8A. Between 1990 and 1993, residential condominiums were developed on Lot 8 (USEPA 2000).

Extensive surface and subsurface investigations have been conducted on the Broad Brook site. In August 1993, a limited phase II environmental assessment was performed, including the collection of soil gas, soil, and groundwater samples. In October 1994, the Connecticut Department of Environmental Protection (CTDEP) collected soil samples from 13 locations at the site. In October 1995, a second limited phase II environmental assessment was performed, including the collection of a round of soil and groundwater samples. Additional investigations conducted at the site between October 1996 and January 1997 included initial screening investigations, an environmental setting investigation, and an initial site characterization investigation (LEA 1998; Tetra Tech and Dynamac Corporation 2000). In 1997, the Connecticut Department of Public Health conducted a health risk

assessment of the site and concluded that because of subsurface contamination, activities involving the soil should be avoided until the soil could be remediated. In 1998, the CTDEP removed mercury-contaminated soil from Lot 8 (Tetra Tech 2000).

The U.S. Environmental Protection Agency (USEPA) initiated a removal investigation in December 1999, which included soil and soil gas sampling. A hazard ranking system package was completed for the Broad Brook site in December 2000, and the site was proposed to the National Priorities List on December 1, 2000 (LEA 1998; Tetra Tech and Dynamac Corporation 2000). At the request of the USEPA, Hamilton performed an emergency removal, which included installing interim soil cover materials around the 21-unit condominium building and conducting asbestos abatement in the former boiler house. These activities were initiated in May 2001 and completed in July 2001 (USEPA 2001).

Contamination from the site migrates via surface water runoff, which enters Broad Brook either by overland flow or through discharge from catch basins. Groundwater enters the surface waters of Broad Brook, providing a second pathway for the migration of contaminants to NOAA trust resources (Tetra Tech and Dynamac Corporation 2000). Groundwater in the eastern and southern sections of the site flows west into Broad Brook, but in the northern section of the site the groundwater flow is south-southeast (Tetra Tech 2000).

NOAA Trust Resources

The NOAA trust habitats of concern are the surface waters and sediments of Broad Brook. Broad Brook flows approximately 1.6 km (1 mi) south-southwest to the Scantic River. The Scantic River continues southwest approximately 13 km (8.4 mi) to the Connecticut River. The Connecticut River flows approximately 93 river km (58 mi) before draining into Long Island Sound (Tetra Tech and Dynamac Corporation 2000).

There are no dams on the Scantic or Connecticut Rivers to impede the migration of diadromous fish to the vicinity of the site. There are two dams on Broad Brook: one adjacent to the site and one just upstream of the site. The dam adjacent to the site is an old mill dam approximately 1.8 m (6 ft) in height (Figure 2); this dam blocks anadromous fish passage. The dam just upstream of the Broad Brook site forms Broad Brook Millpond (Figure 1) behind it; this dam is also impassable to anadromous fish. There are no plans for near-future restoration of these dams (Gephard 2002).

Historically, the Scantic River has had healthy anadromous fish runs, including alewife, American shad, and blueback herring. Although these runs have been declining for several years as a result of habitat degradation, there are still anadromous fish that migrate into the Scantic River, as well as into Broad Brook. Broad Brook provides spawning and habitat for several NOAA trust resources and adult habitat for the American eel; NOAA trust resources present in the Scantic River and Broad Book are alewife, American eel, blueback herring, sea lamprey, and sea-run brown trout (Table 1). American shad are thought to be present as well; however, their low numbers make it difficult to confirm their presence. Upstream migration for these species is blocked by an old mill dam, except for American eel which can negotiate the dam and access the upper reaches of Broad Brook. There is no commercial fishing in the Scantic River and recreational fishing is closed for all anadromous species except sea-run brown trout, in an effort to restore the fish runs (Gephard 2002).

No fish consumption advisories are currently in effect for either the Scantic River or Broad Brook. A fish consumption advisory is in effect for the Connecticut River, which recommends that carp and

catfish not be eaten by people in the high-risk group and that people in the low-risk group limit their consumption to no more than one meal per two months. This advisory is in effect because elevated levels of polychlorinated biphenyls (PCBs) have been detected in fish tissues (CTDPH 2002).

Table 1. NOAA trust resources found in the Scantic River and Broad Brook (Gephard 2002).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
Alewife	*Alosa pseudoharengus*	◆				
American shad[a]	*Alosa sapidissima*	◆				
Blueback herring	*Alosa aestivalis*	◆				
Sea lamprey	*Petromyzon marinus*	◆				
Searun brown trout	*Salmo trutta*	◆				◆
CATADROMOUS FISH						
American eel	*Anguilla rostrata*			◆		

a: The presence of this species in the Scantic River and Broad Brook is uncertain (Gephard 2002).

