REPORT

MCP INTERIM PHASE II REPORT AND CURRENT ASSESSMENT SUMMARY FOR UNKAMET BROOK AREA/ USEPA AREA 1

VOLUME I OF XIV

General Electric Company

Pittsfield, Massachusetts

January 1995

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

MCP INTERIM PHASE II REPORT AND CURRENT ASSESSMENT SUMMARY FOR UNKAMET BROOK AREA/USEPA AREA 1

GENERAL ELECTRIC COMPANY
PITTSFIELD, MA

JANUARY 1995

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SECTION 1 - INTRODUCTION

1.1 General

This report has been prepared on behalf of the General Electric Company (GE) by Blasland, Bouck & Lee, Inc. (BB&L), to meet two sets of requirements applicable to the GE facility in Pittsfield, Massachusetts. First, the report constitutes an Interim Phase II - Comprehensive Site Assessment Report for the Unkamet Brook Area (ID No. 1-0148), as required by the Massachusetts Department of Environmental Protection (MDEP), pursuant to the Massachusetts Contingency Plan (MCP) and a Consent Order executed by GE and the MDEP in July 1990. Second, this document constitutes a Current Assessment Summary (CAS) Report for the area designated as USEPA Area 1, pursuant to the requirements of a permit (the "Permit") issued to GE by the United States Environmental Protection Agency (USEPA) in February 1991, under the corrective-action provisions of the federal Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA). The Permit was originally issued in February 1991 and was reissued, as modified, effective January 3, 1994.

The MDEP and the USEPA have also executed a Memorandum of Understanding (MOU) that provides for coordination between them in reviewing GE's submittals related to the Consent Order and Permit. Pursuant to the MOU, this document has been prepared to facilitate a coordinated joint agency review.

A previous version of this report was submitted to the MDEP and the USEPA in April 1992 (Blasland & Bouck, April 1992). However, at that time, the USEPA Permit was stayed pending resolution of an appeal of the Permit by GE and others. Following that appeal, the USEPA modified certain portions of the Permit and issued final Permit modifications on December 1, 1993. The modified

Permit became effective on January 3, 1994. This document is being reissued to incorporate new information that has become available since April 1992.

As indicated above, this report is not only an MCP Interim Phase II Report, but also a CAS. Another document, which constitutes an MCP Supplemental Phase II Scope of Work (SOW) and a RCRA Facility Investigation (RFI) Proposal for this site (Supplemental Phase II SOW/RFI Proposal), is being submitted concurrently with this document. In addition, a Preliminary Health and Environmental Assessment (HEA) Proposal for this site is also being submitted concurrently with this document.

1.2 Background Information

Numerous investigations have been conducted at or near the Unkamet Brook Area/USEPA Area 1 Site. A chronological summary of the studies performed to date is presented in Table 1-1. A brief discussion of the history of the site is provided below.

The Unkamet Brook Area has been designated as a "disposal site" by the MDEP under the MCP and is considered to be in Phase II of the MCP process. This site is co-extensive with USEPA Area 1 under the Corrective Action Permit. [Note: In April 1994, the boundaries of the MDEP-designated Unkamet Brook Area Site were expanded to include the entire GE facility east of Plastics Avenue and the area surrounding Buildings OP-1 and OP-2, which was previously included in the MDEP-designated remainder of GE Facility Site (I.D. No. 1-0563). This expansion was made so that the Unkamet Brook Area would be co-extensive with USEPA Area 1, to facilitate coordination between the MDEP and USEPA.] Figure 1-1 shows the general location of the Unkamet Brook Area/USEPA Area 1 Site, while Figure 1-2 shows a more detailed site plan.

The site is traversed by Merrill Road, Plastics Avenue, and several sets of railroad tracks. The entire portion of the site north of Merrill Road consists of

property owned by GE (see Figure 1-2). The remainder of the site is composed of a commercial area and a lowland area. The GE-owned portion of the site is generally bounded by Dalton Avenue to the north, Merrill Road to the south, the Penn Central Railroad tracks to the east, and to the west by the eastern edge of the Building OP-2 parking lot. This area consists of an access-restricted facility to the west of Unkamet Brook and a large undeveloped marsh area to the east of the brook. The commercial area of the site is located south of Merrill Road between Merrill Road and the Penn Central Railroad tracks. To the east of the commercial area is Building OP-3, which is part of the access-restricted industrial facility at the site. The lowland area includes the lower reaches of Unkamet Brook from the Penn Central Railroad tracks to the brook's confluence with the east branch of the Housatonic River. The lowlands area also includes the immediate floodplain on both banks of the brook in this area, as well as the wide expanse of floodplain and wetland areas northeast of the brook.

All three of the manufacturing divisions located at the GE Pittsfield facility (Transformer, Ordnance, and Plastics) have at one time operated, or are currently operating, in the Unkamet Brook Area (sometimes known as the East Plant Area). Activities in this area (beginning in or around 1932) have involved a wide range of research and development activities and the manufacture of power transformer-related products, ordnance-related products monomers, polymers, and industrial resins.

The ordnance-related operations at the GE Pittsfield facility, which take place in Buildings OP-1, OP-2, and OP-3, were sold to the Martin Marietta Corporation in 1993. GE continues to own the property at OP-1 and OP-2, while the U.S. Navy owns the property at OP-3. While Martin Marietta operates these facilities, the environmental investigations associated with these facilities will be performed under GE's direction.

Numerous investigations have been conducted at or near the Unkamet Brook/USEPA Area 1 Site. A summary of studies performed to date is presented in Table 1-1, and a brief discussion of the history of the site is provided below.

For a number of years, process wastewater and non-contact cooling waters from the Plastics Division facility were discharged into an on-site, earthen waste stabilization basin. That basin, formed by constructing earthen embankments to enclose a portion of an existing bog area, provided clarification and equalization of process wastewater from the East Plant Area. The waste stabilization basin has been closed and remediated. Phase I of the basin's closure consisted primarily of the construction of the Building 119W oil/water separator in 1971 and the installation of process modifications. Phase II of the closure involved the construction of a wastewater source control plant (Building 120W) that began operations in February 1979 to handle all contact waste flows. The actual basin remediation activities were performed between August 1980 and June 1981. Remediation consisted of removing the standing liquids and the sludge layer, covering the area with synthetic stabilization fabric, and covering the area with cement/bentonite materials and fill. A vegetative cover was then installed (O'Brien & Gere, August 1981).

North of the former waste stabilization basin is a former landfill area referred to as the former Interior Landfill. A study of the area starting in 1979 was prompted by the concern that some materials placed within this area may be a source of groundwater concern.

From 1979 to 1981, GE studied the effects of manufacturing activities on groundwater quality in the portion of the Unkamet Brook Area east of Plastics Avenue. The purpose of the investigation was to describe the nature and extent of groundwater concerns resulting from general operations within this area, and specifically related to the former Interior Landfill and the waste stabilization basin.

In 1981, GE entered into a Consent Order with the MDEP (then known as the Department of Environmental Quality Engineering). In May 1983, pursuant to that Consent Order, the USEPA, the MDEP, and GE agreed to a monitoring program for stream sediment, surface water, and groundwater in the Unkamet Brook area. The monitoring program consisted of sediment and surface water sampling, and mapping groundwater flow patterns at the site. The program also included describing lateral and vertical groundwater quality using the chemical data obtained from surface water and groundwater analysis. The areas included in the program were located along the perimeter of the former Interior Landfill, in the vicinity of the plume that is emanating from the former waste stabilization basin, along the length of the brook itself, and at a number of locations in the marshy area adjacent to the brook.

During the summer of 1983, ambient air PCB monitoring was conducted in and around Unkamet Brook and the former Interior Landfill in response to the 1981 Consent Order. Additional air monitoring for volatile organic compounds (VOCs) was performed in 1988 within the basement of a building located above the VOC plume area (located in the commercial area south of Merrill Road).

In 1987, hydrogeologic investigations were conducted to assess the relationship (if any) between a small oil plume floating on the water table near Buildings 51, 59, and 119 and the storm water drainage system in these areas. Between 1988 and 1992, GE monitored the thickness of free-phase oil on the water table in this area and conducted oil recovery activities.

Pursuant to a Consent Order executed by GE and the MDEP, effective July 2, 1990, GE was required to undertake a Phase II Comprehensive Site Investigation of the site under the MCP, and prepare and submit a report thereon to the MDEP. In accordance with the MCP and the 1990 Consent Order, GE prepared a Scope of Work for the Phase II Comprehensive Site Assessment of the Unkamet Brook Area (Blasland & Bouck, August 1990a). That SOW, which

incorporated the MDEP's comments on a prior draft, was submitted to the MDEP in August 1990. The document was accompanied by an Unkamet Brook Supplemental Data Summary, which presented the results of investigations conducted prior to that date (Blasland & Bouck, August 1990b). The revised SOW was approved by the MDEP (subject to certain conditions) by letter dated November 7, 1990.

Investigations associated with the MCP Phase II Site Assessment were initiated in October 1990, and have since been completed. A detailed review of available data for the CAS as outlined in the USEPA Permit has also been performed. This report summarizes the scope and findings of the MCP Phase II investigation to date and provides the data necessary to fulfill the CAS requirements of the USEPA Permit. As indicated above, a previous version of this report was submitted to the MDEP and USEPA in April 1992 (Blasland & Bouck, April 1992). This document incorporates new information that has become available since April 1992.

1.3 Format of Document

This document is divided into several sections, including a detailed description of the site history and location, a summary of previous investigations conducted at the site, the results of the MCP Phase II investigations to date, and a characterization of the presence of polychlorinated biphenyls (PCBs) and other hazardous constituents associated with the site.

Specifically, Section 1 presents pertinent background information, while Section 2 describes the physical and environmental setting of the site, including site mapping, historic photographs, topography, surface drainage, vegetation, surface water, flooding potential, wetlands and critical wildlife habitats, geology, groundwater/hydrogeology, land use, climatology/meteorology and utilities.

Section 3 provides an identification and characterization of potential sources of contamination at the site, including a description of various Solid Waste Management Units (SWMUs), as identified in the Permit.

Sections 4 through 11 present and discuss the field investigations associated with the site, both prior to and as part of the MCP activities. In particular, Section 4 presents the hydrogeologic investigations and characterization. Section 5 discusses surface water investigations, Section 6 discusses sediment investigations, Section 7 discusses surficial soils investigations, Section 8 discusses miscellaneous investigations, Section 9 discusses air monitoring, Section 10 discusses the Building 51/59 oil plume investigations, and Section 11 discusses fish investigations at the site. Section 12 describes fate and transport characteristics associated with hazardous constituents detected at the site. Section 13 discusses potential migration pathways based on the information contained in previous sections, and Section 14 identifies remaining data needs. Finally, Section 15 presents conclusions and future activities.

In addition, Appendices A through O and the various tables and figures included herein provide supporting information referenced in this report.

SECTION 2 - PHYSICAL AND ENVIRONMENTAL SETTING

2.1 General

This section summarizes the current physical and environmental characteristics of the Unkamet Brook Area/USEPA Area 1 Site located in Pittsfield, Massachusetts. Characteristics including site location, topography, surface drainage, vegetation, surface water, flooding potential, wetlands and critical wildlife habitats, geology, groundwater/hydrogeology, land use, climatology/meteorology, and utilities are described herein.

2.2. Geographic Location of Site

The general geographic location of the Unkamet Brook Area/USEPA Area 1 Site is illustrated on Figure 1-1, and the boundaries of the site are shown on Figure 1-2.

The Universal Transverse Mercator (UTM) coordinates for the site are approximately 4,702,300 N, 647,200 E. The site is located at approximately 42° 27' 40" N latitude and 73° 12' 36" W longitude.

Several parcels are located within or border the Unkamet Brook Area/USEPA Area 1 Site. Figure 2-1 illustrates the on-site and adjacent parcels and presents the corresponding City of Pittsfield Tax Assessors' property identification numbers. Table 2-1 lists the owner names and parcel addresses of these on-site and adjacent parcels.

The Allendale School located on Connecticut Avenue appears to be the only institution located within a 500-foot radius of the Unkamet Brook Area/USEPA Area 1 Site. The population residing within a one-half mile radius of the site boundary is estimated to be approximately 2,000 individuals. This number is based on a review of 1990 aerial photographs of the area that show approximately 500 homes located within this radius. For purposes of estimating

the population within one-half mile of the site, an average of four people are assumed to reside in each home.

2.3 Site Mapping and Photographs

2.3.1 Site Mapping

Figure 1-1 provides a general location plan of the Unkamet Brook Area/USEPA Area 1 Site. This figure was prepared using United States Geological Survey (USGS) 7.5 x 15-minute quadrangle topographic mapping. The figure includes topographic contours and elevations; streets, roads, buildings, and other manmade structures; and water features. Figure 1-2 provides a more detailed site plan, including various physical site features such as roads, fencing, and structures. The majority of this site plan was photogrammetrically mapped based on April 1990 aerial photographs by Lockwood Mapping, Inc., while a small portion along the west side of the site was prepared by GE. In addition, detailed topographic mapping of the majority of the site was developed as part of the photogrammetric mapping prepared by Lockwood using the April 1990 aerial photographs of the site. This mapping has been incorporated into the site plan presented as Figure 1-2 of this document.

2.3.2 Site Photographs

Table 2-2 presents a summary of available aerial photographs of the Unkamet Brook Area/USEPA Area 1 Site. Representative aerial photographs have been reproduced to illustrate the progression of change to the site. These photographs are presented in Figures 2-2 through 2-4, and include photographs taken in 1969, 1983, and 1990, respectively.

2.4 Topography, Surface Drainage, and Vegetation

The general topography of the Unkamet Brook Area/USEPA Area 1 Site is characterized by relatively flat land that slopes gently from the north toward the east branch of the Housatonic River on the southeastern edge of the site. Most of the GE-owned northern portion of the site, north of Merrill Road, is generally flat with topography ranging between approximately 990 feet and 1,000 feet (above mean sea level). In contrast to the majority of this area, the area along the east bank of the brook, adjacent to the former Interior Landfill, is characterized by a relatively low marshy area which ranges in elevation between 986 feet and 988 feet. South of Merrill Road to the Housatonic River, which includes both the commercial and the lowland areas of the site, the topography slopes gently towards the brook and the Housatonic River.

Surface drainage in the Unkamet Brook Area/USEPA Area 1 Site occurs largely via Unkamet Brook, which empties into the Housatonic River, although portions of the site drain directly to the Housatonic River. Because portions of the area contain commercial and industrial buildings, as well as paved areas, the natural drainage has been modified to some degree. In particular, the surface drainage associated with the GE-owned portion of the site occurs largely by means of a stormwater collection system, which is described in detail in a report entitled "Final Stormwater, I. Facilities Description" (Blasland & Bouck, July 1990) and figures included in Appendix A of the present report. Surface drainage in the lowland areas of the site, south of Merrill Road, drain directly to Unkamet Brook and the Housatonic River.

A variety of deciduous trees and shrubbery is present at the site. Typical tree species include American Elm, Ashleaf Maple, Cottonwood, Red Osier, Dogwood, and Trembling Aspen. Other woody and herbaceous vegetation may include grasses, Black Raspberry, Honeysuckle, Riverbank Grape, Wild Strawberry,

Cypress Spurge, Dames Rocket, Rough Cinquefoil, Spotted Knapweed, and Yarrow.

2.5 Surface Water

Surface waters within the Unkamet Brook Area/USEPA Area 1 Site include an unnamed decorative pond and Unkamet Brook. The unnamed decorative pond, located in the northern portion of the site, is illustrated on Figure 1-2. In addition, the site is bordered along the southeast by the east branch of the Housatonic River, which is being addressed in a separate MCP Interim Phase II Report/CAS (Blasland & Bouck, December 1991 and August 1992).

Unkamet Brook, a tributary to the Housatonic River, generally flows year-round and runs north to south through the East Plant Area for approximately 600 feet. Flow then proceeds past the commercial area (via an underground conduit), and then through the lowlands area of the site prior to convergence with the Housatonic River.

2.6 Flooding Potential

The flooding potential of the Unkamet Brook Area/USEPA Area 1 Site has been documented in several technical reports and studies. Approximately 50 percent of the site is located within the 100-year floodplain as determined by the Federal Emergency Management Agency's (FEMA's) National Flood Insurance Program (NFIP) (FEMA, January 1987). The elevation of the FEMA 100-year floodplain is 995 feet above mean sea level. Portions of the site, south of Merrill Road, are located within the 10-year floodplain (approximately 985 feet above mean sea level) based on HEC-2 modeling conducted in 1991 as part of MCP Phase II activities associated with the Housatonic River. Figure 1-2 illustrates the approximate 10-year floodplain limit.

2.7 Wetlands and Critical Habitats

Wetlands within the site are associated primarily with Unkamet Brook. In addition to the lands occupied by the stream, Unkamet Brook passes through a lowland area located in the northeastern portion of the site (to the east of the brook on the GE-owned portion of the site), and another lowland area south of Merrill Road. These areas are drained by Unkamet Brook, which in turn discharges into the Housatonic River.

The Massachusetts Wetland Protection Act identifies specific resource areas as wetlands subject to protection. Resource area designations applicable to the site include the 100-year floodplain of the Housatonic River and a 100-foot buffer zone from the banks of both the Housatonic River and of Unkamet Brook.

The National Wetlands Inventory, performed by the U.S. Department of the Interior - Office of Biological Services, identifies wetlands within the site as "Palustrine-Emergent" (lands adjacent to Unkamet Brook), "Palustrine-Emergent and Palustrine-Scrub/Shrub" (marsh areas), and "Palustrine-Open Water" (decorative pond). Wetlands associated with the Housatonic River, which forms the southeast border of the site, are identified as "Riverine-Lower Perennial" and "Riverine-Open Water".

The Massachusetts Division of Fish and Wildlife - National Heritage and Endangered Species Program indicates that the Wood Turtle (Clemmys insculpta), the American Bittern (Botaurus lentiginosur), and the Least Bittern (Ixobrychus exilis) possibly inhabit the riverbank and wetlands associated with the site, although this information has not been confirmed. The Division of Fish and Wildlife lists the Wood Turtle and American Bittern as species of special concern, and the Least Bittern as threatened.

2.8 Regional Geology

Pittsfield is situated in the Housatonic River Basin between the Berkshire Hills to the east and the Taconic Range to the west. Bedrock in the Pittsfield area consists of an assemblage of north-south trending metamorphic units (mainly gneiss, schist, and marble), which has resulted from a series of Paleozoic mountain-building episodes that occurred between 520 to 480 million years ago. The bedrock is overlain by a series of unconsolidated materials formed by glacial scouring and deposition, as well as pre- and post-glacial fluvial modification of the landscape.

The main axis of the Housatonic River Valley is underlain by carbonate rock (marble, limestone, and dolomite) of the Ordovician-Cambrian Stockbridge Group. These rock types are less resistant and erode more easily than the gneiss and schist of the Berkshire Highlands.

The bedrock underlying the area is reported to be lower Ordovician age, tan-beige quartzose calcite and dolomite marble (USGS, 1983). Based on available geologic logs and the results of seismic studies, described in Section 4, the estimated depth to bedrock ranges from approximately 140 to 250 feet below the Unkamet Brook Area.

The unconsolidated surficial geologic deposits within the basin (excluding swamps and alluvium) are a Pleistocene glacial origin (1.6 million to 10,000 years ago) and are classified as either stratified (glaciofluvial and glaciolacustrine) or nonstratfied (till) deposits. Known thicknesses of stratified and till deposits associated with the basin have been documented at 240 feet and 90 feet, respectively (Norvitch et al., 1968). Unconsolidated deposits in the floodplain area are predominantly composed of sediment released from meltwater during the last glacial retreat from the area. As the sediment was released from the melting ice front, sorting occurred as a function of sediment size relative to the energy of the fluvial system. As a result, coarse materials were deposited

close to their original location and finer materials were deposited further downstream. Site boring logs indicate an increased occurrence of well sorted sand and gravel deposits with depth. The higher permeability of this material is characteristic of undisturbed glacial outwash.

Lenses of various types of sediment including silt, fine to coarse sand, and peat have been identified at shallower depths of up to approximately 40 feet below the ground surface in the study area. These deposits are the result of glacial outwash being reworked by the fluvial systems of the Housatonic River and to a lesser extent, Unkamet Brook.

Aquifers and water bodies within the basin are recharged by precipitation (rainfall plus snowfall). The nearest mapped aquifers are within the Housatonic River Basin to the north and the Connecticut River Basin to the southeast, as indicated on the Pittsfield East Quadrangle. According to the Pittsfield Department of Public Utilities, the city obtains its industrial and municipal water supply from the following surface water bodies located several miles to the south and to the east: Sand Washington Reservoir, Cleveland Reservoir, Farnham Reservoir, New Sackett Reservoir, Lake Ashley, and the Lower Ashley Intake. In the past, Onota Lake (approximately 3 miles to the north) has been used as an emergency municipal and recreational water supply.

The stratified and nonstratified surficial deposits are not considered productive aquifers (Norvitch et al., 1968), and the carbonate bedrock will provide sufficient water for domestic and industrial use only if a well is installed within a solution or fault zone.

A more detailed discussion of the geology associated with the site is presented in Section 4.4.

2.9 Groundwater/Hydrogeology

In general, the depth of the groundwater table at the Unkamet Brook Area/USEPA Area 1 Site varies from 5 to 25 feet below the ground surface (995 to 985 feet above mean sea level). Groundwater may locally flow either into or out of Unkamet Brook, depending upon the level of the water table in the surrounding marshlands and the stage of the brook. However, the overall direction of groundwater flow from the site is predominately southeastward toward the Housatonic River.

Previous investigators have concluded that the Housatonic River serves as a discharge point for the aquifer that underlies the site, receiving groundwater from depths as great as 150 feet below the ground surface. The results of the groundwater divide study conducted during MCP Phase II activities supports this premise and is further discussed in Section 4.5.5.

Marshlands located in the vicinity of the former Interior Landfill serve as groundwater recharge zones and, therefore, localized groundwater mounding results in radial groundwater flow away from the area. As groundwater moves away from the mound, the direction of flow resumes its southward course. This situation accounts for the prior appearance of chlorobenzene in monitoring well 43B located upgradient of the former Interior Landfill, which is discussed in Section 4.2.1.1 below.

Further characterizations of groundwater conditions at the site are available in several technical studies, and from the Unkamet Brook monitoring program. These investigations address a number of issues including groundwater quality, the extent of the VOC plume, and local groundwater hydraulics (Geraghty & Miller, December 1983a; Geraghty & Miller, December 1983b; Geraghty & Miller, January 1985; Blasland & Bouck, November 1985; Geraghty & Miller, January 1986; Geraghty & Miller, April 1988; Geraghty & Miller, December 1988; Geraghty & Miller, December 1989).

2.10 Land Use

Land comprising the Unkamet Brook Area 1/USEPA Area 1 Site is divided into three zones according to the Pittsfield zoning map. The majority of the site is zoned as General Industry, with a small portion along Dalton Avenue being zoned Commercial, Warehousing, and Storage. In general, the site is comprised of a portion of the GE facility, a commercial district, and undeveloped lowlands, which include portions of the floodplain of the Housatonic River.

The large northern portion of site, located north of Merrill Road and west of Unkamet Brook, consists of an industrial facility owned by GE. This area is surrounded by chain-link fence and locked gates, and access is restricted to authorized personnel. Because the Ordnance operations at the GE facility were sold to Martin Marietta Corporation in 1993, the Ordnance facilities in Buildings OP-1 and OP-2 are currently operated and maintained by Martin Marietta. The underlying land, however, remains owned by GE. The remainder of the site is operated and maintained by GE.

The northern portion of the site, east of Unkamet Brook, consists of a fairly large undeveloped marsh area, which is also owned by GE. While access to this undeveloped area is not restricted by fencing, very wet ground and heavy brush make human access highly unlikely.

A commercial area is located between Merrill Road and the railroad tracks.

To the east of the commercial area, just south of Merrill Road, is Building OP-3, which is part of the Ordnance operations at the plant site. This facility is currently operated by Martin Marietta, but the land is owned by the U.S. Department of the Navy. Like the other portions of the industrial facility at the site, the area surrounding OP-3 is fenced and access is restricted to authorized personnel.

The portion of the site between the railroad tracks and the Housatonic River is the lowland area. This area is meadow-like, with both wet and dry areas,

and some small wooded portions. Access to this area is possible by individuals pursuing recreational activities.

No change in land use at the site is expected, since continued industrial/ commercial activities are planned for the facilities currently in use. Lands located to the east of Unkamet Brook on the GE-owned portion of the site, and the lowlands area south of the railroad tracks are not expected to be significantly developed, due to limitations on the development of wetland/floodplain areas.

2.11 Climatological and Meteorological Information

The climate in the area of the site is characterized as humid, with a mean annual temperature of about 46°F based on data recorded at the nearby Pittsfield Municipal Airport. The mean summer temperature is 68°F, while the mean winter temperature is 28°F (Norvitch et al., 1968). Prevailing winds are from the west. This fact is supported by wind directional data collected during 1992 as part of a facility air monitoring program. These data, illustrated on Figure 2-6, were collected at a meteorological station at GE's East Street Area 2/USEPA Area 4 Site, which is located west of the Unkamet Brook Area/USEPA Area 1 Site.

The average precipitation varies from a low of 2.5 inches per month during the winter months, to a high of about 5 inches per month in the summer months. The Housatonic River Basin, which includes the site, receives an average of 46 inches of precipitation per year. Approximately 22 inches per year escape by evaporation and transpiration to the atmosphere, while the remaining 24 inches per year are lost as runoff or collected in reservoirs, lakes, and ponds (Norvitch et al., 1968).

2.12 Site Utilities

The Unkamet Brook Area/USEPA Area 1 Site contains numerous site utilities such as buried utility lines, sewers, and water mains. In general, such utilities are concentrated within the areas associated with the GE facility. A map illustrating a portion of the GE facility north of Merrill Road is included in Appendix B. This map presents wastewater piping, storm drains, and sanitary sewers for the related portion of the GE facility. Appendix B also includes maps obtained from the City of Pittsfield Engineering Department that depict a sanitary sewer line traversing the site generally parallel with Unkamet Brook. These maps also depict a separate sanitary sewer line within the Housatonic River floodplain south of Merrill Road.

In addition, various other above-ground utility services, such as telephone and cable television, are available for the commercial areas of the site.

As discussed in Section 4, the utilities in the area, which may possibly act as preferential pathways for VOC migration, have been identified. The construction details and the nature of the utilities are discussed, in addition to the results of the preferential pathway investigation.

SECTION 3 - SOURCE IDENTIFICATION AND CHARACTERIZATION

3.1 General

The USEPA Corrective-Action Permit identifies 23 SWMUs within the Unkamet Brook Area/USEPA Area 1 Site. They are:

SWMU No.	SWMU Name
G-11	Interior Landfill
G-12	Former Waste Stabilization Basin
G-17	Building 119W Oil/Water Separator
O-B	Building 51 Underground Drainage Pipe
O-8	Building 51 Elementary Neutralization Unit
O-41	Building OP-3 Metal Treat Area
O-45	Building OP-3 Abandoned Storage Tank
O-2	Building OP-1 Abandoned Anodize Tank
O-A	Underground Fuel Storage Tanks
T-EEE, T-FFF (two tanks)	Transformer Division Inactive Underground Storage Tanks
P-D through P-L (nine tanks)	Plastics Division Inactive Underground Storage Tanks
P-4	Building 109 Wastewater Tank Farm
O-M	Ordnance Division Leaking Active Underground Storage Tank
[No Number Assigned]	Underground Pipes and Tunnels

The approximate locations of the SWMUs are illustrated on Figure 3-1 and each is described in more detail below. The discussion of these SWMUs will also serve as the identification of sources and potential sources in this area, as required by the MCP for Phase II activities.

Analytical data associated with select SWMUs described below are contained in Appendix C. Analytical data related to other SWMUs within the site are contained in Appendix D.

In addition, as further described in Section 8.11, an area west of Building OP-3 was found in June 1993 to contain buried drums. At that time, all drums that were present in this area were removed and disposed of properly. In November 1994, a Ground Penetrating Radar (GPR) survey was performed in this area. Preliminary results of that survey indicate that additional drums may be buried in this area. As discussed in the Supplemental Phase II SOW/RFI Proposal, GE plans to excavate these drums and dispose of them, and any contaminated soil, in accordance with applicable regulations. For purposes of future activities, this area will be labeled as SWMU 0-46. The location of this area is also illustrated on Figure 3-1. The Supplemental Phase II SOW/RFI Proposal also proposes procedures related to the identification of additional SWMUs.

