

4.0 NATURE AND EXTENT OF CONTAMINATION

This section summarizes the results of the chemical characterization conducted to support completion of the RI. A discussion of the potential sources of contamination affecting the entire OU3 study area (see Figures 1-1 and Figure 1-2) is provided in Section 4.1. Section 4.2 presents an overview of the types of chemical compounds detected in the study area, and a brief discussion relating the presence of these chemicals to past operations at the Raymark Facility. Section 4.3 provides a discussion of the background concentrations developed for comparison with OU3 study area values. Summaries of the nature and extent of contamination for each portion of Area II are provided in Sections 4.4 through 4.6. Section 4.7 provides a discussion of the correlation among the contaminants of concern in sediments. Analytical data used to evaluate the nature and extent of contamination can be found in Appendix B. While the evaluation of the nature and extent of contamination includes discussions of the major classes of chemical contaminants analyzed, EPA directed that the RI focus on chemical characterization of the four major contaminants (copper, lead, PCBs, and asbestos) associated with past activities conducted at the Raymark Facility. In Area II, copper has not been a consistent indicator of contamination; therefore only figures depicting the presence and concentrations of lead, PCBs and asbestos are included to support the summaries in Sections 4.4 through 4.6.

4.1 Potential Sources of Contamination

A description of the potential sources of contamination affecting Area II which are associated with past operational and disposal practices of the Raymark Facility is presented below. The contamination sources include locations where Raymark soil-waste/fill materials were disposed of (dumped) at residential and commercial properties within or adjacent to Area II, locations where erosion and/or leaching of the Raymark soil-waste/fill is occurring, former discharge of wastewater from the Raymark Facility to Ferry Creek, and discharge of contaminated groundwater to Ferry Creek and connecting waterways. Efforts to evaluate the groundwater as a potential contaminant source are being conducted part of the OU2 Groundwater RI.

4.1.1 Raymark Soil-Waste/Fill Materials Disposal

As detailed in Section 1.3.1, lagoons were used at the former Raymark Facility to collect wastewater, storm water drainage, and surface water runoff. Settled materials in the lagoons were periodically dredged and used as "fill" material both at the Raymark Facility and at various locations in Stratford. Sampling at some of these locations confirmed the presence of contaminants at levels designated a human health threat (based on EPA-established criteria).

The EPA and its contractors excavated and removed approximately 60,000 cubic yards of Raymark soil-waste/fill material during time-critical removal actions at residential properties from 1993 to 1996. Approximately 30,000 cubic yards of Raymark soil-waste/fill material were also excavated and removed from the Wooster Middle School playing fields in 1995 by the CT DEP. All excavated areas were backfilled with clean fill. All excavated materials were transported to the Raymark Facility and placed under a RCRA-type cap installed as part of the source control remedial action for the Raymark Facility. The Record of Decision (ROD) for this remedial action was signed July 3, 1995.

The excavation of Raymark soil-waste/fill under time-critical removal actions at residential properties located adjacent to wetland areas was terminated at the boundary of the wetland area. These excavations were terminated because of the presence of saturated wetland soils and vegetation marked the limits of the area where soils would present the greatest human health threat. Surficial wetland soil/sediment samples were collected at the termination point for use in future investigations of the area. These samples are included in the pertinent areas in this RI. (HNUS, 1995 and Ebasco, 1995). Those sampling locations included within the study area are discussed in further detail in Sections 4.4 through 4.6.

Additional field investigations and actions were completed in and around the Raymark Facility (see Section 2.0). Extensive sampling of commercial properties was conducted on properties where disposal of Raymark soil-waste/fill was suspected. Based on sampling results, properties with surface contamination were fenced and/or the waste areas covered (by pavement or wood chips) by the CT DEP. Commercial and adjacent properties with surface and subsurface contamination are the subject of this RI.

The wetlands along Lockwood Avenue in Area B, the wetlands near the Housatonic Boat Club in Area C, as well as residential properties adjacent to Selby Pond in Area F received Raymark soil-waste/fill. Erosion of these materials into proximate waterways (Ferry Creek, Housatonic River, Selby Pond) may have occurred thereby transporting contaminants throughout Area II.

4.1.2 Raymark Wastewater Discharge

As discussed in Section 1.3.1, the majority of the Raymark Facility's wastewater was collected and discharged to a series of four settling lagoons, that in turn discharged directly into Ferry Creek (HNUS, 1995). These lagoons also received stormwater drainage and surface water runoff from the Raymark Facility. Primarily, the wastewater discharge affected areas along Ferry Creek and the Housatonic River in Area B (See Figure 1-2). The contaminants identified in river sediments are similar to those identified at the Raymark Facility.

Wastewater discharge from the Raymark Facility may also have contributed to contamination in Area F (Selby Pond), since Ferry Creek and Selby Pond are hydrologically joined by the tidal creek, culvert, and open drainage channel.

4.1.3 Groundwater Discharge

Ongoing investigations show that groundwater within the study area is contaminated. Some of the contaminants are similar in nature to the contaminants found at the former Raymark Facility. Groundwater flow directions within the shallow overburden aquifer (water table aquifer) at the Raymark facility are generally south or southeasterly toward Ferry Creek (HNUS, 1995). Preliminary findings from a groundwater discharge study completed in March 1999 indicate groundwater is discharging VOC contaminated water into Upper Ferry Creek. Complete results of the study will be presented in detail in the OU2 groundwater RI report.

4.2 Overview of Chemicals Detected

Brief descriptions of the major classes of chemical contaminants detected in the sediment, surface water, soil, and biota in OU3 study area, and the common industrial uses of these chemicals, are provided in Sections 4.2.1 through 4.2.7. Section 4.2.8 and Table 4-2 provide a

summary of the specific chemicals known to have been stored, handled, and/or used at the former Raymark Facility during its operation that may have contributed to contamination of the OU3 study area. A discussion of the terminology used for evaluating the analytical data collected in the OU3 study area is provided in Section 4.2.9. An evaluation of the usability of field screening data collected to support the RI is included in Section 4.2.10.

4.2.1 Volatile Organic Compounds (VOCs)

The VOCs detected in environmental samples collected from the OU3 study area may be separated into three major groups: chlorinated hydrocarbons, aromatic hydrocarbons, and ketones. Many of these VOCs are organic solvents commonly used in industrial processes for degreasing parts; preparing metal surfaces prior to painting, coating, or bonding; thinning paints and resins; and extracting organic compounds from materials. Additionally, some of the detected VOCs are common constituents of gasoline and petroleum fuels.

VOCs detected in Area II and used at the former Raymark Facility consisted mainly of chlorinated hydrocarbons, aromatic hydrocarbons, and ketones used as organic solvents.

4.2.2 Semivolatile Organic Compounds (SVOCs)

The SVOCs detected in environmental samples collected from the OU3 study area may be separated into three major groups: phenolic compounds, polynuclear aromatic hydrocarbons (PAHs), and phthalates. Other SVOCs detected include only a few isolated compounds. SVOCs are common constituents of various industrial products. Phenolic compounds are typically associated with fuels, coal, and petroleum products, and are used to manufacture friction materials. PAHs are common components of coal tar (bitumen and asphaltic tars), petroleum products (motor and fuel oil), and combustion by-products. Phthalates are typically used as plasticizers in the manufacture of synthetic materials.

SVOCs used at the former Raymark Facility included phenolic compounds, the PAH naphthalene, and phthalates. Phenolic resins were used in manufacturing friction materials.

4.2.3 Pesticides

Pesticides are typically used to control the presence or population of unwanted insects in both residential and commercial areas, as well as to prevent crop destruction in agricultural settings. Pesticide formulations may include chlorinated and organophosphorus varieties.

Pesticides were detected in Area II and may have been used at the former Raymark Facility to control insect populations. However, no documentation of use has been identified.

4.2.4 Polychlorinated Biphenyls (PCBs)

The PCBs detected in the environmental samples collected from the OU3 study area consisted primarily of Aroclor 1262 and Aroclor 1268, as well as Aroclor 1254. PCBs are extremely stable chemicals with a wide range of physical properties. They have been historically used in plasticizers, adhesives, lubricants, heat transfer fluids, and as dielectric fluids in transformers and capacitors. Aroclor 1262 and Aroclor 1268, specifically, are commonly used as plasticizers in synthetic resins. Aroclor 1268 is also commonly used as a wax extender and plasticizer in rubbers.

No information has been provided directly by the Raymark Facility documenting the specific use of PCBs as part of their manufacturing process. However, the EPA has reported that PCBs were used in manufacturing brake linings. The Raymark Facility also used and/or manufactured both rubbers (gasket materials) and resins (phenolic resins in brake linings). Aroclor 1262 and Aroclor 1268 may have been used as plasticizers in these materials.

Aroclor 1262 and Aroclor 1268 were the only Aroclors detected in Raymark soils and groundwater. Although PCBs are used by many industries, the presence of Aroclor 1262 and Aroclor 1268 within the Stratford area appears to be unique to the Raymark Facility. Because of their widespread presence at the former Raymark Facility, and their absence from other industries that could have influenced the OU3 study area, the presence of these two PCBs can be attributed to Raymark soil-waste/fill.

4.2.5 Dioxins and Furans

Environmental samples from the OU3 study area contained detectable concentrations of dioxins and furans. Dioxins and furans are not manufactured commercially, but are formed during the production of chlorinated compounds (such as, PCBs, herbicides, pesticides, and chlorophenols), or as a result of incomplete combustion of chlorinated chemical compounds (such as PCBs). The term "dioxins" is commonly used to refer to a specific group of polychlorinated dibenzo-p-dioxin chemical compounds. The toxicity of one specific compound, 2,3,7,8-tetrachloro-dibenzo-p-dioxin (2,3,7,8-TCDD), has been studied more than other known dioxins and furans. The toxicity of all other dioxins and furans are expressed in relation to 2,3,7,8-TCDD, and are reported in terms of Toxic Equivalency (TEQ) concentrations.

