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RAYMARK
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RAC1-EPA-1581

Contract No. 68-W6-0045

October 4, 1999

Mr. Ronald Jennings (HBT)
U. S. Environmental Protection Agency
One Congress Street, Suite 1100, HBT
Boston, Massachusetts 02114-2023

Subject: Transmittal of Final Remedial Investigation Report
Raymark – Area I - Ferry Creek, OU3, Remedial Investigation/Feasibility Study
RAC I W.A. No. 002-RICO-01H3

Dear Mr. Jennings:

Enclosed are nine copies (seven bound, one unbound, and one other for distribution) of the Final Area I Remedial Investigation for the Ferry Creek, OU3 study area. As instructed by you, I have also transmitted three copies to the Connecticut Department of Environmental Protection (CTDEP).

If you have any questions, please contact me.

Very truly yours,

Heather M Ford

Heather M. Ford
Project Manager

PMO - @

HMF:pmp

Enclosures – 3 volumes per person

c: H. Horahan (EPA) w/o enc.
R. Curan (CTDEP) w/enc. (3)
A. Ostrofsky (TtNUS) w/o enc.
File N7491-1.0 w/o enc./N7491-3.4w/enc.

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FINAL
AREA I
REMEDIAL INVESTIGATION

VOLUME I OF III
TEXT

RAYMARK-FERRY CREEK-OPERABLE UNIT 3
STRATFORD, CONNECTICUT

RESPONSE ACTION CONTRACT (RAC), REGION I

For
U.S. Environmental Protection Agency

By
Tetra Tech NUS, Inc.

EPA Contract No. 68-W6-0045
EPA Work Assignment No. 002-RICO-01H3
TtNUS Project No. N7491

October 1999

Heather M. Ford
Project Manager

George D. Gardner, P.E.
Program Manager

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STRATFORD, CONNECTICUT

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ACRONYMS AND ABBREVIATIONS USED IN THE REMEDIAL INVESTIGATION REPORT

ABS	Absorption Factor
ARARs	Applicable or Relevant and Appropriate Requirements
ARCS	Alternative Remedial Contracting Strategy
AST	aboveground storage tank
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
B&RE	Brown & Root Environmental
°C	degree Celsius
CDM	Camp Dresser and McKee
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Amended by SARA in 1986. Also called the Superfund Law.
cc	cubic centimeter
cf	cubic foot
cfm	cubic foot per minute
cfs	cubic foot per second
CFR	Code of Federal Regulations
CLP	(EPA) Contract Laboratory Program
cm	centimeter
cm/sec	centimeter per second
COC	Contaminant of Concern
COCP	Contaminant of Potential Concern
CPF	Carcinogenic Potency Factor
CSF	Carcinogenic Slope Factor
CSI	Comprehensive Site Investigation
CT DEP	Connecticut Department of Environmental Protection
CT DHS	Connecticut Department of Health Services
CT DOH	Connecticut Department of Health
CT DOT	Connecticut Department of Transportation
CT DPHAS	Connecticut Department of Public Health and Addiction Services
CTE	Central Tendency Exposure
CWA	Clean Water Act
CY	cubic yard
DAS	Direct Analytical Services
DDT	Dichloro diphenyl trichloroethane
dia	diameter
DNAPL	dense non-aqueous phase liquid
ELI	Environmental Laboratories, Inc.
EM	Electromagnetic
EPA	U.S. Environmental Protection Agency
ESI	Expanded Site Inspection
°F	degree Fahrenheit
FEMA	Federal Emergency Management Agency

Foster Wheeler	Foster Wheeler Environmental Corporation
FS	Feasibility Study
ft	foot
ft^2/day	square foot per day
ft^3/day	cubic foot per day
g	gram
GA/GAA	State of Connecticut classification for drinking water sources
gal	gallon
GB	State of Connecticut classification for non-drinking water sources
gpd	gallon per day
gpm	gallon per minute
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HEAST	EPA's Health Effects Assessment Summary Tables
HI	Hazard Index
HNUS	Halliburton NUS Corporation
hr	hour
HQ	Hazard Quotient
i	hydraulic index
ID	inner diameter
IEUBK	EPA's Integrated Exposure Uptake and Biokinetic Model for lead exposure
ILCR	Incremental Lifetime Cancer Risk
in.	inch
IDW	Investigation-Derived Waste
IRIS	EPA's Integrated Risk Information System Database
K	Hydraulic conductivity
K_d	Adsorption coefficient
kg	kilogram
K_{oc}	Adsorption partitioning coefficient
K_{ow}	Octanol-water partitioning coefficient
l	liter
lb	pound
LDR	land disposal restriction
LOAEL	Lowest Observed Adverse Effect Level
m	meter
μ	micro (prefix)
μg/dL	micrograms per deciliter
μg/kg	microgram per kilogram
μg/l or μg/L	microgram per liter
MCL	Federal Safe Drinking Water Act maximum contaminant level. The primary MCL is health-based; the secondary is aesthetic-based.
MCLG	Federal Safe Drinking Water Act maximum contaminant level goal.
MEP	Multiple Extraction Procedure
MFL	million fibers per liter
mg	milligram
mg/kg	milligram per kilogram

mg/l or mg/L	milligram per liter
mi	mile
ml	milliliter
mph	miles per hour
MSL	mean sea level
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
NTCRA	Non-Time Critical Removal Action
OSHA	Occupational Safety and Health Administration
OSWER	(EPA's) Office of Solid Waste and Emergency Response
OU2	Operable Unit No. 2
OU3	Operable Unit No. 3
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	Polychlorinated dibenzo dioxins
PCDF	Polychlorinated dibenzo furans
PCE	Tetrachloroethene
pH	hydrogen-ion concentration
ppb	part per billion
ppm	part per million
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
psi	pound per square inch
QA/QC	Quality Control/Quality Assurance
RAC	Response Action Contract
RAO	Remedial Action Objective
Raymark Facility	Raymark Industries, Inc. Facility
RRCs	EPA Region III Risk-based Calculation
RCP	reinforced concrete pipe
RCRA	Resource Conservation and Recovery Act
Removal Action	Action taken by EPA to address immediate danger to public health and the environment
RfC	Reference Concentration
RfD	Reference Dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	(EPA's) Record of Decision. Documents the selection of a cost-effective Superfund remedy.
RSRs	State of Connecticut Remediation Standard Regulations
SARA	Superfund Amendments and Reauthorization Act of 1986.