3.2 General SWMUs

3.2.1 Interior Landfill (SWMU G-11)

North of the former waste stabilization basin is a former Interior Landfill that is approximately 14 acres in size and was operated by GE until the late 1970s (Figure 3-1). An investigation was conducted by GE in the early 1980s in an attempt to define the areal extent of the fill area, and to determine groundwater flow and quality.

The extent of the former Interior Landfill has been defined through visual field inspections of the area, analysis of aerial photographs and a magnetometer survey conducted by Weston Geophysical Corporation, Westboro, Massachusetts (O'Brien & Gere, August 1981). The results of the magnetic survey indicated that two distinct zones are present within the fill area. Zone A, located on the western portion of the landfill, is characterized as exhibiting a highly irregular magnetic field indicative of buried metallic objects near the surface. Zone B, located on the eastern

portion of the landfill, is characterized as exhibiting a relatively smooth magnetic field indicative of natural deposits or the absence of buried metal objects.

The extent of the former Interior Landfill has been further confirmed by various data, including the PCB data recently collected during pre-excavation sampling for the installation of a fence in this area, which is discussed in Section 8.14, and floodplain sampling conducted during MCP Phase II activities, which is discussed in Section 7.

3.2.2 Former Waste Stabilization Basin (SWMU G-12)

The GE Plastics Division, located within the Unkamet Brook Area/USEPA Area 1 Site, is involved in manufacturing, research, and development activities pertaining to monomers, polymers, and industrial resins. Previous activities in this area included the manufacturing of power transformers. For more than 40 years, process wastewater effluent, non-contact cooling water, and stormwater from these operations were discharged into the former waste stabilization basin and then to Unkamet Brook. The location of the former waste stabilization basin is shown on Figure 3-1. Past studies have determined that 98 percent of the waters discharged into the waste stabilization basin were non-contact cooling waters and the remaining 2 percent were process wastewater and stormwater (O'Brien & Gere, July 1980).

The waste stabilization basin was formed by constructing earthen embankments in an existing bog area adjacent to Merrill Road and Unkamet Brook (Figure 3-1). Laboratory analysis of the influent to the waste stabilization basin indicated that the discharge water contained vinyl chloride, methylene chloride, chloroform, bromodichloromethane, carbon tetrachloride, bromoform, chlorodibromomethane, sodium chloride, sodium bromide, sodium nitrate, and phenols. Although, it is also reported that the

composition of the influent waste stream was shown to vary considerably (O'Brien & Gere, August 1981). In December 1979, in accordance with an agreement between GE and the MDEP, the discharge of process wastewater to the waste stabilization basin was stopped.

Characterization of the basin sediments was initiated in June 1979, by collecting seven core samples from the waste stabilization sludge blanket, designated P-1 through P-7, at the locations shown on Figure 3-2. Two of the seven cores (P-1 and P-7) were analyzed for priority pollutant constituents. Subsequently, in October 1979, two additional cores (K-1, not illustrated and X-2, Figure 3-2) were collected to further identify the constituents present within the waste stabilization basin. The sediment samples contained organic constituents similar to those found in the basin aqueous layers (i.e., benzene, chlorobenzene, trichloroethylene, methylene chloride, phenols, etc.) (see below) and in groundwater samples near the perimeter of the basin. (Locations of perimeter wells are denoted as B-1 through B-6 on Figure 3-2. Sampling activities and results related to these wells are discussed in Section 4.2.1.2 below.) The results of these analyses were described by O'Brien & Gere (August 1981) and are presented in Table 3-1.

To define the limits of the basin sludge layer, two additional core samples designated X-3 and X-6 (also shown on Figure 3-2) were collected in November 1979 and again in June 1980 and analyzed for metals and VOCs. The results of these analyses were described by O'Brien & Gere (August 1981) and are presented in Table 3-2. An additional sample (X-8, shown on Figure 3-2) is shown to have been collected and analyzed for metals in November 1979 (O'Brien & Gere, August 1981). The results of these analyses are presented in Table 3-2.

Also as part of these investigations, the aqueous layer within the waste stabilization basin was characterized with the collection and analysis of aqueous samples in October 1979 and March 1980. These samples were analyzed for priority pollutants and various water quality parameters. The results of these analyses were described by O'Brien & Gere (August 1981) and are presented in Table 3-3.

Based on this initial work, extensive PCB characterization was accomplished by collecting and analyzing 155 sediment cores on a 20-foot by 20-foot grid. The results of this investigation were described by O'Brien & Gere (August 1981). In general, these results showed that approximately 46 percent of the top 8 inches of sediment contained total PCBs in excess of 50 ppm. Visual inspection of the core samples revealed 2 to 4 feet of stratified layers consisting of reddish-brown, resin-impregnated sludge overlying natural deposits of fine grained, wet, dark grey sand and silt. Therefore, an easily identifiable line of demarcation defining the physical extent of the basin was evident. In addition to the visual separation of the two layers, the concentrations of the organic and metallic constituents found in the sludge, and presented in Tables 3-1 and 3-2, were consistently greater than those present in the underlying natural material. Due to the presence of organic constituents in both the aqueous and sludge/sediment layers of the waste stabilization basin, the presence of similar organic constituents in lower concentrations in the underlying natural deposits, as well as in the groundwater around the basin periphery, the conclusion was reached that the constituents were of the same origin. The waste stabilization basin was determined to be the source of the contamination. The physical limits of the basin were easily identifiable based upon visual observations at the site (depicting the sludge layer and natural soil layer interface), and laboratory analysis.

The waste stabilization basin was remediated in 1981. The closure process initially involved removing the associated standing liquids and sludge layer. This was done by first placing synthetic fabric over the standing liquids to control any potential vapor emissions. A layer of cement/bentonite materials was then placed over the sludge layer (standing liquids still in place). The standing liquids were then pumped from the basin and discharged to the publicly owned treatment works (POTW) following pretreatment. Subsequently, the sludge layer and cement/bentonite cap were removed to an off-site secure landfill. The physical limits of the basin were easily identifiable based on visual observations (depicting the sludge layer and natural soil interface) and laboratory analysis. The basin was then backfilled with gravel, capped with soil, and seeded. A more detailed description of the basin closure is provided in O'Brien & Gere's August 1981 report.

3.2.3 Building 119W Oil/Water Separator (SWMU G-17)

The Building 119W Oil/Water Separator is 60 feet long, 20 feet wide, and 3 feet deep. The unit is constructed of concrete, and is underlain by soil. The Building 119W Oil/Water Separator was installed in 1978 and is currently in use. It is located adjacent to the former waste stabilization basin on the southern side of this site, as illustrated on Figure 3-1. The unit consists of a gravity separator used to skim oil from the surface of wastewater originating from Buildings OP-1, OP-2, 51, and 59 (Plastics and Ordnance Divisions) and from stormwater runoff from facility parking lots. Collected oil is placed in containers and transferred to the Building 121 Drum Storage Area (SWMU P-8) for off-site disposal. Treated water is discharged to Unkamet Brook through NPDES Outfall 009.

3.3 Ordnance Division SWMUs

3.3.1 Building 51 Underground Drainage Pipe (SWMU O-B)

This unit is an underground drainage pipe located east of Building 51 as illustrated on Figure 3-1. The pipe was constructed of clay tile and installed in 1922. This pipe connected to the Building 119W Oil/Water Separator (SWMU G-17) following its construction in 1970. The pipe received stormwater, boiler blowdown, and washwater from boiler cleaning operations in Building 51. Operation of the Building 51 powerhouse ceased in 1990 with the commencement of operation of the Altresco Cogeneration Facility. This line is currently inactive except for the routing of stormwater.

The photograph of SWMU O-B, presented in the RFA Report, depicts the area east of Building 51 and north of Building 119. In this area, Building 51's underground storm drain runs beneath the pavement to the Building 119W Oil/Water Separator. Also, the depicted pavement in this area is a small oil plume, which is described in Section 10.

Due to the observed presence of oil in the Building 119W Oil/Water Separator that was entering from the Building 51 Underground Drainage Pipe, Geraghty & Miller, on GE's behalf, began an investigation of this area (Geraghty & Miller, July 1987). The investigation determined that oil present in the Building 51/59 oil plume was able, under seasonably high groundwater table conditions, to rise with the water table and enter a specific leaking section of the pipe. Following additional activities, including a video reconnaissance of the leaking section of pipe, the clay tile pipe was crushed and left in place and replaced with a new stormwater drainage pipe installed above the high water table elevation. Since the replacement of the pipe, there has been no indication of oil from the Building 51/59 oil plume entering the pipeline.

3.3.2 Building 51 Elementary Neutralization Tank (SWMU O-8)

The Building 51 Elementary Neutralization Tank was located in Building 51 (Figure 3-1) and consisted of a wastewater treatment system, which included tanks, sand filters, cartridge filters, and a spill collection pit. The unit was used to process incoming city water and wastewater associated with the manufacture of printed wiring board, and was designed to treat up to 30,000 gallons per day (gpd) on a batch-operated basis.

Wastes generated by the unit included spent cartridge filters and activated carbon, acidic and caustic effluent, and precipitated metals. Metal wastes were transported for off-site disposal.

The Building 51 Elementary Neutralization Tank was approximately 80 feet long and 40 feet wide, and was fabricated of stainless steel, concrete, PVC, polypropylene, and polyester materials, with an underlying concrete base. The unit was operated from 1983 to 1987. Soon thereafter, the Elementary Neutralization Tank was removed from a non-cracked concrete floor. Analytical data were not collected during removal activities.

3.3.3 Building OP-3 Metal Treat Area (SWMU O-41)

The Building OP-3 Metal Treat Area is located inside Building OP-3 along the southern wall of the building, as illustrated on Figure 3-1. The unit incorporates a full-scale metal cleaning and treating system, which includes wastewater treatment. The unit originally operated as a paint area in 1952, and was upgraded to include anodizing in 1962. The existing tanks were installed in 1982.

Wastes generated at this unit originate from metal cleaning and treating operations, and include spent chemical baths (sulfuric acid, chromic acid, zinc phosphate, nickel acetate, nitric acid, hydrofluoric acid, and sodium dichromate), metal hydroxide sludges, and cresol. Wastewater from the unit is treated in an ion exchange system (Building OP-3 Backwash

Tanks), while precipitated metals and spent chemical baths are placed in 55-gallon barrels and disposed of in an off-site hazardous waste facility. Clarified water is discharged to the Housatonic River through NPDES Outfall No. 011.

The Building OP-3 Metal Treat Area is underlain by concrete and occupies an overall area of 34 feet by 14 feet. The area consists of a total of 26 tanks ranging from 2- to 3-feet long and 2- to 3-feet wide, and having a maximum depth of 4 feet. The tanks are constructed of stainless steel, lead, polypropylene, and fiberglass reinforced polyester. The unit is designed to treat up to 3,000 gpd.

3.3.4 Building OP-3 Abandoned Storage Tank (SWMU O-45)

This storage tank (Tank OP3-A1) was formerly located outside the south wall of Building OP-3, as illustrated on Figure 3-1. This unit consisted of an underground fiberglass tank with a capacity of 750 gallons. The wastewater contained in this unit likely consisted of spent rinse water containing chromium, nickel, and hydrofluoric acid. It is not known when the unit came on line. However, the tank was taken out of service before 1967, and was removed in 1992. Details regarding the removal of this SWMU are presented in Appendix C.

3.3.5 Building OP-1 Abandoned Anodize Tank (SWMU O-2)

The Building OP-1 Abandoned Anodize Tank (Tank OP1-A1) was located below the Drum Storage Area No. 224 (SWMU O-6) immediately outside the west wall of Building OP-1 (Figure 3-1). The tank was situated underground, constructed of steel, and underlain by soil. Tank dimensions are not available although it formerly held 1,000 gallons of wastewater.

The unit was operated from 1942 to 1970. In 1981, under supervision of the Massachusetts Department of Environmental Quality Engineering (DEQE), a "Close-In-Place" plan was implemented, for which the unit was

emptied and filled with sand. In 1991, this tank was removed and disposed of in accordance with all applicable local, state, and federal regulations. Analytical data collected during the tank removal are presented in Appendix C.

3.3.6 Underground Fuel Storage Tanks (SWMU O-A)

This unit consisted of two underground storage tanks (USTs) (Tanks OP2-01 and OP2-02), formerly located adjacent to the east wall of Building OP-2 (Figure 3-1). The tanks were in operation from 1944 to 1959 and were constructed of steel. Each tank had a storage capacity of 550 gallons. The tanks reportedly contained gasoline. These tanks were removed in 1991 and disposed of in accordance with all applicable local, state, and federal regulations. Analytical data collected during the tank removal are presented in Appendix C.

3.3.7 Ordnance Division Active UST (SWMU O-M)

SWMU O-M (Tank OP2A-04) was located immediately south of Building OP-2 in the east section of the facility (Figure 3-1). This tank was constructed in 1975 and formerly contained gasoline (Blasland & Bouck, July 1990).

While this tank did show leaks during two leak tests performed in August and October 1988, excavations to determine the source revealed that the leaks were due to a loose fitting on the top of the tank, which allowed the tank to leak when overfilled for testing. That fitting was then tightened, and the tank was retested in November 1988 and found not to leak. This tank also passed the annual hydrostatic testing in 1989 (Blasland & Bouck, July 1990).

SWMU O-M was removed in 1991 in accordance with all applicable local, state, and federal regulations. Analytical data collected during the tank removal are presented in Appendix C.

3.4 Transformer Division SWMUs

3.4.1 Transformer Division Inactive USTs (SWMUs T-EEE and T-FFF)

SWMUs T-EEE and T-FFF (also known as Tanks 51-01 and 51-05, respectively) were part of a group of six underground storage tanks located just west of Building 51 (Figure 3-1). They were constructed of steel, SWMU T-EEE in 1937 and SWMU T-FFF before 1944. The tanks previously contained fuel oil and each had a capacity of 20,000 gallons. SWMU T-EEE was emptied and filled with sand in 1978, while SWMU T-FFF was emptied and filled with sand in 1958. These tanks were removed in 1991, in accordance with all applicable local, state, and federal regulations. The removal activities are described in more detail in Section 8.5.

3.5 Plastics Division SWMUs

3.5.1 Plastics Division Inactive USTs (SWMUs P-D through P-L)

SWMUs P-D through P-L consist of nine inactive underground storage tanks associated with the Plastics Division. Tanks P-D through P-K appear on old plant drawings and were located adjacent to Buildings 114, 115, and 119A as illustrated on Figure 3-1.

Three of these tanks (SWMUs P-D through P-F) had a capacity of 30,000 gallons each. Two of these tanks reportedly contained benzene, and the other reportedly contained phenol. These tanks were removed between 1949 and 1952. Three other tanks (SWMUs P-G through P-I) each had a capacity of 15,000 gallons. All of these tanks reportedly contained benzene, and were removed from service by 1952 and pulled from the ground in 1982. Two tanks (SWMUs P-J and P-K) had capacities of 15,000 gallons and 10,000 gallons, respectively and both reportedly contained No. 2 fuel oil. The date of removal of these tanks is currently unknown.

SWMU P-L was not identified on old plant drawings; however, two additional USTs were identified during this review. Both of these tanks had a capacity of 800 gallons, and both were located adjacent to the south east corner of Building 59. One of these tanks reportedly contained toluene, and the other reportedly contained allyl chloride. Both tanks were removed between 1949 and 1952.

Ground penetrating radar (GPR) was used in August of 1993 to verify the removal of SWMUs P-D, P-E, and P-F. The GPR study was conducted by Blasland & Bouck in and around the area of these USTs, and the results showed no reflections characteristic of USTs. The results of this study are provided in Appendix E.

GPR was also used in November 1994 to verify the removal of SWMUs P-J, P-K, and the two additional USTs. The GPR study was conducted by Blasland & Bouck in and around the area of these USTs, and the results showed no reflections characteristic of USTs. The results of this study are also provided in Appendix E.

3.5.2 Building 109 Wastewater Tank Farm (SWMU P-4)

The Building 109 Wastewater Tank Farm is located west of Building 109 as shown on Figure 3-1. This unit began operation in or around 1943 and has been used since for the storage of liquid raw materials, process wastes (including waste waters), process intermediates, and finished product. The vessels used to store these materials have included both above and below ground tanks. Over the years, storage tanks have been added and removed as business needs changed. Above ground tanks, of which there have been numerous, ranged in size from 600 gallons to 10,000 gallons. Below ground tanks, of which there have been four known, had storage capacities of 1,000, 2,400, and two of 5,000 gallons. According to historical records, above ground tanks were used to store allyl chloride,

formaldehyde, isopropyl alcohol, methanol, methylene chloride, phenol, toluene, acids and caustics, while below ground were used to store methanol and toluene only.

Currently, the tank farm consists of 11 above ground storage tanks and no below ground storage tanks. Materials stored include raw materials, process intermediates, and waste water. These materials contain the chemical constituents toluene, methanol, and sodium hydroxide.

All below ground tanks have been removed from the ground. The 1,000 gallon and 2,400 gallon tanks were removed between 1971 and 1979. The two 5,000 gallons tanks were removed in 1988 in accordance with UST regulations following a tightness test performed on June 17, 1988 which determined the tanks to be leaking. Following excavation of the tanks, approximately 35 cubic yards of soil were removed and transported off-site for disposal.

3.6 Underground Pipes and Tunnels

The Unkamet Brook Area/USEPA Area 1 Site is traversed by a series of underground electronic, electric, power, and water conduits that provide a variety of services throughout the area. Design drawings for these service lines were obtained from GE and the City of Pittsfield Municipal Engineer and are presented in Appendix B of this report.

The portion of the GE facility within the site is also underlain by a series of pipelines and tunnels carrying steam, electricity, telephone service, security surveillance, potable water, stormwater, and process wastewater.

The Building 12F Former Oil Tank Farm area located west of the site within East Street Area 1/USEPA Area 3 was serviced by a series of underground lines. These pipelines transferred 10c transformer oil from the Building 12F tanks to Building 51 located within the Unkamet Brook Area/USEPA Area 1 Site.

According to facility information, use of the storage facility was discontinued in 1964 in favor of a new, aboveground facility, which was installed to the east of Building 29.

In 1989, as part of the construction of the Altresco Steam Line distribution system, the former distribution lines were reportedly drained at the low spot along Tyler Street midway between New York Avenue and the parking lot west of Building OP-2. The lines were disconnected and capped at New York Avenue. The lines were sampled when drained. Two 4-inch lines were drained of approximately 754 gallons of 10c oil. The lines were found to be located in the same trench beneath inactive individual hydrogen, oxygen, and nitrogen gas lines. An additional 1,315 gallons of oil were collected from the eastern terminal lines at Building 51. All of the recovered oil was disposed of at GE's Thermal Oxidizer located in the Building 60 complex, west of the site. These pipelines, together with additional investigational activities that will be performed related to these pipelines, are described in the Hill 78 Area MCP Phase II Scope of Work (Blasland & Bouck, February 1992).

A discussion of the underground pipes and tunnels acting as preferential pathways for the Building 51/59 oil plume is presented in Section 10.4. In addition, the preferential pathway investigation that was performed during Phase II activities related to the VOC plume in this area is discussed in Section 4.8.

SECTION 4 - HYDROGEOLOGIC INVESTIGATIONS

4.1 General

Since 1979, a number of investigations have been completed at the Unkamet Brook Area/USEPA Area 1 Site to define the physical and chemical characteristics of soil and groundwater. This report section presents a discussion of those work efforts that have principally addressed the migration of a VOC plume from the former waste stabilization basin toward the Housatonic River. The groundwater investigations in the Unkamet Brook Area were undertaken in a sequential, phased approach. As illustrated on Figure 4-1, a sequence of seven monitoring well installation and subsequent groundwater sampling and analysis activities occurred between 1979 and 1982. The rationale for these phased investigations were: 1) to determine if groundwater was impacted, and; 2) to define the extent of the VOC plume emanating from the former waste stabilization basin. Subsequent groundwater monitoring rounds were conducted between 1982 and 1989 primarily to monitor the configuration of the VOC plume.

Three additional deep monitoring wells (39D, 39E, and 116E) and two additional shallow wells (RF-14 and RF-15) were installed within the limits of the Unkamet Brook Area/USEPA Area 1 Site during MCP Phase II activities. The locations of these wells are shown on Figure 4-2. These new wells and a total of 42 existing wells at the site were sampled during MCP Phase II activities.

In addition, three shallow monitoring wells (OBG-1, -2, and -3) were installed on behalf of GE by O'Brien & Gere during November 1992. These wells were installed near Building OP-3 in conjunction with a release of No. 4 fuel oil encountered during the removal of three USTs (Tanks OP3-01, OP3-02, and OP3-03). The locations of these wells are shown on Figure 4-3 along with the locations of all the wells installed at the site to date.

More recently, two additional shallow monitoring wells (MW-38 and MW-39) were installed and sampled at the site by ERM-Northeast, Inc. (ERM) of Albany, New York on behalf of Martin Marietta Corporation. These two wells were installed as temporary wells related to excavations for the planned extension of a streamline west of Building OP-3. The locations of these wells are also shown on Figure 4-3.

Work activities completed as part of Pre-MCP Phase II and subsequent investigations are summarized below.

4.2 Groundwater Investigation Activities

4.2.1 Pre-MCP Groundwater Investigations

This section describes various groundwater investigations that were performed at the Unkamet Brook Area/USEPA Area 1 Site between 1979 and 1989. The analytical results of these investigations are discussed in more detail in the following subsections and are summarized in Table 4-1.

It should be noted that monitoring wells at the site are typically installed in clusters of two or more. Monitoring wells in any one cluster have been labeled A, B, C, D, E, or F, depending on the general depth of the screened interval. These labels represent typical screened intervals of 15- to 20-feet below land surface (B-series), 30- to 35-feet below land surface (F-series, presently at only one location), 45- to 50-feet below land surface (A-series), 70- to 75-feet below land surface (D-series), 95- to 100-feet below land surface (C-series), and 145- to 150-feet below land surface (E-series). Although these ranges of screen depth generally correspond to the listed letter designations, individual monitoring well depths may vary. Construction details for the monitoring wells at this site are presented in Table 4-2.

In April 1979, Geraghty & Miller investigated groundwater in the vicinity of the former waste stabilization basin to determine if the basin area was affecting groundwater quality. This preliminary investigation involved the installation of seven well clusters adjacent to the former waste stabilization basin, and an additional three clusters at upgradient locations, as presented on Figure 4-1. Groundwater from these wells was analyzed for priority pollutants. This investigation is described in more detail in Section 4.2.1.2.

To determine if the former Interior Landfill was impacting groundwater, Geraghty & Miller initiated an investigation of the area in 1980. This investigation involved the installation of 17 well clusters, as illustrated on Figure 4-1, with groundwater from select wells analyzed for priority pollutants and PCBs. This investigation is described in more detail in Section 4.2.1.1.

Based upon the results of the preliminary groundwater investigation performed in 1979, it was apparent that the former waste stabilization basin was impacting groundwater quality. As a result, to further define the extent of the groundwater impacts, Geraghty & Miller performed a more detailed study, known as the "on-site investigation," in 1980. This investigation involved the installation of 35 well clusters around the perimeter of the GE facility in the Unkamet Brook Area and two well clusters in the interior of the site, as illustrated on Figure 4-1. Groundwater from these clusters was analyzed for select priority pollutants. This investigation is described in more detail in Section 4.2.1.2.

Based upon the results of the on-site investigation described above, a three-phased off-site investigation was conducted in 1980 and 1981. This investigation involved the installation of a total of 27 well clusters southeast of Merrill Road (Phase I), approximately halfway between Merrill Road and the Housatonic River (Phase II), and in the vicinity of the Housatonic River

(Phase III). Groundwater was sampled and analyzed for select priority pollutants. Well cluster locations are illustrated on Figure 4-1, and the investigations are described in more detail in Section 4.2.1.3.

The results of the Phase III off-site investigation indicated that the VOC plume emanating from the former waste stabilization basin may have migrated as far south as the Housatonic River. To further investigate the extent of the plume in that area, Geraghty & Miller installed a total of 14 well clusters, between November 1981 and April 1982, in the area between the railroad tracks south of Merrill Road and the Housatonic River, as presented on Figure 4-1. Groundwater from these wells was analyzed for priority pollutant VOCs. This investigation is described in more detail in Section 4.2.1.3.

In May 1983, the USEPA, MDEP (at that time known as the Massachusetts Department of Quality Engineering), and GE entered into an agreement to perform a sediment, surface water, and groundwater monitoring program in the Unkamet Brook Area as part of the Consent Order issued to GE by the USEPA in 1981.

As part of this effort, groundwater was sampled in December 1983, April/May 1984, October 1984, and April/May 1985 at well Clusters 2AB, 16ABCE, 39AB, 43AB, 46AB, 72AB, 79AB, 80AB, 89ABD, 90AB, 93AB, 95ABC, 97ABC, 102ABC, 104AB, 111AB, 114ABC, and 115ABC. Samples were analyzed for priority pollutant VOCs, and groundwater from select wells was also analyzed for total organic halogens (TOX) and PCBs. The results of this two-year monitoring program indicated, among other things, that PCBs were not migrating from the former Interior Landfill, that the major components of the VOC plume were benzene and chlorobenzene, and that both the horizontal and vertical boundaries of the VOC plume did not

extend beyond the monitoring well network (Geraghty & Miller, January 1986).

As recommended in Geraghty & Miller's 1986 report, the Unkamet Brook Area groundwater monitoring program became an annual investigation between 1987 and 1989. As also recommended in that report, in addition to collecting groundwater elevation information at a number of wells, groundwater was collected at well clusters 90AB, 97ABC, 102ABC, 111AB, and 114ABC and analyzed for VOCs. The conclusions reached as a result of these studies were similar to those made at the conclusion of the two-year monitoring program and are stated above.

The groundwater monitoring programs conducted during 1983 through 1985 and 1987 through 1989 are described in more detail in Sections 4.2.1.1 and 4.2.1.4.

4.2.1.1 Former Interior Landfill

In 1980, 13 monitoring well clusters (59, 71 through 75, 79, 80, 87, 93, 94, 96 and 98) were installed downgradient of the former Interior Landfill, around its perimeter. A fourteenth well cluster (11) was installed near the center of the fill area (Figure 4-1). These wells were installed as two well clusters each containing an A-series and a B-series well, and screened as explained above. Although not sampled at this time, monitoring well clusters 76, 77, and 78, each consisting of an A- and B-series well, were installed during this phase of investigation.

Upon completion, these monitoring wells were sampled for VOCs, PCBs, and a number of priority pollutants. As shown in Table 4-1, detectable levels of organic compounds or priority pollutants were found at monitoring wells 72AB, 79AB, 80AB, and 93AB. PCBs were detected above the Massachusetts Maximum Contaminant Level (MMCL)

Guideline of 0.0005 ppm in well cluster 80AB. Vinyl chloride was detected above the MMCL of 0.002 ppm in the 72AB composite sample. Selected priority pollutant metals were detected at all locations where metals analysis was performed, with zinc being the metal detected most frequently.

Between 1983 and 1985, groundwater samples were collected semi-annually from several of the monitoring well clusters including 72AB, 79AB, 80AB, and 93AB installed in 1980, and also from well clusters 43AB and 46AB, two clusters installed as part of the "on-site" investigation (Figure 4-1). The purpose of this periodic monitoring was to characterize the nature and extent of constituents that may be migrating from the former Interior Landfill.

Well clusters 43AB and 46AB were selected as upgradient (background) wells, because they were hydraulically upgradient of the former Interior Landfill during most monitoring periods, based on recorded water level elevations. These wells were sampled and analyzed for VOCs, TOX, total organic carbon (TOC), PCBs, pH, selected priority pollutant metals, and specific conductance. As shown in Table 4-1, the only VOC detected was chlorobenzene in well 43A. The levels detected were well below the MMCL for chlorobenzene (0.1 ppm). The appearance of chlorobenzene in this well can be explained by local mounding from the former Interior Landfill, and, in part, by construction dewatering effects in 1984 (which would locally cause a groundwater flow reversal).

Well clusters 72AB, 79AB, 80AB, and 93AB were selected as downgradient monitoring locations, outside the perimeter of the former Interior Landfill, based on local groundwater flow directions determined prior to the monitoring program. However, each of these locations

appears to be upgradient of the former Interior Landfill at certain times, according to local groundwater flow patterns determined during the monitoring program. Since the local groundwater flow direction in this area may vary over 180 degrees, the chemical data from these wells may reflect a combination of effects from upgradient and downgradient areas (see Section 4.5 for groundwater flow information). Accordingly, data collected from these wells during the monitoring program did not give reliable depth-specific data concerning possible migration of constituents from the former Interior Landfill.