4.2.6 Metals

Numerous metals were detected in the environmental samples collected from the OU3 study area. Metals are naturally occurring components of soil and/or localized mineral deposits, or are the result of decomposition of weathered bedrock. Metals may also be introduced into the environment through various industrial activities including disposal of waste materials or process sludges, and fugitive emissions from various thermal or combustion processes.

Barium, copper, lead, tin, and zinc were the primary metals used at the Raymark Facility to fabricate various brake and friction materials. Each was detected at elevated concentrations in the study area.

4.2.7 Asbestos

Asbestos was detected in sediment and soil samples collected from the OU3 study area. Asbestos is a group of magnesium silicate minerals that contain varying quantities of iron and calcium silicates. Because of its non-combustible and heat-resistant properties, asbestos was commonly used to manufacture brake linings, gaskets, fireproof fabrics, roofing materials, and electrical and heat insulation, and as a reinforcing agent in rubber and plastics.

Asbestos-containing materials were a primary component in the products manufactured at the former Raymark Facility. Asbestos fibers were mixed with phenolic resins to manufacture brake pads and linings. Asbestos was also used to manufacture friction materials (clutches and automatic transmission plates) and gaskets. Chrysotile was the most common commercial form of asbestos used.

4.2.8 Chemical Compounds Used or Handled at the Raymark Facility

A number of chemical compounds and materials were handled, stored, and/or used in manufacturing processes at the Raymark Facility during its operation. A list of these chemicals, presented in Table 4-1, was developed from information provided in the *RCRA Facility Investigation Report* (ELI, 1995) and the RCRA Part A application (August 15, 1980). No Part B application was ever filed for the facility.

4.2.9 Terminology for Evaluating Analytical Data

In order to evaluate the nature and extent of contamination in the OU3 study area, and determine its relationship to past disposal and operational practices at the Raymark Facility, data generated from analysis of field samples are typically compared to background concentrations and reviewed in relation to the data collected throughout an entire area of concern. Definitions of the terms used to describe and compare the contaminant concentrations in these subsequent sections are as follows:

- elevated - detected at a concentration either greater than its corresponding average background concentration or greater than a specified concentration if no average background concentration was determined
- high, higher or highest - detected in one location at one or more orders of magnitude greater than at another location
- comparable - detected in one location at the same order of magnitude as another location

- low or lower - detected in one location at one or more orders of magnitude less than another location

Discussion about the development of background concentrations is provided in Section 4.3.

Definitions of terms related to sampling depths and media are as follows:

- **Surface Samples** – Samples collected at depths of up to 2.0 feet below ground surface (bgs).
- **Subsurface Samples** – Samples collected at depths of greater than 2.0 feet bgs.
- **Sediment Samples** – Samples collected in Ferry Creek or within a delineated wetland or marsh area.
- **Soil Samples** – Samples collected outside of Ferry Creek, and outside a delineated wetland or marsh area.

4.2.10 Evaluation of Usability of Field Screening Data

During the Phase I RI conducted by TtNUS under Work Assignment 42-1LH3, Contract No. 68-W8-0117, soil samples were collected from various properties in the study area. To characterize the depth of Raymark soil-waste/fill in these areas, and to determine if the fill was associated with past disposal of Raymark soil-waste/fill, the samples were analyzed for asbestos and screened for lead, copper, and PCBs. A select number of these lead, copper, and PCB samples were also submitted for confirmatory analysis through EPA CLP.

The lead, copper, and PCB screening data were evaluated by two statistical analyses (linear regression and Wilcoxon Rank-Sum nonparametric t-test) to determine correlation between the screening data and the results of CLP analyses. The linear regression analysis involved a point-by-point comparison of the data generated by the two methods. The nonparametric t-test approach compared the means between the two data sets.

The results of the statistical analyses indicated that the screening data collected for copper and lead could be used with the same level of confidence as the CLP data for concentrations within the ranges of 300-1000 mg/kg (copper) and 100-4000 mg/kg (lead). A poor correlation was found between the PCB screening and CLP data. EPA, therefore, deemed the copper and lead screening data acceptable for quantitative use in the RI and risk assessment; the PCB screening data were determined to be acceptable only for qualitative use (B&RE, 1997b and 1997c).

4.3 Background Concentrations

To assess whether chemicals (organic compounds and metals) detected in study area environmental media are related to or are the result of past disposal activities or releases, it is necessary to compare the analytical results for samples collected in the study area with those obtained from locations that are unlikely to have been affected by past site activities. In this way, chemical presence in the study area may be attributed to naturally occurring sources (such as metals in soils); contamination that is pervasive in an area, i.e., pesticides in agricultural communities, lead in urbanized areas, etc.; or to site-related occurrences.

Because of variability in the analytical data and/or heterogeneity of the samples, average background concentrations were developed by averaging the numerical data from samples deemed representative of background conditions. (The numerical averages were calculated as the arithmetic average of the detected concentrations and half the detection limits for those compounds/analytes reported as undetected.)

For purposes of evaluating the nature and extent of contamination, the average background concentrations serve as a basis to identify elevated contaminant concentrations in samples collected within Area II (see Sections 4.4 through 4.6). If contaminant concentrations exceeded the average background concentrations, a contaminant source was suspected and the contaminant concentrations were considered "elevated." Because of the industrial nature of the Stratford area, contaminant concentrations below the average background levels are not considered representative of an affected area and, therefore, did not warrant further discussion in the evaluation of nature and extent. However, it is important to note that for the human health risk assessment the background concentrations were not used to eliminate

chemicals of potential concern (COPCs) except in the case of non-carcinogenic metals. Contaminants not analyzed in the background samples were compared to other soil/sediment screening values such as the Connecticut Pollutant Mobility Criteria (CT PMC) for GB Aquifers or the Connecticut Direct Exposure Criteria (CT DEC) for Residential Soils. Surface water results were compared to the Connecticut Water Quality criteria (human health criteria – water and organisms).

Sediment, surface water, and soil samples were collected throughout various locations of the town of Stratford. Based on the analytical results, specific locations were determined as representative samples of background conditions, and average background concentrations were calculated. The following subsections (4.3.1, 4.3.2, 4.3.3) discuss background samples for sediment, surface water, and soil in more detail.

4.3.1 Sediment

Sediment samples were collected from Great Meadow (located in the southern portion of Stratford, along Long Island Sound and adjacent to the Bridgeport Municipal Airport) and Nell's Island (located on the eastern side of the Housatonic River in the Town of Milford). The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, dioxins/furans, and metals. Following a review of the analytical data, four samples from four locations were determined to be representative of background conditions. Representative background sediment concentrations were developed by averaging the concentrations from these four samples. The average background concentrations for VOCs, SVOCs, pesticides/PCBs, dioxins/furans, and metals are presented in Table 4-2. Background sediment samples were not analyzed for asbestos.

4.3.2 Surface Water

Surface water samples were also collected from Great Meadow and Nell's Island. The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and metals. The analytical results of eight samples from eight locations, determined to be representative of background conditions, were averaged to develop the representative background surface water concentrations. The average background concentrations for VOCs, SVOCs, pesticides, PCBs, and metals are

presented in Table 4-3. No SVOCs were detected in the background samples of surface water. Background surface water samples were not analyzed for dioxins/furans, or asbestos.

4.3.3 Soil

Soil samples were collected from various locations around the Town of Stratford from schools, day care centers, and recreational areas. The samples were analyzed for pesticides PCBs and metals. Metals results from 34 of 39 sample locations and pesticides/PCBs results from 27 of 37 sample locations were determined to be representative of background conditions. These values were averaged to develop the representative background soil concentrations. The average background concentrations for pesticides, PCBs, and metals are presented in Table 4-4. Background soil samples were not analyzed for VOCs, SVOCs, dioxins/furans, or asbestos.

4.4 Area B: Lower Ferry Creek - Summary of Contamination

A summary of the nature and extent of contamination in sediment, surface water, soil and biota in Area B is provided below. Sample locations are depicted on Figure 4-1. A list of samples collected and the analyses performed is provided in Table 4-5. Tables 4-6, 4-7, 4-8 and 4-9 provide ranges of contaminant concentrations detected, frequency of detection of contaminants, locations of maximum concentrations, comparison to background concentrations, and criteria for sediment, surface water, soil, and biota, respectively.

4.4.1 Sediment

This section presents a summary of sediment results for Area B. See Table 4-6 for a statistical summary and comparison to criteria.

Asbestos

Asbestos was present in 63 percent of the samples analyzed. Asbestos concentrations ranged from trace amounts to 40 percent (at DBL-23, and B2-SD06 from 0 to 2 feet bgs and 2 to 4 feet bgs). Asbestos was found mostly in the 2- to 4-foot range, however, samples

collected from the wetlands along Lockwood Avenue contained asbestos to 16 a depth of feet (B2-SB05 and B2-SB09). Samples with elevated asbestos were collected throughout Area B in both the Ferry Creek bed and the wetland areas. Figures 4-6 and 4-7 show the ranges of concentrations of asbestos in surface and subsurface sediment in Area B.

Dioxins/Furans

Elevated concentrations of dioxins and furans were present in 88 percent of the sediment samples (both surface and subsurface), mostly in the wetland areas. Elevated concentrations of dioxin and furan congeners were detected as deep as 6 feet at B2-SB08 and B2-SB09, which are located in wetlands in the northern and southern portions of Area B, respectively. TEQ values ranged from 0.0006 $\mu\text{g}/\text{kg}$ at SD08 (0 feet to 0.5 feet bgs) to 0.3484 $\mu\text{g}/\text{kg}$ at DB01 (0 feet to 0.5 feet).