	Amended CERCLA. Also known as the Superfund law.
SB/SC	State of Connecticut Classification for Coastal and Marine Surface Water
SCT	Salinity-Conductivity-Temperature
SDWA	Safe Drinking Water Act
SPLP	Synthetic Precipitation Leaching Procedure
SPT	Standard Penetration Testing
sq ft	square foot
sq in.	square inch
sq yd	square yard
SSL	EPA's generic soil screening levels
SVOC	Semivolatile Organic Compound
TAL	(CLP) Target Analyte List for Inorganics
TAT	Technical Assistance Team
TBC	To Be Considered
TC	Toxicity Characteristic
TCB	Trichlorobiphenyl
TCDD	2,3,7,8 – tetrachlorodibenzo-p-dioxin
TCE	Trichloroethene
TCL	(CLP) Target Compound List for Organics
TCLP	Toxicity Characteristic Leaching Procedure
TEF	Toxicity Equivalence Factor
TEQ	Toxicity Equivalency
TERC	Total Environmental Restoration Contract
TOC	Total Organic Carbon
TOX	Total Organic Halides
TPH	Total Petroleum Hydrocarbons
TPY	ton per year
TSCA	Toxic Substances Control Act
TSD	(RCRA) Treatment, Storage, and Disposal
UCL	Upper Confidence Limit
USACE	U.S. Army Corps of Engineers
USCS	Unified Soils Classification System
USDOI	U.S. Department of the Interior
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	Volatile Organic Compound
VSP	Vertical Sampling Program
Weston	Roy F. Weston, Inc.
WQC	State of Connecticut water quality standards
1,1-DCA	1,1-Dichloroethane
1,1,1-TCA	1,1,1-Trichloroethane
1,2-DCE	1,2-Dichloroethene
1,1-DCE	1,1-Dichloroethene
2,4-D	2,4-dichlorophenoxyacetic acid

1.0 INTRODUCTION

This Area I Remedial Investigation (RI) Report defines the nature and extent of contamination in Ferry Creek, other ecological areas, and adjacent properties resulting from past disposal practices at the Raymark Industries, Inc. Facility (Raymark Facility), located in Stratford, Fairfield County, Connecticut (Figure 1-1). This RI Report was prepared by Tetra Tech NUS, Inc. (TtNUS, formerly Brown & Root Environmental (B&RE)), for the U.S. Environmental Protection Agency (EPA) under RAC Work Assignment No. 002-RICO-01H3, Contract No. 68-W6-0045, to partially fulfill the requirements for Operable Unit No. 3 (OU3), Raymark - Ferry Creek. Originally, a Draft RI was issued in June 1998, for all the OU3 areas affected by Raymark-type waste. In that document the OU3 study area was divided into 8 areas (A-1, A-2, A-3, B, C, D, E, and F – see Figure 1-2). However, when EPA decided additional information was needed for some of these areas, a decision was made to sub-divide the areas into 3 separate cleanups. The Area I study area (study area), which includes subareas A-1, A-2, and A-3, is on the fastest track and is the subject of this Final RI report. The Area II study area contains subareas B, C, and F, and it is anticipated that the Draft RI report will be issued in the winter of the year 2000. The Area III study area contains subareas D and E, and it is anticipated that the Draft RI report will be issued in the winter of the year 2000.

As requested by EPA, this RI Report incorporates information collected for OU3 during 1997 to 1999, with data previously compiled in the *Final Technical Memorandum, Compilation of Existing Data, Raymark - Ferry Creek* (B&RE, January 1997). This RI Report was developed based on the original Work Plan (December 1996), Work Plan Amendment No. 2 (March 1997), and Work Plan Amendment No. 4 (February 1998). The results of the field work executed under Work Plan Amendment No. 3 are also a part of this RI. Additional efforts to evaluate groundwater contamination beneath and downgradient of the former Raymark Facility are currently being conducted by TtNUS under a separate work assignment.

This Area I RI Report was prepared in accordance with the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988). It is consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980; as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986; and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This Area I RI Report is consistent with the State of Connecticut's applicable and relevant environmental laws and regulations.

1.1 Purpose of Report

This Area I RI Report documents the nature and extent of contamination, and associated public health and environmental risks within Ferry Creek, other ecological areas, and adjacent properties associated with the Raymark Facility. (Figure 1-2 identifies the OU3 study area and the Area I study area.) The overall objectives of the RI are to:

- Compile and evaluate all available data needed to characterize the study area conditions and to determine the nature and extent of contamination in the surface water, sediment, and soil in Ferry Creek and other ecological areas,

- Assess the total risks to human health and the environment within the study area,

- Serve as the data resource for developing, screening, and evaluating a range of potential alternative remedial actions that address the contamination within the study area. The RI also supports the remedial alternatives screening and the Feasibility Study (FS).

1.2 Report Organization

This RI Report is comprised of three volumes. Volume I presents the text and discussion of investigation activities, results, interpretations, and references. Volume II contains

tables and figures (including oversize figures). Volume III presents the appendices. Appendix A contains the boring logs; Appendix B is comprised of a disk, which contains analytical data used to produce this RI Report; Appendix C is the Hydraulic Assessment prepared by the U.S. Army Corps of Engineers (USACOE); Appendix D is the Ecological Risk Assessment prepared by the National Oceanic and Atmospheric Administration (NOAA); Appendix E is the Ground Penetrating Radar Survey; Appendix F is the backup tables and calculations for the Human Health Risk Assessment; Appendix G contains the supplemental evaluations of the Nature and Extent of Contamination; and Appendix H contains the supplemental evaluation of Contaminant Fate and Transport.

This RI Report is organized as follows:

- Section 1.0, Introduction, discusses the purpose and scope of the RI, summarizes the background and history, and describes the study area,

- Section 2.0, Study Area Investigations, presents a summary of the previous field investigation activities conducted in the study area,

- Section 3.0, Physical Characteristics of the Study Area, presents descriptions of surface features and land uses, geology, hydrogeology, surface water hydrology, and meteorology,

- Section 4.0, Nature and Extent of Contamination, discusses the potential sources, contaminant presence, and contaminant distribution in the soil, surface water, and sediment in the study area,

- Section 5.0, Contaminant Fate and Transport, presents an interpretation of potential contaminant migration pathways and transport mechanisms,

- Section 6.0, Baseline Human Health Risk Assessment, includes identification of human receptors and exposure pathways, selection of contaminants of concern

(COCs), a discussion of the human health effects associated with the COCs, and the results of the human health risk evaluation,

- Section 7.0, Ecological Evaluation, presents a summary of the environmental setting and identifies areas of potential ecological concern. The ecological risk assessment is presented in Appendix D,

- Section 8.0, Summary and Conclusions, details the summary of Sections 4.0, 5.0, 6.0, and 7.0 and the conclusions reached on contaminated areas.

1.3 Study Area Background

This section summarizes the history of the study area and vicinity, the past operations at the Raymark Facility, describes the study area, identifies other on-going activities associated with the Raymark Facility, and summarizes the types of investigations previously conducted at the Raymark Facility and its environs.