Wells located downgradient of the former Interior Landfill and the former waste stabilization basin were sampled for PCBs. The groundwater quality data show that PCBs have not migrated from this area via groundwater, as presented in Table 4-1.

The recommendation presented at the conclusion of the two-year monitoring program (1983 - 1985) was that any potential migration from the former Interior Landfill would be better assessed by sampling Unkamet Brook surface water upstream and downstream of the former landfill. This investigation, which was conducted annually between 1987 and 1989, is described in Section 5.

4.2.1.2 Former Waste Stabilization Basin

In April 1979, concurrent with investigations being conducted in conjunction with the closure of the waste stabilization basin, GE initiated a subsurface investigation to determine if the constituents present in the waste stabilization basin had affected the local groundwater. The first phase of this investigation involved the analysis of basin aqueous and sediment samples, as well as groundwater samples from monitoring wells installed adjacent to the basin. Details regarding the surface water and sediment sampling are discussed in

Section 3.2 above, while information related to groundwater monitoring is discussed below.

The preliminary groundwater investigation involved the installation of 19 monitoring wells at 10 locations - seven around the basin perimeter and three in background areas. Each well location, with the exception of monitoring well 1, was designed as an A and B well cluster, screened in the manner described above, in order to assess groundwater quality at different depths around the basin and in assumed background areas.

Upon completion of monitoring wells 1 through 10, groundwater was sampled and analyzed for TOC, specific conductivity, and pH. The results of these analyses, shown in Table 4-1, indicated generally higher TOC and conductivity readings in the perimeter wells (1 through 7) than in the assumed background wells (8 through 10). In addition, the perimeter wells also generally exhibited higher TOC and specific conductivity values in the shallow wells (B-series) than in the deep wells (A-series). At background well clusters 8 and 9, however, the deeper wells generally exhibited higher TOC and specific conductivity values than the shallow wells.

In order to identify the constituents responsible for these elevated conductivity and TOC readings, priority pollutant analyses were performed on all of the perimeter monitoring well samples (1 through 7). The results, presented in Table 4-1, indicated the presence of organic compounds such as benzene, chlorobenzene, trichloroethylene, methylene chloride, and phenols, and inorganic constituents such as lead, zinc, and chromium.

A comparison of the constituents present in the basin sediments and aqueous phase with the preliminary on-site groundwater

investigations indicated that the waste stabilization basin was the principal source of groundwater contamination. However, additional monitoring wells were necessary to determine if groundwater containing the detected constituents was migrating off-site and, if so, to what extent. To accomplish this, 35 additional perimeter well clusters were installed (19 through 32, 34, 35, 37 through 41, 43 through 55, and 60). In addition, monitoring well clusters 81 and 101 were installed in the interior portion of the site. These wells, installed as part of the "on-site" investigations, were in addition to the 23 cluster locations installed as part of the preliminary investigation (13 in the vicinity of the former Interior Landfill and 10 near the waste stabilization basin) (Figure 4-1).

These wells were installed as two-well clusters, each containing an A- and a B-series well, and screened in the same manner as those wells installed during the preliminary investigation. Well cluster 81 is an exception because, in addition to the A- and B-series wells, it also contains an F-series well (screened 30 to 35 feet below land surface) and an additional well screened from the water table down to 45 feet below land surface (well 81°). All of these wells were sampled and analyzed for organic and inorganic priority pollutants. In general, the analytical results, shown in Table 4-1, indicated elevated concentrations of organic constituents such as chlorobenzene, benzene, trichloroethylene, and methylene chloride in the cluster wells immediately south (downgradient with respect to groundwater flow) of the waste stabilization basin.

In addition, the results indicated localized, but elevated, levels of a number of organic constituents in several of the well clusters along Plastics Avenue. The two interior wells (81 and 101) also showed

elevated levels of benzene, chlorobenzene, and methylene chloride. Samples collected from wells 81B and 81° contained levels of PCBs above the MMCL.

4.2.1.3 Off-Site Investigations

The off-site investigations were conducted as a series of detailed well installation and sampling and analysis activities proceeding downgradient in the direction of groundwater flow. The initial results of prior investigations had indicated the presence of a plume of organic constituents originating in the vicinity of the waste stabilization basin and moving downgradient toward the Housatonic River. The primary objectives of the off-site investigation were to define the horizontal and vertical extent of the plume, the rate of the organic constituent movement, and to determine if impacted groundwater discharges to the Housatonic River.

Phase I of the off-site investigation was initiated in an area just south (downgradient) of the waste stabilization basin. A total of 13 well clusters were installed in areas south of Merrill Road (Figure 4-1). Seven of these well clusters (17, 18, 33, 36, 56, 57, and 58) were installed as two-well clusters, each containing an A- and B-series well. Three of the clusters (14, 15, and 42) contain A-, B-, and C-series wells, while two others (12 and 13) contain A-, B-, C-, and D-series wells. Well cluster 16, also a four-well cluster, contains A-, B-, C-, and E-series wells. The deeper wells were generally installed to facilitate the investigation of groundwater quality and hydraulic gradients at depth.

All wells were sampled and analyzed for priority pollutant organics. These results, presented in Table 4-1, indicate the presence of benzene, chlorobenzene, and other organic compounds in the well

clusters immediately south of the waste stabilization basin. Additionally, lesser concentrations of the same organics were present in the well clusters installed southwest of the basin.

Based on the results of the Phase I investigation, a Phase II off-site investigation was recommended. This subsequent activity included the installation of a series of wells along a north-south line located approximately half-way between Merrill Road and the Housatonic River. During this investigation, seven well clusters (82 through 86, 88, and 89) were installed at the locations illustrated on Figure 4-1. With the exception of well cluster 89, these are all two-well clusters consisting of A- and B-series wells. Well cluster 89 is a three-well cluster consisting of A-, B-, and D-series wells. All wells were sampled and analyzed for priority pollutant organics. Results, as shown in Table 4-1, indicated the presence of elevated levels of benzene and chlorobenzene in well cluster 89. This set of well clusters provided information on the centerline and depth of the plume between Merrill Road and the Housatonic River.

Based on the results of Phase II investigation, a third phase of the off-site investigation was undertaken and included the installation of seven cluster wells (90, 91, 92, 95, 97, 99, and 100) just north of the Housatonic River. Monitoring well 91 is a single well screened at the B horizon, whereas locations 90, 92, and 100 are two-well clusters consisting of A- and B-series wells. Well clusters 95, 97, and 99 are three-well clusters consisting of A-, B-, and C-series wells. All of these wells were sampled and analyzed for priority pollutant organics, with results indicating the presence of benzene and chlorobenzene in many of the wells (Table 4-1). The highest concentrations were detected in wells 92A, 95A, 95B, 95C, and 99C.

The results of the Phase III off-site investigation indicated that the groundwater plume may have migrated as far south as the Housatonic River. At that time, in order to provide more detail regarding the nature of the VOC plume, additional off-site wells were installed and groundwater monitoring continued.

Between November 1981 and April 1982, 14 additional well clusters (102 through 115) were installed on the west side of Unkamet Brook between Merrill Road and the Housatonic River, with the exception of well 114, which was placed on the eastern side of the brook. Nine of the 14 clusters (104 through 106, and 108 through 113) were installed as two-well clusters containing A- and B-series wells. The remaining five were installed as three-well clusters containing A-, B-, and C-series wells. Groundwater samples from these wells were collected and subsequently analyzed for priority pollutant VOCs. The analytical results are shown in Table 4-1.

4.2.1.4 Subsequent Monitoring of VOC Plume

A two-year, semi-annual groundwater monitoring program was conducted between December 1983 and April 1985 to monitor the VOC plume associated with the former waste stabilization basin. These efforts involved the mapping of groundwater flow patterns and describing lateral and vertical groundwater quality using field and analytical data obtained from groundwater analyses.

Groundwater flow in the area of the former waste stabilization basin was found to be toward the confluence of Unkamet Brook and the Housatonic River. This observation was noted to be consistent with previous monitoring (Geraghty & Miller, January 1986).

Groundwater samples were collected on various occasions from well clusters 95, 97, 102, 109, 114, and 115 and analyzed for USEPA

priority pollutant VOCs, TOX, and PCBs. Likewise, groundwater samples were also collected from well clusters 89, 90, and 111, and analyzed for VOCs and PCBs. Well clusters 2, 16, 39, and 104 were analyzed for VOCs only. The locations of these wells are illustrated on Figure 4-1 and the analytical results are summarized in Table 4-1.

The results of this investigation showed that the principle constituents of the plume were benzene, chlorobenzene, ethylbenzene, methylene chloride, toluene, trans-1,2-dichloroethene, and trichloroethene. PCBs were detected at levels near the detection limit in wells 102BC and 114C, during one monitoring round.

Subsequent to the semi-annual groundwater monitoring performed from 1983 through 1985, annual monitoring was performed related to the former waste stabilization area VOC plume during 1987, 1988, and 1989.

During the 1987 monitoring activities, wells 90AB, 97ABC, 102ABC, 111AB, and 114ABC were targeted for priority pollutant VOC and PCB analyses. The results of these analyses are summarized in Table 4-1 and show that only benzene (0.008 ppm) and toluene (0.016 ppm) were detected in wells 97A and 102C, respectively.

Groundwater monitoring performed in 1988 included the collection of groundwater from the same wells sampled in 1987, and sample analysis for priority pollutant VOCs and PCBs. The results of these analyses (Table 4-1) show that only benzene (0.016 ppm) and chlorobenzene (0.420 ppm) were detected in well 114B, and toluene (0.006 ppm) was detected in well 114C.

The same wells targeted as part of the 1987 and 1988 groundwater monitoring activities were also sampled as part of activities performed in 1989. These samples likewise were analyzed

for priority pollutant VOCs and PCBs. The results of these analyses (Table 4-1) show that the only VOCs detected above quantitation limits were benzene (0.057 ppm) and chlorobenzene (1.0 ppm) which were detected in well 114B.

4.2.2 MCP Groundwater Investigations

The primary objective of the MCP Phase II groundwater monitoring program for the Unkamet Brook Area/USEPA Area 1 Site was to monitor the VOC plume originating at the former waste stabilization basin. The investigation included sampling of 26 wells that had been sampled in previous monitoring programs, in order to confirm the plume boundaries and establish the current concentrations within the plume. Samples were also collected from 16 selected well clusters located up- and down-gradient of other potential sources (Building 51/59 area and the former Interior Landfill) for an indication of groundwater quality in these areas. In addition, three new "deep" monitoring wells were installed and sampled (39D, 39E, and 116E) at the locations shown on Figure 4-2.

Figure 4-3 shows the locations of all of the monitoring wells installed in the Unkamet Brook Area/USEPA Area 1 Site to date. As part of the MCP Phase II program, a complete inventory of existing wells was completed prior to sampling (Table 4-3). Wells that could not be sampled, because they were not located or had been destroyed, were either substituted with nearby wells or deleted from the program based on MDEP concurrence. A list of the monitoring wells originally proposed for sampling and subsequent modifications to that list is presented in Table 4-4.

Also, as part of the MCP Phase I Remainder of GE facility (ROGEF) investigation, two new monitoring wells (RF-14 and RF-15)

were installed within USEPA Area 1, near Building OP-1 (Figure 4-2).

In all, 47 wells were sampled in a single sampling round. The wells sampled are shown on Figure 4-4.

4.2.2.1 Well Inventory

Between December 5 and 7, 1990, a complete monitoring well inventory was performed at the site. The purpose of the inventory was to determine the number of existing monitoring wells in the area and assess their condition. The inventory consisted of locating wells, assessing their integrity, sounding each well, and collecting water-level measurements. This information was recorded on well inventory logs. The results of the well inventory, summarized in Table 4-3, established that several wells proposed for the MCP sampling program could not in fact be sampled. Table 4-4 lists the wells that could not be sampled, the reason for such conclusion, and the substitutions (if any) made with MDEP concurrence for those wells.

4.2.2.2 Monitoring Well Installation

The MCP Phase II groundwater monitoring program called for the installation of two "deep" borings/monitoring wells. One boring was to be located near well cluster 39 and designated as 39E, while the other was to be located near well cluster 102. Due to problems accessing the 102 location with the drill rig, a location as close to 102 as possible was chosen with MDEP concurrence and designated as 116E (Figure 4-3). Borings RF-14 and RF-15, installed as part of the Remainder of GE Facility (ROGEF) Investigation, are located north and south of Building OP-1, respectively, as illustrated on Figure 4-3.

The 39E boring was proposed to extend 5 feet into till (if till was present) or to the bedrock surface (if till was not present). Soil boring 116E was to extend to 150 feet below land surface or to the bedrock surface, whichever occurred first. These deep borings were installed for the dual purpose of monitoring for dense non-aqueous phase liquids (DNAPLs) at depth and providing information on the presence of vertical gradients. Soil borings RF-14 and RF-15 were to extend to approximately 10 feet below the water table.

The borings were to be installed using a truck-mounted hollow-stem auger drill rig. However, due to problems drilling in the dense sand present at the site, the auger method could not be used deeper than 67 feet at the 39E location. GE, with the approval of the MDEP, chose to set a well in this borehole at 66 feet (designated as 39D), and continue drilling deeper in another borehole (39E). Soil boring 39E was drilled first by using the hollow-stem auger method, followed by the mud-rotary method after auguring became difficult. Soil boring 39E was drilled to 235 feet below the ground surface, 7 feet into till which was encountered at 228 feet below the ground surface. Due to the problems encountered during installation of 39E, it is possible that chemicals of concern were carried down by the drilling process. VOCs were detected in 39E in April 1991, as discussed in Section 4.6.1, but were not subsequently detected in February 1992.

Boring 116E was also initially drilled with the hollow-stem auger method, then finished with the mud-rotary method to a depth of 150 feet. Borings RF-14 and RF-15 were each

completed to a depth of 24 feet using the hollow-stem auger method.

The multi-purpose of the new well at cluster 39 was to determine groundwater quality at depth, to measure vertical hydraulic gradients at this location, and to determine if DNAPLs were present on top of the bedrock surface or till (if present). The purpose of monitoring well 116E was to determine the vertical groundwater hydraulic gradient in the area of the Housatonic River as part of the Groundwater Divide Study (see Section 4.5.5), as well as to determine groundwater quality at depth at the downgradient edge of the VOC plume. These wells, together with the additional well designated as 39D, were installed by Empire Soils, Inc., of Ballston Spa, New York.

The purpose of the two new wells installed as part of the ROGEF Investigation (RF-14 and RF-15) was to determine groundwater quality in the area and characterize the presence of any hazardous materials.

Monitoring wells 39D, 39E, and 116E, are constructed of 4-inch-diameter Schedule 40 PVC casing with 10 feet of 0.020-slot screen. Monitoring well 39D was screened from 56 to 66 feet, monitoring well 39E was screened from 225 to 235 feet, and monitoring well 116E was screened from 140 to 150 feet. Monitoring wells RF-14 and RF-15 were constructed of 4-inch-diameter Schedule 40 PVC casing with 15 feet of 0.010-slot screen (installed at 7 to 22 feet and 9 to 24 feet, respectively). In all wells, the annular space between the screen and borehole was packed with 1Q or 2Q sand to 2 feet above the screen, with a bentonite seal above the sand pack. The remainder of the

borehole was grouted to the surface with a cement/bentonite slurry. Locking protective casings were installed to complete the wells. Well construction logs are presented in Appendix F.

Upon completion, each well was thoroughly developed to ensure a good hydraulic connection between the formation and the well screen. Well development was performed using a submersible or bladder pump. The wells were developed until visibly sediment-free water was produced.

4.2.2.3 Groundwater Sample Collection

As part of the groundwater sampling program, 47 monitoring wells at the site were sampled, including the wells installed under the MCP program (39D, 39E, and 116E) and the wells installed under the ROGEF Investigation (RF-14 and RF-15). The existing monitoring wells that were sampled during this program were re-developed by Clean Berkshires using a bladder pump and by air lifting, before any sampling took place. Between February 20 and 28, April 17 and 19, and on August 29, 1991, groundwater samples were collected from the monitoring wells.

Prior to sampling, depth to water and total depth of well measurements were taken, and three or more volumes of water were purged from each well. Table 4-5 presents a list of monitoring wells sampled and corresponding analyses, as well as quality assurance/quality control (QA/QC) samples taken. Appendix IX+3 refers to those constituents listed in 40 CFR plus three additional constituents (benzidine, 2-chloroethyl vinyl ether, and 2-diphenylhydrazine). Analyses designated as "Appendix IX+3** did not include analysis for pesticides and herbicides.

Table 4-6 contains the field measurements of specific conductivity, pH, and temperature taken at each well sampled.

Water samples were chemically preserved according to laboratory specifications. The samples were put on ice immediately after sampling and, following standard chain-of-custody procedures, shipped to CompuChem Laboratories. As specified in the approved SOW, QA/QC procedures consisted of collecting a duplicate, matrix spike/matrix spike duplicate, and field blank at a frequency of one per 20 (1/20) samples collected.

4.2.2.4 Groundwater Quality Data

The analytical results of groundwater samples collected from monitoring wells in the Unkamet Brook Area during the MCP groundwater investigation are summarized in Tables 4-7 through 4-10. Analytical results from wells RF-14 and RF-15, located within the MCP ROGEF area and the Remainder of USEPA Area 1, are presented in Tables 4-11 and 4-12, respectively. In each of the tables, only detected compounds are presented. The laboratory reports containing all analytical results and sample data packages, including detection limits and quality control raw data, have previously been submitted to the MDEP and the USEPA in the MCP monthly reports. These data reports are included, in an organized fashion, in Appendix G. The distribution of the detected compounds is discussed in detail in Section 4.6.1.

4.2.3 Recent Groundwater Investigation Activities

During November and December 1992, O'Brien & Gere installed and sampled three shallow monitoring wells (OBG-1, -2, and -3) at the Unkamet Brook Area/USEPA Area 1 Site on behalf of GE. These wells were installed near Building OP-3 (see Figure 4-3) in conjunction with the release of No.

4 fuel encountered during the removal of USTs OP3-01, OP3-02, and OP3-03. Details regarding these activities and a discussion of the resulting data are presented in a report prepared by O'Brien & Gere (March 1993) entitled "Building OP-3 Monitoring Well Installation, Naval Industrial Reserve Ordnance Plant/PN38-029," which is included in Appendix H. A brief summary of the associated activities and resulting data is presented below.

Monitoring wells OBG-1, -2, and -3 were installed to depths of approximately 15 feet below the ground surface. These wells were constructed using 2-inch diameter PVC and 12-foot-long manufactured 0.010 slotted well screens. The tops of the well screens were placed approximately 3 feet above the water table.

As part of the installation of these wells, soil samples were collected continuously at 5-foot depth intervals. Each sample was screened in the field with a photoionization detector (PID). Screening results, soil descriptions, and other pertinent information are presented in Appendix H.

Upon the completion, development, and purging of wells OBG-1, -2, and -3, groundwater samples were collected from each well and submitted for analysis of total petroleum hydrocarbons (TPHs). As summarized in Appendix H, only well OBG-1 exhibited TPHs above detection limit at 0.538 ppm.

During January 1994, ERM installed and sampled two temporary monitoring wells (MW-38 and MW-39) at the Unkamet Brook/USEPA Area 1 Site on behalf of Martin Marietta. These wells were installed as part of excavations related to the planned extension of a steamline west of Building OP-3 (see Figure 4-3). Details regarding these activities and a discussion of the resulting groundwater data are presented in a report prepared by ERM (February 1994) entitled "Martin Marietta Corporation, Ground Water

Sampling, MW-38 and MW-39," which is included in Appendix I. A brief summary of the associated activities and resulting data is presented below.

Monitoring wells MW-38 and MW-39 were installed to depths of 14 and 16 feet below ground surface, respectively. These wells were constructed using 2-inch diameter schedule 40 PVC and 10-foot-long manufactured 0.010 slotted well screens. The tops of the well screens were placed as close as possible to or above the water table.

As part of the installation of these wells, soil samples were collected continuously at 2-foot depth intervals to the water table and at 5-foot depth intervals below the water table. Each sample was screened in the field with an organic vapor analyzer (OVA). Screening results, soil descriptions, and other pertinent information are presented in Appendix I.

Upon the completion, development, and purging of wells MW-38 and MW-39, groundwater samples were collected from each well and submitted for the analysis of Appendix IX constituents, excluding polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

As summarized in Appendix I, the results of these analyses indicated that Aroclor 1254 was detected in well MW-39 at 0.0007 ppm along with tetraethyldithiopyrophosphate (an insecticide) at 0.0013 ppm. Also, various inorganics were detected in both wells at relatively low concentrations.

4.3 Subsurface Soil Investigation Activities

4.3.1 General

As discussed in Section 4.2.2.2 above, the MCP Phase II Investigation of the Unkamet Brook Area/USEPA Area 1 Site included the installation of three new "deep" soil borings to be completed as monitoring wells 39D, 39E, and 116E (Figure 4-2). Also, as part of the ROGEF field activities, two borings (RF-14 and RF-15) were installed near Building OP-1 in June

1991 and completed as monitoring wells. The soil boring program, which began on January 24, 1991, included the sampling and analysis of soil samples collected during the drilling process. A limited amount of soil sampling has also been completed in the study area in conjunction with miscellaneous excavation activities. These data are discussed in Section 8. In addition, PCB data were generated for three soils samples collected during the installation of monitoring wells OB-1, OB-2, and OB-3. As detailed in Appendix H, the samples were collected at the water table interface (5 to 7 feet below the ground surface in borings OB-1 and OB-2, and 10 to 12 feet below the surface in boring OB-3), and no PCBs were detected in any of these samples.

4.3.2 MCP Soil Sample Collection

At each MCP well location, soil sampling was conducted in accordance with the MDEP-approved Sampling and Analysis Plan (SAP) (Blasland & Bouck, September 1990). Split-spoon soil samples were collected continuously at 2-foot intervals from soil boring 39D to a depth of 68 feet. At the nearby boring for 39E, split-spoon samples were collected at approximately 10- to 30-foot intervals from depths of 86 to 235 feet. In soil boring 116E, soil samples were collected at 5-foot intervals from 0 to 40 feet and from 107 to 144 feet. Sampling was at 10-foot intervals between 40 and 107 feet. Continuous 2-foot interval samples were collected from soil borings RF-14 and RF-15. A Geraghty & Miller hydrogeologist observed the drilling and logged each soil sample in detail for texture, structure, and moisture content. The hydrogeologist field-screened the samples for the presence of VOCs using a portable PID and following the protocols described in the SAP (Blasland & Bouck, September 1990). The PID results obtained during the field-screening of each sample

are presented in Table 4-13, and soil boring logs are provided in Appendix F.

For soil boring 39D, soil samples that produced a headspace PID reading greater than 10 PID units above background to a depth of 50 feet were submitted to CompuChem Laboratories of Research Triangle Park, North Carolina, for analysis of VOCs and SVOCs. In addition, although none of the samples from boring 39E showed a PID reading of greater than 10 PID units, the soil sample from 233 to 235 feet in that boring was submitted for analysis of VOCs and SVOCs to determine soil quality at this depth. Samples were not submitted for VOC analysis from soil boring 116E, as no PID readings above 10 PID units were obtained.

As described in the MCP Phase I ROGEF SOW, the one soil sample from soil boring RF-14 and from RF-15 which exhibited the highest PID reading above background was to be submitted for analysis of Appendix IX+3 constituents. However, samples from both borings did not exhibit PID readings above background, and consequently the sample for Appendix IX+3 analysis was taken from each boring at the first groundwater saturated interval.

Soil samples that were to be submitted for VOC analysis were placed in coolers with ice immediately after sampling and shipped to the laboratory with standard chain-of-custody forms. A soil sample collection summary is presented in Table 4-14.

In soil borings 39D, 39E, RF-14, and RF-15, each soil sample collected was also submitted for PCB analysis by USEPA Method 8080. Samples from soil boring 116E were not submitted for PCB analysis due to the distance of this boring from the facility areas associated with the occurrence of PCBs. The samples collected for PCB analysis were submitted to IT Analytical Services of Knoxville, Tennessee.

A QA/QC program was followed to ensure the quality of both field and laboratory data collected during the field investigation per the SAP. Duplicate, matrix spike, and matrix spike duplicate (MS/MSD) samples were analyzed at a frequency of one per twenty (1/20) samples collected for VOCs and PCBs. A field equipment blank was collected from a decontaminated split spoon and submitted for PCB and VOC analysis.

4.3.3 Soil Quality

As described in Section 4.3.2, soil samples were collected during installation of monitoring wells 39D, 39E, and 116E, and selected soils were submitted for VOC and SVOC analysis as shown in Table 4-14. One soil sample each from soil borings RF-14 and RF-15 was analyzed for Appendix IX+3 constituents. Additionally, soil samples collected from 39D, 39E, RF-14, and RF-15 were analyzed for PCBs.

The analytical results of the soil samples are summarized in Tables 4-15 through 4-23. These tables present only those compounds that were detected. Complete laboratory data packages have previously been submitted on a monthly basis to the MDEP and USEPA, and the data reports are included in an organized fashion in Appendix G.

In samples from soil boring 39D, concentrations of chlorobenzene ranged from 0.31 ppm in the sample from 26 to 28 feet, to 240 ppm in the sample from 16 to 18 feet, as presented in Table 4-15. Other constituents were present, but at concentrations appreciably less than chlorobenzene. Although acetone and methylene chloride were detected in each of the soil samples submitted, both of these compounds were nearly always detected in the associated method blanks (at similar concentrations) and are common laboratory contaminants, thus indicating that the sample results are most likely due to laboratory contamination. In samples collected from soil boring 39E, chlorobenzene was identified above the detection limit, at 0.007

ppm, in only one from 233 to 235 feet below ground surface (Table 4-16). Detected VOCs may have been carried downward by the drilling fluid (mud) used to advance the boring.

Several SVOCs were detected in soil samples from soil boring 39D, including substituted naphthalene compounds and dichlorobenzenes as shown in Table 4-17. SVOC concentrations varied with depth and the highest concentrations were generally present at depths that had also exhibited higher concentrations of chlorobenzene (i.e., 16 to 18 feet, 32 to 34 feet, and 40 to 42 feet). The highest SVOC concentrations were detected in the sample from 16 to 18 feet, where both naphthalene and 1-methylnaphthalene were detected at 17 ppm, 1,2-dichlorobenzene was detected at 6.6 ppm, and 1,4-dichlorobenzene was detected at 11 ppm. In boring 39E, the only SVOC detected above the detection limit was bis(2-ethylhexyl)phthalate at 0.48 ppm (Table 4-16).

Soil samples collected in boring 39D from 0 to 68 feet in 2-foot intervals were analyzed for PCBs. The highest concentration of 3.1 ppm was detected in the 0- to 2-foot sample, and PCB concentrations ranged from 0.09 to 0.34 ppm in samples collected from depths of 8 to 20 feet. PCBs were not detected in soil collected from depths of greater than 20 feet at 39D. At the adjacent boring 39E, PCBs were not detected. Samples from boring 116E were not analyzed for PCBs.

In borings RF-14 and RF-15, soil samples submitted for Appendix IX+3 analysis were collected from just below the water table. With the exception of VOCs detected in both the blanks and the field samples, no VOCs were detected in these soil samples above the detection limit, as shown in Table 4-19. Similarly, no SVOCs were detected above the detection limit, as presented in Table 4-20. DDT and DDE were detected in the sample from boring RF-14 at concentrations of 0.078 and 0.21 ppm, respectively (Table

4-21). PCBs were detected in both borings at concentrations ranging from 0.05 to 1.1 ppm (Table 4-22). Finally, inorganic constituents that were detected are listed in Table 4-23. The detected inorganic constituents appear to be similarly distributed at the two boring locations and may be representative of background soil conditions.

4.4 Site Geology

4.4.1 Unconsolidated Deposits

The overburden deposits found in the study area are unconsolidated sediments of glacial origin which have been deposited in a broad bedrock valley occupied by the Housatonic River and Unkamet Brook. Areas within the floodplains of the river and brook also include geologically recent deposits such as fine-grained sand, silt, and peat.