Metals

Numerous metals were present in the surface and subsurface sediments throughout the entire area. Samples were collected as deep as 14.0 feet bgs. Lead and copper occurred at elevated concentrations frequently throughout the area, and at depths up to 12 feet bgs. Figures 4-4 and 4-5 show the ranges of concentrations of lead in surface and subsurface sediment within Area B.

Concentrations of arsenic, beryllium, cadmium, chromium, copper and lead exceeded the CT DEC in numerous samples throughout the wetland portions of Area B, and to depths of 8 feet bgs at B2-SB03 and B2-SB05. The CT PMC was also exceeded for cadmium, chromium, copper and lead at B2-SB05, B2-SB08, and B2-SB09, which are all located in the wetlands.

SVOCs

SVOCs, mainly PAHs, were detected frequently in the surface and subsurface sediments throughout the area. Phthalates and phenols were detected, but less frequently. Concentrations of SVOCs including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethyhexyl)phthalate, dibenzo(a,h)anthracene, and indeno(1,2,3-

cd)pyrene exceeded both the CT PMC and CT DEC. Average sediment background concentrations of these contaminants (except bis(2-ethylhexyl)phthalate) also exceeded the CT PMC and CT DEC. The highest concentrations were detected in Ferry Creek at SD10 and SD07 and in the wetland along Ferry Creek at DB05. Most criteria exceedances occurred in surface samples, but the CT PMC was exceeded for several PAHs at depths greater than 2 feet bgs including indeno(1,2,3-cd)pyrene at B2-SB05 from 12 feet to 14 feet bgs. Benzo(k)fluoranthene, carbazole, chrysene, and N-nitrosodiphenylamine also exceeded just the CT PMC. Samples were not collected below 14 feet.

VOCs

Overall, the analytical results of sediment samples indicate that VOCs were detected infrequently in the surface and subsurface samples throughout Area B, and at relatively low concentrations. Samples were collected to 8 feet bgs, but the majority of samples were from less than 2 feet bgs. The higher concentrations of VOCs occurred at surface sample locations OU3-B2-SD07-0002 and RM-SD-DB04-03, where acetone and 2-butanone were detected at relatively high concentrations (greater than 1000 µg/kg). These concentrations did not exceed the CT PMC of CT DEC. No other VOCs exceeded State of Connecticut criteria.

Pesticides/PCBs

Numerous pesticides and PCBs, including Aroclors 1262 and 1268, were detected at elevated concentrations in the surface and subsurface sediment samples. The most frequent detections and the highest concentrations occurred in the central portion of the area, from the parking area to the wetlands along Lockwood Avenue. Elevated levels of pesticides were detected down to 8 feet, and elevated levels of PCBs were detected to 14 feet, however, most occurred in the 2- to 8-foot range. The contamination occurred more frequently in the wetland areas than in Ferry Creek.

Concentrations of several pesticides and PCBs exceeded the CT DEC and CT PMC. 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, and delta-BHC exceeded the CT PMC, while dieldrin exceeded both the CT PMC and the CT DEC. Aroclors 1248, 1254, 1260, 1262, and 1268 all exceeded the CT DEC of 1,000 µg/kg. Aroclors 1262 and 1268 exceeded the regulatory limits

at the same locations. Aroclor 1262 and aroclor 1268 exceeded CT DEC in samples from all three depths (0 to 2 feet, 2 to 4 feet, and 5 to 7 feet bgs) at B2-SD06. Criteria exceedances were found throughout Area B in the wetland area as well as in Ferry Creek; and in surface samples and samples collected from as deep as 8 feet bgs. Figures 4-2 and 4-3 show the ranges of concentrations of total Aroclors in surface and subsurface sediment in Area B.

4.4.2 Surface Water

This section presents a summary of surface water results for Area B. See Table 4-7 for a statistical summary and comparison to criteria. Surface water samples were not analyzed for dioxins/furans or asbestos.

Metals

Various metals, including lead and copper were frequently detected in the surface waters. Most detections occurred in the western portion of Area B. The metals were present at concentrations comparable to average background except for antimony, iron, lead, mercury, and zinc which were detected at high concentrations. Concentrations of antimony, arsenic, mercury, and thallium exceeded CT AWQ criteria in every sample in which they were detected. Samples that exceeded CT AWQ criteria are located throughout Area B from Broad Street along Ferry Creek to the Housatonic River. Figure 4-4 shows the ranges of concentrations of lead in surface water in Area B.

SVOCs

Bis(2-ethylhexyl)phthalate, diethylphthalate, fluoranthene, phenanthrene, and pyrene were detected in the surface water samples collected for SVOC analysis. Only bis(2-ethylhexyl)phthalate was detected in more than one sample. It was present in 2 of the 25 samples, and both results exceeded the CT AWQ criterion and average background concentrations. Phenanthrene exceeded CT AWQ criterion at SW-20-03. No other contaminants exceeded the CT AWQ criteria or average background concentrations.

VOCs

VOCs were detected infrequently (16 percent of the samples) and at relatively low concentrations in the surface water samples collected throughout Area B. Concentrations of 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, acetone, chloromethane, and trichloroethene exceeded average background concentrations in some samples. The CT AWQ criteria were also exceeded for 1,1-dichloroethene, chloromethane, and trichloroethene, as well as vinyl chloride.

Pesticides/PCBs

Pesticides and PCBs were not detected at elevated concentrations. However, 4,4'-DDD, dieldrin, gamma-chlordane, heptachlor, and heptachlor epoxide exceeded the CT AWQ criteria at every location where they were detected. 4,4'-DDD exceeded CT AWQ criteria in 4 of 25 samples analyzed. The remaining four pesticides each exceeded CT AWQ criteria in one of 25 samples.

4.4.3 Soil

This section presents a summary of soil results for Area B. See Table 4-8 for a statistical summary and comparison to criteria.

Asbestos

Observable asbestos (at least 1 percent) was present in 20 percent of the soil samples. Percentages ranged from trace amounts to 50 percent (at DBL008 and DBL009). Average asbestos was 2 percent. The highest percentages were located in the central portion of the western side of the Area B. Asbestos was observed to 16 feet in that area. Figures 4-6 and 4-7 show the ranges of concentrations of asbestos in surface and subsurface soil in Area B.

Dioxins/Furans

Relatively few dioxin and furan congeners were present in the soil samples collected, however, the concentrations detected were high. The dioxin congener OCDD was detected in all of the samples, and was found at depth (6.6 feet). The calculated toxicity equivalency (TEQ) from the six samples analyzed for dioxins/furans ranged from 0.005 to 0.105 µg/kg. The highest TEQ was found at SA674AC-N37, E103 from 1.5 feet to 2.2 feet bgs.

Metals

Elevated levels of various metals, including lead and copper, were present in all surface and subsurface soil samples. High concentrations of metals were detected in subsurface soils, to 16 feet. Lead and copper were detected in both surface and subsurface samples, 6 feet and 16 feet respectively. Elevated levels of copper were present in the subsurface samples (to 14 feet). Figures 4-4 and 4-5 show the ranges of concentrations of lead in surface and subsurface soil in Area B.

Arsenic and lead were the only metals to exceed the CT DEC. Concentrations of both metals exceeded the CT DEC at B2-SB04 from 4 feet to 6 feet bgs. Arsenic only exceeded the CT DEC in that one sample, while lead concentrations exceeded CT DEC in 33 samples from throughout Area B and at depths ranging from 0.3 feet to 8 feet bgs.

Four subsurface samples were also analyzed for synthetic precipitation leaching procedures (SPLP) metals. Only chromium and lead were detected at concentrations exceeding the CT PMC. The maximum chromium concentration (575 µg/l detected at B2-SB04 from 4 feet to 6 feet bgs) was the only exceedance of the CT PMC of 500 µg/l. Three of four lead results exceeded the CT PMC of 150 µg/l including the maximum lead concentration of 14,600 µg/l at B2-SB04 from 4 feet to 6 feet bgs.

SVOCs

SVOCs were detected infrequently and at low concentrations in surface soil samples. However, SVOCs were detected frequently and at elevated concentrations ranging from low to

high level, in the subsurface samples. Detected SVOCs were primarily PAHs, and the higher concentrations were found in the 4- to 6-foot range. Low level detections were present as deep as 16 feet bgs.

Concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and dibenzo(a,h)anthracene exceeded both the CT DEC and CT PMC. Benzo(k)fluoranthene, carbazole, and chrysene also exceeded the CT PMC. CT criteria were exceeded throughout Area B soils and from depths ranging from 2.2 feet to 16 feet bgs.

VOCs

VOCs were not detected in the surface soil samples, and occurred infrequently in the subsurface soils collected in Area B. Samples were collected down to 8.0 feet. Carbon disulfide and 2-butanone were detected at low concentrations in one subsurface sample location (OU3-B2-SB07-0608) in the southern portion of the area, but concentrations did not exceed CT DEC, or CT PMC. No other VOCs were detected in soil samples from Area B.

Pesticides/PCBs

Elevated levels of pesticides and PCBs, including Aroclors 1262 and 1268, were detected in 47 percent of the soil samples collected in Area B. Aroclor 1268 was detected down to 16 feet. Figures 4-2 and 4-3 show the ranges of concentrations of total Aroclors detected above background in surface and subsurface soil in Area B.

Concentrations of alpha-chlordane and dieldrin exceeded CT DEC and CT PMC at B2-SB02 from 4 feet to 6 feet bgs and at DBL017 from 0 feet to 0.5 feet bgs. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT concentrations also exceeded the CT PMC at DBL017 as well as B2-SB04 from 4 feet to 6 feet bgs.