1.3.1 History of Raymark Facility and Environs

The Raymark Facility, formerly named Raybestos - Manhattan Company, was located at 75 East Main Street in Stratford, Fairfield County, Connecticut at latitude 41°12'02.5"N and longitude 73°07'14.0"W (see Figure 1-1). The Raymark Facility operated from 1919 until 1989, when the plant was shut down and permanently closed. The Raymark Facility produced and manufactured products mainly for the automotive industry. The manufacturing of these products generated waste. The facility was demolished and a cap was placed over the contaminated areas on the property in 1996 and 1997. Based on Stratford tax map information, the facility occupied 33.4 acres and manufactured friction materials containing asbestos and non-asbestos components, metals, phenol-formaldehyde resins, and various adhesives. Primary products were gasket material, sheet packing, and friction materials including clutch facings, transmission plates, and brake linings. As a

result of these activities, soils at the facility became contaminated primarily with asbestos, lead, and polychlorinated biphenyl compounds (PCBs).

Between 1919 and 1984, low-lying portions of the Raymark Facility were filled with manufacturing waste materials from various plant operations. The filling of those areas occurred over the life of the facility operations, and progressed essentially from north to south, across the Raymark Facility. New buildings and parking areas were constructed over these filled areas as the manufacturing facility expanded.

The Raymark Facility was underlain by an extensive drainage system network. This network collected water and wastes from the manufacturing operations and diverted it into the facility drainage system. The system also collected stormwater runoff. These liquids were transported through the drainage system network, mixed with lagoon wastewaters, and discharged to Ferry Creek.

During peak operations at the Raymark Facility, approximately two million gallons of water were used for plant processes each day. Municipal water was used for both contact and non-contact cooling water. To supplement this source, Raymark installed an additional on-site supply well. The well, located in the northeastern corner of the facility, was used for non-contact cooling water. Facility water was recirculated, with some percentage reinjected into the on-site well, the remaining water and municipal water were discharged through the facility drainage system. Wastewater from facility operations was collected and discharged to a series of four settling lagoons located in the southwestern corner of the facility, and along the southern property boundary near Longbrook Avenue and the Barnum Avenue Cutoff. The wastewater consisted of wastewater from the acid treatment plant, wet dust collection, and paper making processes; non-contact cooling water, and solvent recovery plant operations. The lagoons also received stormwater drainage and surface water runoff.

Solids were allowed to settle in Lagoon Nos. 1, 2, and 3 prior to discharge of clarified wastewater and unsettled solids to Lagoon No. 4, that in turn discharged directly into

Ferry Creek. Discharge of wastewater to Lagoon Nos. 1, 2, and 3 ceased in 1984. These lagoons were closed in December 1992 and January 1993. During the fall of 1994, stormwater drainage that exited the Raymark Facility through Lagoon No. 4 was diverted around this lagoon and connected directly to the storm sewer, which ultimately discharges to Ferry Creek. Lagoon No. 4 was closed in early 1995.

During the operation of the lagoons, the settled material in the lagoons was periodically removed by dredging. During the facility's 70 years of operation, it was common practice to dispose of both this dredged lagoon waste and other manufacturing waste as "fill" material (referred to as "Raymark-type waste" in this RI) both at the Raymark Facility and at various locations in Stratford. Several of these locations that received Raymark-type waste are included within the area designated as "the study area" (Figure 1-2).

A number of these off-the-facility "locations," with levels of asbestos, lead, and PCBs that may pose a threat to public health, were remediated under EPA CERCLA time-critical removal actions during 1993 to 1996. The remediated locations are residential properties that were designated a health threat and excavated under EPA direction to abate the public health threat that may have existed. The excavated material from these residential locations was stored and ultimately placed under the cap at the Raymark Facility. Waste from one municipal property, Wooster Middle School, was also excavated, stored, and ultimately placed under the cap at the Raymark Facility.

In 1980, Raymark filed a Notification of Hazardous Waste Activity in accordance with RCRA. RCRA activities are detailed in Sections 1.3.3.1 of this report.

In 1992, EPA issued Raymark a CERCLA 106 Removal Order and work plan designed to abate the danger or threat to public health and welfare, and the environment posed by four open lagoons containing asbestos, metals, solvents, and PCBs; a hazardous waste pile; buildings and land containing hazardous substances; and large tanks of questionable integrity containing asbestos and hazardous substances; and to eliminate the potential for hazardous substances to migrate off-site.

1.3.2 Facility Operating History

The following narrative presents a summary of plant operations and waste handling practices for Raymark's manufacturing operations; see OU1 RI (HNUS, 1995) for further details.

1.3.2.1 Phenolic Resin Manufacturing

Solid and liquid phenolic resin was manufactured at the Raymark Facility. The resin was produced in five or six pressure vessels; companion tanks held the raw product. After production, the liquid resins were transferred to the plant floor to manufacture plant goods or to set in order for use in solid form. Prior to use, the solid resins were pulverized on site to meet product specifications, and then transferred to the plant floor for use.

1.3.2.2 Brake Lining Production

Brake lining production began by adding dry asbestos materials, liquid phenolic resins, and solvents (to thin the resins) to the mixers located on the plant floor. The mixers operated for approximately one hour until the liquid resin had penetrated and coated all the dry materials. This mixture, resembling a soft heavy mud, was formed into brake lining parts that were then baked in ovens for six hours. The end product was a hard material that was machined to the specifications of a finished brake lining. As necessary, materials that were trimmed and ground during the machining operations and not used in the finished product were disposed of on- or off-site as fill/soil-waste material; after 1984, these processed wastes were shipped off site in containers.

During the machining operations, waste particulates were collected in a wet-type dust collection system. Particulates collected from the system were mixed with process water and pumped to the on-site lagoons as a 90/10 water/dust slurry mixture. The slurry mixture settled out in the lagoons and eventually filled them. When a lagoon was filled, the slurry mixture would be diverted to another lagoon, to allow time (several months) to

dewater. The dewatered material in the lagoon was excavated and disposed of either on-site or off-site. After 1984, the waste particulates were collected in dry dust collectors and disposed of off site in one-cubic yard bags.

1.3.2.3 Standard Transmission Clutch Plates

The process of producing clutch plates began by creating a mixture of asbestos, other components, and water and forming a paper-like sheet of material. This sheet was rolled onto a machine roller, saturated with phenolic resin, and then oven dried and cured. The clutch plates were machined to specifications from these sheets and the finished clutch plate was bonded to a steel core. As in the brake lining production, the manufacturing process produced machining particulates that were collected in the dust collection system, mixed into a wet slurry, and pumped to the lagoons to settle. This system was replaced in 1984, by the dry dust collectors.

In the early 1980s, the process was modified to allow water to be reused and captured into the manufacturing process resulting in no discharge of water. In addition, the dry asbestos used in the original manufacturing of the paper-like material was replaced with a cotton-type material, so the product became asbestos-free.

The Raymark Facility molded (raw) steel into a steel core onto which the clutch plate was mounted. After molding the steel core was degreased, etched to specification, coated with a phenolic resin, and allowed to dry. The clutch plate was then mounted to the steel core.

A specialty heavy-duty clutch was also manufactured on the Raymark Facility. The process of mixing the asbestos, resins, and water to produce heavy-duty clutches was similar to that used to produce the standard transmission clutch plates.