Information on the thickness of the overburden deposits is available from the drilling results of the newly installed well 39E. The boring for this well, which encountered till at approximately 228 feet, indicates an overburden thickness of greater than 235 feet near the former waste stabilization basin. The data from the seismic-refraction survey, described in Section 4.4.2 below, indicate overburden thicknesses varying from at least 150 to 200 feet south of Merrill Road.

As described in Section 2.6, unconsolidated deposits in the floodplain area are predominantly composed of sediment released from meltwater during the last glacial retreat from the area. At depths of up to approximately 40 feet below the ground surface in the study area, lenses of various types of soil including silt, fine to coarse sand, and peat have been identified. These deposits are the result of glacial outwash being reworked by the fluvial systems of the Housatonic River and, to a lesser extent, Unkamet Brook.

As a result of this type of deposition, a high degree of variability exists in the types of soils encountered near the surface from place to place throughout the site. Localized lenses of silt, peat, and fine sand are typically found near the surface. Although generally low, the permeabilities of these surficial deposits vary, as evidenced by the variable hydraulic conductivities of "B" wells, which are screened across different units described below. Hydraulic conductivity values in the area are discussed in detail in Section 4.5.2. Figure 4-5 presents a cross-section that transects the study area from north to south and shows the relative distribution of the various soil types.

Four soil types that can be observed at the ground surface include:

- brown or black, very soft peat;
- gray, micaceous silt with occasional lenses of fine sand;
- brown, olive, or gray, gravelly and silty sand; and
- brownish gray, well-sorted quartzose sand.

Peat is exposed beneath the swampy areas on both sides of Unkamet Brook. It contains thin (less than one-foot thick) lenses of gray, micaceous silt, and fine sand. The peat averages 10 feet in thickness and thins toward the periphery of the swampy areas. The peat also appears to grade into a moist, gray silt that underlies the GE Plastics parking lot areas. This silt is fairly tight and very rich in organic material.

The silt unit interfingers with a heterogeneous mixture of silt, poorly sorted sand, and gravel. Distinct changes in color and grain size indicate deposition in a variety of geologic environments. Because of the abundance of silt grains between the coarser particles, this unit, present south of Dalton Avenue and along Plastics Avenue, is dense and is of relatively low permeability. The unit thins to the south and is underlain by, or interfingers with, a water-bearing sand.

A unit composed primarily of sand underlies the area south of the former waste stabilization basin and partially to the south of Merrill Road. Brownish gray, well-sorted sand with thin lenses of gray micaceous silt and brown peat which "pinch out" to the southeast characterize this unit. The sand is relatively homogeneous, with only a trace of gravel and silt present. At depth, the silt and peat beds are absent and the unit becomes very homogeneous.

The deeper soils, characteristic of glacial outwash deposits, are for the most part composed predominately of fine to medium sand, but vary throughout the study area with respect to silt and gravel content, density, and degree of stratification. Soils at well 39E are described as mainly homogenous fine to coarse sands that are fairly dense, which contrasts the loose silty sands observed at well cluster 99C. Closer to the Housatonic River, the deeper soils show evidence of greater stratification but are fairly tight and compact deposits. This interpretation is supported by the low hydraulic conductivities for the deep wells at clusters 114 and 102, and well 116E, and the field description of deposits at each location.

Differences in density between the unconsolidated deposits on the west and east sides of Unkamet Brook are also suggested by the results of the seismic-refraction survey. As described in the following section, at Line GEO1, a north-south trending seismic line which crossed Unkamet Brook, higher seismic velocities were calculated for the deposits west of the brook. This roughly correlates with dense silt, boulders, possibly till, and generally difficult drilling conditions described on geologic logs for wells west of the brook (e.g. wells 109A, 106A, 112).

4.4.2 Bedrock - Geophysical Investigation

Between November 3 and 7, 1991, a seismic-refraction survey was conducted at the site in an attempt to determine the depth to bedrock and

to characterize the topography of the bedrock surface. The survey was performed in the open lowland area south of Merrill Road, along both the east and west sides of Unkamet Brook.

Four seismic-refraction lines were recorded, as presented on Figure 4-6. Lines GE01, GE02, and GE04 were oriented north-south, with line GE03 oriented roughly northwest-southeast and crossing each of the previous three lines. Line GE01 was 830 feet in length, while lines GE02, GE03, and GE04 were each 965 feet in length.

Seismic signals were recorded along each line using 14-hertz geophones which were laid out in a tapered array. In this type of configuration, the spacing of the geophones at the ends of the lines is less than in the center so as to measure the velocity of near-surface layers more accurately. An EG&G 2401 24 channel seismic recorder with floating point amplifier was used to record the output of the geophones. Kinepack charges were used as the energy source (shots) to generate the seismic waves. Shots were placed at the ends of the lines, at the center, and about 400 feet off the ends of the lines. On line GE02, shots were also placed 700 feet from the end of the line to determine if deeper layers were present.

In conducting a seismic-refraction survey, shots are fired to create seismic waves which travel along the surface of the ground and into the underlying strata. If a layer has a seismic velocity greater than that of the overlying layers, energy waves are refracted along the interface of the layers and continuously radiate energy back to the ground surface, where it is detected by the geophones. The lower layer is then referred to as a refractor. The seismic waves are recorded simultaneously by all 24 geophones for approximately one-half of a second immediately after the

shot is fired. The resulting signals by the 24 geophones, known collectively as seismic record, form the basis for subsequent interpretation.

Several shots were fired on each line, resulting in several records for each line. These records were then loaded onto a computer, and the individual geophone signals (traces) were analyzed to determine the arrival time of the seismic waves. Because the energy level of some of the waves arriving first was small, an Automatic Gain Control (AGC) software routine was used. This software, along with user-controlled signal amplification, was employed to enhance the small signals, which often cannot be clearly observed on the field records. Once these first arrival times were selected, the data from each record were plotted against geophone distance from the shot point to create a time-distance plot. Where appropriate, these data were then loaded into a seismic interpretation program called GREMIX, developed by Interpex of Golden, Colorado, and an interpretation of the subsurface layers was produced.

The geophysical and geological interpretations of each of the seismic lines are discussed below. Since the determination of the depth to bedrock was generally quite complex, the interpretation was completed using two methods. In the first method, theoretical time-distance curves were calculated from models using the measured velocities and times from each seismic line. The second method involved implementation of the GREMIX program, which is based on the Generalized Reciprocal Method (GRM) of interpretation. However, the GRM interpretation method has to meet very specific requirements before it can be used, the main one being that a refractor (or layer) must be detected by a common set of geophones for shots at different ends of the line. This situation only occurred for the deeper refractors on line GE04, and even then only for a small number of geophones.

4.4.2.1 Geophysical Interpretation

Generally, the data quality was good to excellent, with fairly clear arrival times being recorded. The poorest data were observed for shots placed in the fill material at the railroad yard located near the western end of the site (near Line GE01). In a few cases, these data could not be used. Data quality is also poorer for the shots placed 700 feet from the ends of the spread on line GE04.

Line GE01

Data quality was generally good, except for data obtained from shot 3 and from the shots offset from the ends of the line, where first arrival times could not be observed.

The interpretation of this line was difficult since there was no indication of consistent geological layers across the line. As shown by the time-distance curves (Figure 1 in Appendix J), the velocities are much higher along the line from 0 to 300 feet than they are from 500 feet to the end of the line. In addition, the velocities beneath the early part of the line increase with depth from about 6,600 feet/second (ft/s) to over 10,000 ft/s. At the other end of this line, the velocities remain fairly constant with depth at approximately 5,300 ft/s. The interpretation of these data is shown on Figure 4-7. Unfortunately, depths to bedrock could not be calculated since neither layered modeling nor the GRM method was appropriate.

Line GE02

Data quality was good, except for shot 12 and the shot offset 700 feet from the end of the line, for which first breaks were not observed. Only first breaks on the first 16 geophones could be observed on shot 12. Shots 9, 10, and 11 were used

for the velocity and depth calculations, although all of the data were used to assign the layers to the first break times. The time-distance curves are shown on Figure 2 in Appendix J. Although GRM interpretation was not possible for the deeper refractors, the GREMIX program was used to provide an interpretation. The deeper refractor observed in the data from shot 15 had a measured velocity of 10,760 ft/s, with its depth calculated using a horizontally layered earth model. All of the refractors are shown on the depth profile generated from the GREMIX interpretation (Figure 4-8).

Line GE03

All of the shots on this line provided good-quality data, and the time-distance plot (Figure 3 in Appendix J) indicates that three layers are present. GREMIX was used to produce an interpretation, although only the top of the second layer was interpreted using the GRM technique. Layered earth models were used to obtain the depths to the deeper refractor. The interpretation is shown on Figure 4-9.

Line GE04

Data quality was good, except for the shot 400 feet off the beginning of the line, for which first breaks were not observed. The interpretation was complex because a simple layering of strata was not observed. GREMIX was used to interpret this line, along with calculations using a horizontally layered earth model. A GRM interpretation was performed for the refractors at a depth of approximately 120 feet beneath line distances of 350 feet to 900 feet. The depths to the deeper refractors were obtained

using layered earth models. Figure 4-10 shows the depth profile interpreted for this line.

4.4.2.2 Geological Interpretation

The depth to bedrock beneath each seismic line was evaluated by comparing the calculated velocities with published and unpublished velocity data for unconsolidated deposits and bedrock. Information on velocities included those reported in USGS reports (Hansen et al. 1974; Hanei 1988; and Dobrin 1976). The USGS office in Marlboro, Massachusetts, was also contacted to obtain information, on unpublished velocity data for glaciated geologic terrain in New England.

Using the above sources of information, the expected ranges of velocities are as follows:

Geologic Material	Velocity (ft/s)
Unsaturated gravel or sand	1,500 - 3,000[a]
Saturated sand	2,000 - 6,000[a]
Saturated sand and gravel	4,000 - 6,000[b]
Glacial till	5,600 - 7,400[c]
Soft limestone	7,000 - 13,000[d]
Limestone	7,000 - 20,000[e]

Sources:

(a) Hansen et al. (1974)
(b) Clark (1966)
(c) Hanei (1988)
(d) Dobrin (1976)
(e) Jakosky (1950)

These velocities were then compared with calculated velocity data from each line, which are shown on the depth profiles generated for each line (Figure 4-7 through 4-10), and with existing well log information to generate a geological interpretation of the data.

For Line GE01, a characterization of the depth to bedrock was not possible because distinct refractors at depth were not observed in the data. However, calculated velocities indicate a sharp transition in velocity beneath Unkamet Brook. The calculated velocity west of Unkamet Brook is 6,600 ft/s, and the velocity east of the brook decreases from 5,500 to 5,250 ft/s. These results roughly correlate with more dense (higher velocity) unconsolidated deposits observed west of Unkamet Brook at well locations 106, 109, and 112.

In Line GE02, four different velocity layers are indicated in the depth profile (Figure 4-8). Based on comparisons with geologic logs of wells in the area, the 1,800 ft/s layer probably includes unsaturated deposits and saturated peat and sand. The 5,000 to 5,200 ft/s layer correlates with predominantly silty sand deposits such as those observed at well 99C.

The geological interpretation for the 7,200 ft/s layer in Line GE02 is not clear; the refractor may represent the top of till or bedrock. In situations where till is relatively thin and/or has a velocity similar to that of the top of bedrock, it may not be possible to distinguish the till/bedrock interface. The depth to the 7,200 ft/s layer ranges from approximately 210 feet near the beginning of the line to approximately 120 feet near the end of the line. At well 39E, which is approximately 1,000 feet west of this line, till was encountered at a depth of 228 feet. The boring for this well was advanced 10 feet into the till and completed before reaching bedrock. The 10,670 ft/s layer is most likely representative of a deeper bedrock layer beneath the site, although this layer is not observed beneath the entire length of the line.

In each of the other seismic lines, a refractor was also observed at a depth of approximately 200 feet. In Line GEO3, oriented northwest-southeast and crossing Lines GE01, GE02, and GE04, velocities typical of the unconsolidated deposits (4,600 to 5,700 ft/s) overlie a higher velocity layer of 8,600 ft/s to 8,200 ft/s. Although only a limited interpretation was possible for Line GE04, velocities in the range typical of unconsolidated deposits overlie an 8,030 ft/s layer near the south end of the line.

In summary, the layer at a depth of approximately 150 to 200 feet has a velocity range of 7,200 to 8,600 ft/s. The calculated velocity of 7,200 ft/s is within the upper range of velocity expected for glacial till but is also within the potential velocity range for weathered and unweathered limestone, which is the type of bedrock that underlies the unconsolidated deposits in the Unkamet Brook Area. Generally, bedrock that is weathered will have lower velocities. Velocities of limestone terrain within the Hoosic River Valley typically exceeded 10,000 ft/s (Hansen et al., 1974). At the same time, personal communication with the USGS in Marlboro, Massachusetts, indicates that velocities for glacial till in New England are typically 6,000 to 7,000 ft/s, and that velocities in excess of 8,000 ft/s are probably too high for glacial till (Hansen, USGS, January 14, 1992). The 7,200- to 8,600-ft/s layer observed in lines GE02, GE03, and GE04 probably represents glacial till, weathered bedrock, or a combination of the two; however, this conclusion cannot be confirmed. This layer undulates somewhat beneath Line GE03 (ranging from roughly 150 to 200 feet) and dips to the south beneath Line GE02, ranging in depth from approximately 140 feet at the northern end to 210 feet at the southern end of the line.

4.5 Site Hydrogeology

4.5.1 Hydraulic Gradients

An extensive amount of groundwater elevation data exists for this area. The data, collected during groundwater monitoring programs over the past 12 years, have been used to construct a series of groundwater flow maps encompassing both on-site and off-site areas.

The direction of groundwater flow in the vicinity of the former Interior Landfill has historically been variable, but has generally indicated some component of discharge to Unkamet Brook. These maps also show Unkamet Brook and the Housatonic River as gaining streams (discharge areas), although isolated areas along reaches of both the brook and river have in the past indicated losing stream conditions.

Groundwater flow maps constructed from water levels collected during the December 1990 well inventory and February 1991 groundwater sampling program show similar groundwater flow characteristics to those historically observed at the site. Historical groundwater elevation data, presented in Table 4-24, are contoured and presented in Appendix K. Figures 4-11 and 4-12 show groundwater flow conditions in the shallower (less than 25 feet) zone, based on water levels collected in "B" wells in December 1990 and February 1991 (Tables 4-25 and 4-26). Both maps show the variable direction of groundwater flow in the vicinity of the former Interior Landfill (e.g., ranging from east to north near the landfill and from east to west toward Unkamet Brook), with a transition to a dominantly southeast groundwater flow direction southeast of the landfill. Groundwater contours curve in the upstream direction of Unkamet Brook and the Housatonic River, indicating a gaining flow system and a discharge of groundwater to both these surface water bodies. Hydraulic gradients calculated using these maps were highest in the Building 51 area (0.007 in December 1990 and

0.006 in February 1991) and slightly lower in the vicinity of the VOC plume (0.003 in December 1990 and 0.004 in February 1991).

Potentiometric surface maps constructed from water levels collected in "A" wells in December 1990 and February 1991 (Figures 4-13 and 4-14) show groundwater flow patterns that are comparable to those observed in the "B" wells (Figures 4-11 and 4-12). Comparison of the "A" well groundwater flow maps with those for "B" wells for both December 1990 and February 1991 clearly illustrates the similarity of groundwater flow direction in both zones throughout the site. The hydraulic gradients calculated from the "A" well maps are also highest near the Building 51 area (0.005 both in December 1990 and February 1991) and slightly lower in the area of the VOC plume (0.003 both in December 1990 and February 1991).

Groundwater flow maps for "C" wells show similar flow directions and characteristics as those constructed from water-level data for "A" and "B" wells (Appendix K). The similarity of these maps confirms previous indications that the Housatonic River influences groundwater flow to depths in excess of 100 feet. Evidence that the river is a discharge area for groundwater from the entire saturated thickness of unconsolidated deposits is supported by the existence of upward vertical hydraulic gradients and upward flow to the river.

The existence of vertical hydraulic gradients throughout the site and upward flow to the Housatonic River is well-documented. Water-level measurements collected from well clusters during the past 12 years indicate upward vertical hydraulic gradients with only local and periodic occurrences of downward vertical flow (Table 4-24). These latter occurrences are typically shallow (less than 50 feet) in depth and can be observed in well clusters along the Housatonic River (e.g., 102, 114) when a rapid rise in river level temporarily causes apparent reversal in the local hydraulic

gradient. In addition, groundwater flow profiles constructed from water levels collected during the groundwater monitoring programs show upward flow and discharge to the Housatonic River.

Vertical hydraulic gradient maps have been prepared from the data collected by Geraghty & Miller during the groundwater monitoring program completed between 1983 and 1985. These maps represent vertical hydraulic gradients on December 7 and 8, 1983; April 30 to May 3, 1984; October 1, 1984; and April 24, 1985 (Appendix L). On all occasions, the vertical hydraulic gradient was consistent with data collected during other periods of the monitoring program. The data indicated that all groundwater in the unconsolidated deposits will discharge into the Housatonic River and/or Unkamet Brook.

Although downward vertical flow has occurred locally, such as at well clusters 16, 35, 102, and 114, the water-level data collected over the previous 12 years and during the Phase II field activities support the conclusion that groundwater within the entire saturated thickness of unconsolidated deposits discharges to Unkamet Brook or the Housatonic River. This occurrence is illustrated by Figure 4-15, which shows the most recent groundwater profile constructed from water levels measured in February 1991. As shown on the figure, upward vertical hydraulic gradients become more pronounced towards the Housatonic River as groundwater flows upward and discharges into the river. The upward vertical flow regime depicted in Figure 4-15 supports the conclusion that the Housatonic River acts as a discharge area (and a hydraulic divide) for groundwater from the entire saturated thickness of unconsolidated deposits. Data collected as part of the Groundwater Divide Study (Section 4.5.5) also support this conclusion.

4.5.2 Hydraulic Conductivity Testing

For the purpose of determining permeability characteristics of the overburden material throughout the Unkamet Brook Area, slug tests were performed on 27 monitoring wells.

The December 1990 well inventory established that several wells which were preselected for slug testing could not be used because they could not be located or were damaged. Table 4-27 lists the wells that could not be used and the resulting substitutions made. Slug tests were performed at the following 27 monitoring wells: 8AB, 16ACE, 27AB, 31AB, 37AB, 43AB, 79AB, 94AB, 99ABC, 102ABC, 114ABC, and 116E.

The slug tests were performed by causing an instantaneous change in water level by suddenly removing a solid slug from the well (rising head test). The resulting initial drawdown and rise of water level with time in each well was recorded using a pressure transducer in conjunction with a Hermit SE 1000B data logger. The time-drawdown data stored in the data logger were then downloaded to a computer and analyzed using the Geraghty & Miller Aquifer Test Solver (AQTESOLV) software. Slug test data from each well were analyzed using the method of Bouwer and Rice (1976) for unconfined aquifer conditions. The graphical results of this analysis for each well are presented in Appendix M.

The calculated hydraulic conductivities do not show distinct linear trends across the area or with depth at each well cluster location. As shown in Table 4-9, hydraulic conductivities are generally low (less than 10^{-4} centimeters per second [cm/s]) and are within the range of values expected for fine sand and silty sand and gravel deposits (U.S. Bureau of Reclamation, 1977). These types of deposits are generally found at most of the well locations that were slug tested. The highest hydraulic conductivities were observed at well 102B (1.95×10^{-2} cm/s), well cluster 99

(approximately 2.5 to 2.8 x 10^{-3} cm/s), and well 16E (1.90 x 10^{-3} cm/s). Geologic logs from well cluster 99, located near the downgradient edge of the VOC plume, indicate that the higher conductivity deposits at this location consist of uniform loose silty sand. The higher conductivity at well 102B results from less dense silty and gravelly sand which occurs to a depth of approximately 50 feet. These deposits grade downward into less permeable light silty sand and sandy silt as evidenced by the decreasing hydraulic conductivities calculated for well 102A (8.77 x 10^{-4} cm/s) and well 102C (3.62 x 10^{-5} cm/s).

4.5.3 Groundwater Flow Rates

Estimated groundwater flow rates were calculated using the equation:

$$V = \frac{iK}{\eta}$$

where:

V = average linear velocity (otherwise known as seepage velocity)

i = hydraulic gradient

K = hydraulic conductivity

η = the effective porosity.

Flow rates were calculated using the hydraulic gradient measured in the Building 51 area and in the vicinity of the VOC plume using representative hydraulic conductivities from both areas (Table 4-9). Effective porosity values of 0.15 and 0.25 were used to represent the potential range of effective porosity of the unconsolidated deposits in the area.

Calculated groundwater flow rates for the Building 51 area ranged from 0.004 to 0.006 ft/day. In the vicinity of the VOC plume, groundwater flow rates were higher, ranging from 0.160 to 0.267 ft/day.

4.5.4 Groundwater Discharge to Unkamet Brook and the Housatonic River

Geraghty & Miller prepared estimates of VOC concentrations in groundwater discharging to the Housatonic River as part of the evaluation of groundwater conditions in the Unkamet Brook Area (Geraghty & Miller, January 1986 and December 1989). These estimates were based on chemical data obtained from well cluster 114, flow data for the Housatonic River as measured at the Coltsville, Massachusetts gauging station, an approximation of the cross-sectional area of the river through which groundwater may discharge, and estimated hydraulic conductivity values. Calculations were made using the general form of the Darcy equation:

$$Q = AiK$$

where:

Q = discharge

A = cross-sectional area through which groundwater discharge occurs from the sediments adjacent to Unkamet Brook to the Housatonic River

i = hydraulic gradient

K = hydraulic conductivity.

Groundwater discharge to the river was calculated and then divided by the flow of the river itself to obtain a dilution factor. Based on this analytical model, the calculations indicated that VOC concentrations, using the most conservative estimates, would be diluted to concentrations of less than 1 ppb by the Housatonic River.

Recent water quality data for Unkamet Brook and the Housatonic River (see Section 5) indicate that several constituents present in the groundwater plume may be migrating into Unkamet Brook (and possibly the Housatonic River) in the area of the confluence of Unkamet Brook and the Housatonic River. This is apparent since plume constituents (principally benzene,

chlorobenzene, chloroform, and trichloroethene) are detected in Unkamet Brook surface water sample locations USW-4, USW-8, and USW-10. The detection of select plume constituents (benzene and chlorobenzene) in Housatonic River surface water samples collected during low-flow, at locations downstream of the brook, reinforces this conclusion.

It is not clear, however, whether the plume constituents are discharging solely to Unkamet Brook, and thus entering the Housatonic River indirectly via surface water transport, or whether a direct connection of the plume to the river is occurring (or both). It is also not clear how seasonal trends will affect these migration patterns, if at all. For these reasons, further investigation work, as described below, will be performed.

It is evident that a connection of the plume to Unkamet Brook (and possibly the Housatonic River) is resulting in the detection of certain constituents in the brook and river. As discussed in Section 5.4, however, comparison of the VOC concentrations found in the brook and the river with the pertinent USEPA ambient water quality criteria (AWQC) indicate no impacts of immediate concern in the book and no significant impacts on the river. Specifically, as described further in Section 5.4, the data on VOC concentrations in the river downgradient of the confluence with Unkamet Brook show no exceedances of any acute or chronic AWQC for VOCs; and the VOC data from the brook show no exceedance of any acute AWQC and exceedances of only one chronic AWQC, for chlorinated benzenes, in only two samples during one of two sampling rounds. Thus, it is apparent that the contribution of VOC constituents from the plume to the surface waters in this area presents no acute or immediate concern even in Unkamet Brook, and that the constituents associated with Unkamet Brook have only a negligible effect on the water quality of the Housatonic River.

To further address the issue of VOC-loading to Unkamet Brook and the Housatonic River, additional work will be conducted to allow for the development of a mass transport analysis and quantification of groundwater discharge to both the brook and the river, adjacent to their confluence. This issue is discussed further in Section 14.

4.5.5 Groundwater Divide Study

Water-level elevation data collected over the past 12 years from monitoring wells in the Unkamet Brook Area, along with mapping of the vertical extent of the dissolved VOC plume, have indicated that the Housatonic River acts as a groundwater divide. Based on these data, it has been concluded that groundwater from the saturated thickness of unconsolidated deposits discharges to the river. To confirm this theory, a one-year Groundwater Divide Study was proposed as part of the Unkamet Brook Area MCP Phase II field activities. The scope of this investigation and the data obtained are summarized below and presented in more detail in Appendix N.

The SOW proposed the installation of one deep well (150-feet deep) near well cluster 102 and three piezometers in the Housatonic River to serve as water-level monitoring points. However, due to the inability to obtain physical access for drilling at well cluster 102, the well location was moved, with the approval of the MDEP, to its present location and named well 116E. As described in Section 4.2.2.2, the well was constructed of 4-inch-diameter Schedule 40 PVC casing and screened from 140 to 150 feet below land surface.

Three piezometers (PZ-1, PZ-2, PZ-3) were installed on June 13 and July 19, 1991, in the bed of the Housatonic River at locations upstream of the confluence with Unkamet Brook, at the confluence, and downstream of the confluence. These locations are shown on Figure 1 in Appendix N.

Each piezometer consisted of a 1 1/4-inch-diameter, 3-foot-long stainless-steel drive point attached to 1 1/4-inch-diameter galvanized riser pipe. Each piezometer was driven approximately 4 feet into the riverbed. Table 4-29 presents a summary of piezometer information.

Water-level measurements were taken each month in the three piezometers, the newly installed well 116E, and several existing wells listed in Table 4-30, as specified in the SOW, to assess any seasonal fluctuations in the hydraulic head at the various horizons. The existing monitoring wells were chosen, with MDEP concurrence, to develop a representative presentation of the vertical hydraulic gradients. These water-level data were used to confirm whether the river acts as a groundwater divide. The results of this study are presented in Table 4-30.

Review of the data for each month shows that the hydraulic head (elevation of groundwater in each well) increased with depth at well cluster locations 102, 103, and 114. This confirms the existence of upward hydraulic gradients near the river throughout the 12 month monitoring period.

To evaluate the nature of groundwater flow at different depths within the saturated deposits near the river, groundwater contour maps (using "B" wells) and potentiometric surface maps (using "A" and "C" wells) were constructed from the water-level data from the summer (July 24, 1991), fall (October 24, 1991), and winter (December 27, 1991) months. Figures 1 through 9 in Appendix N depict groundwater flow using groundwater measurements collected at the shallow "B" wells and deeper "A" and "C" wells.

Comparison of the shallow "B" well contour maps with the deeper "A" and "C" maps shows similar flow directions and characteristics. The similarity in flow characteristics of the shallow and deep portions of the

saturated deposits indicates that both the Housatonic River and Unkamet Brook are influenced by groundwater flow from a depth of at least 150 feet. Collection of water-level measurement data from well cluster 39 and well 116E has established that on upward vertical gradient exists at depths in excess of 150 feet.

The conclusion that the Housatonic River acts as a groundwater divide is also supported by groundwater flow profiles constructed by contouring the vertical distribution of hydraulic head. Figure 10 in Appendix N is a groundwater flow profile constructed from water levels collected from well 116E, well clusters 102 and 103, and piezometer PZ-2. As shown on the figure, upward flow and discharge to the river is indicated by the contoured head distribution. Discharge to the river is also supported by the groundwater flow profile which is shown on Figure 4-15 and discussed in Section 4.5.1.

The conclusion that the Housatonic River acts as a groundwater divide is supported by an analysis of the 12 months of data described above.

4.6 Evaluation of Groundwater Quality and Trends

This section provides a review of groundwater quality data associated with this site, including that data collected during pre-MCP, MCP Phase II, and subsequent investigations. This information is presented below in Section 4.6.1 Evaluation of Groundwater Quality. An analysis of groundwater quality trends and related conclusions is provided below in Section 4.6.2, Trend Analysis.

4.6.1 Evaluation of Groundwater Quality

Benzene, chlorobenzene, and trichloroethene were identified in previous investigations as the primary constituents of the plume. Groundwater analytical data collected during the MCP Phase II program are summarized in Tables 4-7 through 4-10. The highest concentrations of benzene,

chlorobenzene, and trichloroethene were detected in well clusters 39, 16, and 89. Chlorobenzene was the VOC detected at the highest concentration; the highest concentrations of this constituent were detected in well 16A (65 ppm), well 39B (44 ppm), well 89B (48 ppm) and well 101B (58 ppm). 1,2-Dichloroethene (total) was detected in well 39B, well 89A, and during the initial sampling of the newly installed deep well 39E, but at lower concentrations than the three primary plume constituents. Analysis of SVOCs in samples from well cluster 39 detected naphthalene and dichlorobenzene in wells 39B and 39D at concentrations ranging from 0.13 ppm to 2.2 ppm. In addition, analyses for phenols in well clusters 39 and 89 identified maximum concentrations of 4.24 ppm at 39B and 0.263 ppm at 89A. Appendix IX dioxin/furan compounds, pesticides, and herbicides were also analyzed for in samples from wells 35B, 39B, 39D, 39E, 94A, and 94B, but were not detected. PCBs, included in the analysis of Appendix IX parameters in samples from these wells, were also not detected.