Aroclors 1254, 1262 and 1268 were also detected in samples from Area B. Concentrations of Aroclors 1254 and 1262 exceeded the CT DEC at DBL017 and B2-SB02 from 4 feet to 6 feet bgs, respectively.

4.4.4 Biota

The biota samples collected from the confluence of Ferry Creek and the Housatonic River contained the PAH chrysene in similar concentrations in nearly every mussel and oyster sample analyzed. Aroclor 1254 was present in each mussel and oyster sample. The Aroclor 1254 concentrations ranged from 0.0034 mg/kg to 0.015 mg/kg. The highest concentrations were detected in the oyster samples. Pesticides were not detected. All four metal analytes (cadmium, lead, mercury, and nickel) were present in each oyster and mussel sample. Individual concentrations ranged from 0.0172 mg/kg to 1.18 mg/kg. Cadmium was found at the highest concentrations.

4.5 Area C: Housatonic Boat Club Wetlands Area - Summary of Contamination

A summary of the nature and extent of contamination in sediment, surface water, and soil in Area C is provided below. No biota samples were collected in this area. Sample locations are depicted on Figure 4-8. A list of samples collected and the analyses performed is provided in Table 4-10. Tables 4-11, 4-12, 4-13, and 4-14 provide ranges of concentrations of contaminants, frequency of detection of contaminants, locations of maximum concentrations, and comparison to criteria for sediment, surface water, soil, and biota respectively.

4.5.1 Sediment

This section presents a summary of sediment results for Area C. See Table 4-11 for a statistical summary and comparison to criteria.

Asbestos

Five of 28 surface and 8 of 23 subsurface sediment samples contained at least 1 percent asbestos, but only samples from BC-SB8 and BC-SB8A contained more than 1 percent. BC-SB8 and BC-SB8A, collected from the wetland just east of the Shore Road contained elevated levels of asbestos at more than one depth. Levels of asbestos at BC-SB8 decreased with depth: 60 percent at 0 feet to 2 feet bgs, 30 percent at 2 to 4 feet bgs, 28 percent at 4 to 6 feet bgs, and 6 percent at 8 to 10 feet bgs. Two samples from BC-SB8A from 6 to 8 feet bgs

had 8 percent and 15 percent. Only 1 percent was detected in deeper samples. Samples with 1 percent asbestos were found in the northern-most portion of the wetlands behind the Housatonic Boat Club buildings, and in the wetlands just east of Shore Road. Figures 4-13 and 4-14 show the ranges of asbestos in surface and subsurface sediment in Area C.

Dioxins/Furans

Numerous dioxins and furans were detected in both surface and subsurface sediment samples. TEQ values ranged from 0.000204 µg/kg to 8.6132 µg/kg with an average of 0.29 µg/kg. Some high concentrations were detected, primarily at HB07 in the southwest portion of Area C, and at HB23 and BC-SB8 just east of Shore Road in the wetlands. The highest TEQ value was calculated for BC-SB8 from 2 feet to 4 feet bgs. No dioxins or furans were detected in subsurface sediment samples deeper than 4 feet.

Metals

Concentrations of all metals except mercury exceeded average background concentrations at least 50 percent of the time. However, the average concentrations of metals were generally comparable to average background concentrations. Barium, chromium, copper, lead, and silver average concentrations were an order of magnitude higher than average background concentrations. High concentrations of these metals were detected in both surface and subsurface samples. Elevated concentrations of metals were typically found in surficial sediment samples collected from the wetlands behind the Housatonic Boat Club buildings and further south/southwest along Shore Road. Figures 4-11 and 4-12 show the ranges of lead concentrations in surface and subsurface sediment in Area C. Lead was detected at elevated concentrations to depths of 14.0 feet at BC-SB8A. The highest concentrations of lead were found at BC-SB8 from 2.0 feet to 4.0 feet bgs, and at HB3A from 0 feet to 0.5 feet bgs. Copper was also detected at elevated concentrations to depths of 14.0 feet with the highest concentrations found at the same locations where the highest lead concentrations were detected.

Arsenic, barium, chromium, copper, lead, and thallium concentrations exceeded the CT DEC. Both copper and lead exceeded the CT DEC as deep as 10 feet bgs at BC-SB8. The other

four metals exceeding the CT DEC did so only to depths of 4 feet bgs. The CT DEC were exceeded throughout Area C.

SVOCs

Few SVOCs, mostly PAHs and phenols, were detected in surface and subsurface sediment samples. Concentrations were typically higher in surface sediment samples. Samples with elevated SVOCs were widely distributed in the wetlands of Area C and were detected at depths to 4.0 feet.

Concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and N-nitroso-diphenylamine exceeded the average sediment background concentrations and the CT PMC. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene also exceeded the CT DEC. HB07 and HB13 at the southwest portion of wetlands near Elm Street had the highest total PAH concentrations.

VOCs

The analytical results of sediment samples indicate that few VOCs were detected above background concentrations, and their distribution was sporadic throughout Area C. Only 35 percent of surface samples and one subsurface sample (2.0 to 4.0 feet) had VOCs greater than background. Carbon disulfide was detected most frequently (in 22 of 41 total samples), but exceeded background concentrations (13.63 µg/kg) in only seven samples. 2-butanone, acetone, and toluene are the only other VOCs detected in more than one sample, and their concentrations exceeded average background concentrations in at least one sample. The CT PMC and CT DEC were not exceeded for any VOCs in Area C sediments.

Pesticides/PCBs

Numerous pesticides were detected at elevated concentrations in both surface and subsurface sediments in Area C. All pesticides detected at elevated concentrations at depth were also detected in surface sediments. Elevated levels of pesticides were most often found in surface

sediments, and were widely distributed throughout Area C. No pesticide concentrations exceeded CT DEC, however, the CT PMC were exceeded for 4,4'-DDE, 4,4'-DDT, aldrin, beta-BHC, delta-BHC, and dieldrin. Exceedances occurred in surface and subsurface (to 4 feet bgs) samples collected throughout the wetland area south of the Housatonic Boat Club. Because of the widespread use of pesticides and their weak association with contaminants detected within Raymark soils and groundwater, pesticide contamination cannot be attributed solely to Raymark waste.

PCB contamination, particularly Aroclor 1262 and Aroclor 1268, appears to be concentrated in a "pocket" located just east of Shore Road in the wetlands, although high concentrations were also detected further south in the wetlands. PCB concentrations are generally higher in surface sediments, but the highest concentrations were detected at BC-SB8 from 2 feet to 4 feet bgs. Elevated PCB concentrations were found to depths of 14 feet. Figures 4-9 and 4-10 show the ranges of concentrations of total Aroclors detected above background in surface and subsurface sediment in Area C. Aroclor 1262, and Aroclor 1268 exceeded the CT DEC of 1,000 µg/kg at locations throughout Area C. Aroclor 1242 and Aroclor 1254 also exceeded the CT DEC of 1,000 µg/kg. The highest concentrations of Aroclor 1242 and Aroclor 1254 were found from 2 feet to 4 feet bgs just east of Shore Road. Aroclor 1262 and 1268 were detected above the CT DEC mostly in the "pocket" just east of Shore Road, predominantly in surface samples.

Total Organic Carbon

Eighteen surface and four subsurface sediment samples from Area C were analyzed for TOC. Concentrations ranged from 9,000 mg/kg to 149,000 mg/kg in surface samples, and from 1650 mg/kg to 51,800 mg/kg in subsurface samples. The highest concentrations were found in surface samples (0 feet to 2 feet bgs) at locations CSD1 and HB3A.

4.5.2 Surface Water

No VOCs, SVOCs, pesticides, or PCBs were detected above background levels in the surface water samples obtained from Area C. Chrysene, 4,4'-DDD, alpha-BHC, dieldrin and Aroclor 1268 did exceed the CT AWQ criteria. Only metals exceeded average background

concentrations. Metals were most often detected above background and at the highest concentrations in the southeastern portion of the wetlands. Antimony, arsenic, lead, mercury, and thallium exceeded the CT AWQ criteria. Most exceedances of the CT AWQ criteria were detected at location HB01, in the wetlands behind the main building of the Housatonic Boat Club. No surface water samples were analyzed for asbestos. Table 4-12 presents the analytical data summary and comparison to criteria. Total Aroclors and lead concentrations are presented on figures 4-9 and 4-11, respectively.

4.5.3 Soil

The original evaluation of the nature and extent of soil contamination in Area C in the Draft RI, June 1998 included all soils in the area of the Housatonic Boat Club property as well as the portion of Area C near Elm Street. Since that document was issued, an EE/CA has been generated for the soils at and surrounding the Housatonic Boat Club. As a result, those soil samples will not be evaluated as part of this RI. The only soil samples evaluated in this RI are those around the Harbor Woods Condominiums and the property at 1564 Elm Street.

A total of 87 soil samples from this area were collected to a depth of 5.0 feet bgs, and were only analyzed for asbestos and lead, and PCBs using a screening method. Table 4-13 presents the analytical data summary and comparison to criteria for Area C soil. Figures 4-11 through 4-13 show the ranges of lead and asbestos in Area C surface and subsurface soil. Results from the PCB screening method did not correlate to results from the confirmation analysis (Section 4.2.10). Therefore, the PCB results will only be discussed briefly, and will not be presented on Table 4-13 or depicted on the figures.

Only four of 87 soil samples contained PCBs, and concentrations were relatively low. Aroclors 1260 and 1268 were the only Aroclors detected, and concentrations did not exceed the CT DEC of 1 mg/kg for PCBs. Lead was detected in 30 of 87 samples, 29 in surface soils. Twenty-nine of those samples had concentrations that exceeded average background concentrations (28 surface, one subsurface), and one surface sample (HWCO AA+500) exceeded the CT DEC of 500 mg/kg. Only trace amounts of asbestos were detected in 3 of 87 samples all from surface soils.