1.3.2.4 Gasket Material Manufacturing

Gasket material was produced in large rubber sheets. The rubber was composed of naphtha, toluene, asbestos, phenolic resins, and various fillers. The process began by mixing asbestos, latex, rubber cement, and rubber together until the mix was homogeneous. The mix was then loaded onto a roller machine where it was flattened into a sheet. The sheet was removed and laid out on a large table for cutting. The gaskets were then cut to specification.

The trim from cutting was pulverized and re-used in the process. Vapors were collected and passed through the activated carbon solvent recovery plant. Prior to the mid-1980s, no vapor collection or handling occurred.

1.3.2.5 Disc Brake Pad Manufacturing Operations

Asbestos, glass, and semi-metallic disc brakes were manufactured at the Raymark Facility. Asbestos disc brakes were composed of asbestos, phenolic resin, and fillers; glass disc brakes were composed of fiberglass, phenolic resin, and fillers; and semi-metallic disc brakes were composed of steel wool, phenolic resin, and fillers. The operations to process these disc brake pads involved mixing components in plant mixers until a homogenous mixture was coated completely with phenolic saturate, pouring the mixture into electronically heated molds to form a hard part, and machining this part into the needed specified product size.

Waste generated from the machining process was collected in the dust collector system, and transported as described above, as a water/waste slurry mixture to the on-site lagoons. After 1984, dry dust collectors collected the particulate matter and the material was disposed of off site in one-cubic yard bags. The trim and off-specification material, if not pulverized for reuse, was disposed of as fill.

1.3.2.6 Miscellaneous Activities

The following activities also occurred on the Raymark Facility:

- Coal-fired Steam Generation - The Raymark Facility generated steam from August 1919, until the early 1940s. Steam was generated from coal-fired steam boilers. The coal was delivered by rail directly onto the facility by a railroad spur that has since been removed. The coal was stored in the area surrounding the boiler house and heavy equipment transported it around the plant. No figures are available on the quantities of coal used,

- Steam Boilers - The steam boilers were converted to oil in the early 1940s. Number six fuel oil was stored in two 50,000 gallons tanks. No figures are available on quantities of oil used,

- Material Storage - Numerous tanks located throughout the plant stored raw product, manufactured goods not yet turned into a product, and waste products remaining from the various manufacturing processes,

- Dry Trim Reclamation - The materials that were trimmed from the baked products (dry trim) were stored outside under a roof on the asphalt pavement. The trim re-use process consisted of using hammer mills to pulverize the waste trim. As dry trim re-use occurred more frequently during later years of facility operations, particulates from this process were collected in a separate dry dust collector system and bagged for disposal,

- Finished Products - These materials were stored on-site pending off-site shipment to customers.

1.3.3 Environmental Permits

The Raymark Facility was subject to the requirements of both state and Federal Permits.

1.3.3.1 RCRA Activities

Raymark filed a Notification of Hazardous Waste Activity form on August 15, 1980, under the name of Raybestos Friction Materials Company. The activities delineated on this form indicated that the company generated, treated, stored, and disposed of hazardous wastes such as chlorinated solvents, acetone, formaldehyde, toluene, sludge from lime treatment generated from steel finishing operations, asbestos, acids, phenols, methyl ethyl ketone, and ignitable, corrosive, toxic wastes.

On November 12, 1980, the notification was expanded to include the activities and quantities listed below for each waste activity. However, the quantities listed below were the total permitted quantities and not the actual quantities or units reportedly used at Raymark.

- The Raymark Facility was permitted to process more than 2.5 billion gallons of lead-contaminated waste liquid each year in the on-site lagoons. It is estimated that 6 million gallons of the 2.5 billion gallons were treated each year.

- The Raymark Facility container storage area was permitted to handle approximately 23 million gallons of toxic, ignitable, corrosive, and acidic wastes each year.

- The Raymark Facility tank storage area was permitted to handle approximately 10 million gallons of waste yearly.

- The Raymark Facility incinerator was permitted to process approximately 240,000 gallons per year of toxic and ignitable wastes.

In 1986, Raymark filed a permit application for the various Raymark Facility activities under the name of Raymark Industries, Inc. At that time, the original RCRA Part A notification was re-filed and the on-site activities and waste generated were significantly reduced. The activities described in the revised submittal included 7,040 gallons of liquid container waste, 150 cubic yards of solid container waste stored on the property, and an approximately 7-acre landfill on the property. The "landfill" was comprised of the lagoons previously located along the southern boundary of the Raymark Facility. Each of these activities appeared to include the handling of ignitable, toxic, corrosive, and toluene-contaminated wastes.

The facility closed in September 1989. In 1990, pursuant to a RCRA 3007 information request, Raymark indicated it still had significant quantities of waste and unused products remaining on-site. Some of these waste products were 400,000 gallons of asbestos slurry in tanks and 1,700 cubic yards of unfinished asbestos product. These wastes were removed from the Raymark Facility between 1990 to 1994.

During the operations of the Raymark Facility, wastewaters were routed into four lagoons. Three of the lagoons stopped receiving waste in 1984, and were temporarily closed in December 1992 and January 1993, under an EPA order. The fourth lagoon was temporarily closed in 1994. In 1993, on-site storm water was rerouted around Lagoon No. 4 so the storm water no longer discharged into Lagoon No. 4. The facility cleanup/remediation was conducted under the CERCLA program, and the on-site sources (lagoons, tanks, incinerator) have been removed and/or remediated as part of the long-term solution.

1.3.3.2 Wastewater Activities

The Raymark Facility had a 2.5 million gallon per day water and wastewater discharge flow from the plant operations into the lagoons for discharge into Ferry Creek. This discharge was permitted under the State of Connecticut National Pollution Discharge Elimination System (NPDES) program from the early 1970s until the early 1990s, with

volumes decreasing as plant activities were reduced. The activities permitted included: acid treatment plant wastewater, dust collection system wastewater, noncontact cooling water, and solvent recovery plant wastewater. A separate permit was issued for an extraction well, which was installed on-site to remove groundwater contaminated with toluene from the aquifer which was discharged to the sanitary sewer. The toluene contamination was the result of a spill that occurred on site in 1984.

1.3.4 Study Area Description and Setting

The area identified as the study area for this Area I RI includes Ferry Creek, other ecological areas, and adjacent properties impacted by the Raymark Facility soil-waste. Originally, the OU3 area was defined as the commercial properties (Morgan Francis, Spada, and the Housatonic Boat Club) where Raymark-type waste was known to have been deposited. The OU3 area was expanded to include Ferry Creek and surrounding wetlands based on analytical results of surface water and sediment sampling conducted in the creek. The proximity of additional commercial and municipal properties that may also have received fill from Raymark waste increased the scope of the OU3 area to its present configuration (Figure 1-2). Because additional information was needed on these parcels, EPA decided to separate the OU3 areas into three study areas. This RI contains information on Area I, which includes subareas A-1, A-2, and A-3. These locations are downgradient of the facility and may have been affected by wastewater discharge, stormwater drainage, surface water runoff, manufacturing waste direct deposition, and groundwater contaminant migration. The name designations used for locations and properties in this report are those that have become convention for the study area, as established by EPA.