VOCs were not detected in the wells sampled to confirm the plume boundaries (111AB, 97AB, 82AB, 102ABC, 114ABC, and 116E), except well 114B (chlorobenzene - 0.13 ppm) and well 116E during initial sampling (trichloroethene - 0.010 ppm and toluene - 0.005 ppm).

A review of Table 4-31, which presents historical analytical data, shows that although chlorobenzene was not detected during the 1985 sampling event at 114B, it was previously found in that well at 0.42 ppm in April 1984. Wells 39E and 116E were resampled in February 1992 because it was suspected that constituents may have been introduced to this depth during the mud rotary drilling (which may convey fluids downward and out from the boring). Reanalysis of the groundwater from these two wells supports this conclusion because most VOCs were non-detect and only one was identified below the detection limit.

Within the Building 51/59 area, VOCs were detected in wells 34A, 34B, and 35B. VOCs were also detected in well 101AB, which is located north of the Building 51/59 area. VOCs detected at well clusters 34 and 35, located southeast of Building 51, included trichloroethene, chlorobenzene, 1,2-dichloroethene (total), and vinyl chloride. The highest VOC concentrations were detected at well cluster 101, where chlorobenzene was detected in well 101A at 1.3 ppm and in well 101B at 58 ppm. VOCs were not detected in well cluster 27, located adjacent to Plastics Avenue northwest of the Building 51/59 area. At wells 34A, 35A, and 35B, located south of the Building 51/59 area, trichloroethene was detected at concentrations in excess of the MMCL of 0.005 ppm. The occurrence of trichloroethene in this area is not new, and is discussed below. SVOCs analyzed for in samples from well clusters 34, 35, 37, and 38 were not detected. Analysis for phenols in each of these well clusters detected concentrations of 0.0115 ppm in well 34A and 0.101 ppm in well 38A. Dioxin/furan compounds were not detected in the samples from well clusters 34, 35, 37, or 38. In addition, during the monthly measurement of water levels in wells 34B, 35B, 37B, and 38B during 1991, oil was not observed in any of these wells. These monitoring results are discussed further in Section 10.

Analytical results from wells in the vicinity of the former Interior Landfill (43AB, 72A, 74B, 79AB, and 94AB) indicate that both VOCs and SVOCs were detected only in well 79B. Phenols were detected in wells 74B and 79B at a concentration of 0.0128 ppm. PCBs were detected in well 79A at 0.0043 ppm and well 79B at 0.00085 ppm.

Appendix IX+3 analysis of water samples from wells RF-14 and RF-15 detected only carbon disulfide in well RF-14, at a concentration of 0.006 ppm. Analytical results for the other Appendix IX+3 parameters (excluding

metals and dioxin/furans) were non-detect. With respect to dioxin/furans in wells RF-14 and RF-15, analysis of split samples by two laboratories revealed conflicting results. IT Analytical Services, Inc. reported the presence of furan compounds in both wells, but with possible interference from polychlorinated diphenyl ethers. At the same time, CompuChem Laboratories, Inc. reported non-detect levels of furan compounds in both wells.

Metals analysis of samples from wells in the Building 51/59 area, the former Interior Landfill area, the former waste stabilization basin plume area, and wells RF-14 and RF-15, detected the naturally-occurring ions of calcium, magnesium, potassium, and sodium in each well. These results generally reflect background water quality in the area, based on a comparison with metals results from upgradient wells 43A and 43B. Locally high concentrations of iron were found in wells 35AB, 37AB, and 38AB. Chromium was detected in well 79B at a concentration of 0.0132 ppm and at concentrations of less than 0.09 ppm in wells 35A, 37A, and 38A.

TPH analysis of water samples from wells OBG-1, -2, and -3, detected these constituents only in OBG-1 at 0.538 ppm.

Appendix IX analysis (excluding PCDDs/PDCFs) of water samples from wells MW-38 and MW-39 detected PCBs and tetraethyldithiopyro-phosphate (an insecticide) in well MW-39 at concentrations of 0.0007 and 0.0013 ppm, respectively. Also, several inorganic constituents were detected in both wells but at relatively low concentrations.

The results of groundwater samples from existing wells located within and at the edges of the VOC plume confirm the historical plume boundaries. As noted at well 114B (Table 4-31), the plume extent does fluctuate within horizontal limits. The plume predominantly consists of chlorobenzene, benzene, and trichloroethene, as evidenced by elevated

concentrations of these compounds detected in well clusters 39, 16, and 89, located within the central portions of the plume. In addition, phenols were detected in wells located within the plume. Groundwater quality trends observed in the historical VOC plume data and data for the former Interior Landfill are discussed in detail in the following sub-section.

Groundwater results from the Building 51/59 area indicate the presence of chlorobenzene in wells 35B, 101A, and 101B, and trichloroethene in wells 34A, 34B, 35A, and 35B. These wells had last been sampled in 1980 and analyzed for VOCs. In that prior sampling, chlorobenzene alone had been detected in wells 101A and 101B, while chlorobenzene had been detected in wells 34B and trichloroethene had been detected in 34A, 34B, and 35AB. In 1980, chlorobenzene and trichloroethene had also been detected in samples from wells 33A, 33B, 36A, and 36B, located south of Merrill Road and downgradient of well clusters 34 and 35.

Analytical results from wells RF-14 and RF-15, installed in the GE-Ordnance area, do not indicate impacts to groundwater at these locations.

4.6.2 Trend Analysis

Extensive evaluations have been completed in the Unkamet Brook Area to characterize the subsurface environment. Monitoring wells have been installed to provide groundwater quality monitoring locations along the facility perimeter, and adjacent to and downgradient of the former waste stabilization basin, former Interior Landfill, and Building 51/59 areas. Groundwater analyses have been completed periodically since 1979 for the various site areas. Although analytical parameters have varied, VOCs have remained the primary constituents of concern in groundwater.

Groundwater sampling completed during the recent MCP Phase II investigation provides comprehensive data at key monitoring locations in the identified areas of concern. As discussed in Section 4.2.2.3, analytical

parameters for the MCP Phase II program include VOCs and various combinations of Appendix IX+3 parameters, thus expanding on the number of constituents addressed at the facility.

To look at trends in groundwater quality, data from five sampling dates have been compared. Analytical data from four semi-annual sampling events completed between December 1983 and May 1985, and from the recent MCP Phase II program, were selected for comparison. Comparison of the selected historical analytical data is limited to some extent due to the following factors:

- A number of parameters, including phenols and metals, were not analyzed as part of the semi-annual sampling events in 1983 through 1985, and therefore, trends cannot be evaluated for these constituents.
- In a few cases, parameters have been identified in a sample, but their concentrations cannot be quantified due to a high analytical detection limit.

Despite the factors noted above, the available data are sufficient to compare the historical distribution of a number of VOCs. VOCs that have been consistently detected in the study area include benzene, chlorobenzene, ethylbenzene, methylene chloride, toluene, trans-1,2-dichloroethene, and trichloroethylene (trichloroethene). Figures 4-16 and 4-17 show the distribution of benzene, chlorobenzene, and trichloroethene in the shallow B-series and deeper A-series groundwater monitoring wells in February and March 1991, respectively. In the B-series wells (Figure 4-16), benzene and chlorobenzene were found at concentrations in excess of the corresponding MMCL concentrations in an elongated area extending from just north of the former waste stabilization basin toward the Housatonic River. Trichloroethene was identified at 39B, south of the former waste

stabilization basin area, and also at monitoring well 35B located east of Building 59. In the deeper "A" zone (45 to 50 feet below ground surface), a less extensive distribution of VOCs was encountered (Figure 4-17).

Figure 4-18 illustrates the 1991 groundwater equipotential flow lines and the distribution of chlorobenzene along a north-south cross-section approximating the long axis of the plume. Chlorobenzene has been chosen to illustrate the relationship between vertical flow gradients and the distribution of VOCs because it is a major constituent of the plume and has been consistently detected in a number of wells. The migration of VOCs is in a direction perpendicular to the equipotential lines, downward beneath the former waste stabilization basin and then upward toward the lower reaches of Unkamet Brook, which acts as a local groundwater discharge point. Although regional groundwater flow is toward the Housatonic River, the plume appears to discharge to Unkamet Brook just upstream of the confluence with the Housatonic River. It is also possible that the plume discharges directly to the Housatonic River; however, further analysis of this topic will be needed (see Section 14). It is clear, however, that the Housatonic River acts as a groundwater divide, thus precluding possible concerns that plume constituents could be migrating beyond the Housatonic River. Section 4.5.5 discusses the Groundwater Divide Study which was performed as part of Phase II activities.

Table 4-31 presents a summary of historical chlorobenzene concentrations in various monitoring wells. In addition, figures showing the distribution of chlorobenzene in cross-sections for 1983 through 1985 are presented in the Unkamet Brook Area SDS Report (Blasland & Bouck, August 1990a). Although these figures show some variability in chlorobenzene distribution over this time interval, a comparison of the 1983 and 1991 data in cross-section reveals that the distribution of

chlorobenzene in the subsurface has remained relatively constant (Figures 4-18 and 4-19). Although the detected concentrations of chlorobenzene and the other volatile constituents in monitoring wells within the plume have varied during individual sampling events, concentrations have essentially remained within historic limits during this period of almost 10 years.

At monitoring well cluster 39, located south of the former waste stabilization basin, concentrations of benzene, chlorobenzene, and trichloroethene increased slightly between 1985 and 1991 in the B-series well (Table 4-28). At the southern plume boundary, concentrations of VOCs remained relatively constant. Although increases in the concentrations of benzene and chlorobenzene of one and two orders of magnitude, respectively, were noted at monitoring well 89B between May and October 1984, the concentrations of these compounds have remained relatively constant since 1984.

As previously discussed, groundwater samples have been collected from recently installed monitoring well 39E, which is screened from a depth of 225 to 235 feet below land surface. The first sample was found to contain a number of organic constituents, including chlorobenzene, which was detected at a concentration of 0.24 ppm. These data were anomalous, as previous data suggest an upward vertical hydraulic gradient in this area. The second sample was found to contain only trace levels of VOCs, supporting the belief that contamination had initially been introduced during drilling activities, as discussed in Section 4.2.2.2. Results from the initial sampling of well 116E indicated that trace levels of several VOCs were present in the groundwater. The results of the resampling conducted in February 1992 indicate that no VOCs were present in groundwater from this well, again supporting the belief that contamination had initially been introduced during drilling activities.

In summary, VOCs continue to be present in groundwater south of the former waste stabilization basin in an area that extends to the south, toward Unkamet Brook and the Housatonic River. VOCs follow the path of groundwater flow in the subsurface, migrating downward from the source area, and then upward toward Unkamet Brook and the Housatonic River, which act as local and regional groundwater discharge areas. Based on the analyses described herein, the components of the plume can be considered stable. The constituents of concern are not migrating beyond previously known plume boundaries, and portions of the plume with high concentrations of the various constituents are not migrating downgradient. Additionally, deep soil borings which were performed to assess the possible presence of DNAPLs were successful in demonstrating that these materials are not present. The stable plume condition exists as a result of the source removal performed in the early 1980s, as well as the natural processes (i.e., attenuation, adsorption, and hydrogeologic dynamics including the flushing of soils near the river due to periodic reversals of the hydraulic gradient during times of high river flow) which affect the plume.

This plume configuration is expected to remain stable into the future, based on interpretation of ten years of groundwater monitoring data. VOCs detected in Unkamet Brook and the Housatonic River were present at low levels that do not constitute an immediate concern, although chlorobenzene was detected in the lower stretch of Unkamet Brook at concentrations above the chronic ambient water quality criteria. Since it has been demonstrated that the plume does not pass under the Housatonic River, possible concerns regarding that issue can be dismissed. Due to attenuation of the VOCs, it does not appear that groundwater will directly impact the Housatonic River. However, due to the discharge of groundwater to

Unkamet Brook, the river can be indirectly affected. The occurrence of VOCs in surface water is discussed in Section 5.

4.7 Preferential Pathway Analysis

4.7.1 Description of Investigation

As originally outlined in the MCP Phase II SOW, the preferential pathway analysis investigation consisted of an evaluation and investigation to determine if utilities passing through the plume area act as preferential pathways for the migration of contaminants from the GE property. After underground utilities that have the potential to act as preferential pathways were identified, and the utility selection process was approved by the MDEP, well points were installed in transects both in the utility trench excavation backfill materials (to the base of excavation) and adjacent to the utilities trench. Well points that yielded water were then sampled for Appendix IX VOCs. Subsurface gas samples were collected from well points that did not yield water and were analyzed for Appendix IX VOCs.

Following an evaluation of underground utilities (water, sewer, storm drains) in the vicinity of the former waste stabilization basin and Interior Landfill, a field investigation was designed, through standard soil-gas sampling techniques and groundwater sampling of well-points, to determine whether the utilities act as preferential pathways. From a review of utility plans and construction diagrams, a sanitary sewer, storm drain, and oil-water separator effluent pipe were identified as potential preferential pathways. The locations of the sanitary sewer, storm drain, and effluent pipe are shown on the utility plans contained in Appendix B. The 30-inch-diameter concrete sanitary sewer runs northwest to southeast from Dalton Avenue to Merrill Road through the location of the former Interior Landfill. The 42-inch-diameter concrete storm drain runs parallel to Merrill Road and

discharges storm water into Unkamet Brook. The effluent pipe from the oil-water separator also discharges into Unkamet Brook. The storm drain and effluent pipe are located approximately 32 feet and 6 feet, respectively, south of the former waste stabilization basin. The proposed field investigation and target utilities were submitted to and approved by the MDEP. The approved field investigation program is described below, in addition to the rationale for the selection of sampling methods.

Sanitary Sewer

The review of construction diagrams for the sanitary sewer and historical water levels recorded at nearby monitoring wells indicated that the elevation of the bottom of the sewer along Unkamet Brook was below the water table elevation in December 1990 and at several other times during the past nine years. This information, together with the orientation of the sewer parallel to the direction of groundwater flow, suggested that the sewer may act as a preferential pathway for migration of groundwater. As such, it was proposed to install well-point clusters to investigate whether backfill in the sewer trench acts as a preferential pathway. Although the construction diagrams for the sewer do not show the width or depth of the trench, each cluster was installed with three well points, one placed adjacent to the concrete pipe (in the trench backfill) and the other two placed on either side of the pipe (outside of the trench backfill). One well cluster was located upgradient, and two downgradient, of the former Interior Landfill.

On November 21, 1991, nine well points were installed along the sewer at locations shown on Figure 4-20. Each well-point was constructed of 1 1/4-inch-diameter stainless-steel well screen, 3 feet in length. Galvanized steel pipe (1 1/4-inch-diameter) was attached

to the well points as riser pipe. Each well point was driven to a depth of approximately 2 feet below the bottom of the sewer pipe. Following installation, each well point was developed until visibly sediment-free water was obtained. A summary of the installation of well points is presented in Table 4-32.

On December 2, 1991, approximately one week following well-point installation and development, groundwater samples were collected from well points WP-1B, WP-2B, and WP-3B and analyzed for Appendix IX VOCs (Table 4-31). Groundwater and QA/QC sample collection was performed in accordance with the SAP. Field parameters (pH, temperature, and specific conductivity) were measured in the collected groundwater samples. A field blank was collected prior to sampling WP-3B, and a duplicate sample was collected at WP-3B.

Further, groundwater elevations from the well points and nearby wells were analyzed to determine if the sewer trench was influencing groundwater flow patterns. Water-level data collected on November 21, 1991; December 2, 1991; and January 23, 1992 are set forth in Table 4-34.

Storm Drain and Effluent Pipe

Construction diagrams for the storm drain and the oil-water separator effluent pipe running parallel to Merrill Road were not available. However, utility plans for both show that they are oriented perpendicular to the direction of groundwater flow. Consequently, the backfill of the storm drain and effluent pipe would not be expected to act as a preferential pathway for groundwater. Further, measurements taken in inverts of the storm drain at the east and west ends of Building 119 indicate that the depth to the bottom of the pipe at each location (from grade) is roughly 7 feet, which indicates that the bottom

of the storm drain is above the water table observed in December 1990. The depth of the drain has been approximately 3 to 5 feet above the top of the water table, as determined from recent and historical water levels in nearby wells.

Although the backfill associated with both the storm drain and effluent pipe is not expected to act as a migration pathway for groundwater, the backfill may potentially act as a preferential pathway for any soil gas in this area. To evaluate this possibility, a soil gas sampling program was proposed. The sampling locations along the storm drain are shown on Figure 4-22. At each location, a pair of soil gas vapor probes was installed; one directly adjacent to the utility, and one further from the utility, in native material. Hollow stainless-steel vapor probes were installed at a depth 4 feet below grade at each location. Soil gas samples were collected in Summa canisters and submitted for laboratory analysis of VOCs using the TO-14 method.

4.7.2 Analytical Results

Sanitary Sewer

The analytical results of groundwater samples collected from well points WP-1B, WP-2B, and WP-3B are summarized in Table 4-33. Benzene, chlorobenzene, and xylenes were detected in both well points WP-1B and WP-2B, located north and south of the former Interior Landfill, respectively, with the highest concentrations found in WP-2B. Benzene and chlorobenzene were detected in WP-2B at concentrations of 0.33 ppm and 1.1 ppm, respectively, and in WP-1B at concentrations of 0.15 ppm and 0.78 ppm, respectively. The concentration of xylenes (total) found in both WP-1B and WP-2B was approximately 0.02 ppm. Low concentrations of toluene (0.033 ppm)

in WP-1B and ethylbenzene in WP-2B (0.027 ppm) were also detected. VOCs were not detected above the detection limit in WP-3B or the duplicate sample from WP-3B.

In addition to the analytical results, groundwater elevation data for the well points are presented in Table 4-34.

Storm Drain and Effluent Pipe

Analysis of VOCs in the soil gas samples collected along the storm drain detected the presence of benzene, chlorobenzene, and trichloroethene in several samples (Table 4-35). The highest concentrations of total VOCs were detected at vapor points VP-4B and VP-3B. VOC concentrations generally decreased from vapor-point VP-4 to VP-1, with the exception of trichloroethene, which showed a slight increase in concentration. The number of compounds detected also decreased from VP-4 to VP-1.

At VP-3 and VP-4, the data exhibit a marked difference in VOC concentrations between soil gas samples collected adjacent to the storm drain and samples collected at a distance. As shown in Table 4-33, soil gas samples collected adjacent to the storm drain contained fewer VOCs and at lower concentrations than samples collected at a distance from the drain. This relationship is not as distinct at well-point clusters VP-1 and VP-2.

4.7.3 Interpretation of Results

Sanitary Sewer

Profiles of water levels in the well points were constructed from data collected on November 21, 1991, December 2, 1991, and January 23, 1992 (Table 4-34). These profiles, shown in Figure 4-21, illustrate the slope of the water table in the immediate vicinity of the sanitary sewer on each of these dates. If the sewer backfill were acting as

a preferential pathway for groundwater migration, it would be expected that the water level of the center well point at each cluster location would be lower. This relationship is similar to what is observed for a stream which is receiving groundwater recharge.

With the exception of water level data collected at clusters 1 and 2 on January 23, 1992 the data show that the sewer does not appear to influence groundwater flow. At cluster 1 on this date, the water level is slightly higher at the center well point as compared to the surrounding well points. This may indicate that the sanitary sewer is actually recharging the groundwater to some extent during this time period. At cluster 2, the water elevation of the center well point is lower than that of the surrounding well points. This suggests that the sewer or backfill may occasionally act as a preferential pathway for groundwater in this area. Additional investigative activities related to this phenomenon are discussed in Section 14.4.3.

Several VOCs were detected above the sample detection limit in WP-1B and WP-2B. However, at the most downgradient location, VOCs were not found above the detection limit in WP-3B or the duplicate sample from that well point. This appears to support the water level data which indicate that the sanitary sewer backfill is not transporting groundwater from upgradient clusters 1 and 2 towards downgradient cluster 3. It should also be pointed out that cluster 1 and 2, adjacent to Dalton Avenue and a GE parking area, contain several VOCs that are typical components of gasoline.

Storm Drain and Effluent Pipe

The results of samples from vapor-point clusters VP-3 and VP-4 indicate that the greatest number of volatile compounds were detected in soil gas at a distance from the drain in native material. The VOCs

detected adjacent to the drain were generally found at significantly lower concentrations. VOC concentrations were lower at clusters VP-2 and VP-1, located farther south. At VP-1, VOC concentrations were lower immediately adjacent to the storm drain, whereas, at VP-2, the concentrations nearest the storm drain were slightly higher than those in native soil. Although the data indicate that VOCs are present within soil gas in this area, there is no systematic indication that the backfill associated with the storm drain and effluent pipe is acting as a preferential pathway for VOC migration.

4.8 Summary of Soil Gas Data

As discussed in Section 4.3, during the installation of the various soil borings at this site, headspace screening of split-spoon soil samples was performed using a PID. PID headspace readings give a qualitative estimate of the concentration of volatile constituents present in the soil gas. Table 4-13 summarizes the PID readings from the various borings at the site. These data, which were collected in the vicinity of several SWMUs, show related PID readings ranging from 0 to 548 PID units. The vertical profile of PID readings in borings that exhibited measurable readings shows an increase from zero or background levels (less than 1 PID unit) near the surface to higher levels at depths greater than 6 feet below grade. This PID information indicates that while volatile constituents may be present at the site in subsurface materials, there is no appreciable vertical migration of constituents in subsurface gas to the ground surface in the majority of the site.

Additional PID data have been collected at the site as part of various miscellaneous investigations. These data, which are discussed in more detail in Section 8, are consistent with the observations noted above.

In addition to PID readings obtained at the site, as described above and in Section 8, soil gas at the site was also investigated as part of preferential pathway analyses discussed previously in Section 4.7. As discussed in Section 4.7, these analyses showed the presence of several VOCs, notably benzene, chlorobenzene, and trichloroethene, in soil gas associated with two separate utility trenches near Merrill Road. Specifically, these concentrations ranged from 0.8 to 5.9 ppm for benzene, from 3.7 to 13.0 ppm for chlorobenzene, and from 0.11 to 3.5 for trichloroethene, respectively, at locations generally southwest of the former waste stabilization basin and southeast of the Building 119W Oil/Water Separator. As also stated in Section 4.7, although these data indicate that VOCs are present within soil gas in this area, there are no systematic indications that the backfill associated with these utilities is acting as a preferential pathway for VOC migration.

SECTION 5 - SURFACE WATER INVESTIGATIONS

5.1 General

The surface water of Unkamet Brook has been subject to various investigations since 1981. In addition to the preliminary investigations performed in 1981, subsequent investigations have been performed between 1982 and 1989. These pre-MCP activities are described in Section 5.2. Surface water sampling has also been performed more recently as part of MCP Phase II activities. These activities are described in Section 5.3. An overall interpretation of Unkamet Brook surface water results is presented in Section 5.4.

5.2 Pre-MCP Surface Water Investigations

5.2.1 Description of Sampling Programs

A preliminary investigation of Unkamet Brook's surface water was conducted in 1981 by O'Brien and Gere (August 1981). Surface water was collected at stations S1 through S15 and analyzed for priority pollutant VOCs and PCBs (Figure 5-1). Groundwater was collected at the same time from well points at stations S1 through S15 and also analyzed for priority pollutant VOCs and PCBs.

The 15 sampling stations that were established are described as follows:

- Stations S1-S10, along the profile of Unkamet Brook;
- Stations S13-S15, along unnamed drainage areas between Merrill Road and the Housatonic River; and
- Stations S11 and S12, along the Housatonic River.

The purpose of the overall monitoring program (which involved the sampling and analysis of surface water, sediment, and well-point groundwater) was to: 1) determine the extent of contaminants within

Unkamet Brook; 2) to determine where constituents enter Unkamet Brook; and 3) to determine to what extent the brook transports constituents to the Housatonic River. The analytical results of this investigation are presented in Table 5-1 and are described in Section 5.2.2.

Surface water samples were also collected from Unkamet Brook in the vicinity of sampling stations SW-4 and SW-8 (Figure 5-1) in March 1982, December 1983, April and October 1984, and April 1985. These samples were analyzed for priority pollutant VOCs and PCBs. The results of these analyses are presented in Table 5-2 and are described in Section 5.2.2.

In 1987 based on the results of the related groundwater monitoring program, an annual monitoring program was established. During this program, surface water samples were collected at stations SW-1, SW-2, SW-4, and SW-8 as illustrated on Figure 5-1. All samples were collected in accordance with the "Monitoring Protocols - Unkamet Brook Area" and analyzed for VOCs and PCBs.

Between 1987 and 1989, three annual sampling rounds were conducted for the purpose of monitoring Unkamet Brook's surface water quality. These sampling rounds occurred in October 1987, September 1988, and October 1989. The results of the analyses from these sampling rounds are presented in Table 5-3 and are described in Section 5.2.2.

5.2.2 Analytical Results

As part of the 1981 preliminary investigation, surface water samples were collected at stations S1 through S15, as illustrated on Figure 5-1. These samples were analyzed for priority pollutant VOCs and PCBs. Low levels of trichloroethylene, toluene, chloroform, 1,1,1-trichloromethane and PCBs were detected at some of the stations, as presented in Table 5-1.

Groundwater samples were also collected from well points at stations S1-S15 and analyzed for priority pollutant VOCs and PCBs. The results of

these analyses are also presented in Table 5-1, and show the presence of chlorobenzene at two stations, trichloroethylene at one station and low concentrations of other organics. PCBs were detected at a range of 0.0043 ppm to less than 0.0001 ppm. It was determined that further sampling was necessary to satisfy the objectives of the study.

Various levels of VOCs were detected during the five sampling rounds conducted between March 1982 and April 1985 (Table 5-2). In general, the levels of VOCs in the Unkamet Brook surface water declined during the semi-annual monitoring program that concluded in 1985. No PCBs were detected during any of the monitoring events.

In October 1987, low levels of chloroform and methylene chloride were detected in locations SW-4 and SW-8 (Table 5-3). In September 1988, chlorobenzene, chloroform, and methylene chloride were detected at locations SW-4 and SW-8. In addition, trace levels of Aroclor 1254 and 1260 were detected at SW-2. In October 1989, low levels of benzene, chlorobenzene, chloroform, methylene chloride, toluene, and PCBs were detected at locations SW-2, SW-4, or SW-8.

5.3 MCP Surface Water Investigation

5.3.1 Description of Sampling Program

Pursuant to the Unkamet Brook Area MCP Phase II SOW surface water sampling was performed to supplement information collected during previous investigations, and to provide a current assessment of the presence of any constituents in Unkamet Brook surface water. This sampling program involved the collection of surface water samples from five locations on Unkamet Brook as illustrated on Figure 5-2, and described below.

Location ID	Location Description
USW-1	Upstream of the Former Interior Landfill
USW-2	Downstream of the Former Interior Landfill
USW-4	Just Below Railroad Crossing
USW-8	Downstream of the Railroad Crossing
USW-10	Just Upstream of the Housatonic River Confluence

Four of the sampling locations correspond to locations that were sampled as part of previous investigations (USW-1, USW-2, USW-4, and USW-8) (see Figure 5-1). The fifth location, USW-10, was located just upstream on Unkamet Brook from the confluence of Unkamet Brook and the Housatonic River.

Surface water samples were collected from each of these locations under both high-flow and low-flow conditions (May 9, 1991 and September 12 and 13, 1991, respectively). The timing of the high-flow sampling event was approved by the MDEP and corresponded to a time of prolonged rain fall. The low-flow sampling event was triggered by the low-flow sampling of the Housatonic River. This sampling took place when the flow measured by the USGS gaging station at Great Barrington was less than 100 cubic feet per second (cfs).