4.5.4 Biota

The mussel samples collected from the wetland/Housatonic River interface were analyzed for PAHs, pesticides, PCB congeners, and selected metals. All samples contained 2-methylnaphthalene, acenaphthene, benzo(a)anthracene, fluoranthene, naphthalene, and phenanthrene at similar concentrations. Total PAHs ranged from 376 ug/k at C-2 to 624 ug/kg at C3. PCBs were only detected at C-3 and HB-9, and the sums of PCB homologs were comparable (27.2 ug/kg and 28.4 ug/kg, respectively). 4,4' DDD was the only pesticide detected, and was only detected in C-3. Metals were detected in every sample, and concentrations were comparable among the samples. Table 4-14 presents the analytical data summary.

4.6 Area F: Selby Pond Site - Summary of Contamination

A summary of the nature and extent of contamination in sediment, surface water, and biota in Area F is provided below. No soil samples were collected from this area. Sample locations are depicted on Figure 4-15. A list of samples collected and the analyses performed is provided in Table 4-15. Tables 4-16, 4-17, and 4-18 provide ranges of concentrations exceeding the average background concentrations, frequency of detection above the average background concentration, and locations of maximum concentrations for sediment, surface water, and biota, respectively.

4.6.1 Sediment

This section presents a summary of sediment results for Area F. See Table 4-16 for a statistical summary and comparison to criteria.

Asbestos

Thirty-eight sediment samples were analyzed for asbestos (12 surface and 26 subsurface). Asbestos was detected in only six samples (five surface and one subsurface) and only two surface samples had more than trace amounts of asbestos (2 percent at SP12 and 10 percent

at SP15). Both locations are in the northern portion of the pond near the inlet/outlet. Figures 4-20 and 4-21 show the ranges of asbestos detected in surface and subsurface sediment.

Dioxins/Furans

Elevated concentrations of dioxins and furans were detected frequently in samples from throughout Area F to depths of 5 feet bgs, however, most elevated concentrations were detected in surface samples. TEQ values ranged from 0.000413 µg/kg to a maximum of 1.587 µg/kg at SP13.

Metals

All metals detected in Area F were reported at least once at concentrations exceeding average background concentrations. Elevated concentrations were found in surface samples and also in subsurface samples to a maximum depth of 10.8 feet bgs. (at SP19). Arsenic, chromium and lead were detected at concentrations exceeding the CT DEC. Most exceedances were detected in surface samples, but chromium concentrations exceeded the CT DEC as deep as 9 feet bgs. Sixteen samples had detected arsenic concentrations, which ranged from 2.6 mg/kg to 23.3 mg/kg; six samples had concentrations above the CT DEC of 10 mg/kg. Chromium was detected in 73 of 74 samples with concentrations ranging from 0.89 mg/kg to 505 mg/kg. Twelve of those samples had concentrations exceeding the CT DEC of 100 mg/kg. Lead was detected in 65 of 74 samples with concentrations ranging from 1.1 mg/kg to 775 mg/kg. Five samples had concentrations above the CT DEC of 500 mg/kg. Figures 4-18 and 4-19 show the ranges of lead detected in surface and subsurface sediment.

Thirty-seven sediment samples were also analyzed for toxicity characteristic leading procedure (TCLP) metals. Only lead concentrations exceeded the CT PMC of 150 µg/l (in surface sediment at SP12, SP15, and SP16). Lead concentrations ranged from 3.7 µg/l to 636 µg/l. Barium was most frequently detected (36 of 37 samples) and concentrations ranged from 3.5 µg/l to 171 µg/l. Concentrations of barium did not exceed the CT PMC.

SVOCs

SVOC detections appear to be scattered throughout Area F. Detected SVOCs were primarily PAHs with few phthalates and chlorinated aromatic hydrocarbons, and most were detected at concentrations higher than average background concentrations. The highest concentrations were detected in surface samples, primarily at location F-3 from 0 to 0.5 feet bgs. Concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene exceeded the CT PMC. Each of these contaminants, except carbazole and chrysene, also exceeded the CT DEC. Concentrations exceeding the CT criteria were typically found in surface sediment samples, however, some were detected as deep as 5 feet bgs in locations throughout the Selby Pond.

VOCs

Overall, the analytical results of sediment samples indicate that VOCs were detected infrequently and at relatively low concentrations in the surface sediment samples throughout Area F. 2-Butanone, acetone, benzene, and carbon disulfide were the only VOCs detected, and all but benzene were detected at concentrations higher than average background concentrations. The highest concentrations were most often detected at SP07, which is located in the eastern portion of the wetlands near the 635 Stratford Avenue property. No VOC concentrations exceeded the CT PMC or the CT DEC.

Pesticides/PCBs

Numerous (18 of 21) pesticides were detected at elevated concentrations at nearly every sample location. Elevated pesticide concentrations were found predominantly in surface sediment samples, but elevated levels were detected as deep as 14 feet bgs. Concentrations of ten pesticides exceeded the CT PMC in surface and subsurface samples.

PCBs were detected infrequently in sediments throughout Area F. Aroclors 1262 and 1268 were the only Aroclors detected. Concentrations of Aroclor 1268 exceeded the CT DEC of 1,000 ug/kg in surface samples from SP14 and SP15 near the inlet/outlet of the Selby Pond.

No other locations contained concentrations of Aroclors exceeding CT DEC. No PCBs were detected in subsurface sediment samples. Figures 4-16 and 4-17 show the ranges of Aroclors detected in surface and subsurface sediment.

4.6.2 Surface Water

VOCs and SVOCs were not detected in surface water samples. Dioxins/furans and asbestos were not analyzed in Area F. Pesticides and PCBs were not detected at concentrations greater than background concentrations; however concentrations of heptachlor epoxide did exceed CT AWQ criteria at SP01 near the inlet/outlet of the pond. Figure 4-16 shows the distribution of the total Aroclor results of surface water locations. Concentrations of several metals were higher than average background concentrations. The highest concentrations were detected at SP14 collected during the incoming tide at the inlet of the pond. Arsenic, beryllium, mercury and thallium concentrations did exceed CT AWQ criteria at SP14. Copper was not detected at concentrations above background, and lead exceeded background concentrations in only one surface water sample. Figure 4-18 shows the range of lead concentrations in surface water in Area F. Table 4-17 provides a statistical summary and comparison to criteria.

4.6.3 Biota

Biota samples from Area F were analyzed for lead, mercury, pesticides, and PCBs. Analytical results indicate that pesticides, PCBs (specifically Aroclor 1262) and the metals lead and mercury, appear to be concentrating in both American Eels and White Perch in Selby Pond. The highest concentrations of pesticides, Aroclor 1262, and mercury were found in eel fillets, while lead was more frequently found in eel offal samples. Aroclor 1268 was not detected in any sample. Mercury was detected in 2 of 30 samples, while lead was detected in all but one sample. Table 4-18 provides a statistical summary of analytical results.

4.7 Correlations Among Contaminants of Concern (COCs)

Relationships among the COCs were investigated to see how strongly the COCs varied together and whether they changed from area to area. The relationships have the potential to

be used for assessing the source(s) of contaminants and the likelihood that a restricted set of COCs could be used as surrogates for all of the COCs.

4.7.1 COCs in Sediment

The analysis consisted of calculating correlation coefficients using logarithms of the concentrations for:

Arsenic	Lead	Zinc
Cadmium	Mercury	Total PAHs
Chromium	Nickel	Total PCBs
Copper	Silver	Total 2,3,7,8-TCDD TEQ

Total PAHs, total PCBs, and toxicity equivalents (TEQ) for dioxins were used to simplify the analysis.

In Area B, each COC was significantly correlated with at least four other COCs (Table 4-19). Strongest relationships occurred between metals, with correlation coefficients as high as 0.95 for chromium and copper and 0.90 for nickel and zinc. This means that 90 percent ($[0.95]^2 = 0.90$, or 90%) of the variation in chromium and copper concentrations, and 81 percent of the variation in nickel and zinc concentrations, can be explained by the relationships between the metals in each pairing. Silver and PAHs had the fewest significant correlations.

In Area C results were similar, except that PAH concentrations were not related to any other COC (Table 4-19). This is evidence that PAHs and the other COCs did not have the same source or the same transport pathway. The highest correlation coefficients were for copper and nickel (0.95) and copper and lead (0.93).

Results for Area F differed from Areas B and C in having no COCs related to total PCBs, and in having only one COC (arsenic) related to mercury and silver. This may mean that PCBs in Area F are not from the same source as the other COCs. The strongest relationships in Area F were between copper and zinc (0.92) and lead and zinc (0.95).

For the reference area, only three or four samples are in the data base, making interpretation of the correlation results speculative. Table 4-19 includes correlation coefficients for all

surface sediment data, including Areas A, D, and E. The results for the combined data are more similar to those for Area B than they are to the results for Areas C or F. Some of the coefficients for the combined data are quite low, especially for the organic COCs, yet they are statistically significant. These results are from the large number of samples, between 164 and 244. In these cases a low coefficient means that the relationship explains relatively little of the variation between the two COCs, yet there is still the same level of confidence (99.5 percent or more) that a relationship exists. Although the number of samples is high for the combined data, it is apparent that some relationships are strong, especially among the metals chromium, copper, lead, nickel, and zinc.