Site-Related Contamination

The primary contaminants of concern are polynuclear aromatic hydrocarbons (PAHs) and other semivolatile organic compounds (SVOCs), and inorganic compounds, primarily metals. Soil, surface water, groundwater, and sediment samples have been collected from the Broad Brook site since at least 1993. The maximum contaminant concentrations detected are summarized in Table 2 and represent data collected in 1996 and 1998. A total of 131 soil locations, six surface water locations, 34 groundwater locations, and 12 sediment locations were sampled. The samples were analyzed for SVOCs, metals, and volatile organic compounds (VOCs) (LEA 2002a; LEA 2002b; Tetra Tech 2000; Tetra Tech and Dynamac Corporation 2000).

Several contaminants were detected in soil samples. PAHs were detected in the soil samples and maximum concentrations ranged from 1.4 mg/kg of dibenz(a,h)anthracene to 17 mg/kg of both phenanthrene and pyrene. Maximum concentrations of 9 of the 11 PAHs listed in Table 2 were detected in a sample collected from the northwest end of the property. No mean U.S. soil concentrations exist for comparison to the maximum concentrations of PAHs that were detected in soil samples. All metals analyzed for were detected in soil samples, several at concentrations that exceeded the mean U.S. soil concentrations. The maximum concentration of mercury exceeded the mean U.S. soil concentration by three orders of magnitude. The maximum concentration of silver exceeded the mean U.S. soil concentration by two orders of magnitude. Maximum concentrations of arsenic, lead, selenium, and zinc all exceeded their mean U.S. soil concentrations by at least one order of magnitude. Chromium, copper, and nickel were detected at maximum concentrations that exceeded the mean U.S. soil concentration by at least a factor of two. The maximum concentrations of arsenic, chromium, copper, lead, and selenium were all detected in samples collected from the east side of Lot 8.

Table 2. Maximum concentrations of contaminants of concern detected in soil, groundwater, surface water, and sediment samples collected from the Broad Brook Mill site (Tetra Tech 2000; Tetra Tech and Dynamac Corporation 2000; LEA 2002a, 2002b).

	Soil (mg/kg)		Water (µg/L)			Sediment (mg/kg)	
Contaminant	Soil	Mean U.S.[a]	Ground-water	Surface Water	AWQC[b]	Sediment	TEL[c]
INORGANIC COMPOUNDS							
Arsenic	280	5.2	9	<4.0	150	6.5	5.9
Cadmium	N/A	0.06	N/A	<1.0	2.2[d]	5.9	0.596
Chromium[h]	89	37	1900	<50	11	53	37.3
Copper	58	17	43	<30	9[d]	66	35.7
Lead	1000	16	N/A	<5.0	2.5[d]	32	35
Mercury	370	0.058	0.4	<0.40	0.77[e]	N/A	0.174
Nickel	29	13	N/A	<100	52[d]	33	18
Selenium	8.4	0.26	11	<100	5.0[e]	N/A	NA
Silver	21	0.05	N/A	<10	0.12[d,f]	N/A	NA
Zinc	860	48	68	<50	120[d]	170	123.1
PAHs							
Acenaphthene	1.5	NA	N/A	<10	520[g]	3.5	NA
Acenaphthylene	2.4	NA	15	<1.6	NA	1.0	NA
Anthracene	3.6	NA	N/A	<10	NA	4.6	NA
Benz(a)anthracene	9.3	NA	N/A	<0.82	NA	13	0.0317
Chrysene	8.6	NA	N/A	<10	NA	17	0.0571
Dibenz(a,h)anthracene	1.4	NA	N/A	<10	NA	1.6	NA
Fluoranthene	15	NA	N/A	<10	NA	29	0.111
Fluorene	4.7	NA	26	<10	NA	2.9	NA
Naphthalene	1.8	NA	100	<10	620[g]	2.6	NA
Phenanthrene	17	NA	29	<1.1	NA	25	0.0419
Pyrene	17	NA	N/A	<10	NA	20	0.053

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

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

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

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

e: Criterion expressed as total recoverable metal.

f: Chronic criterion not available; acute criterion presented.

g: Lowest Observable Effects Level (LOEL).

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

NA: Screening guidelines not available.

N/A: Contaminant not analyzed for.

Groundwater samples were analyzed for selected PAHs and inorganic compounds. PAHs and inorganic compounds were detected in groundwater samples. The maximum concentration of chromium exceeded the ambient water quality criteria (AWQC) by two orders of magnitude, while the maximum concentrations of copper and selenium exceeded their AWQCs by factors of 4.5 and two, respectively. Arsenic, mercury, and zinc were detected, but maximum concentrations did not exceed their AWQCs. The PAHs acenaphthylene, fluorene, naphthalene, and phenanthrene were all detected in the groundwater samples. The maximum concentration of naphthalene did not exceed its AWQC; no AWQCs are available for comparison to the maximum concentrations of other PAHs detected in groundwater.