Samples obtained during high-flow conditions were collected by utilizing teflon tubing and a peristaltic pump, while samples obtained during low-flow conditions were collected by placing a glass beaker into the center of flow. During both sampling events, samples were collected from each location near the center of the brook at approximately one-half the total water depth. Each water sample (with the exception of samples slated for VOC analysis) was thoroughly mixed and distributed into containers supplied by CompuChem Laboratories, Inc. and IT Analytical Services Samples were submitted to CompuChem for analysis of Appendix IX+3 volatiles (and 1,2,4-

trichlorobenzene) and total and dissolved (Appendix IX) metals. (CompuChem also reported results for all Appendix IX+3 semivolatiles, although only the analysis for 1,2,4-trichlorobenzene was requested.) Samples were also submitted to IT Analytical Services for analysis of total and dissolved PCBs and total suspended solids (TSS).

QA/QC samples were submitted during each sampling event. These samples included one set of MS/MSD samples collected at Location USW-1, one blind duplicate sample collected at location USW-8, and one field blank sample. Trip blank samples were also included with all samples to be analyzed for VOCs.

Velocity profiles were measured during high-flow conditions along brook cross-sections near sample locations USW-1, USW-4, and USW-10 to determine the approximate flow rate of the brook at the time of sample collection. Stream discharge was measured to be approximately 3 cfs, 4 cfs, and 5 cfs at these locations, respectively, during high-flow conditions. Velocity profiles could not be measured during low-flow conditions due to the limited water column and low velocities encountered. However, the flow rate of the brook was estimated to be approximately one cfs at the time of sample collection.

Additional field data recorded during each sampling event included date, time, brook width, average water depth, average velocity, calculated or estimated flow, pH, temperature, and conductivity. These data are maintained in associated field log books.

In addition, in 1991, as part of MCP Phase II investigations for the Housatonic River, surface water samples were collected from the Housatonic River at locations immediately upstream and downstream of the Unkamet Brook confluence. These samples were collected to assess the potential impact (if any) to the Housatonic River from Unkamet Brook. Samples were

collected during high-flow and low-flow conditions. These samples were analyzed for Appendix IX+3 constituents by CompuChem, with the exception of PCBs (and TSS) analyses which were performed by IT Analytical Services.

5.3.2 Analytical Results

The analytical results associated with the Unkamet Brook sampling at high-flow conditions indicated the presence of PCBs and various Appendix IX+3 VOCs, SVOCs, and metals. A summary of the results is presented in Table 5-4. This summary includes only those constituents that were found at concentrations above the detection limit in at least one sample. All other constituents were reported as "Not Detected." As shown in Table 5-4, the various constituents found in the Unkamet Brook water column under high-flow conditions include the following constituents at the following concentration ranges:

Analyte[1,2]	Concentration Range (ppm)
Acetone	ND to 0.013
Benzene	ND to 0.017
Chlorobenzene	ND to 0.098
4,6-dinitro-2-methylphenol	ND to 0.050
Trichloroethene	ND to 0.030
PCB-Aroclor 1242 (filtered)	ND to 0.00013
PCB-Aroclor 1242 (total)	ND to 0.000086
PCB-Aroclor 1260 (total)	ND to 0.000069
Total PCBs (filtered)	ND to 0.00013
Total PCBs (total)	ND to 0.000135
Aluminum	0.104J* to 0.226
Calcium	39 to 47.7
Iron	0.632 to 0.704
Lead	0.0024J* to 0.0045
Magnesium	14.7 to 18.2
Manganese	0.0703 to 0.151
Sodium	21.8 to 25.3

Notes:

[1] Analytes for which only estimated values were reported or which were found in blank samples are not summarized.

[2] Results are presented for unfiltered samples, unless otherwise indicated.

ND- Not detected above the detection limit.

J*- Analyte was detected at a level between the quantitation limit and instrument detection limit.

The analytical results associated with the Unkamet Brook sampling at low-flow conditions likewise indicated the presence of PCBs and various Appendix IX+3 VOCs and metals. A summary of the constituents detected are presented in Table 5-5. These constituents and their corresponding concentration ranges are as follows:

Analyte[1,2]	Concentration Range (ppm)
Chlorobenzene	ND to 0.043
Chloroform	ND to 0.013
PCB-Aroclor 1242 (filtered)	ND to 0.00007
PCB-Aroclor 1242 (total)	ND to 0.00012
PCB-Aroclor 1260 (total)	ND to 0.00011
Total PCBs	ND to 0.00007 (filtered)
Total PCBs	ND to 0.00023 (total)
Aluminum	0.0923J* to 0.372
Calcium	1.04J* to 48.4
Copper	ND to 83.6
Iron	0.0647J* to 0.824
Lead	ND to 0.0079
Magnesium	0.293J* to 18.6
Manganese	0.013J* to 0.112
Sodium	2.02J* to 27.7
Zinc	0.0149J* to 0.0721

Notes:

[1] Analytes for which only estimated values were reported or those also found in blank samples are not summarized.

[2] Ranges for metal constituents represent a combined summary of both filtered and total results. See Table 5-5 for actual data.

J*- Analyte was detected at a level between the quantitation limit and the instrument detection limit.

ND- Not detected above the detection limit.

The results associated with the 1990 Housatonic River surface water sampling are presented in Table 5-6. In general, these results showed the presence of various inorganic constituents during both high-flow and low-flow conditions, but benzene, chlorobenzene, and endosulfan I were also detected during low-flow conditions above the detection limit. Additional sampling and analysis of Housatonic River surface water under both low-flow and high-flow conditions will be conducted upstream, adjacent to, and downstream of the GE

facility during Supplemental Phase II/RFI activities (Blasland, Bouck & Lee, June 1994).

5.4 Interpretation of Surface Water Results

In general, it appears that PCBs and Appendix IX+3 metals are more prevalent in the Unkamet Brook surface waters than are Appendix IX+3 volatile and semivolatile constituents. This is more evident at low-flow conditions since few volatiles and semivolatiles were detected. The following observations are made with regard to the high-flow and low-flow sample results for Unkamet Brook:

Volatile Organic Constituents

- Under both high-flow and low-flow conditions, VOCs were not detected above the detection limit at locations from USW-1 (just below where Unkamet Brook crosses under Dalton Avenue) to USW-4 (where Unkamet Brook emerges from the culvert below the railroad tracks), with the exception of chloroform detected at USW-4 during low-flow conditions at 0.013 ppm and chlorobenzene detected at USW-2 under high-flow conditions at 0.005 ppm. Under high-flow conditions, VOCs such as chlorobenzene (0.098 ppm) and benzene (0.017 ppm) were detected in the two stations near the Housatonic River (USW-8 and USW-10), with trichloroethane (0.030 ppm) and acetone (0.013 ppm) also detected at high flow at USW-8. (Acetone was detected in the duplicate sample at USW-8, but not in the original sample.) Under low-flow conditions, the VOCs chloroform (0.008 ppm to 0.012 ppm) and chlorobenzene (0.036 ppm to 0.043 ppm) were detected at locations USW-8 and USW-10. As discussed in Section 4, the presence of these VOCs in this area of the brook is apparently associated with the discharge of groundwater and the VOC plume

emanating from the former waste stabilization basin into the brook. To better understand the relationship of the VOC plume to Unkamet Brook and the Housatonic River, further investigation activities are proposed in Section 14.

- As described above, a number of VOCs were detected in the Unkamet Brook and Housatonic River surface water at several locations near the confluence with Unkamet Brook. The concentrations of these VOCs have been compared with the pertinent USEPA AWQC. (Note that GE does not necessarily accept the validity of such criteria; the AWQC have been used here solely for comparison purposes.) As also shown in the MCP Interim Phase II Report on the Housatonic River (Table 5-6), the data on VOC concentrations in the river downgradient of the confluence with Unkamet Brook show no exceedance of either the acute or chronic AWQC for aquatic life protection or of the AWQC for consumption of aquatic organisms. In Unkamet Brook, the VOC data show no exceedance of any acute AWQC for aquatic life protection, and exceedances of only one chronic AWQC, for chlorinated benzenes, in only two samples during one of two sampling rounds. [It should also be noted that the VOCs in the brook did not exceed any AWQC for consumption of aquatic organisms, although such criteria are not relevant to the brook, since it sustains only a limited aquatic population due to its size, and the fish found in the brook are not of the size or type commonly consumed by humans (see Section 11).] Thus, it is apparent that the VOCs in these surface waters present no immediate or acute concern in Unkamet Brook and have no significant impact at all on the water quality of the Housatonic River.
- Unkamet Brook surface water was analyzed for VOCs in 1981, semi-annually between 1983 and 1985, and annually in 1987, 1988, and

1989 at multiple locations. Upon comparing this database to the results obtained during Phase II activities, it is apparent that several of the VOCs (i.e., toluene, and 1,1,1-trichloroethane) that were found during previous sampling rounds were not detected during Phase II activities. The remaining VOC concentrations were within the range of concentrations observed during past monitoring rounds.

PCBs

- PCB concentrations (both total and dissolved) associated with low-flow conditions are higher than those measured during high-flow conditions. This may be attributed to dilution effects that occur during high-flow sampling, to low-flow sampling occurring closer to the channel bottom (because flow was collected at the midpoint of the water column depth), or to increased partitioning from the sediments due to increased water temperatures.
- PCBs were measured during low-flow conditions near the detection limit just downstream of the former Interior Landfill. PCB levels then increased between USW-2 and USW-4, and then increased further in the lower reaches of the brook. This increase was primarily in the non-filtered fraction, and could be the result of a higher prevalence of fines (silts and clays) in this section of the brook.
- The PCB concentrations detected in the Unkamet Brook surface water exceed the freshwater chronic AWQC for PCBs of 0.000014 ppm for aquatic life protection. However, the freshwater acute criteria for PCBs (0.002 ppm) was not exceeded in any of the samples. Thus, the presence of PCBs in the brook water presents no acute or immediate concern. Moreover, while the chronic AWQC for PCBs was exceeded in Unkamet Brook, the brook sustains only a limited aquatic population due to its size. By contrast, in the Housatonic River, no such

exceedances were observed in the river water directly below the confluence with Unkamet Brook.

- Unkamet Brook surface water was analyzed for PCBs in 1981, 1987, 1988, and 1989 at multiple locations prior to MCP Phase II activities. During Phase II activities, surface water was analyzed for PCBs at five locations during high-flow and low-flow conditions. Comparing the database of PCB concentrations obtained between 1981 and 1989 to the Phase II results indicates that the PCBs detected in 1991 were within the range of concentrations observed in the past.

Inorganics

- The Appendix IX metals found in Unkamet Brook surface water during high-flow conditions appear to remain relatively constant at all locations and in fact decrease for some constituents. This observation suggests that additional Appendix IX metals are not entering Unkamet Brook in the study area at any significant concentration.
- Levels of Appendix IX+3 metals found during low-flow conditions appear to be consistent with those found during high-flow conditions at locations immediately upstream and downstream of the Interior Landfill. The concentrations of many of these constituents decrease at the downstream sampling locations. The decrease in metals concentrations at downstream locations could be explained by the lack of sources of these constituents within this region combined with dilution effects by the influence of groundwater in this region.
- Of the inorganics detected in the Unkamet Brook surface water, aluminum and lead are the only two that exceed freshwater chronic AWQC. The hardness-dependent chronic AWQC have been calculated using the hardness of the Housatonic River surface water (71 ppm) and is equal to 0.087 ppm and 0.002 ppm for aluminum and lead,

respectively. No freshwater acute AWQC for the inorganics was exceeded in any of the samples. Again, therefore the presence of aluminum and lead in Unkamet Brook does not present an acute (i.e. imminent) concern. It should also be noted that although aluminum and lead were also detected in the Housatonic River surface water adjacent to the GE facility at similar concentrations, and these constituents were screened from consideration as "target" constituents of concern because these concentrations were not higher than background data collected upstream of the GE facility.

Regarding the 1990 Housatonic River surface water data presented in Table 5-6, a number of supplemental observations are noted. These observations are presented below:

- Under high-flow conditions, several metals (e.g., aluminum, iron, lead, manganese, potassium, and sodium) decrease in concentration between the sampling location upstream of the Unkamet Brook confluence and the location downstream of the confluence. Under low-flow conditions, several metals (aluminum, sodium, and zinc) also decrease between these stations. It is possible that these decreases may be attributable to dilution effects from Unkamet Brook. Under low-flow conditions, some metals (e.g., iron and manganese) slightly increase between these locations suggesting a slight contribution from Unkamet Brook or another source in this area.
- Under low-flow conditions, low concentrations of benzene (0.008 ppm) and chlorobenzene (0.024 ppm) were detected at the sampling station downstream of the Unkamet Brook confluence. These data would indicate a source of such constituents in this area. Since benzene was not detected at further downstream locations, its presence at this station appears to be a localized occurrence. Chlorobenzene, however,

was also detected at the three further downstream locations (at 0.006 to 0.011 ppm) (See MCP Interim Phase II Report/CAS for Housatonic River, Blasland and Bouck, December 1991). While endosulfan I (a pesticide) was also detected under low-flow conditions at the station downstream of Unkamet Brook, it appears to reflect a contributing source other than GE, since it was also found (at higher concentrations) in upstream samples. All of the VOCs detected at the Housatonic River sampling locations below the Unkamet Brook confluence are below chronic and acute AWQC for aquatic life protection and below the AWQC for consumption of aquatic organisms. Thus, it is apparent that the constituents associated with Unkamet Brook have no more than a negligible effect upon the water quality of the Housatonic River.

SECTION 6 - SEDIMENT INVESTIGATIONS

6.1 General

The sediments of Unkamet Brook and associated areas have been subject to extensive investigation beginning in 1981. Section 6.2 presents a general description of investigations, performed prior to the MCP program, while Section 6.3 provides a discussion of the recent MCP Phase II sediment investigations. Section 6.4 provides an overall interpretation of the results of the various sediment investigations, and Section 6.5 presents estimated volumes of affected sediments.

6.2 Pre-MCP Sediment Investigations

6.2.1 Description of Sampling Programs

6.2.1.1 Unkamet Brook Sediments

An initial investigation of Unkamet Brook sediments was conducted in 1981. As part of this investigation, 15 sampling stations (S-1 through S-15) were established as illustrated on Figures 6-1 and 6-2. At each of these locations, core samples were collected and analyzed for PCBs. The results of the sampling activities are presented in Table 6-1.

Based upon the results of the 1981 assessment of the Unkamet Brook sediments, the following sediment sampling stations were established as illustrated in Figures 6-1 and 6-2:

- Stations 2, 7, 12, and 13 - located in the lower reaches of the brook.
- Stations 14, 15, and 16 - located downstream of the railroad storage yard culvert, just upstream of the meandering reaches of the brook.

- Stations 17 and 18 - located within an open channel section of the brook, immediately downstream of the 10-foot wide steel culvert.
- Stations 24, 25, and 26 - located in a reach between the outlet of the Merrill Road culvert and the inlet to the 10-foot wide steel culvert.
- Stations 27, 28, 29, and 30 - located in the brook channel, adjacent to the bog area.
- Stations 31 and 36 - located in the brook channel, upstream of the bog area.
- Station 44 - located upstream of Dalton Avenue.

The station numbers correspond to 100-foot increments of the distance between the station and the confluence of Unkamet Brook and the Housatonic River, measured along Unkamet Brook (i.e., Station 7 is 700 feet upstream of the confluence).

At each station, sediment cores were collected across each streambed cross-section and analyzed for PCBs and chlorobenzene. The results of this sampling are presented in Table 6-2 and are described in Section 6.2.2.

Following these activities, a supplemental sediment sampling program was established to assist in defining the extent of PCBs between Stations 31 and 44, in the vicinity of the former Interior Landfill. The supplemental sampling program consisted of nine sampling locations - Stations 32, 33, 34, 35, 37, 38, 39, 40, and 41, located in Unkamet Brook, adjacent to the former Interior Landfill.

As during prior sampling, sediment cores were collected for analysis of PCBs and chlorobenzene. The results are included in Table 6-2 and are described in Section 6.2.2.

Based on the results of the Unkamet Brook 1981 and 1982 sediment investigations, it was recommended that a semi-annual monitoring program be established at Stations 2, 7, and 12 to monitor PCB migration (if any) towards the Housatonic River.

From 1983 through 1985, Unkamet Brook sediments were sampled and analyzed for PCBs at Stations S2, S7, and S12 in accordance with the procedures specified in "Monitoring Protocols - Unkamet Brook Area." The sampling locations are illustrated on Figures 6-1 and 6-2. The results of this monitoring program are presented in Table 6-3 and are described in Section 6.2.2.

6.2.1.2 Bog Area Sediments

In addition to investigations specific to Unkamet Brook, five soil samples were obtained in 1981 within the bog area located east of the former waste stabilization basin and adjacent to Unkamet Brook. Two samples (Nos. 1 and 2, not illustrated) were taken in the area of a storm drain outfall northeast of the waste stabilization basin. Two other samples (Nos. 3 and 4, not illustrated) were taken in the area of the basin outfall. Additionally, one sample (No. 5, not illustrated) was taken just north of Merrill Road on the western side of Unkamet Brook. All five samples were analyzed for PCBs. The results of these analyses indicated the presence of PCBs in concentrations greater than 50 ppm only in sample No. 4 (O'Brien & Gere, August 1981).

Based on the results of the bog samples taken during the 1981 assessment, a more detailed investigation of the bog area was undertaken in 1982. During the 1982 investigation, the bog area was divided into a grid system designated by letters ascending along the south to north axis, and numerals ascending along the east to west axis as illustrated in Figure 6-3. A total of 17 bog sampling locations

were established east of the former waste stabilization basin. One core sample was collected from each bog sampling location and analyzed for PCBs and chlorobenzene. The results of the sampling are presented in Table 6-4 and are discussed in Section 6.2.2.

6.2.2 Discussion of Analytical Results

A summary of the sediment sampling data generated for Unkamet Brook between 1981 and 1985 are summarized in Tables 6-1 through 6-3 and on Figures 6-1 and 6-2. The results of the initial investigation activities performed in 1981 indicated that PCBs were present in Unkamet Brook sediments at concentrations ranging from less than 0.5 ppm to 114 ppm (Table 6-1). Generally, higher PCB concentrations (>50 ppm) were found just downstream of the former Interior Landfill and the railroad crossing south of Merrill Road. Results of further investigations indicated the presence of PCBs at concentrations exceeding 50 ppm, at a number of stations (generally in the same reach as during the 1981 investigations) and at a lower concentration (3.8 ppm) at Station 44, the background sediment location. Chlorobenzene was detected in the sediments, downgradient of the former fill area and adjacent to the former waste stabilization basin at concentrations of approximately 24 ppm, with concentrations of chlorobenzene decreasing in both directions along Unkamet Brook, as shown in Table 6-2.

The results of the monitoring performed between 1983 and 1985 indicated PCB levels ranging from less than 0.05 ppm to 51 ppm. The conclusions drawn from this program in 1985 were that the transport of PCBs to the Housatonic River via Unkamet Brook was not significant. A significant migration of PCBs downstream for lower reaches of Unkamet Brook had not occurred despite approximately 40 years of available transport time (Blasland & Bouck, January 1986).

The results of the 1982 bog area sampling were summarized by O'Brien & Gere (June 1982). In general, these results showed PCB levels averaging 22 ppm. Three samples (F4, L3, and U7) contained PCB levels greater than 100 ppm. Analysis of these samples for chlorobenzene detected concentrations between less than one and 54 ppm.

6.3 MCP Sediment Investigation

6.3.1 Description of Sampling Program

The MCP Phase II sediment sampling program for Unkamet Brook was designed to provide updated information on the concentrations of constituents in the sediments of Unkamet Brook, including the lower reaches near the confluence of the Housatonic River. In addition, this sampling program was designed to assess the presence of any Appendix IX+3 constituents in the reach of Unkamet Brook within the former Interior Landfill.

Sediment samples were collected from the same five sampling stations used for the surface water investigations (see Figure 5-2). In addition to these five stations, samples were collected from two locations within the former Interior Landfill area. The seven sampling locations are illustrated on Figure 6-4 and described below.

Station	Location Description
USW-1	Upstream of the Former Interior Landfill
SE-1	Within the Former Interior Landfill
SE-2	Within the Former Interior Landfill
USW-2	Downstream of the Former Interior Landfill
USW-4	Just Below the Railroad Crossing
USW-8	Downstream of the Railroad Crossing
USW-10	Just Upstream of the Housatonic River Confluence

Sediment core samples were collected from the stations described above on September 30 and October 1, 1991. All seven core samples were obtained utilizing stainless steel core tubing. The core tubing was pushed into the sediment and driven manually downward with a stainless steel core driver until resistance. The sample cores were extruded with a push rod onto a stainless steel tray. Samples USW-1, USW-2, USW-4, USW-8, and USW-10 were segmented into 0- to 6-inch and 6- to 12-inch samples and submitted for analysis. Samples SE-1 and SE-2 were segmented into 0- to 2-foot and 2- to 4-foot samples following the MDEP-approved protocols in the MCP SAP for sediment samples slated for Appendix IX+3 analysis. However, due to poor recovery of these sediments, only the 0- to 2-foot segment contained enough material for analysis.

Samples collected from Locations SE-1 and SE-2 were submitted to CompuChem for analysis of Appendix IX+3 constituents except organochlorine pesticides/PCBs. Split samples were submitted to ITAS for PCB analysis. Samples collected from Locations USW-1, USW-2, USW-4, USW-8, and USW-10 were submitted to CompuChem for analysis of Appendix IX+3 VOCs, 1,2,4-trichlorobenzene (although CompuChem reported results associated with all Appendix IX+3 SVOCs), total phenols, and metals. Split samples were again submitted to IT Analytical Services for PCB analysis.

QA/QC samples associated with this investigation included one blind duplicate sample at Location SE-1, one set of MS/MSD samples at Location SE-2, and one field blank. Trip blanks were also included with all samples submitted for VOC analyses.

In addition, as part of MCP Phase II investigations for the Housatonic River, sediment samples were collected from the Housatonic River immediately upstream and downstream of the Unkamet Brook confluence in 1991 to assess the potential impact of Unkamet Brook on Housatonic River

sediments. These samples were collected utilizing methods similarly described above for Unkamet Brook sediments and were analyzed for Appendix IX+3 constituents by IT Analytical Services.

6.3.2 Analytical Results

The results of the MCP Phase II sediment investigations of Unkamet Brook indicate the presence of PCBs and various Appendix IX+3 organic and inorganic constituents. A summary of the constituents detected and their corresponding concentrations is presented in Tables 6-5 and 6-6 for the organic and the inorganic constituents, respectively. The results associated with the Housatonic River MCP Phase II sediment sampling activity in relation to Unkamet Brook are summarized in Table 6-7.

6.4 Interpretation of Sediment Results

As shown in Tables 6-5 and 6-6, PCBs and various Appendix IX+3 constituents were detected at varying concentrations in Unkamet Brook sediments. Upon review of these data, the following general observations have been made:

- PCBs were detected at each of the seven locations sampled. The PCB concentrations detected between Dalton Avenue and the entrance to the culvert under Merrill Road were much higher than PCB concentrations detected below Merrill Road. At locations USW-1, SE-1, SE-2, and USW-2, PCB concentrations ranged from 19 to 430 ppm. Downstream of the culvert beneath Merrill Road (locations USW-4, USW-8, and USW-10), PCB concentrations were found to range from less than detectable to 12 ppm. These concentrations are generally within the range of concentrations detected in this reach of the brook during previous studies. This data, along with the surface water data presented in Section 5, support the conclusion that was developed during the 1980s that only very limited transport of PCBs occurs from

the upper stretch of Unkamet Brook to the lower stretch. This conclusion is further supported by the results of the Housatonic River hazardous constituent sediment sampling in which sediment samples were collected above and below the Unkamet Brook confluence and analyzed for Appendix IX+3 constituents. As presented on Table 6-7, PCBs were not detected at either location.

- With the exception of samples collected at location USW-2, PCB concentrations detected in the 0- to 6-inch sample were higher than those detected in the 6- to 12-inch increment. This is particularly evident downstream of the culvert (USW-4, USW-8, and USW-10) where the highest PCB concentration detected in the 6- to 12-inch increment was 0.07 ppm. This vertical distribution of PCBs is indicative of an area with limited sediment deposition, which further supports the conclusion that sediment transport within the brook is limited.
- The highest concentrations of VOCs were detected in the vicinity of the former Interior Landfill. The concentrations generally decreased with distance downstream. There were no VOCs detected at location USW-10 above the detection limit. This data further supports the previous conclusion regarding the lack of significant transport of sediment from Unkamet Brook to the Housatonic River.
- SVOCs were detected at USW-1 and within the former Interior Landfill (SE-1 and SE-2) at concentrations generally below 5 ppm, but with several at concentrations up to 15 ppm. The concentrations of most semivolatiles increased at sampling location USW-4 with typical concentrations being in the 20 ppm to 55 ppm range. These concentrations then decreased at locations USW-8 and USW-10. This sudden increase in the concentrations of semivolatiles at USW-4 may be related to the presence of adjacent railroad tracks (Figure 6-4).

- Most of the inorganics were detected at each sampling location. No clear trend seems to exist related to the depth increment of the samples. Inorganics concentrations are generally highest at location USW-1 and within the former Interior Landfill (locations SE-1 and SE-2). These concentrations generally decrease with respect to downstream distance along Unkamet Brook.

The results of the Housatonic River sediment sampling, shown in Table 6-7, illustrate that, with the exception of acetone, only inorganic constituents were detected. Acetone was not detected upstream of the Unkamet Brook confluence, but was detected downstream of the confluence at an average concentration of 0.26 ppm. This may suggest a slight contribution by Unkamet Brook in this area. Described in Sections 4 and 5, however, acetone is not a constituent of concern with respect to groundwater or surface water related to the VOC plume.

Regarding the inorganics data, all metal constituents detected at the downstream location were also detected upstream. A number of these metals were detected at the downstream location at concentrations that were consistent with upstream concentrations. However, various metals, namely barium, chromium, copper, lead, zinc, and sulfide were detected at higher concentrations at the downstream location. With the exception of sulfide, in which an order of magnitude increase was noted, the metals found at higher concentrations at the downstream location show only slight increases, which suggests only a slight contribution from Unkamet Brook or another source in this area.

6.5 Estimated Volume of PCB-Containing Sediments

The volume of PCB-containing sediments in Unkamet Brook was estimated using the extensive coring data generated as a result of the pre-MCP sediment investigations, performed by O'Brien & Gere, and the MCP Phase II sediment sampling. This database includes 27 brook transects established between Dalton

Avenue and the Housatonic River (see Figures 6-1 and 6-2 for approximate sample locations). At each of those transects, three to 11 cores were collected. These cores were segmented into groups of similar materials, and these materials were composited across a given transect and analyzed for PCBs. Accurate measurements of reach lengths and widths as well as core lengths were provided. This information was summarized by O'Brien & Gere (June 1982) in detailed core logs. The MCP Phase II sediment sampling results consisted of seven cores analyzed in 6-inch increments at five locations and in a 0- to 2-foot core at two locations.

For the purpose of estimating the volume of PCB-containing sediments in Unkamet Brook, the O'Brien & Gere core logs were reviewed in conjunction with the composite core PCB concentrations and the MCP Phase II sediment results. From this review, depths of sediments containing PCB levels greater than one ppm, greater than 10 ppm, and greater than 50 ppm were determined at each transect or location. This information was combined with information presented regarding the brook dimensions at each transect or location. This facilitated the calculation of sediment volume estimates corresponding with the three PCB concentration ranges. These concentration levels were selected for illustrative purposes only and do not represent levels of regulatory significance for this project. The following sediment volumes were estimated:

PCB Concentration Range	Approximate Sediment Volume
greater than 1 ppm	1,500 cubic yards (cy)
greater than 10 ppm	1,200 cy
greater than 50 ppm	900 cy

SECTION 7 - MCP SURFICIAL SOILS INVESTIGATIONS

7.1 Description of Sampling Program

Surficial soils of the Unkamet Brook Area were sampled as part of MCP Phase II activities to investigate the potential presence of PCBs, VOCs, and SVOCs in the floodplain of Unkamet Brook, and the potential presence of PCBs and Appendix IX+3 constituents in the area adjacent to Building OP-3. Soils data collected as part of excavation activities or other miscellaneous sampling and analysis activities are discussed in Section 8.

Soil samples were collected along three floodplain transects and from 20 locations within an area adjacent to Building OP-3, as illustrated on Figure 7-1. All locations were surveyed in the event there is a need to relocate the exact sample locations at a future date. Floodplain transect UFP-1 is located closest to the confluence of the Housatonic River; transect UFP-2 is located between UFP-1 and Merrill Road; and transect UFP-3 is located in the northern part of the floodplain within the GE facility near and within the former Interior Landfill.