Ferry Creek is located approximately 500 feet west of and parallel to the Housatonic River. It flows south from the Interstate 95 overpass through the Morgan Francis Property, under East Broadway Street and Ferry Boulevard, through the Spada Property, to the non-functioning flood control barrier (spring-loaded sluice gate system that is stuck partially open by debris) at Broad Street, and discharges into the Housatonic River. The OU3 area

also includes "other ecological areas impacted by Raymark Facility waste", which are defined by the delineated wetland boundaries along Ferry Creek; the delineated wetland boundaries along the Housatonic River, the Housatonic Boat Club and Beacon Point Road (north and south of the boat launch); the wetland located adjacent to and south of 1260 Elm Street, Lot K; and the Selby Pond Site, located south of the intersection of Stratford Avenue and Lockwood Avenue. Wetlands have been delineated throughout the study area. The Area I study area is comprised of the following properties;

- **Subarea A-1 (Upper Ferry Creek – Morgan Francis Property)** is located approximately 600 feet south of the Raymark Facility property. The boundaries consist of Interstate 95 to the north and northwest, residential properties along Blakeman Place to the west, Ferry Boulevard and East Broadway Street to the east and northeast, and residential properties along Harris Court to the south. It encompasses a portion of Ferry Creek, which flows south from Interstate 95 to Ferry Boulevard; some commercial properties that EPA refers to as Salce Construction, Preferred Products, Shock's Autobody, and the Morgan Francis property; and the State of Connecticut properties near Interstate 95 and the triangle-shaped parcel of land between Ferry Boulevard and East Broadway Street. It is noted that "clean" fill was placed on a portion of the Morgan Francis property in Subarea A-1. Subarea A-1 covers approximately 11.1 acres, including approximately 0.44 acres of wetlands (including the creek channel). The upland vegetation at the Morgan Francis property consists of early successional open field vegetation, with areas of shrubs and trees along the property boundary fenceline and along the Ferry Creek channel. Wetland vegetation along Ferry Creek in this area is sparse since much of the creek channel is rip-rapped and has steep-sided banks. The State of Connecticut properties near Interstate 95 and the triangle-shaped parcel of land between Ferry Boulevard and East Broadway Street consist of mowed grass areas. A small swale (approximately 500 square feet), dominated by common reed is present in the triangle-shaped parcel. The commercial properties (Salce Construction, Preferred Products, and Shock's Autobody) are unvegetated developed properties, with the exception of landscape plantings. The area surrounding the buildings on these commercial properties are typically covered with pavement or gravel.

- **Subarea A-2 (Upper Ferry Creek – Commercial Property)** is located approximately 50 feet east of Subarea A-1. The boundaries consist of Ferry Boulevard to the west, Ferry Creek and an undeveloped lot to the south and east, residential properties along Willow Avenue to the north, and Broad Street to the south. It encompasses numerous commercial properties that EPA refers to as the Blue Goose Restaurant, Rotary Ski Shop, Fordham Realty, Dan Perkins Subaru, Veras Motors, Ink Masters Shop, and an empty lot at 170 Ferry Boulevard. Area A-2 covers approximately 10.3 acres, none of which is wetlands. The area surrounding the commercial property buildings are generally paved parking lots with some landscape plantings.

- **Subarea A-3 (Upper Ferry Creek - Wetlands)** runs parallel to Housatonic Avenue. The boundaries consist of Subarea A-2 to the west, residential properties along Housatonic Avenue to the east, residential properties along Willow Avenue to the north, and Broad Street to the south. It includes undeveloped wetlands and uplands, with Ferry Creek flowing south along the western border. A non-functioning flood control barrier/hydraulic sluice gate system is located to the south where Ferry Creek and Broad Street intersect. Area A-3 covers approximately 7.1 acres, including approximately 2.4 acres of wetlands (including the creek channel). Generally, area A-3 vegetation is dominated by common reed (*Phragmites australis*) along the upland creek bank and wetland area. The upland bank along Ferry Creek has a narrow tree line with a dense understory of shrubs and vines. A small grassland area of approximately one-quarter acre is also present at the north end of area A-3, east of the Blue Goose restaurant.

1.3.5 Other On-Going Activities

Activities undertaken in the vicinity of the study area that are related to the investigations conducted to support this RI include;

- Raymark Facility Closure - The property has been capped by EPA under the U.S. Army Corps of Engineers Total Environmental Restoration Contract (TERC). An enhanced soil gas collection system was installed with the purpose of removing

NAPL from the absorbed phase of the soil adjacent to the water table. A NAPL extraction system was installed in the western portion of the site to prevent mobilization and migration of NAPL. Operation and maintenance activities are being conducted by the CTDEP.

- Groundwater Remedial Investigation Activities - TtNUS is undertaking an RI for Raymark - OU2 to evaluate groundwater contamination under and downgradient of the former Raymark Facility. The OU2 RI is being conducted concurrently with this OU3 RI work assignment. A Technical Memorandum was submitted to EPA in May 1998.

- Raybestos Ballfield Remedial Investigation Activities – TtNUS is undertaking an RI for Raymark – OU4 to evaluate soil contamination at the Raybestos Ballfield located north of the former Raymark Facility.

1.3.6 Previous Investigations

A substantial number of field investigations relating to soil, sediment, surface water, and groundwater have been conducted at the Raymark Facility and its environs. A list of the major activities conducted to date is provided in Table 1-1. A discussion of those investigations pertinent to the study area identified in this RI is included in Section 2.0.

2.0 STUDY AREA INVESTIGATIONS

This section presents a brief description of each investigation performed to characterize the impacts to ponds, wetlands, and other properties resulting from past disposal of Raymark Facility waste materials. Previous investigations performed by TtNUS; Environmental Laboratories, Inc. (ELI); Roy F. Weston, Inc. (Weston/TAT); Foster Wheeler Environmental Corporation (Foster Wheeler); Connecticut Department of Environmental Protection (CT DEP); Connecticut Department of Public Health and Addiction Services (CT DPHAS) under cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR); and the National Oceanic Atmospheric Administration (NOAA) are described in Section 2.1 and summarized on Table 1-1. Information collected from these investigations will be used to meet the Remedial Investigation objectives presented in Section 1.1.

Additional investigations performed at the Raymark Facility to characterize the on-site materials and facility setting are summarized in the *Final RCRA Facility Investigation Report, Raymark Industries, Inc.* (ELI, 1995) and the *Final Remedial Investigation Report, Raymark Industries, Inc. Facility* (HNUS, 1995). Further evaluation of groundwater contamination beneath and migrating downgradient of the former Raymark Facility is currently being conducted by TtNUS under Raymark - Operable Unit No. 2 (OU2-Groundwater), RAC W.A. 029-RICO-01H3.