A somewhat similar analysis was undertaken by SAIC (1997) on the surface sediment data that were available at the time for all areas. The purpose of the analysis was to determine whether groups of sampling locations had unique chemical patterns and which chemicals were primarily responsible for these patterns. A multivariate statistical approach was used, principal components analysis (PCA). The combined data showed that sampling locations with high PAH concentrations were distinguished from those with high metals and PCB concentrations, suggesting different transport mechanisms for the different COC classes. The PCA analysis of metals suggested that "copper/lead contamination is a distinct chemical signature for site sediments." In the summary, PCBs, copper and lead are COCs that were likely to indicate Raymark waste. This supported criteria developed earlier by EPA for Raymark waste that included asbestos, lead, and PCBs at certain levels. The correlation analysis (Table 4-19) corroborates these findings. The correlations also show that dioxins, PAHs, and several other metals are related to PCBs, copper, and lead overall, and that differences in some of these relationships are seen for Areas C and F.

4.7.2 COCs in Soils

Correlations among concentrations of COCs in soil were performed to see how well they varied together. If the COCs vary together, one or two COCs may be used as surrogates for the others, in order to save time and effort. Asbestos, lead, arsenic, chromium, dieldrin, several "individual" Aroclors, total PCBs, several individual PAHs, total PAHs, and summed dioxin (TCDD) equivalents were investigated for this purpose. Most of the Aroclors had all, or nearly

all, of their values not detected, so only Aroclor-1262 and Aroclor-1268 were retained for calculations.

Correlations among all data from Areas II and III were calculated first, to discern overall patterns (Table 'All and All'). High correlation coefficients (about 0.5 or greater, associated with an error level of 0.005 or lower) were seen among several COCs. Some of these were obvious results, such as the Aroclors correlating with total PCBs. There were also high correlations among asbestos, lead, and PCBs, which were the COCs considered most characteristic of Raymark waste during past removal actions. Among these COCs the highest coefficients are obtained between total PCBs and asbestos (0.636) and total PCBs and lead (0.749). Squaring the coefficients provides an indication of how much of the data's variation is explained by the relationship. Therefore, the relationship between total PCBs and asbestos explains $0.636 \times 0.636 = 0.4$ or 40 percent of the variation in their concentrations. The relationship between total PCBs and lead explains 56 percent of the variation in the data. High correlations are also seen between asbestos and total PAHs, lead and PAHs, dioxins and PCBs, and between dieldrin and PCBs.

Correlations were also performed for subareas (B and C) and for strata (surface soil and subsurface soil) within each area. No soil samples were collected from Area F. For the surface soil in Area B, high correlation coefficients were only seen among related concentrations, like Aroclors and total PCBs. The small number of samples, 3 to 5, may be a reason why the surface soil in Area B differs from the combined data. Area B's subsurface soil had high correlation coefficients (about 0.8 or greater, associated with an error level of 0.01 or lower) between asbestos and total PCBs, dieldrin and PCBs, arsenic and chromium, and between arsenic and PAHs (Table 4-20). In Area C, a coefficient could only be calculated between lead and asbestos in surface soil; it was not significant.

5.0 CONTAMINANT FATE AND TRANSPORT

Complex factors govern the fate and transport of contaminants within Area II. The past operations and disposal history associated with the Raymark Facility, the varying geologic and hydrogeologic conditions of Area II and environs, and the transfer and cross-migration of contaminants between environmental media, all influence the migration of contaminants in the sediment, surface water, soil, and groundwater. This section presents a summary of the fate and transport for contaminants in sediment, surface water, and soil within Area II. A detailed discussion of the general mechanisms and factors that govern fate and transport are presented in Appendix E.

Section 5.0 summarizes the fate and transport of contamination including:

- Section 5.1 - Contaminant Sources and Releases
- Section 5.2 - Contaminant Fate and Transport in the Area II Study Area

The location of Area II is shown on Figure 1-2 and is defined in Section 1.3.2. Sample locations are identified on Figures 4-1, 4-8, and 4-15, Areas B, C, and F.

5.1 Contaminant Sources and Releases

Contaminants were released into the environment in Area II by various historical disposal and operational practices associated with the Raymark Facility, and potentially from other commercial and industrial operations within the OU3 area. A summary of past sources and releases of contamination is presented below. A description of facility operations and manufacturing processes is presented in Section 1.3.

Throughout the history of the Raymark Facility, large quantities of organic and inorganic chemicals and fuels were handled in storage tanks, drums, and process equipment situated throughout the property. The moving, opening, and emptying of drums and the loading and unloading of tanks may have resulted in discharges or spills of solvents and fuel. Solvents and fuels reportedly leaked to soils from above and underground storage tanks (ELI, 1995).

Acid neutralization pits were located at the facility and received spent acids and caustic solutions laden with metals. Solvents may also have been disposed of in the acid neutralization pits.

In addition, a series of four lagoons was used to retain and settle particulate matter from clarified process waters generated as a by-product of the manufacturing activities. Liquid wastes bearing residual VOCs, heavier organic compounds, asbestos, and metals were directly discharged into the lagoons. A system of drains under the buildings of the facility also conveyed process water, spills, and discharges to the lagoons. Storm drains throughout the facility directed surface runoff into this discharge system, which ultimately discharged to Ferry Creek. Thus, the Raymark Facility runoff, storm and facility drains, and process water all discharged to Ferry Creek, which then flowed to the Housatonic River and Long Island Sound. The discharge from the lagoons continued until 1995 when drainage was diverted around the lagoons directly into a stormwater drain. Off-site discharge of process water and manufacturing facility drainage ceased in 1984.

Sludges excavated or dredged from the lagoons, "off-specification" materials that were discarded, and other waste products were disposed of as fill materials throughout a substantial portion of the Raymark Facility property, as well as at residential, commercial, and industrial properties within Stratford, including properties in Area II. The nature and concentrations of contaminants in the fill materials changed over the 70-year operational lifetime of the Raymark Facility due to alterations in manufacturing processes and product lines.

Area II does include other commercial and industrial properties that probably are, or have in the past, contributed to the contamination of the soil, surface water, sediment, and groundwater. The likelihood of these releases of petroleum hydrocarbons, volatile organic and semi-volatile organic compounds, and other contaminants is based on the long history of industrial and commercial activities in the area. Identification and evaluation of releases from these other potential sources are not within the scope of this RI.

A summary of the distribution of contaminants in Area II follows:

Area B – Lower Ferry Creek - was directly impacted by Raymark Facility wastes. The upland soils within this area received Raymark wastes as fill (Raymark soil-waste/fill). Ferry Creek received direct discharges from the lagoons on the Raymark Facility and Raymark soil-waste/fill that eroded from the properties surrounding the creek. The wetlands in this area received both direct disposal of Raymark soil-waste/fill and contaminated wastes that eroded from Raymark soil-waste/fill from surrounding properties. Contaminated groundwater is discharging as base-flow to Ferry Creek; further evaluation of groundwater discharge to Ferry Creek is being conducted as part of the OU2 RI.

Area C – Housatonic Boat Club - received Raymark soil-waste/fill to fill in marshy wetlands for development. Transport of contaminated sediment from Ferry Creek, and wastes that eroded and washed in from surrounding properties may also contribute to the contaminants in the wetland areas.

Area F - Selby Pond Site - Direct discharge of both organic and inorganic contaminants from the Raymark Facility lagoons into the northern reaches of Ferry Creek, and the leaching of contaminants from Raymark soil-waste/fill from the region surrounding Ferry Creek may have contributed to the contamination of sediment in the Selby Pond Area. Selby Pond is assumed to be hydraulically connected to Ferry Creek through the reinforced concrete pipe and tidal creek channel located in the southwestern corner of Ferry Creek.

The disposal of fill material from the Raymark Facility did occur in or near the sediment in the Selby Pond Area. This resulted in the direct release of contaminants in areas where fill materials were disposed, and the potential indirect release to naturally occurring sediment and soil in the vicinity. Surface water flow, runoff, infiltration, and tidal fluctuations are the key transport mechanisms moving the contaminants into the pond. Sediments in and around the pond had frequent detections of elevated levels of PAHs, PCBs, and metals, with fewer detections of asbestos, VOCs, and dioxins/furans. Dissolution of contaminants in the fill material caused by runoff and/or groundwater infiltration, or tidal fluctuations may result in indirect release to groundwater and/or downgradient environmental media.

Due to the physical and chemical properties of the contaminants in these potential sources, metals alone appear to impact Selby Pond's surface water. Although other contaminants may have migrated with particulates and colloids as the result of limited dissolution, they did not remain suspended or dissolved in the surface water sampled. These contaminants would have adsorbed to sediment particles throughout Selby Pond and the wetlands areas.

Area II Summary

The main sources and releases of contaminants to the Area II study area are as follows:

- Disposal of Raymark wastes, including sludges from the lagoons, "off-specification materials" that were discussed, and Raymark soil-waste/fill from the facility that were used to fill in low topographic areas. These fill materials have become sources of further release to the wetlands, Ferry Creek, the Housatonic River, and other low lying topography through erosion, surface water transport (dissolved and suspended contaminants), volatilization, and possibly solute transport in groundwater.
- Discharge of surface runoff, facility drains, and process water from the Raymark Facility into Ferry Creek, and ultimately the Housatonic River and Long Island Sound.
- Spillage, leakage, and other sources of release of contaminants from the Raymark Facility discharged into the ground, into the local drainage area and as base-flow to Ferry Creek, and ultimately the Housatonic River and Long Island Sound.
- Spillage, leakage, and other sources of release of contaminants from other (non-Raymark) commercial and industrial properties within the drainage area.

5.2 Contaminant Fate and Transport in the Area II Study Area

The fate and transport of contaminants within the Area II study area were evaluated to support the human health and ecological risk assessments, and for future use in the feasibility study that will evaluate potential remediation options.

This section describes the distribution and releases of contaminants, summarizes the physical states of contaminants in the environmental media (soil, sediment, and surface water), and discusses the primary pathways for contaminants to move from the potential source into the environmental media within Area II. A detailed discussion of the mechanisms and factors governing fate and transport is provided in Appendix E.