Most floodplain and surficial soil samples were collected during the week of April 8-11, 1991. The two samples adjacent to Building OP-3, that were analyzed for Appendix IX+3 constituents, (excluding PCBs, VOCs, and SVOCs, which were previously analyzed) were collected on January 29, 1992. Each sample consisted of the top 0 to 12 inches of soil. Samples were obtained by utilizing a stainless-steel scoop or a stainless-steel bucket auger soil sampler with a stainless steel liner. Each sample was placed onto aluminum foil and mixed prior to placing in laboratory supplied jars. At each sampling location, two additional jars were filled halfway, quickly covered with aluminum foil, and screw-capped to tightly seal the jars for field screening with a PID.

All floodplain and surficial soil samples were submitted to IT Analytical Services for PCB analysis. In addition, each sample was also screened with a

PID to indicate the presence of volatiles and semivolatiles. PID readings for each sample are presented in Table 7-1. Samples exhibiting a PID reading greater than 10 PID units were submitted to CompuChem for analysis of Appendix IX+3 volatiles and 1,2,4-trichlorobenzene. CompuChem also reported the remaining semivolatile constituents. Also, the two samples adjacent to Building OP-3 that exhibited the highest PID readings were submitted to CompuChem for analysis of all Appendix IX+3 constituents.

QA/QC samples submitted, related to these investigations, included two blind duplicate samples, one set of MS/MSD samples, and two field blank samples. Trip blanks were also included with all samples submitted for volatile analyses.

7.2 Analytical Results

The results of the Unkamet Brook floodplain and surficial soils investigation indicate the presence of PCBs and various Appendix IX+3 volatile and semivolatile constituents. Summaries of the constituents detected and their corresponding concentrations are presented in Tables 7-2 through 7-4. Specifically, Table 7-2 describes each sample and presents the PCB concentration, while Tables 7-3 and 7-4 present the Appendix IX+3 data for the surficial soils near Building OP-3 and the floodplain soils, respectively. Discussions regarding these results are presented below.

7.2.1 PCB Results

PCBs were detected at sampling locations along each of the three Unkamet Brook floodplain transects and at low but detectable concentrations in all 20 of the surficial soil samples collected near Building OP-3. As shown in Table 7-2 and on Figure 7-1, PCB concentrations measured along transect UFP-3, range from 650 ppm at the top of the brook's east bank to less than one ppm between 274 and 382 feet from the top of the east

bank. Specifically, PCB levels sharply decrease from 650 ppm at location UFP3-R1 and vary from 12 to 91 ppm between locations UFP3-R2 and UFP3-R4. PCB levels then decrease to 3 ppm approximately 274 feet from the top of the east bank and to less than one ppm along the remainder of the transect. One sample was collected at the top of the west bank, and this sample had a PCB concentration of 120 ppm.

PCB concentrations measured along transect UFP-2 generally range from less than one ppm to 190 ppm (Figure 7-1). More specifically, along the east bank of the brook at this transect, PCB concentrations decrease from 41 ppm measured at the top of the east bank (location UFP2-R1) to less than 1.1 ppm approximately 200 feet from the top of the east bank. Along the west bank, PCB concentrations range from 190 ppm detected approximately 20 feet from the top of the west bank (location UFP2-L3) to 1.1 ppm at a distance of approximately 170 feet, as illustrated on Figure 7-1.

Along transect UFP-1, PCBs appear to be limited to within approximately 20 feet of the brook on the east bank and within 80 feet on the west bank (Figure 7-1). Specifically, along the east bank, PCBs were only detected greater than one ppm (52 ppm) at the top of the brook bank (location UFP1-R1). Along the west bank, PCBs were detected at concentrations greater than one ppm at the top of the brook bank at location UFP1-L1 (28 ppm) and at location UFP1-L2 (2.5 ppm), which is approximately 36 feet from the top of the bank.

As for the surficial soils near Building OP-3, PCB concentrations ranged from less than one ppm to 14.3 ppm, but 14 out of the 20 samples exhibited PCB concentrations less than one ppm (Figure 7-1). The average PCB concentration for these data is 1.6 ppm.

7.2.2 Appendix IX+3 Constituents

As previously mentioned, all floodplain and surficial soil samples were screened with a PID to indicate the presence of volatiles and/or semivolatile constituents. Table 7-1 presents the PID readings associated with each sample. These readings generally ranged from less than one to 21 PID units. Based on these results, a total of 32 samples (excluding duplicates) were submitted to CompuChem for analysis of Appendix IX+3 volatiles and 1,2,4-trichlorobenzene. CompuChem also reported the results for all Appendix IX+3 semivolatiles. These samples included 10 surficial soil samples and 22 floodplain soil samples. In addition, the two surficial soil samples exhibiting the highest PID readings (UOP3S-15 and UOP3S-20) were submitted to CompuChem for analysis of all Appendix IX+3 constituents.

The results of these analyses are summarized in Tables 7-3 and 7-4 for surficial and floodplain soils, respectively. As shown in each of these tables, various Appendix IX+3 constituents were found in each sample, although many only at estimated concentrations below the analytical quantification limits.

7.3 Interpretation of Floodplain and Surficial Soils Data

Upon review of USGS topographic quadrangles associated with the Unkamet Brook Area, it appears that the area sampled near Building OP-3 would not be directly impacted by surface water of Unkamet Brook. Therefore, data associated with this area are considered to be independent of the floodplain soils data. Separate discussions regarding these data are presented below.

Data needs identified based on the review of MCP Phase II and RFI requirements, in conjunction with the data presented below, are discussed in Section 14.3.

7.3.1 Surficial Soils Near Building OP-3

Upon review of data related to surficial soils near Building OP-3, it is apparent that the PCBs and volatile and semivolatile constituents above the quantitation limits are limited to a few locations. Specifically, with the exception of only two locations, where PCBs were detected at concentrations of 14.3 and 6.1 ppm, all locations exhibited PCB levels between 0.07 and 2.9 ppm.

Methylene chloride and acetone were detected at each location, but these constituents were also found in the associated method blanks. Chloroform was detected at three locations, but not above the quantification limit. Various semivolatile constituents were also detected at each location; however, at most locations, only estimated values were reported below the associated quantification limits. Levels of semivolatiles above quantification limits were detected in only five of the 10 samples subject to these analyses. The highest concentration of semivolatiles was detected in samples collected at locations UOP3S-13 and UOP3S-17. Because the results of these analyses show no apparent trends or patterns associated with the locations, the presence of these constituents is likely isolated and not indicative of a source area.

7.3.2 Floodplain Soils

7.3.2.1 PCBs

The presence of PCBs in the floodplain soils of Unkamet Brook within the former Interior Landfill is not expected to reflect PCBs deposited during flood events. Rather, the PCBs detected in this area more likely reflect the presence of a source of PCBs in this area. By contrast, the presence of PCBs in floodplain soils associated with the lower section of Unkamet Brook may reflect prior flooding events that could have deposited brook sediments onto the floodplain. This

mechanism is supported by the distribution of PCBs in the floodplain soils in which the PCB concentrations detected in floodplain soils are generally within close proximity of the brook, and concentrations decrease at distances away from the brook.

7.3.2.2 Appendix IX+3 Constituents

A number of volatiles and semivolatiles were detected at varying concentrations along each of the three transects. At floodplain transect UFP3 (within the former Interior Landfill, as illustrated on Figure 7-1), the presence of volatile and semivolatile constituents were restricted to less than 382 feet from the top of the Unkamet Brook bank. [Several constituents were detected further from the brook (in samples from UFP3-R6 to UFP3-R11), but at concentrations less than one ppm.] Concentrations of detected constituents were generally less than 10 ppm with the exception of 1,1,1-trichloroethane (76 ppm), and di-n-butylphthalate (21 ppm).

At floodplain transect UFP2 (located downstream of where Unkamet Brook emerges from the culvert under Merrill Road as illustrated on Figure 7-1), no VOCs were detected above one ppm. A number of semivolatiles were detected on the western bank of Unkamet Brook at this transect. Maximum concentrations for these constituents were detected at location UFP2-L2 (approximately 13 feet into the floodplain) and include fluoranthene (45 ppm), pyrene (37 ppm), benzo(a)anthracene (29 ppm), chrysene (28 ppm), benzo(b)fluoranthene (24 ppm), benzo(k)fluoranthene (17 ppm), and benzo(a)pyrene (13 ppm). These constituents were also detected at UFP2-L1 (at the top of bank), but at lower concentrations. In samples collected at UFPL-L3, UFP2-L4, and UFP2-L5, similar semivolatile constituents were detected as were found at UFP2-L2, but at lower

concentrations. Samples collected and analyzed for semivolatiles on the eastern bank of the same transect at locations UFP2-R1, UFP2-R2, and UFP2-R7 detected very few semivolatiles and then only at low concentrations. It is important to note that the western portion of this transect extended into the floodplain in close proximity to various railroad facilities which are unrelated to GE.

At floodplain transect UFP1 (the transect closest to the confluence of Unkamet Brook with the Housatonic River), no VOCs were detected above one ppm (although a total of 10 samples were analyzed for VOCs). No semivolatiles were detected at this transect above 2 ppm except for several constituents that were qualified by the laboratory as indicating coeluting isomers (and even then these concentrations were less than 3.2 ppm).

The floodplain volatile and semivolatile data indicate that very little transport of these constituents has occurred from the GE facility to the Unkamet Brook floodplain. The occurrence of select constituents along the western bank of transect UFP2, (in the vicinity of the railroad tracks) will be investigated further during supplemental Phase II activities as discussed in Section 14.

7.4 Estimated Volumes of Affected Floodplain Soils

As described in Section 14.7, volume estimates regarding Unkamet Brook floodplain soils will be developed during supplemental Phase II/RFI activities using the detailed topographic mapping which is now available for the majority of the site.

SECTION 8 - MISCELLANEOUS SOILS INVESTIGATIONS

8.1 General

In accordance with agreements between GE and the MDEP, certain soil excavation activities at the GE facility, whether they are associated with construction, demolition, landscaping, or other miscellaneous site work, are to be accompanied by a sampling and analysis program. The purpose of this program is to assess the potential presence of chemical constituents in the soils and to assist in determining the appropriate disposition of the materials. This section summarizes the various sampling and analysis activities that have been performed in connection with such excavations at the Unkamet Brook Area/USEPA Area 1 Site. Figure 8-1 shows the approximate locations of the various areas that have been subject to such investigations. Figures 8-2 through 8-5 illustrate PCB data from the upper increment of depth-specific sampling activities associated with miscellaneous soils investigations. In addition, PCB data associated with soil piles or data collected from inside buildings are not illustrated.

An overview of these investigations is provided below, while further details are provided in Appendix O. The following overview discusses investigations conducted through August 22, 1994.

In general, these investigations included the collection of various discrete or composite samples to assess soils prior to excavation or following excavation, and the subsequent analyses of these samples for various parameters such as PCBs, priority pollutants, or constituents associated with the Toxicity Characteristic Leaching Procedure (TCLP). Many of the investigations described below also involved the screening of samples for the presence of VOCs using a PID. Samples that were screened with a PID and exhibited readings greater than 10 PID units were subsequently submitted for laboratory VOC analysis.

8.2 Building OP-1

Sixteen sampling investigations have been conducted in connection with materials originating from within or around Building OP-1. These investigations are summarized as follows:

- On February 18, 1992, 10 samples (six discrete soil grab samples, two discrete soil core samples, and two discrete concrete core samples) were collected from three piles of soil and concrete (of 0.6, 5.3, and 13 cy, respectively) excavated during the replacement of the Building OP-1 Loading Dock. All 10 samples were analyzed for PCBs, with no PCBs being detected. The eight soil samples were also screened for VOC's using a PID; however, all PID readings were shown to be less than 10 PID units. Refer to Figure 8-1, location A1, and Appendix O, Section A1 for sampling locations and further information.
- On May 7 and 8, 1992, 78 discrete grab samples were collected for PCB and PID/VOC analyses from four soil piles (of 2.6, 11, 15, and 263 cy, respectively), generated during the excavation of a backflow valve east of Building OP-1. PCBs were not detected in any of the 78 samples. PID readings were shown to be less than 10 PID units for all samples. Refer to Figure 8-1, location A2, and Appendix O, Section A2 for sampling locations and further information.
- On May 12, 1992, seven samples (five composite soil samples and two discrete concrete core samples) were collected for PCB and TCLP analyses from two areas of the Building OP-1 Metal Treatment Area floor prior to its removal. PCBs were detected in the two concrete samples at concentrations of 2.1 and 2.5 ppm, respectively. Four of the soil samples were analyzed for PCBs, and no PCBs were detected. The remaining soil sample was analyzed for TCLP metals, and no metals were detected above quantitation limits. PID readings were

also taken for the five soil samples, and were all shown to be less than 10 PID units. Refer to Figure 8-1, location A3, and Appendix O, Section A3 for sampling locations and further information.

- On August 13 and 18, 1992, 32 samples (eight discrete soil grab samples and 24 discrete concrete core samples) were collected for PCB analysis from eight areas of the Building OP-1 foundation and floor prior to its removal. PCBs were detected in three of the concrete samples at concentrations of 1.4, 4.5, and 5.8 ppm, respectively. PCBs were not detected in any of the remaining samples. Refer to Figure 8-1, location A4, and Appendix O, Section A4 for sampling locations and further information.
- On August 19, 1992, five discrete grab samples were collected for PCB and PID/VOC analyses from a soil pile (11 cy), which was excavated during the removal of the foundation of the Building OP-1 Precision Assembly Area. No PCBs were detected in any of the five samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location A5, and Appendix O, Section A5 for sampling locations and further information.
- On August 20, 1992, five discrete grab samples were collected for PCB and PID/VOC analyses from a soil pile (11 cy), which was excavated during the Building OP-1 Airco Tank Pad removal. PCBs were not detected in any of the five samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location A6, and Appendix O, Section A6 for sampling locations and further information.
- On August 24, 1992, six samples (three discrete soil grab samples and three discrete concrete core samples) were collected for PCB and PID/VOC (soils only) analyses from a pile of soil and concrete (25 cy),

which was excavated during the removal of the Building OP-1 Grinding Room. PCBs were not detected in any of the six samples, and PID readings of the three soil samples were all shown to be less than 10 PID units. Refer to Figure 8-1, location A7, and Appendix O, Section A7 for sampling locations and further information.

- On February 2 and 3, 1993, 12 samples (six discrete soil grab samples and six discrete concrete core samples) were collected for PCB analysis from six areas of the floor within Building OP-1, prior to its removal. PCBs were detected in one of the soil samples at a concentration of 6.0 ppm, and in two of the concrete samples at concentrations of 2.3 and 2.8 ppm, respectively. PCBs were not detected in any of the remaining samples. Refer to Figure 8-1, location A8, and Appendix O, Section A8 for sampling locations and further information.
- On May 20, 1993, six discrete concrete core samples were collected for PCB analysis from a soil pile generated from the removal of the floor within Building OP-1 (near columns 17-21). PCBs were not detected in any of the six samples. Refer to Figure 8-1, location A9, and Appendix O, Section A9 for sampling locations and further information.
- On June 2, 1993, two composite soil samples were collected for PCB and PID/VOC analyses prior to the Building OP-1 Access Ramp excavation along the east side of Building OP-1. PCBs were not detected in either sample; however, elevated detection limits were noted due to matrix interference. PID readings for both samples were shown to be less than 10 PID units. Refer to Figure 8-1, location A10, and Appendix O, Section A10 for sampling locations and further information.

- On June 16, 1993, three discrete grab samples were collected for PCB and PID/VOC analyses from a soil pile (4.7 cy) excavated during a barrier pole removal, south of Building OP-1. PCBs were not detected in any of the three samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location A11, and Appendix O, Section A11 for sampling locations and further information.
- On July 12, 1993, two samples (one composite soil sample and one composite concrete sample) were collected for PCB analysis from a soil pile (1.2 cy) and a concrete pile (4.1 cy), respectively. The soil and concrete piles were generated during the Building OP-1 Medical Clinic trench excavation. PCBs were not detected in either sample. PID readings were also taken for the soil sample, and were shown to be less than 10 PID units. Refer to Figure 8-1, location A12, and Appendix O, Section A12 for sampling locations and further information.
- On August 23, 1993, two samples (one composite soil sample and one composite concrete sample) were collected for PCB analysis from a pile of soil and concrete excavated during a barrier pole removal, south of Building OP-1. PCBs were not detected in the soil sample, but were detected in the concrete sample at a concentration of 110 ppm. PID readings were also taken for the soil sample, and were shown to be less than 10 PID units. Refer to Figure 8-1, location A13, and Appendix O, Section A13 for sampling locations and further information.
- On July 22, 1994, four discrete water grab samples were collected for PCB analysis from four manholes within and to the west of the Unkamet Brook Area/USEPA Area 1 Site. Only one of these manholes (manhole EMH-12, located south of Building OP-1) is located within the site. PCBs were not detected in any of the samples. Refer to

Figure 8-1, location A14, and Appendix O, Section A14 for the location of manhole EMH-12 and further information.

- On August 9, 1994, 25 soil samples were collected for PCB and PID/VOC analyses from two borings at the proposed location of the Martin Marietta Oil-Water Separator, southeast of Building OP-1. PCBs were not detected in any of the samples. PID readings were measured to be greater than 10 PID units for four of the samples (ranging from 16 to 60 PID units), and these samples were subsequently analyzed for VOCs and 1,2,4-trichlorobenzene. No analytes were detected. Refer to Figure 8-1, location A15, and Appendix O, Section A15 for sampling locations and further information.
- On August 10, 1994, one groundwater sample was collected at the proposed location of the Martin Marietta Oil-Water Separator, southeast of Building OP-1. This sample was analyzed for metals, pesticides, PCBS, herbicides, VOCs, and SVOCs. Zinc, arsenic, lead, and selenium were detected in this sample at concentrations of 34.9, 14.4, 49.0, and 8.8 ppm, respectively. Pesticides, herbicides, VOCs, SVOCs, and other metals were not detected. Refer to Figure 8-1, location A16, and Appendix O, Section A16 for sampling locations and further information.

8.3 Building OP-2

Five sampling investigations have been conducted in connection with materials originating from within or around Building OP-2. These investigations are summarized as follows:

- On September 7, 1989, 14 samples (six discrete asphalt grab samples, four discrete soil grab samples, two discrete concrete grab samples, and two discrete concrete core samples) were collected for PCB

analysis from nine locations surrounding Buildings OP-2, OP-1, and 51. The samples were collected during fire hydrant replacements. PCBs were not detected in any of these samples. Refer to Figure 8-1, location B1, and Appendix O, Section B1 for sampling locations and further information.

- On April 18, 1990, six samples (one discrete soil grab sample, one composite soil grab sample, two discrete concrete core samples, and two discrete wood block core samples) were collected from the Building OP-2 Shipping Area. PCBs were detected in the two wood block samples at concentrations of 16 ppm, and were not detected in the remaining four samples. One of the soil samples was also analyzed for VOCs, and none were detected. Refer to Figure 8-1, location B2, and Appendix O, Section B2 for sampling locations and further information.
- On July 6, 19, and 24, 1990, four samples (one discrete wood block core sample, one discrete concrete core sample, and two discrete soil grab samples) were collected from the foundation of Building OP-2 (near column R-21). The wood block sample, concrete core sample, and one of the soil grab samples were each analyzed for PCBs. PCBs were not detected in the soil and concrete samples, but were detected in the wood block sample at a concentration of 5.1 ppm. The second soil sample was analyzed for VOCs and SVOCs. Fluoranthene, pyrene, and bis(2-ethylhexyl)phthalate were detected at concentrations of 0.54, 0.42, and 1.0 ppm, respectively. However, bis(2-ethylhexyl) phthalate was also detected in the associated method blank sample. Refer to Figure 8-1, location B3, and Appendix O, Section B3 for sampling locations and further information.

- On July 19, 1991, six discrete grab samples were collected for PCB and PID/VOC analyses from three soil piles (30 cy total) on the concrete pad north of Building OP-2. PCBs were not detected in any of the six samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location B4, and Appendix O, Section B4 for sampling locations and further information.
- On April 19, 1993, two samples (one discrete soil grab sample and one composite concrete sample) were collected for PCB analysis from the parking lot west of Building OP-2 following a light pole excavation. PCBs were not detected in either sample. PID readings were also taken for the soil sample, and were shown to be less than 10 PID units. Refer to Figure 8-1, location B5, and Appendix O, Section B5 for sampling locations and further information.

8.4 Building OP-2A

Three sampling investigations have been conducted in connection with materials originating from within and around Building OP-2A. These investigations are summarized as follows:

- In June 1986, seven samples (one composite concrete sample, one composite asphalt sample, and five composite soil samples) were collected for PCB analysis from the floor of Building OP-2A. Also, one composite dust and dirt scrape sample was collected for PCB analysis from the surface of lights and a beam within Building OP-2A. PCBs were detected in the dust and dirt sample at 4.8 ppm; in the asphalt sample at 1.0 ppm; and in three of the five soil samples at 0.52, 0.31, and 0.08 ppm. PCBs were not detected in the remaining samples. Refer to Figure 8-1, location C1, and Appendix O, Section C1 for sampling locations and further information.

- In February 1987, three samples (one composite concrete sample, and two composite soil samples) were collected for PCB analysis from the floor of Building OP-2A. PCBs were not detected in any of the three samples. Refer to Figure 8-1, location C2, and Appendix O, Section C2 for sampling locations and further information.
- On June 3, 1994, one discrete grab sample was collected from a soil pile (0.2 cy) excavated during a barrier pole removal, north of Building OP-2A. PCBs were not detected in this sample, and PID readings were shown to be less than 10 PID units. Refer to Figure 8-1, location C3, and Appendix O, Section C3 for sampling locations and further information.

8.5 Building 51

Eleven sampling investigations have been conducted in connection with materials originating from within and around Building 51. These investigations are summarized as follows:

- In June, 1986, seven samples were collected for PCB analysis from eight locations along a proposed pedestrian walkway west of Building 51. The samples consisted of two discrete soil samples, three composite soil samples, one concrete pavement sample, and one asphalt pavement sample. PCBs were detected in the asphalt sample at a concentration of 0.81 ppm, and in two of the composite soil samples at concentrations of 0.18 and 0.46 ppm, respectively. PCBs were not detected in any of the remaining samples. Refer to Figure 8-1, location D1, and Appendix O, Section D1 for sampling locations and further information.
- On May 31 through June 13, 1989, 23 samples were collected for PCB analysis from the floor and surrounding yard of Building 51. The

samples consisted of 21 discrete soil grab samples and two discrete concrete sampling cores. PCBs were detected in eight of the 23 samples at concentrations ranging from 0.05 to 2.9 ppm. Refer to Figure 8-1, location D2, and Appendix O, Section D2 for sampling locations and further information.

- In August 1989, 12 soil boring samples were collected for PCB analysis from the yard surrounding the northwest corner of Building 51. PCBs were detected in the samples at concentrations ranging from 0.34 to 22 ppm. Refer to Figure 8-1, location D3, and Appendix O, Section D3 for sampling locations and further information.
- On November 7, 1989, one composite soil grab sample was collected for PCB analysis from two locations west of Building 51 during a sign installation. PCBs were not detected in this sample. Refer to Figure 8-1, location D4, and Appendix O, Section D4 for sampling locations and further information.
- On May 23 and June 17 through June 21, 1991, 60 samples were collected for PCB, TPH, VOC, and TCLP analyses from materials excavated during the removal of USTs 51-01 through 51-06, east of Building 51. The samples consisted of 56 discrete soil grab samples (for PCB, TPH, and VOC analyses), three composite soil samples (for VOC analysis), and one composite grab sample of material inside UST 51-05 (for TCLP analysis). Of the discrete soil grab samples, PCBs were detected in only one sample at a concentration of 0.8 ppm. TPHs were detected at concentrations ranging from 950 to 150,000 ppm, and no VOCs were detected above quantitation limits. In the composite soil samples, xylene was detected in two of the samples at concentrations of 37 and 46 ppm, respectively, and no other VOCs were detected above quantitation limits. The one composite sample

analyzed for TCLP constituents did not exceed TCLP regulatory criteria. Refer to Figure 8-1, location D5, and Appendix O, Section D5 for sampling locations and further information.

- On August 8 and 13, 1991, three samples (one discrete soil grab sample and two composite soil samples) were collected from seven soil piles excavated during the removal of USTs 51-01 through 51-06, east of Building 51. The two composite samples were analyzed for TCLP constituents, and did not exceed TCLP regulatory criteria. The discrete grab sample was analyzed for PCBs, but no PCBs were detected. Refer to Figure 8-1, location D6, and Appendix O, Section D6 for sampling locations and further information.
- On August 26 and 27, 1991, 23 samples (21 discrete soil grab samples and two discrete concrete core samples) were collected for PCB and VOC analyses from materials excavated during the removal of USTs 51-01 through 51-06, east of Building 51. PCB concentrations for the concrete samples were shown to be less than 1.0 ppm. Fifteen of the soil samples were analyzed for PCBs, and a concentration of 0.9 ppm was detected in one sample, while no PCBs were detected in the other 14 samples. The remaining six soil samples were analyzed for VOCs. Xylene was detected in one sample at a concentration of 0.041 ppm, and no other VOCs were detected. Refer to Figure 8-1, location D7, and Appendix O, Section D7 for sampling locations and further information.
- On September 12, 1991, nine discrete soil grab samples were collected for TPH analysis from three soil piles excavated during the removal of USTs 51-01 through 51-06, east of Building 51. TPHs were detected in all the samples at concentrations ranging from 350 to 3,800 ppm.

Refer to Figure 8-1, location D8, and Appendix O, Section D8 for sampling locations and further information.

- On September 20 through 30 and October 29, 1991, 92 samples were collected for PCB, TPH, VOC, and TCLP analyses from materials excavated during the removal of USTs 51-01 through 51-06, east of Building 51. The samples consisted of 56 discrete soil grab samples and 36 composite soil samples. PCBs were detected in five samples at concentrations ranging from 3.1 to 46 ppm, and TPHs were detected in all but two samples at concentrations ranging from 110 to 44,000 ppm. One composite sample was analyzed for TCLP constituents, and it did not exceed TCLP regulatory criteria. VOCs that were detected above quantitation limits were chlorobenzene (0.044 to 4.4 ppm in 18 samples), ethylbenzene (0.019 to 1.2 ppm in five samples), xylene (0.032 to 2.3 ppm in six samples), and acetone (0.034 ppm in one sample). Refer to Figure 8-1, location D9, and Appendix O, Section D9 for sampling locations and further information.
- On August 27 and September 8, 1992, 19 samples (14 discrete grab soil samples and five discrete asphalt grab samples) were collected for PCB and PID/VOC analyses from materials excavated during the removal of stairway footings within Building 51. PCBs were detected in only one soil sample at a concentration of 4.5 ppm. PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location D10, and Appendix O, Section D10 for sampling locations and further information.
- On July 19, 1994, three samples (one discrete soil grab sample and two discrete concrete core samples) were collected for PCB and PID/VOC analyses from materials generated during the repair of the Building 51 Steam Line. PCBs were not detected in any of the three

samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location D11, and Appendix O, Section D10 for sampling locations and further information.

8.6 Building 59

Eight sampling investigations have been conducted in connection with materials originating from within and around Building 59. These investigations are summarized as follows:

- In June 1986, five composite soil samples were collected for PCB analysis from the parking area west of Building 59. PCBs were detected in only two of the five samples at concentrations of 0.21 and 0.13 ppm. Refer to Figure 8-1, location E1, and Appendix O, Section E1 for sampling locations and further information.
- On September 5, 1986, 24 composite soil samples were collected for PCB analysis from the floor of Building 59. PCBs were not detected in any of the 24 samples. Refer to Figure 8-1, location E2, and Appendix O, Section E2 for sampling locations and further information.
- On September 16 through 18, 1986, five samples (one composite concrete sample, one discrete soil sample, and three composite soil samples) were collected for PCB analysis from the utility trench north of Building 59. PCBs were only detected in the discrete soil sample at a concentration of 1.1 ppm. Refer to Figure 8-1, location E3, and Appendix O, Section E3 for sampling locations and further information.
- On April 10 through 27, 1987, 16 samples (one composite asphalt sample and 15 composite soil samples) were collected for PCB analysis from materials excavated from within and around Building 59. PCBs were not detected in any of the 16 samples. Refer to Figure

8-1, location E4, and Appendix O, Section E4 for sampling locations and further information.