Investigation of properties potentially impacted by Raymark Facility wastes have been conducted since 1992 (see Table 1-1 and sections below). The information is presented below in chronological order. Many dates overlap because contractors were hired by a variety of entities (EPA, State of Connecticut, and the Army Corps of Engineers) to perform specific tasks. In addition, many investigations were conducted on properties both within the Area I study area, and outside of the Area I study area. These investigations are included in this section. Note there have been investigations conducted for other Raymark work assignments that do not impact the Area I Study area. These investigations have not been included.

2.1 Surface Water and Sediment Investigations (1992 - 1994)

Surface water and sediment sampling was conducted by EPA and its contractors, and the various contractors hired by Raymark Industries Inc., at the Raymark Facility and environs from 1992 through 1994, to determine whether site contaminants were migrating off the property. The sampling was conducted to assess a series of four lagoons located at the Raymark Facility in the southwestern corner and along the southern property boundary near Longbrook Avenue and the Barnum Avenue Cutoff. These lagoons, frequently referred to as settling basins or ponds, received stormwater drainage, surface water runoff, and wastewater from various on-site operations. Solids were allowed to settle in Lagoon Nos. 1, 2, and 3 prior to discharge of clarified wastewater and unsettled solids into Lagoon No. 4, which discharged into a culverted tributary that directly discharged into Ferry Creek.

2.1.1 Sediment at Raymark Facility and along Ferry Creek (1992 - 1995)

In 1992, sediment samples were collected as part of an EPA Site Inspection of Raymark Industries. Fifteen samples were collected along Ferry Creek and the Housatonic River. Samples were submitted to EPA-approved laboratories for analysis of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, metals, cyanide, dioxins/furans, and asbestos. Numerous site-related organic and inorganic contaminants were detected at elevated levels. The sampling locations and analytical results are summarized in Weston's Final Site Inspection Report (Weston, 1993).

In September 1992, Weston/TAT collected samples at depths of 0.0 to 0.5 feet from three locations from the northern reaches of Ferry Creek, where until December 1992, Raymark wastewater discharged from Lagoon No. 4 into Ferry Creek. The samples were submitted for analysis of VOCs, SVOCs, pesticides/PCBs, dioxins/furans, and metals.

In August 1994, November 1994, and April 1995, TtNUS conducted three seasonal rounds of sampling in the Ferry Creek channel in the central portion of the study area and along the western arm of the wetlands adjacent to the Morgan Francis Property. Sediment

samples from these locations were obtained from depths of 0.0 to 0.5 feet, and a sample from one of these locations was also collected from 0.5 to 1.0 feet below ground surface (bgs). However, these samples were not collected from each location and depth during each seasonal sampling round. All samples were submitted for analysis of VOCs, SVOCs, pesticides/PCBs, dioxins/furans, and metals.

2.1.2 Surface Water at Raymark Facility (1993)

Five surface water samples were collected in July 1993, to characterize the quality of drainage discharges into and out of Lagoon No. 4. After installation of the surface stormwater drainage diversion system around Lagoon No. 4, the outlet to this lagoon (Station No. 5) was resampled in October 1993. Samples were submitted for laboratory analysis of VOCs, SVOCs, PCBs, metals, cyanide, sulfide, chlorinated herbicides, organophosporous pesticides, dioxin/furan, and asbestos (ELI, 1994). These sampling rounds confirmed that the site had discharged contaminated materials/water into Ferry Creek. Results from subsequent sampling indicated that similar contaminants were detected both at the Raymark Facility and in the creek sediments (HNUS, 1994/1995 sediment and surface water sampling results).

2.2 Soil Sampling (1993)

Numerous properties throughout Stratford were sampled to identify the extent of soil contamination resulting from disposal of Raymark waste. Residential properties were sampled and evaluated, and waste was excavated when appropriate. Commercial and wetland properties were sampled, but no cleanup has occurred to date on these properties. The sample results from the commercial and wetland properties are included in this RI.

2.3 Expanded Site Inspection and Vertical Sampling Program (1993)

Between July and October 1993, soil samples were collected from the Morgan Francis Property, the Spada Property, residential properties on Patterson and Clinton Avenues,

properties along Elm Street, and properties along 3rd/4th/5th Avenue as part of the Expanded Site Inspections (ESIs)/Vertical Sampling Program (VSP). Reports were prepared by Weston for five disposal areas located within the study area.

Soil sampling was conducted to provide information regarding the presence or absence, waste characteristics, and extent of contamination. Soil horizons were selected, and individual sample collection locations were based on EPA recommendations, visual field observations, and data from Ground Penetrating Radar (GPR) interpretations. Samples were collected from soil borings ranging in depth from 0 to 16 feet bgs. The borings were advanced primarily using a Model 8-M Soil Probe Unit developed by Geoprobe Systems. Soil samples collected from various locations and depths at each property were screened for lead, asbestos, and PCBs using EPA-approved screening methods. Approximately 15 percent of the samples were submitted for confirmatory analysis through the EPA Contract Laboratory Program (CLP); these samples were analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, TCL pesticides/PCBs, and target analyte list (TAL) metals. Selected samples were also analyzed under the EPA Special Analytical Services (SAS) program for dioxins/furans, PCBs, Toxicity Characteristic Leaching Procedure (TCLP), and Multiple Extraction Procedure (MEP).

Summary reports for these investigations were completed by Weston in 1995, and report sections relevant to OU3 were presented in the *Final Technical Memorandum, Compilation of Existing Data, RI/FS, Raymark - Ferry Creek* (B&RE, 1997). Field observations, soil boring logs, and analytical results summarized in these reports were used to evaluate the presence or absence, and location of Raymark-type waste on the various properties investigated. The sample results were used to identify the most contaminated residential properties; these properties have been excavated and the contamination transported to the former Raymark Facility and placed under the cap.

The sample results for the non-residential properties within the study area are being evaluated as part of this RI and risk assessment; the need for future cleanup action will be based in part on these data.

2.4 Phase I Remedial Investigation (1993 - 1995)

An investigation of the study area and environs was conducted from 1993 through 1995 by TtNUS. This investigation consisted of treatability studies, field investigations, and sampling. This investigation was conducted by TtNUS under EPA Contract No. 68-W8-0117, ARCS Work Assignment No. 42-1LH3. Field work activities were divided into two tasks: a field investigation and environmental sampling for identified non-residential properties. The activities conducted as part of the field investigation included a soil boring and sampling program, surface water and sediment sampling, a salinity survey, a GPR survey, and a topographic survey. The investigation also included installation of groundwater monitoring wells and sampling of groundwater. These activities are described below. Groundwater sampling conducted as part of the Phase I Field Investigation will be discussed in the OU2 RI.