The fate and transport discussions are focused on the major contaminants of concern (COCs) identified in both the human health risk assessment and the ecological risk assessment. These COCs include: PAHs, PCBs, dioxins/furans (expressed as TEQ concentrations) metals, pesticides, and asbestos. A discussion of VOCs was also included to supplement the evaluation of VOCs in groundwater to be provided in the RI report for OU2.

Contaminants in Area II are present in sediment, surface water, biota and soil samples. A summary of the activities resulting in contaminant release to the area, the physical state of the contaminants present in these environmental media, and the associated fate and transport mechanisms are presented below. The fate and transport mechanisms for the sediment/surface water, and soil media are presented in Appendix E.

Direct discharge of both organic and inorganic contaminants from the Raymark Facility lagoons into the northern reaches of Ferry Creek, and the potential leaching of Raymark soil-waste/fill deposited in the area have contributed to the contamination of sediment throughout Area II. Surface water flow, runoff, infiltration, and tidal fluctuations are the key transport processes bringing contaminants into these areas. PAHs, PCB, dioxin/furans, metals, and asbestos were frequently detected in Area II sediments. VOCs were detected less frequently.

Contaminated Raymark wastes used as fill are a source of soil contamination. Contaminants are directly released from areas where Raymark soil-waste/fill was disposed nearby to

naturally occurring sediment and soil. Contamination by these direct releases then become a source of indirect releases. These sources and releases appear to have contributed to contamination of the soil with elevated levels of PAHS, PCBs, dioxins/furans, pesticides, and metals, as well as less widespread contamination with VOCs and asbestos.

Dissolution of soluble contaminants from the fill, caused by runoff and/or groundwater infiltration, contact with solvents or acids (if present), or tidal fluctuations may also result in indirect release to downgradient environmental media. This transport mechanism may have contributed to subsurface soil contamination as well as to contamination of sediment and/or surface water.

The dredging of contaminated sediment from the mouth of Ferry Creek at its confluence with the Housatonic River, and the subsequent placement of dredged material on land, is also believed to have contributed to indirect contamination of the Wetlands along Lockwood Ave. The dredging operations could have also resulted in the indirect release of contaminants to the Housatonic River and wetland areas along the river downgradient of the dredging operations (both Areas C and F) as a result of suspension and migration of contaminated particulates during dredging.

Migration of chemical contaminants from impacted sediment and soil, and transport as a result of surface water flows and tidal fluctuations, appear to continue to impact downgradient regions of the Housatonic River and wetland areas along the river bank. Contaminants may accumulate in these regions by adsorption to sediment/silt particles with high organic carbon content (Area C).

The fate and transport of contamination in Areas B, C, and F is dependent on physical, chemical, and biological processes, and the type of chemical contaminant present. A summary discussion of the fate and transport of the various categories of chemical contaminants in sediment and surface water, and the soils throughout Area II is presented below, with detailed discussions provided in Appendix E.

5.2.1 Soil

The main contaminants of interest for the soils in Area II are discussed below, with a brief description of the frequency of detection and the apparent source and transport mechanisms.

Various chemical contaminants are present in the soil in Area II. Several pathways are available for contaminants to have entered these media, and for them to have been subsequently transported to adjacent media. The main pathways for soil contamination in Area II are as follows:

- Direct deposition of Raymark soil-waste/fill.
- Transport and redeposition of contaminated soil and sediment particles via erosion from contaminated soils and Raymark soil-waste/fill.
- Transport of dissolved contaminants into soils via runoff from private and commercial/industrial properties, and roadways, including those that have Raymark soil-waste/fill.
- Transport of contaminants into soils via discharge of contaminated groundwater as base-flow seepage into Ferry Creek and ultimately into the Housatonic River.
- Transport of adsorbed contaminants throughout Ferry Creek via erosion and redeposition of contaminated sediment caused by surface flow and tidal fluctuations.

VOCs - VOCs were not frequently detected in the surface soil, and were detected at somewhat higher frequencies in subsurface soil throughout Area II. The higher concentrations of VOCs, primarily carbon disulfide, ketones (2-butanone and acetone), and aromatic hydrocarbons (toluene and xylenes (total)), were detected in subsurface soils located in a few locations adjacent to the wetland areas, including southeast of the wetlands along Lockwood Ave. in Area B, and north and east of the wetlands adjacent to the Housatonic Boat Club in Area C. The presence of these contaminants may have been the result of localized releases at the properties.

Dissolution of the more soluble contaminants, such as VOCs, in the Raymark soil-waste/fill caused by runoff and/or precipitation infiltration may have resulted in a release of contamination into the subsurface soil and groundwater, however, few VOCs were detected in groundwater in MW-312 in Area B (the northern portion of Area II).

Evidence suggests that dissolved contamination is being transported by groundwater. In particular, VOCs may be entering the sediment and surface water of Ferry Creek through base-flow recharge from contaminated groundwater. Groundwater discharge to upper Ferry Creek is being evaluated in OU2 RI.

SVOCs (primarily PAHs) – SVOCs are generally not as soluble in water as VOCs. The primary SVOCs of concern are the PAHs. PAHs were frequently detected in surface soil, with somewhat fewer detections in subsurface soil throughout Area II. The high frequency of detections suggests that the PAHs were adsorbed onto soil particles placed in the area as fill material. The somewhat higher frequency of detections in the surface samples may also suggest a more recent source of contamination, such as runoff from nearby paved roads and parking lots.

The highest concentrations of PAHs were detected in surface soils collected in the vicinity of paved roadways and/or parking lots in Areas B and C, and may have been a result of vehicle exhaust and tire degradation.

PCBs - Aroclor 1262 and Aroclor 1268 (with less frequent detection of Aroclor 1254) were detected in both surface and subsurface soil throughout Area II. The high frequency of PCB detections in both surface and subsurface soil suggests that the PCBs were adsorbed onto soil particles placed in the area as fill material from the Raymark Facility (Raymark soil-waste/fill). Due to the low mobility of PCBs in the environment, they are likely to have remained where they were deposited.

The levels of PCBs in soil samples were relatively consistent in soil samples throughout Area II. The highest levels of PCBs were detected in subsurface soils west of the lowermost

extent of the Ferry Creek channel in Area B, and in both surface and subsurface soils north and east of Area C.

Dioxins and Furans – Dioxins/furans (as TEQ concentrations) were frequently detected in the limited number of surface and subsurface soil samples collected throughout Area II. These contaminants were detected in the same regions as the PCBs and are believed to have been transported to these regions in a similar manner. Because of its low water solubility, dioxins are unlikely to affect groundwater quality. Dioxins are nonvolatile and have a tendency to adsorb to organic materials in soils, so they are expected to be relatively immobile in site soils.

Metals (primarily Copper and Lead) – Copper and lead were detected above background levels in both surface and subsurface soil throughout Area II. The somewhat higher frequency of detections in the surface soils is a result of the scarcity of elevated values in the deeper samples collected. Metals tend to be less mobile in the environment than organic contaminants, suggesting that the metal detections are associated with Raymark soil-waste/fill placed in the area. The metals are likely to have remained where soil-waste/fill was deposited.

The highest levels of both copper and lead were detected in both surface and subsurface samples located southwest of the wetlands along Lockwood Ave. in Area B, and north and east of the wetlands adjacent to the Housatonic Boat Club in Area C. Elevated concentrations of barium were detected at similar frequencies, with the highest concentrations at the same locations as copper and lead.

Asbestos – Asbestos is relatively immobile in the environment, except through bulk advective movement or dispersion in aqueous or airborne environments. Elevated levels of asbestos were detected frequently in both surface and subsurface soil throughout Area II, in similar regions as the presence of elevated levels of copper and lead. Due to the low likelihood of asbestos mobility in the environment, it is likely to have remained where Raymark soil-waste/fill was deposited.

5.2.2 Sediment and Surface Water

The main contaminants of interest in the sediment and surface water in Area II are discussed below, with a brief description of the frequency of detection and the apparent source and transport mechanisms.

Various chemical contaminants are present in the sediment and surface water in Area II. Several pathways are available for contaminants to have entered these media, and for them to have been subsequently transported downstream and/or to adjacent media. The main pathways of surface water and sediment contamination in the Area II study area are as follows:

- Direct deposition of Raymark soil-waste/fill in wetlands.
- Transport and redeposition of contaminated soil and sediment particles via erosion from contaminated soils and Raymark soil-waste/fill.
- Transport of dissolved contaminants into sediment and surface water via surface water runoff from private and commercial/industrial properties, and roadways, including those that have Raymark soil-waste/fill.
- Transport of contaminants into the sediment and surface water via discharge of contaminated groundwater as base-flow seepage into Ferry Creek.
- Transport of adsorbed contaminants throughout Ferry Creek via erosion and redeposition of contaminated sediment caused by surface flow and tidal fluctuations.

VOCs - VOCs were not frequently detected in Area II surface sediment, except for 2-butanone, acetone, and carbon disulfide. The VOCs were even less frequently detected in the subsurface sediment throughout Area II. VOCs were also not frequently detected in surface water. The small number of VOCs detected in surface water included acetone and chlorinated hydrocarbons in a limited number of samples from Area B. Significant concentrations of VOCs were not detected in Area C surface water. Elevated levels of VOCs were not detected in surface water from the Selby Pond Area.