No contaminants of concern were detected in surface water samples collected from Broad Brook.

Sediment samples collected from Broad Brook contained elevated concentrations of PAHs. Eleven PAH compounds were detected at maximum concentrations that ranged from 1.0 mg/kg (acenaphthylene) to 29 mg/kg (fluoranthene). Maximum concentrations of benz(a)anthracene, chrysene, fluoranthene, phenanthrene, and pyrene exceeded their threshold effects levels (TELs) by at least two orders of magnitude. No TELs are available for comparison to the maximum concentrations of the other PAHs that were detected in sediment samples. The sediment samples collected from a pond upstream of the site have similar elevated PAH concentrations to those samples collected from an outfall just downstream of the old mill dam. After the sediment samples were normalized for total organic carbon (TOC) content the PAH concentrations in the sample from near the outfall were considerably greater than those collected from the upstream pond. Excepting acenaphthylene, all of the maximum PAH concentrations detected were collected a sediment sample collected near an outfall just downstream of the old mill dam. The maximum concentration of acenaphthylene was detected in a sediment sample collected upstream of the site boundary in a small pond adjacent to Broad Brook.

Several metals were detected in sediment samples collected from Broad Brook. The maximum concentration of cadmium exceeded the TEL by nearly one order of magnitude. The maximum concentrations of arsenic, chromium, copper, nickel, and zinc exceeded their respective TELs by factors of less than two. All of the maximum concentrations of metals detected in sediment were from samples collected just downstream of the probable point of entry in Broad Brook (Figure 2).

References

Connecticut Department of Public Health (CTDPH). 2002. If I catch it, can I eat it? A guide to safe eating of fish caught in Connecticut. Hartford, CT. 2 pp.

Gephard, S. Fisheries biologist for the Connecticut Department of Environmental Protection. Old Lyme, CT. Personal communication November 25, 2002.

Lindsay, W.L. 1979. Chemical Equilibria in Soils. New York, NY: John Wiley & Sons. 449 pp.

Loureiro Engineering Associates Inc. (LEA). 1998. Final site investigations report property of Millbrook Owner's Association, Inc.: Block 37 Lots 8 and 8A Tax Assessor's Map 22: East Windsor, Connecticut. LEA Comm. No. 88HS701. Plainville, CT: Prepared for United Technologies Corporation - Hamilton Standard Division.

References, *cont.*

Loureiro Engineering Associates Inc. (LEA). 2002a. Memorandum to Anni Loughlin, USEPA Region 1: Re: Broad Brook Mill Site, East Windsor, Connecticut, Sediment Sampling. Plainville, CT: USEPA. 16 pp.

Loureiro Engineering Associates Inc. (LEA). 2002b. Summary report of sediment sampling, United Technologies Corporation, Block 27, Lots 8, 8A, and portion of 18, Broad Brook, East Windsor, Connecticut. Plainville, CT: Prepared for United Technologies Corporation.

Shacklette, H.T. and J.G. Boerngen. 1984. Element concentrations in soils and other surficial materials of the conterminous United States. USGS Professional Paper 1720. Washington, DC: U.S. Geological Survey.

Smith, S.L, D.D. MacDonald, K.A. Keenleyside, C.G. Ingersoll, and L.J. Field. 1996. A preliminary evaluation of sediment quality assessment values for freshwater ecosystems. J. Great Lakes Res. 22(3):624-638.

Tetra Tech NUS Inc. (Tetra Tech). 2000. Draft site inspection report for Millbrook Condominiums: East Windsor, Connecticut. TtNUS Document No. RI00519. Wilmington, MA: Prepared for U.S. Environmental Protection Agency (USEPA). 39 pp.

Tetra Tech NUS Inc. (Tetra Tech) and Dynamac Corporation. 2000. Final hazard ranking system package for Broad Brook Mill: East Windsor, Connecticut. TtNUS Document No. RI00474F: Prepared for the U.S. Environmental Protection Agency (USEPA). 81 pp.

U.S. Environmental Protection Agency (USEPA). 1993. Water quality criteria. Washington, DC: Office of Water, Health and Ecological Criteria Division. 294 pp.

U.S. Environmental Protection Agency (USEPA). 1999. National recommended water quality criteria—correction: U.S. Environmental Protection Agency, Office of Water.

U.S. Environmental Protection Agency (USEPA). 2000. NPL Site Narrative at Listing Broad Brook Mill: East Windsor, Connecticut. Available: http://www.epa.gov/superfund/sites/npl/nar1613.htm.

U.S. Environmental Protection Agency: New England (USEPA). 2001. Community update: Broad Brook Mill Site: East Windsor, Connecticut. Boston, MA. 2 pp.

U.S. Fish and Wildlife Service (USFWS). 1980. Atlantic coast ecological inventory: Hartford, CONN. - MASS. - N.J. - N.Y. 1:250,000. U.S. Geological Survey. Reston, VA.