2.4.1 Soil Borings, Test Pits, and Soil Sampling (1994)

Soil borings were advanced on the Morgan Francis, Spada, and Housatonic Boat Club properties (on portions of Areas A-1, A-2, and C), and four test pits were excavated on the Morgan Francis Property (Area A-1). Individual boring and test pit locations were selected in the field by EPA based on preliminary GPR survey interpretations and other available information. Twenty-seven soil borings were advanced to depths up to 22 feet using hollow stem auger or rotary methods. Six additional borings were advanced at the Housatonic Boat Club Property (Area C) using a slide-hammer to depths of four feet. In addition, 23 borings were advanced to depths up to 115 feet for the purpose of groundwater monitoring well installations. Wells were installed in both overburden and bedrock.

Continuous split-barrel sampling was conducted throughout the advancement of each boring. Representative samples from borings and test pits were sent for laboratory screening for asbestos, lead, copper, and PCBs using EPA-approved screening methods.

Selected samples were also submitted to EPA-approved laboratories for confirmatory analysis of TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, and dioxins/furans.

This work provided information on depth of fill and extent of contamination. The information was used to define the study area.

2.4.2 Surface Water and Sediment Sampling (1994 - 1995)

Four rounds of surface water and sediment sampling were conducted at selected locations primarily within the original study area, but some at locations elsewhere within Stratford, to evaluate potential contaminant migration from the Raymark Facility. In the course of the four sampling rounds, 140 locations were sampled from streams, ponds, wet areas, and leachate outbreaks identified by EPA from within the original study area. Based on sampling results and discussions with EPA, the study area was further refined; 96 of these 140 sampling locations are located within the limits of OU3 study area as currently defined (Areas A-1, A-2, A-3, B, C, D, E, and F). Surface water samples were collected and submitted to EPA-approved laboratories for analysis of TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals. Field measurements included pH, temperature, specific conductivity, dissolved oxygen, and salinity. Sediment samples were submitted to EPA-approved laboratories for analysis of TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, asbestos, dioxin/furans, total organic carbon (TOC), and grain size. In the fourth sampling round, some sediment samples were also submitted for acid volatile sulfide/simultaneously extractable metals (AVS/SEM) analysis.

This field work provided information on the extent of contamination. The information was used to further define the study area.

2.4.3 Salinity Survey (1994)

A salinity survey was performed in June 1994. The survey was conducted along the length of Ferry Creek from just south of the flood control barrier/hydraulic sluice gate

system at Broad Street, north to the confluence of Ferry Creek and Long Brook Creek. The survey was designed to define the saline/freshwater interface within Ferry Creek.

Fifteen survey/sampling locations were established along Ferry Creek. The survey involved measuring in-situ water temperature and salinity using a YSI Model 33 Salinity-Conductivity-Temperature (SCT) meter. In-situ temperature and salinity measurements were recorded for each station during both high and low tides. Sediment samples were also collected from each station during the low tide salinity/temperature survey, using a stainless steel trowel and/or hand auger advanced into the sediment to a depth of approximately three inches. The interstitial fluid of the sediment samples was then analyzed for salinity by the EPA Narragansett Bay Laboratory (HNUS, 1994).

2.4.4 Ground Penetrating Radar Survey (March 1994)

A geophysical survey using ground penetrating radar (GPR) was performed in portions of the study area in March 1994, by Hager-Richter Geoscience, Inc., a subcontractor to HNUS (Hager-Richter Geosciences, 1994). The GPR survey was conducted on properties within three areas, totaling approximately 50 acres: the Morgan Francis Property, Area A-I, the Spada Property, Area A-2, and the Housatonic Boat Club Property, Area C. Twenty-three traverses totaling approximately 9100 feet of profile were completed. The purpose of the GPR survey was to determine the presence, location, and character of wastes disposed of as fill at each area, including the location of potential buried vessels and subsurface utilities. This information was used to select soil boring locations and to develop estimates of the thickness of fill in the study area. Thickness of fill is discussed in detail in Section 3.0, and presented graphically in Figures 3-1 through 3-5.

2.4.5 Topographic Survey/Global Positioning Survey (1994)

A topographic survey was conducted in September and October 1994, by Diversified Technologies Corporation, as a subcontractor to HNUS. The survey was performed to generate a base map and to locate soil borings, test pits, monitoring wells, and GPR survey

lines. The surface water and sediment sampling locations were located by HNUS during the course of the four sampling rounds, using Global Positioning Survey (GPS) methods. All of this information is included on the base maps used in this report.

2.5 Comprehensive Site Investigation Sampling Program (1994 - 1995)

Using data developed by others, Comprehensive Site Investigation (CSI) reports were prepared in 1994 and 1995, for properties under investigation as part of the Stratford Superfund Sites program. The purpose of the CSIs was to determine the extent and magnitude of lead, PCB, and asbestos contamination associated with Raymark Facility waste disposal in surface and subsurface soils. The CSI reports were designed to provide site-specific data necessary to proceed with the Stratford Superfund Sites Removal Action Program. The information contained in the reports was based on the subsurface samples collected during the vertical sampling program (1993).

Sample locations were selected based on a systematic grid approach for each property investigated. Grid intersections were set at 25-foot intervals and sampling was conducted at each grid intersection. Surface soil samples were collected from depths of 0 to 12 inches below ground surface (bgs) using a stainless steel trowel. Subsurface soil samples were obtained from depths of 1 to 12 feet bgs using a hand-operated Geoprobe® slide-hammer piston rod apparatus advanced hydraulically using a Terraprobe® truck-mounted unit. Soil samples from each boring were visually classified and logged. Constituents of all soils were characterized using the Burmister soil classification ranges, and soil color was described using Munsell color charts. Samples were composited from 1-foot intervals and screened at the on-site laboratory for asbestos, lead, and PCBs. Approximately 10 percent of the samples were submitted for confirmatory analysis at an off-site laboratory.

Site-specific data for numerous properties were generated through the CSI program. Based on a review of these reports, it appears that data from ten CSI reports are applicable to the OU3 study area because these properties are adjacent or closely proximate to the subject study area. CSIs were conducted in portions of Areas A-3, B, C,

D, and F. Final CSI Reports for these applicable properties were completed in 1995, and report sections relevant to OU3 were presented in *the Final Technical Memorandum, Compilation of Existing Data, RI/FS, Raymark - Ferry Creek* (B&RE, 1997).

2.6 Removal Actions Post-Excavation Program (1994 - 1996)

Specific site residential property excavations were performed based on the results of the CSI sampling program discussed in Section 2.5. Upon completion of the excavations, samples were collected to ensure that the contaminated materials were removed. Confirmatory soil sample locations were selected based on a systematic grid approach for each property excavated. Grid intersections were set at 15-foot intervals; samples were collected at depths of 0 to 3 inches from each exposed wall, base, and perimeter of an excavated grid using a pre-cleaned iron shovel or hand trowel. Samples were composited from each exposed surface and screened at the on-site laboratory for asbestos, lead, and PCBs. Approximately 10 percent of the samples were submitted for confirmatory analysis at an off-site laboratory. Once the contaminated materials were removed, the areas were backfilled with clean materials and seeded.