The highest concentrations of VOCs were detected in surface sediment from the Ferry Creek channel immediately south of the bridge under Ferry Boulevard in the western region, and in the mouth of the Ferry Creek channel in the northeastern region of the Area B. The presence of VOCs is most likely the result of localized releases. In both of these areas, sediments consist of thick deposits of silts of high organic content, which may more readily retain VOCs as adsorbed contaminants. Higher concentrations of VOCs were detected along the eastern side of Selby Pond. This may be due to the fact that these samples were collected close to the outer boundary of the designated wetland area where relatively stagnant surface water was less apt to desorb the contaminants from the sediment. No subsurface sediment samples were collected for VOC analysis from the Selby Pond Area.

SVOCS (primarily PAHS) - SVOCS are more readily adsorbed to sediment particles than VOCs. SVOCS are generally not as soluble in water as the VOCs. SVOCS in sediment can volatilize but not to the degree of VOCs. SVOCS usually are not transported long distances by surface or groundwater but from more localized Raymark soil-waste/fill deposits. The highest concentrations of PAHs were detected in the northwestern region of the wetlands along Lockwood Ave. adjacent to the lower Ferry Creek channel and downgradient in the channel opposite the wetlands in Area B, and along the eastern border adjacent to Shore Road in Area C. The occurrence of the PAHs in these areas may have been caused by migration from a nearby source from surface water flows, runoff, or tidal fluctuations, and subsequent adsorption to sediment particles.

PAHs were infrequently detected in the Selby Pond Area, primarily in surface sediments. The higher frequency of PAH detection in surficial samples suggested that the PAHs were adsorbed onto sediment particles that may have migrated to these areas with surface water flows, runoff, or tidal fluctuations. The cause of less frequent detections in subsurface sediment is unknown. It may arise from the lack of erosional scouring and redeposition in the Selby Ponds Area, resulting in the contamination of the shallow subsurface sediments and little mixing with the deeper sediments. The highest concentrations of PAHs were detected in the northeastern portion of Selby Pond and at two locations in the wetlands along the northeastern and southeastern borders of Selby Pond.

PCBs – PCBs are readily adsorbed to sediment particles and are less soluble in water therefore PCBs were not frequently detected in surface water. PCBs were frequently detected in the surface sediment, and less frequently in subsurface sediment samples collected in Area II. Aroclor 1262 and Aroclor 1268 were detected most frequently, with less frequent detection of Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260 with the greatest amount of detections in Area C. The higher frequency of PCB detection in surficial samples suggests that the PCBs were adsorbed onto sediment particles that may have migrated to the areas with surface water flows, runoff, or tidal fluctuations. The cause of less frequent detections in subsurface sediment is not known. It may be the result of the lack of erosional scour and redeposition of contaminated sediments or the deposition of the PCBs is relatively recent (erosion from banks, or surface water transport).

PCBs were detected more frequently in the surface sediment in the Ferry Creek channel than in the Housatonic River wetlands. This is because Raymark discharged directly to Ferry Creek. The detection of PCBs within all three areas B, C, and F, however, may also be attributed to the placement of contaminated fill materials in or adjacent to the wetland areas. PCBs were not as frequently detected in Selby Pond, with infrequent detections in the surface sediment, and no detections in the subsurface sediment in the Selby Pond Area.

Dioxins and Furans - In a pattern similar to the PCBs because of their adsorption tendencies and low water solubilities, dioxins/furans (as TEQ concentrations) were frequently detected in surface sediment and less frequently detected in subsurface samples throughout Area II. The higher frequency of detection in surface samples suggests that the dioxins and/or furans were adsorbed onto sediment particles that migrated to these areas with surface water flows, runoff, or tidal fluctuations. The cause of less frequent detections in subsurface sediment is not known, but may be the result of erosional scour and redepositional mixing of sediments not occurring at these locations. Deposition of the dioxins/furans may also be relatively recent.

The highest TEQ concentrations levels were detected in surface sediment in the narrow wetland area in the mid-western region of Area B, in the surface and subsurface sediment in the southwestern region of the Area B wetlands, and in the wetlands east of Shore Road in Area C. The elevated TEQ concentrations were detected more frequently in the wetland areas than in the Ferry Creek channel. These results suggest that the source may be based on

surface disposal of Raymark soil-waste/fill, and/or the migration of dioxins/furans through surface water flow that tends to accumulate in the wetlands where the sediment/silt media may be higher in organic carbon.

Dioxins/furans were not detected in the subsurface sediment in the Selby Pond Area. The TEQ concentrations were fairly consistent in surface samples collected throughout the Selby Pond Area.

Metals – Metals tend to be less mobile in the environment than organic contaminants. Some dissolution of metals does occur in the presence of water, however, as these metals precipitate out of solution they adsorb to sediment particles. Copper and lead were frequently detected at significant levels above background in both surface and subsurface sediment in Area B; in Area C, detection of these metals was more frequent in the surface sediment than the subsurface sediment. These metals were not detected frequently in surface water, except in the wetlands of Area C. Copper and lead were frequently detected above background levels in a single subsurface sediment sample collected from the Selby Pond Area. A single elevated lead sample was found in surface water in the vicinity of the channel mouth that connects the pond tidally to the Ferry Creek channel.

In the sediment in Selby Pond, the higher frequency of detections in surface samples suggested that the contaminant source is relatively recent (resulting in surficial deposition of contamination), and/or little deposition or mixing with deeper sediments has occurred; and/or the metals migrated in the dissolved state and precipitated on surface sediment particles upon contact. The levels were fairly consistent throughout the Selby Pond Area, with the highest levels detected in the vicinity of the channel mouth that connects the pond tidally to Ferry Creek channel.

In the sediment in the Ferry Creek channel, the similar frequency of detections in surface and subsurface sediment samples suggests that deposition of contaminated sediment has occurred over an extended period of time (resulting in deposition of contamination with depth). Similar detections with depth in the wetland areas adjacent to the lower Ferry Creek channel may be attributable to the placement of contaminated sediments dredged from the mouth of Ferry Creek.

In the Area C wetlands, a higher frequency of copper and lead detections in the surface sediment suggest that the contaminant source is relatively recent (resulting in surficial deposition of contamination), the metals may have migrated in the dissolved state and precipitated onto surface sediment particles upon contact, or contaminants have eroded from the waste deposited on the surface water bodies.

Copper and lead are not apt to dissolve in an aqueous environment under natural conditions (neutral pHs) and were seldom detected in surface water throughout Areas B and F. The more frequent detections in surface water from Area C suggest that these metals may have been present on suspended particulates in this area, or that they were leached out of contaminated sediment or soils. Elevated concentrations of barium (which is more water soluble) were detected at slightly higher frequencies than copper and lead in surface water Area II. Barium was detected at slightly higher frequencies in surface sediment in the Selby Pond Area, but it was not detected in the surface water. The highest concentrations of barium were detected in the same general areas where copper and lead were found.

Elevated levels of lead and/or copper were detected in three sediment samples submitted for SPLP analysis from Area B (no samples were collected for SPLP analysis from the other two areas). This suggests that these materials continually leach copper and lead into the surrounding media under natural conditions.

Asbestos - Asbestos is relatively immobile in the environment, except through bulk advective movement, dispersion in aqueous or airborne environments, or physical erosion and transport in surface water flows.

Elevated levels of asbestos were detected in sediment in the same relative locations as were copper and lead, thereby supporting the conclusion that placement of contaminated fill material in or adjacent to the wetlands in Areas B and C, and the placement of contaminated sediment dredged from the mouth of Ferry Creek in the wetlands adjacent to the lower Ferry Creek channel in Area B, was the source of contamination.

Elevated levels of asbestos were detected infrequently in surface and subsurface sediment from the Selby Pond Area. The highest levels were detected in surface samples from the northeastern region of the pond in the vicinity of the channel mouth that connects the pond tidally to the Ferry Creek channel. The findings suggest the asbestos may have been transported tidally from Ferry Creek, as well as by transport in rainwater runoff from asbestos-laden fill materials placed in close proximity to the northeastern region of Selby Pond.

5.3 Summary

Contaminants were released into the environment in Area II by various historical disposal and operational practices associated with the former Raymark Facility and potentially from other commercial and industrial operations within the OU3 area. The main sources and releases of contaminants to Area II include the disposal of Raymark soil-waste/fill, discharge from the former Raymark Facility into Ferry Creek and connecting waterways, local spillage and/or leakage into the ground, and the possible discharge of contaminated groundwater to proximate water bodies.

VOCs were not widely detected in Area II, so it is unlikely that VOCs have migrated through leaching or erosion. Because no monitoring wells exist in Area II, the possibility of contaminants leaching to groundwater cannot be evaluated. SVOCs were also not widely detected, but PAHs have been detected. PAHs typically have low volatility and are less soluble than VOCs. These SVOCs are likely to remain adsorbed to soil particles and are only gradually leached by precipitation infiltration. Erosion of soils can cause SVOCs to be deposited in sediments in the Housatonic River, and SVOCs adsorbed to sediment particles could migrate through erosion and redeposition, as well as surface water flow.

Pesticides, PCBs, and dioxins are relatively nonvolatile organic compounds that are generally insoluble in water. Most likely, limited leaching of these chemicals to groundwater is occurring, although no monitoring wells exist in Area II to confirm or deny this is happening. Erosion and runoff in Area II can convey these chemicals into nearby waterways. Wind erosion may also cause dusts containing pesticides, PCBs, or dioxins to become mobilized to the air. This could occur in Area D where non-vegetated soils could be prone to erosion.

Metals in Area II soils may become mobilized through erosion and runoff, and although less likely, through fugitive dust emissions. SPLP results for metals indicate that lead and copper could be leaching to groundwater, but no monitoring wells exist in Area II to evaluate metal concentrations in groundwater and the source(s) of contaminants. Metals bound to sediments will be conveyed downstream through sediment transport processes such as mixing, advection, and sedimentation. Unadsorbed metals may continue migrating to surface water. Analytical results indicate that metal concentrations are not exceeding the CT AWQ criteria.