Post-Excavation Record Plans were prepared for these properties. As stated in the *Final Technical Memorandum, Compilation of Existing Data, RI/FS, Raymark - Ferry Creek* (B&RE, 1997), data and information from ten Post-Excavation Record Plans are applicable to the OU3 study area. These properties are adjacent or closely proximate to the subject study area. Portions of Areas A-2, A-3, B, C, E, and F have had Post-Excavation Record Plans prepared. Post-Excavation Record Plans were completed between 1994 and 1996. The Post-Excavation Record Plans documented the soil removal action clean-up activities conducted at each property and showed that the established clean-up criteria had been achieved.

2.7 Ecological Risk Assessment (1996 - 1998)

An Ecological Risk Assessment report was prepared for EPA Region I by NOAA and its contractor (NOAA, 1998). This assessment addressed the risks to ecological receptors posed by contaminants present in Ferry Creek, portions of the Housatonic River, and associated wetlands. Additional ecological sampling was conducted by SAIC, a contractor to the USACE, in August 1997. Sediment, biota, and porewater samples were collected in Areas A-1, A-3, B, and the Great Meadows background area. Samples were analyzed for dioxins, metals, PCBs, PAH, AVS/SEM, VOCs and/or TOC. Results were used to further evaluate ecological risk in upper and middle Ferry Creek, in conjunction with the NOAA risk assessment. The information is summarized in Section 7.0 and presented in its entirety in Appendix D.

2.8 Phase II Site Investigation (1997)

Following a review of all the data from 1992 through 1996, TtNUS identified data gaps. These data gaps indicated the need to collect additional field data to finalize the RI and support the FS for the OU3 study area. Data gaps were identified for each area, except for the Selby Pond site (Area F), which had been investigated previously to determine the need for a Non-Time-Critical Removal Action (NTCRA). Field investigations and sample collection were conducted by TtNUS during July and August 1997. Field activities included advancing soil borings and collecting soil samples, and collecting surficial soil and sediment samples. These activities are described in the sections below.

2.8.1 Soil Borings and Soil Sampling

Additional soil borings were advanced and surficial and subsurface soils were collected and analyzed to further determine the nature and extent of the contamination within the study area.

Soil borings were located in five Areas (A-1, A-2, A-3, B, and D). Individual boring locations were selected based on data gaps, identified by TtNUS, EPA, and CT DEP. Approximately 35 soil borings were advanced to depths of 16 feet using hollow-stem auger methods. The intent was to advance the boring until "natural" soil was encountered. At the direction of EPA no borings were advanced to depths greater than 16 feet.

Continuous split-barrel sampling was conducted throughout the advancement of each boring, and soil samples were field screened using a portable photoionization detector (PID) or flame ionization detector (FID). Based on PID or FID field screening results, selected samples were sent for laboratory analysis of VOCs. Soils from each sampled interval were sent to the Connecticut Department of Health (CT DOH) laboratory for analysis of asbestos. Soil samples were also sent to an off-site laboratory for screening of lead and copper using x-ray fluorescence (XRF). Based on the XRF screening results, approximately two samples were selected from each borehole for analysis at EPA-approved laboratories. Analyses included TCL VOCs, TCL SVOCs, TAL metals, dioxin/furans, and/or TCL pesticides/PCBs (plus Aroclor 1262 and 1268). Selected soil samples were also analyzed for Synthetic Precipitation Leaching Procedure (SPLP) metals, based on the amount of soil recovered from the sampled interval, direction from EPA in the field, and the XRF field screening results.

2.8.2 Sediment Sampling

Additional sediment samples were collected to further determine the nature and extent of contamination within the study area. Samples were collected from stream channels, wetland areas, and estuarine shore locations to evaluate the nature and extent of contamination, and the physical/geotechnical properties of the sediment. Sediment samples were collected at six Areas (A-1, A-3, B, C, D, and E) from depths of up to 6 feet bgs.

Samples submitted for chemical analysis were collected using vibratory coring or grab sampling techniques. Sediment samples were field screened using a portable PID or FID.

Selected samples were submitted to EPA-approved laboratories for analysis of TCL VOCs, TCL SVOCs, TCL pesticides/PCBs (plus Aroclor 1262 and 1268), TAL metals, dioxins/furans, TOC, and/or grain size. Selected samples were also submitted to the CT DOH laboratory for analysis of asbestos. An additional 10 percent of the pesticide/PCB samples were also analyzed for PCB homologues and PCB congeners. Selection of samples for analysis of TCL VOCs was determined based on PID or FID screening results.

In portions of Areas A-1 and A-3 (in Ferry Creek), geotechnical sediment samples were collected, using a split-barrel sampler, and submitted for laboratory analysis of TOC, grain size, and Atterburg Limits. In Areas C, D, and E, sediment samples were collected from predetermined depths, based on existing data gaps, using a piston-core sampler or hand auger. Sediment samples from Areas A-1, A-3, and B were collected from the Ferry Creek channel from up to three units (representing the soft, consolidated, and firm bearing sediment layers), when present within the predetermined sampling depths. Sediment samples from Area B were collected using vibracore techniques. Standard Penetration Testing (SPT) was also conducted in the field on sediments from Areas A-1 and A-3.

2.9 Groundwater Discharge Study

As part of the OU2 groundwater site investigation in March of 1999, 13 seepage meters were installed at 12 locations along Ferry Creek. The objective of these meters was to estimate the rate of groundwater discharge to the creek and the concentration of contaminants in the discharging groundwater. The approach to the seepage meter study was to measure the rate of groundwater flow into the meter by collecting the groundwater from the meters. The elapsed time for groundwater collection and the volume of water in each meter was determined. The groundwater samples were sent to an off-site laboratory for chemical analysis. The results of the chemical analysis indicated that VOCs are discharging into Ferry Creek. The concentrations of the VOCs detected range from 1.0 ug/l to 770 ug/l. The highest VOC concentration detected was 1,2-Dichloroethene (total), at a location that is upstream of Ferry Boulevard and adjacent to the Morgan Francis property. This was also the location of the highest observed groundwater discharge rate.

All of the groundwater samples collected from the seepage meters had detectable concentrations of VOCs. Complete results of the seepage study including groundwater discharge rates, will be presented in detail in the OU2 groundwater RI report.

Sections:
3.0 Physical Characteristics of the Study Area
4.0 Nature and Extent of Contamination
5.0 Contaminant Fate and Transport
(pages 46-103)
are available
in a separate file (size: 4 MB).

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Section:
6.0 Baseline Human Health Risk Evaluation
(pages 104-157)
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Section:
6.0 Baseline Human Health Risk Evaluation Continued
(starting with 6.7.2 Data Evaluation of Area A-1)
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Sections:
7.0 Ecological Evaluation
8.0 Summary and Conclusions
References
(pages 210-249)
are available
in a separate file (size: 3 MB).

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