- On June 16, 1987, two composite soil samples were collected for PCB analysis from four Building 59 floor locations. PCBs were not detected in either sample. Refer to Figure 8-1, location E5, and Appendix O, Section E5 for sampling locations and further information.
- On November 7, 1989, one composite soil grab sample was collected for PCB analysis from two locations west of Building 59 during a sign installation. PCBs were not detected in this sample. Refer to Figure 8-1, location E6, and Appendix O, Section E6 for sampling locations and further information.
- On May 21 and 22, 1991, five discrete soil grab samples were collected for PCB and VOC analyses from the area east of Building 59. PCBs were not detected in any of these five samples. The only VOC detected above quantitation limits was trichloroethene, detected in two samples at concentrations of 0.006 and 0.020 ppm, respectively. Refer to Figure 8-1, location E7, and Appendix O, Section E7 for sampling locations and further information.
- On October 16 through 22, 1991, 27 discrete soil grab samples were collected for PCB, VOC, and SVOC analyses from nine soil piles excavated during the removal of a waterline south of Building 59. PCBs were detected in five of the 27 samples at concentrations ranging from 0.6 to 1.5 ppm. The only VOC detected above quantitation limits was trichloroethene, detected in ten samples at concentrations ranging from 800 to 26,000 ppm. The 13 SVOCs that were detected above quantitation limits were: anthracene (0.62 ppm in one sample); benzo(g,h,i)perylene (1.5 ppm in one sample); 1,4-dichlorobenzene (1.2 ppm in one sample); isophorone (3.8 ppm in one

sample); indeno(1,2,3-cd)pyrene (0.38 and 1.6 ppm in two samples); phenanthrene (0.39 to 2.0 ppm in four samples); fluoranthene (0.54 to 3.7 ppm in five samples); pyrene (0.41 to 4.8 ppm in five samples); benzo(a)anthracene (0.42 to 2.5 ppm in three samples); chrysene (0.45 to 2.4 ppm in three samples); benzo(b)fluoranthene (0.43 to 4.2 ppm in four samples); 1,2,4-trichlorobenzene (0.60 to 92.0 ppm in seven samples); and benzo(a)pyrene (0.45 to 2.5 ppm in three samples). Refer to Figure 8-1, location E8, and Appendix O, Section E8 for sampling locations and further information.

8.7 Buildings 105, 118, 125, and 130

Nine sampling investigations have been conducted in connection with materials originating from within or around Buildings 105, 118, 125, and 130. These investigations are summarized as follows:

- On July 16, 1991, 11 discrete soil grab samples were collected for PCB and PID/VOC analyses. One sample was collected from the plant bed area located northwest of Building 125, and the remaining samples were collected from the plant bed area located northeast of Building 130. PCBs were not detected in any of these 11 samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location F1, and Appendix O, Section F1 for sampling locations and further information.
- On August 14, 1991, 27 discrete soil grab samples were collected for PCB and PID/VOC analyses from the plant bed located northeast of Building 130. PCBs were detected in only one of these samples at a concentration of 1.4 ppm. PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location F2, and Appendix O, Section F2 for sampling locations and further information.

- On August 28, 1991, seven discrete soil grab samples were collected for PCB and PID/VOC analyses from the plant bed located north of Building 125. PCBs were detected in only two of these samples at 1.9 and 3.8 ppm, respectively. PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location F3, and Appendix O, Section F3 for sampling locations and further information.
- On January 7 and 13, 1992, 22 samples (17 discrete soil grab samples and five discrete concrete core samples) were collected for PCB and PID/VOC analyses from materials excavated during a sprinkler repair within Building 118. PCBs were detected in only five of the soil samples at concentrations ranging from 1.0 to 2.2 ppm. PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location F4, and Appendix O, Section F4 for sampling locations and further information.
- On July 8, 1992, three discrete soil grab samples were collected for PCB and PID/VOC analyses from the drainline connection trench located inside Building 118. PCBs were not detected in any of the three samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location F5, and Appendix O, Section F5 for sampling locations and further information.
- On December 22, 1992, 10 discrete grab samples were collected for PCB and PID/VOC analyses from a soil pile (38 cy) excavated during a waterline repair at Building 105. PCBs were detected in only two of the soil samples at 1.3 and 1.4 ppm, respectively. PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location F6, and Appendix O, Section F6 for sampling locations and further information.

- On January 29, 1993, five discrete grab samples were collected for PCB and PID/VOC analyses from a soil pile (18 cy) generated during a storm drain excavation at Building 130. PCBs were not detected in any of these five samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location F7, and Appendix O, Section F7 for sampling locations and further information.
- On January 29, 1993, five discrete grab samples were collected for PCB and PID/VOC analyses from a soil pile (19 cy) generated during an elevator pit excavation within Building 130. PCBs were not detected in any of these five samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location F8, and Appendix O, Section F8 for sampling locations and further information.
- On April 18, 1994, five samples (one discrete concrete core sample, one discrete asphalt core sample, and three discrete soil grab samples) were collected from materials excavated during the repair of the Building 130 (Pod 3) Catch Basin. PCBs were detected in the asphalt sample at a concentration of 1.5 ppm, and in one soil sample at a concentration of 3.3 ppm. PCBs were not detected in the remaining samples. PID readings were also taken for the soil samples, and were shown to be less than 10 PID units. Refer to Figure 8-1, location F9, and Appendix O, Section F9 for sampling locations and further information.

8.8 Building 114

Three sampling investigations have been conducted in connection with materials originating from within and around Buildings 114. These investigations are summarized as follows:

- In November and December 1985, 49 samples (44 composite soil samples and five composite asphalt samples) were collected for PCB and VOC analyses from within and around Building 114. PCBs were detected in 35 of the 44 soil samples at concentrations ranging from less than 0.1 ppm to 340 ppm, and in all of the asphalt samples at concentrations ranging from 0.20 to 1.2 ppm. No VOCs were detected above quantitation limits. Refer to Figure 8-1, location G1, and Appendix O, Section G1 for sampling locations and further information.
- In February 1988, one composite soil sample was collected for PCB analysis from materials excavated from Building 114. PCBs were detected at a concentration of 121 ppm. Refer to Figure 8-1, location G2, and Appendix O, Section G2 for sampling locations and further information.
- On November 26, 1990, one discrete soil grab sample was collected for TCLP analysis from the Building 114 Dike, located north of Building 114. The sample did not exceed TCLP regulatory criteria. Refer to Figure 8-1, location G3, and Appendix O, Section G3 for sampling locations and further information.

8.9 Buildings 119 and 119W

Eleven sampling investigations have been conducted in connection with materials originating from within or around Buildings 119 and 119W. These investigations are summarized as follows:

- On March 15, 1990, six samples (three discrete soil grab samples and three discrete asphalt grab samples) were collected for PCB analysis from areas north and northwest of Building 119W. PCBs were detected in only two of the soil samples at 2.7 and 3.2 ppm,

respectively. Refer to Figure 8-1, location H1, and Appendix O, Section H1 for sampling locations and further information.

- On June 14, 1990, eight samples (one discrete concrete core sample, two discrete wood core samples, two discrete asphalt grab samples, and three discrete soil grab samples) were collected for PCB analysis from a pile of materials located between Buildings 119 and 119W. The source of the materials is unknown. PCBs were not detected in any of these eight samples. Refer to Figure 8-1, location H2, and Appendix O, Section H2 for sampling locations and further information.
- On October 29, 1990, six samples (three discrete soil grab samples and three discrete asphalt grab samples) were collected for PCB analysis from areas north and northwest of Building 119W. PCBs were detected in only two of the soil samples at 1.6 and 8.6 ppm, respectively. PID readings were also taken for the soil samples, and were shown to be less than 10 PID units. Refer to Figure 8-1, location H3, and Appendix O, Section H3 for sampling locations and further information.
- On November 9, 1990, one discrete soil grab sample was collected for TCLP analysis from a soil pile (5 cy) located west of Building 119W. The source of the soil is unknown. The sample did not exceed TCLP regulatory criteria. Refer to Appendix O, Section H4 for further information.
- On October 16, 1991, four discrete soil grab samples were collected for PCB (three samples) and TCLP (one sample) analyses from an area southwest of Building 119. PCBs were not detected, and TCLP regulatory criteria were not exceeded. Refer to Figure 8-1, location H5, and Appendix O, Section H5 for sampling locations and further information.

- On October 22, 1991, seven discrete soil grab samples were collected for PCB (three samples), TPH (three samples), and TCLP (one sample) analyses from the Building 119W MRC Yard. PCB concentrations were detected in two of the three soils samples at 1.9 and 2.1 ppm, respectively. TPHs were detected in three of the samples at concentrations ranging from 1,200 to 4,200 ppm. The sample submitted for TCLP analysis did not exceed TCLP regulatory criteria. Refer to Figure 8-1, location H6, and Appendix O, Section H6 for sampling locations and further information.
- On April 6, 1992, one discrete soil grab sample was collected for PCB and PID/VOC analyses from soil excavated during a manhole repair northeast of Building 119. PCBs were not detected, and PID readings were shown to be less than 10 PID units. Refer to Figure 8-1, location H7, and Appendix O, Section H7 for sampling locations and further information.
- On May 18, 1992, one discrete oil grab sample was collected for PCB analysis from the Building 119W Oil-Water Separator. PCBs were detected at 14 ppm. Refer to Figure 8-1, location H8, and Appendix O, Section H8 for sampling locations and further information.
- On August 12, 1992, 15 discrete concrete core samples were collected for PCB analysis from concrete excavated during a floor repair in Building 119. PCBs were detected in only one sample at a concentration of 1.1 ppm. Refer to Figure 8-1, location H9, and Appendix O, Section H9 for sampling locations and further information.
- On April 18, 1994, six samples (one discrete concrete core sample, one discrete asphalt core sample, one discrete brick core sample, and three discrete soil grab samples) were collected for PCB analysis from materials generated during a manhole excavation near Building 119

(see Figure 8-1). PCBs were detected in the soil samples at 2.1, 3.6, and 6.1 ppm, respectively, and in the asphalt sample at 3.8 ppm. PCBs were not detected in the concrete and brick samples. PID readings were also taken for the soil samples, and were all shown to be less than 10 PID units. Refer to Appendix O, Section H10 for further information.

- On May 20, 1994, one composite sand/sediment sample was collected for PCB analysis from the barrel screen toward the incoming end of the Building 119W Oil-Water Separator. PCBs were not detected in the sample. Refer to Figure 8-1, location H11, and Appendix O, Section H11 for sampling locations and further information.

8.10 Building 120

Four sampling investigations have been conducted in connection with materials originating from within or around Building 120. These investigations are summarized as follows:

- On March 1, 1988, eight samples (one composite asphalt sample, three composite concrete samples, and four composite soil samples) were collected for PCB analysis from a pile of materials located west of Building 120. The source of the materials is unknown. PCBs were not detected in any of these eight samples. Refer to Figure 8-1, location I1, and Appendix O, Section I1 for sampling locations and further information.
- On August 21 and 22, 1989, 15 soil samples were collected for priority pollutant analysis from seven borings located south and southwest of Building 120. PCBs were detected in seven of the samples at concentrations ranging from 3.9 to 283 ppm. SVOCs that were detected above their quantitation limits were: 1,2,4-

trichlorobenzene (18 ppm in one sample); bis(2-ethylhexyl)phthalate (21 ppm in one sample); fluoranthene (5.4 and 8.0 ppm in two samples); phenanthrene (6.4 ppm in one sample); and pyrene (5.6 and 7.7 ppm in two samples). VOCs that were detected above their quantitation limits were: chloroform (0.013 ppm in one sample); chlorobenzene (0.009 to 7.8 ppm in seven samples); methylene chloride (0.005 to 0.018 ppm in 13 samples); benzene (0.005 to 0.12 ppm in four samples); ethylbenzene (0.005 to 0.009 ppm in three samples); and toluene (0.007 to 4.6 ppm in 12 samples). Several metal constituents were also detected at varying concentrations. Refer to Figure 8-1, location I2, and Appendix O, Section I2 for sampling locations and further information.

- On April 4, 1991, one composite grab sample was collected for TCLP analysis from 15 drums of spent carbon originating from the Building 120 Mobile Treatment Plant. This sample did not exceed TCLP regulatory criteria. Refer to Figure 8-1, location I3, and Appendix O, Section I3 for sampling locations and further information.
- On August 22, 1994, two discrete soil grab samples were collected for PCB and PID/VOC analyses from a pile of soil sweepings (3.8 cy) staged north of Building 120. PCBs were not detected in either of these samples, and PID readings were both shown to be less than 10 PID units. Refer to Figure 8-1, location I4, and Appendix O, Section I4 for sampling locations and further information.

8.11 Building OP-3

Six sampling investigations have been conducted in connection with materials originating from within or around Building OP-3. These investigations are summarized as follows:

- On February 8, 1989, nine sediment samples were collected for PCB analysis from the drainage ditch located east of Building OP-3. PCBs were detected in seven of the nine samples at 0.06 to 1.1 ppm. Refer to Figure 8-1, location J1, and Appendix O, Section J1 for sampling locations and further information.
- On May 17, 1989, 10 samples (one discrete concrete grab sample, two discrete soil grab samples, and seven discrete asphalt grab samples) were collected for PCB analysis from materials excavated during an electric gate replacement north of Building OP-3. PCBs were not detected in any of these 10 samples. Refer to Figure 8-1, location J2, and Appendix O, Section J2 for sampling locations and further information.
- On April 19, 1991, eight samples (six composite soil grab samples and two discrete asphalt grab samples) were collected from materials excavated during a cooling tower installation, south of Building OP-3. Five soil samples and both asphalt samples were analyzed for PCBs, and no PCBs were detected. The remaining soil sample was analyzed for VOCs. The two VOCs detected above quantitation limits were 2-butanone at a concentration of 0.023 ppm and acetone at a concentration of 0.15 ppm. However, acetone was also detected in the laboratory blank at a concentration of 0.004 ppm. Refer to Figure 8-1, location J3, and Appendix O, Section J3 for sampling locations and further information.
- Between July 20 and December 17, 1992 various samples were collected and analyzed as part of the removal of USTs OP3-1, -2, and -3. These samples included two discrete grab samples of excavated asphalt (PCB analysis only), four discrete grab samples of excavated concrete (PCB analysis only), 34 discrete grab samples of excavated

soil (all samples were screened with a PID and analyzed for PCBs and TPHs; five of the 34 samples were also analyzed for VOCs), and 10 composite soil samples taken from the sidewalls of the excavation pits (all samples were screened with PID and analyzed for PCBs and TPHs; four of the 10 samples were also analyzed for VOCs). PCBs were not detected in any of these samples. PID readings ranged from 0 to 561 PID units. TPHs were detected in all but three soil samples with concentrations ranging from 1 to 15,330 ppm. Toluene was detected in three soil samples (0.1 to 1.5 ppm). Ethylbenzene was detected in four soil samples (0.069 to 0.5 ppm). Xylenes were detected in four soil samples (0.1 to 1.7 ppm), and dichlorobenzene was detected in two soil samples (0.09 and 1.7 ppm). Refer to Figure 8-1, Location J4, and Appendix O, Section J4 for sampling locations and further information.

- On August 26, 1992, 13 samples (10 discrete soil grab samples and three discrete asphalt grab samples) were collected for PCB analysis from materials generated during a conduit trench turnstile excavation north of Building OP-3. PCBs were detected in only one soil sample at 1.7 ppm. PID readings were also taken for the soil samples, and were shown to be less than 10 PID units. Refer to Figure 8-1, location J5, and Appendix O, Section J5 for sampling locations and further information.
- On August 27 and 28, 1992, 42 samples (37 discrete soil grab samples and five discrete asphalt grab samples) were taken for PCB analysis from materials generated during 10 light stanchion excavations located north, east, and south of Building OP-3. PCBs were detected in only one soil sample at 1.0 ppm. PID readings were also taken for the soil samples, and were shown to be less than 10 PID units. Refer

to Figure 8-1, location J6, and Appendix O, Section J6 for sampling locations and further information.

- In June 1994, 12 samples (four composite soil samples, two discrete liquid samples, two discrete oil samples, and four discrete soil samples) were collected from 19 drums located west of Building OP-3, prior to their remediation. Each soil sample was analyzed for PCBs and TCLP, while the liquid and oil samples were analyzed for PCBs and VOCs. PCBs were detected in five of the soil samples at concentrations ranging from 1.5 to 17,000 ppm, in both liquid samples at 0.0043 ppm and 0.008 ppm, respectively, and in one of the oil samples at 9.3 ppm. VOCs detected in the oil samples included trichloroethene at 17,000 ppm in one sample and toluene at 2,400 ppm in the other sample. Only one of the soil samples exceeded the TCLP regulatory criteria for lead. That sample exhibited a lead concentration of 6 ppm. Refer to Figure 8-1, location J7 and Appendix O, Section J7 for sampling locations and further information.

8.12 Unkamet Brook Culvert

Two sampling investigations have been conducted in connection with materials originating from the Unkamet Brook Culvert, located in the northeast portion of the Unkamet Brook Area/USEPA Area 1 Site. These investigations are summarized as follows:

- On March 29, 1991, three discrete soil grab samples were collected for PCB, VOC, and SVOC analyses from the east bank of the Unkamet Brook Culvert, located east of Building 120. PCBs were detected at concentrations between 32 and 49 ppm. VOCs detected above the quantitation limit were: chlorobenzene (1.8 ppm in one sample); xylene (9.6 to 120 ppm in three samples); and ethylbenzene (4.9 to 55 ppm

in three samples). SVOCs detected above the quantitation limit were: naphthalene (14 to 36 ppm in three samples); phenanthrene (9.7 ppm in one sample); fluoranthene (13 ppm in one sample); pyrene (10 ppm in one sample); chrysene (9.2 ppm in one sample); and dibenzofuran (15 and 17 ppm in two samples). Refer to Figure 8-1, location K1, and Appendix O, Section K1 for sampling locations and further information.

- On May 8, 1991, one discrete soil grab sample was collected for TCLP analysis from the east bank of the Unkamet Brook Culvert, located east of Building 120. This sample did not exceed TCLP regulatory criteria. Refer to Figure 8-1, location K2, and Appendix O, Section K2 for sampling locations and further information.

8.13 Parking Lot Sweepings

Six sampling investigations have been conducted in connection with sand and soils from GE sweepers. The sand and soils were swept up by GE on its property and placed into piles at the plastics parking lot located in the northern portion of the Unkamet Brook Area/USEPA Area 1 Site. In most cases, the sweepings had been used by GE during the winter to sand roads at the facility. These investigations are summarized as follows:

- On April 26, 1990, two composite soil grab samples were collected for PCB analysis from the north corner of the parking lot. PCBs were not detected in either of these samples. Refer to Figure 8-1, location L1, and Appendix O, Section L1 for sampling locations and further information.
- On August 21, 1991, 26 discrete soil grab samples were collected for PCB (25 samples) and TCLP (one sample) analyses from 94 cy of soil in the north corner of the parking lot. PCBs were not detected (0.6

ppm detection limit) in any of these samples. TCLP regulatory criteria were not exceeded in the one sample. Refer to Figure 8-1, location L2, and Appendix O, Section L2 for sampling locations and further information.

- On April 29, 1992, five discrete grab samples were collected for PCB and PID/VOC analyses from a soil pile (16 cy) in the north corner of the parking lot. PCBs were not detected in any of these samples, and PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location L3, and Appendix O, Section L3 for sampling locations and further information.
- On April 28, 1993, three composite grab samples were collected for PCB analysis from 74 cy of sand in the north corner of the parking lot. PCBs were not detected in any of these samples. Refer to Figure 8-1, location L4, and Appendix O, Section L4 for sampling locations and further information.
- On April 18, 1994, six composite grab samples were collected for PCB and PID/VOC analyses from 53 cy of sand in the north corner of the parking lot. PCBs were detected in three of the six samples at 1.0 to 2.5 ppm. PCBs were not detected in the remaining samples. PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location L5, and Appendix O, Section L5 for sampling locations and further information.
- On August 12, 1994, four discrete grab samples were collected for PCB and PID/VOC analyses from 78 cy of soil in the north corner of the parking lot. PCBs were detected in the four samples at 19 to 41 ppm. PID readings were all shown to be less than 10 PID units. Refer to Figure 8-1, location L6, and Appendix O, Section L6 for sampling locations and further information.

8.14 Miscellaneous Locations

Eight sampling investigations have been conducted in connection with materials originating from miscellaneous locations within the Unkamet Brook Area/USEPA Area 1 Site. These investigations are summarized as follows:

- In June, 1989, 28 discrete soil samples were collected for PCB analysis from 11 borings at the site. These borings were located north of Building 51, northeast of Buildings 52 and 53, and to the north, south, and within Building 119. PCBs were detected in 11 of the 28 samples at 0.06 to 0.74 ppm. Refer to Figure 8-1, location M1, and Appendix O, Section M1 for sampling locations and further information.
- On July 13, 1992, one discrete soil grab sample was collected for PCB and TCLP analyses from a drum of soil. The origin of the materials is not known. PCBs were not detected, and the sample did not exceed TCLP regulatory criteria. Refer to Appendix O, Section M2 for further information.
- On October 14, 1992, five discrete grab samples were collected for PCB and PID/VOC analyses from 10.6 cy of soil generated during the excavation of the Gate 4 Gas Meter. Gate 4 is located at the west corner of the Merrill Road and Plastics Avenue intersection. PCBs were detected in only one sample at 1.4 ppm, and PID readings were all shown to be zero. Refer to Figure 8-1, location M3, and Appendix O, Section M3 for sampling locations and further information.
- On January 26 and 27, 1993, 14 discrete soil grab samples were collected for PCB (all samples), PID (all samples), and TPH (six samples) analyses from soils removed during the excavation of the Grid O-40 Fuel Tanks. These tanks were located between Merrill Road and Building OP-2. PCBs were not detected in any of these samples,

and PID readings were all shown to be less than 10 PID units. TPHs were detected in only one sample at a concentration of 190 ppm. Refer to Figure 8-1, location M4, and Appendix O, Section M4 for sampling locations and further information.

- On April 6, 1993, two composite soil samples were collected for PCB and VOC analyses from an area north of Building OP-1 and bordering Plastics Avenue, prior to an excavation activity related to telephone service. PCBs were not detected in either of these samples. The only VOC detected above quantitation limits was acetone, detected at a concentration of 0.018 ppm in one of the samples. Refer to Figure 8-1, location M5, and Appendix O, Section M5 for sampling locations and further information.
- Between April 12 and May 18, 1993, 65 samples were collected from 44 borings located along the streamline between Buildings 51 and OP-3. Fifty-seven samples were analyzed for PCBs and eight samples were analyzed for VOCs. PCBs were detected in 14 samples at concentrations ranging from 0.5 to 5.8 ppm. VOCs detected above quantitation limits were: ethylbenzene (0.3 to 27 ppm in four samples); toluene (0.1 to 26 ppm in five samples); 1,2,4-trichlorobenzene (4.1 and 120 ppm in two samples); chlorobenzene (1.7 to 100 ppm in six samples); total xylenes (1.5 to 88 ppm in four samples); and benzene (1.7 to 58 ppm in three samples). Refer to Figure 8-1, location M6 (illustrated as a dashed line), and Appendix O, Section M6 for sampling locations and further information.
- Between August 17 and September 8, 1994, 38 discrete sand/sediment samples were collected for PCB analysis from various locations throughout the site. Due to the large number of these samples, the locations are not shown on Figure 8-1, but these locations are shown

in Appendix O, Section M7, and select PCB data associated with these locations are illustrated on Figures 8-2 through 8-5. PCBs were detected in 10 samples at concentrations ranging from 1.1 to 150 ppm. Refer to Appendix O, Section M7 for sampling locations and further information.

- During October and November 1994, a total of 67 pre-excavation soil samples were collected from various areas along the perimeter of the GE-owned portions of the Unkamet Brook Area/USEPA Area 1 Site. Again, due to the large number of samples, the locations are not shown on Figure 8-1, but are shown in Appendix O, Section M8. Sample locations and PCB concentrations for uppper-increment depth samples are presented on Figure 8-3. These soil samples were collected as part of the construction of a perimeter fenceline, and were collected as discrete grab samples from depths ranging from 0.25 to 5 feet below the ground surface. Each of these samples were screened in the field using a PID and were subsequently submitted for PCB analysis. The locations, details, and results of these sampling and analysis activities are presented in Appendix O, Section M8. In general, the PID readings associated with the overall sample data base ranged from 0 to 150 PID units, and PCB concentrations ranged from less than 1 to 1,100 ppm. Based on the PID readings, seven of the 67 samples were also submitted for analysis of VOCs and 1,2,4-trichlorobenzene. Only xylene (total) was detected in three of the seven samples at 0.007 ppm (two of the three samples) and 0.008 ppm (one of the three samples).

8.15 Overview of Select PCB Data

As mentioned in Section 8.1, Figures 8-2 through 8-5 illustrate PCB data from the upper increment of depth-specific sampling activities related to the miscellaneous soils investigations discussed in Sections 8.2 through 8.14. These figures illustrate PCB data associated only with those investigations conducted outside of building structures, and exclude data associated with the piles of excavated soil that would have been disposed of at a later date.

Figure 8-2, which covers the area near Buildings OP-1 and OP-2, presents PCB data for several locations along Merrill Road at the 0- to 1-foot and 0- to 2-foot depth increments. PCB concentrations of these soils are all shown to be below detection limits. PCBs are also shown to be below detection limits at 0- to 2-feet at one additional location just north of Building OP-1.

Figure 8-3, which covers the northern portion of the GE facility, presents a considerable amount of data for soils from the 0- to 2-foot and 0- to 3-foot depth increments, and to a lesser extent, data from the 0- to 0.5-foot, 0- to 1-foot, and 0- to 4-foot depth increments. Generally, the highest PCB concentrations are in the area of the former Interior Landfill, along the western bank of Unkamet Brook. Other samples were collected at this same depth along the northern and western perimeters of the GE facility in this area. These samples show that PCB concentrations range from below detection limits to 29 ppm along Dalton Avenue, while along Plastics Avenue, the PCB concentrations are mostly below the detection limit. The majority of the 0- to 2-foot depth increment samples collected just south of the decorative pond area and just north of Buildings 125 and 130, show related PCB concentrations to be mostly below detection limits, with three exceptions ranging from 1.5 to 4.8 ppm. Other detected PCB concentrations include: three 0- to 1-foot depth samples collected just west of Buildings 105 and 130, which ranged from 1.5 to 8.3 ppm; two 0- to 3-foot depth samples collected within the parking area north of

Building 121, which exhibited PCB concentrations of 32 and 33 ppm, respectively; and three 0- to 4-foot depth samples collected just south of Building 120X, which ranged from 2.9 to 23 ppm.

Figure 8-4 covers the area associated with Buildings 51, 59, 114, and 119, and generally shows PCB concentrations to be below detection limits at the 0- to 0.5- foot depth, just north of Buildings 109 through 112, and along the railroad tracks southeast of Building 119W. Soils at this same depth are shown to contain PCBs from 2.0 to 5.8 ppm along the western edge of the former waste stabilization basin (PCBs were not detected in two samples in this area), from less than 1 to 8.6 ppm just north of Building 119W, and less than 1 ppm just west of Building 59. Near Building 51, soils are shown to contain PCBs from less than 1 to 2.9 ppm at the 0- to 2-foot depth, and from less than 1 to 22 ppm at the 0- to 5-foot depth. North and south of Building 119, soils are shown to contain PCBs less than 1 ppm at the 0- to 4-foot depth. Near Building 114, soils are shown to contain PCBs less than 1 ppm at the 0- to 2.5-foot depth (west side only) and from 100 to 340 ppm at the 0.5- to 1.5-foot depth (east side only).

Finally, Figure 8-5, which covers the area near Building OP-3, shows soils just west of Building OP-3 to contain PCBs from 2.9 to 4.5 ppm at the 0- to 0.5-foot depth. In addition, sediments within a drainage swale located east of Building OP-3 are shown to contain PCBs at 1 ppm or less at the 0- to 0.5-foot depth.

SECTION 9 - AIR MONITORING

9.1 General

Three separate air monitoring efforts have been completed related to the Unkamet Brook Area/USEPA Area 1 Site. Pre-MCP investigations included a 1983 program to sample the air with PCB analysis in the vicinity of the former Interior Landfill and a 1988 investigation of air in the basement of a commercial building on Merrill Road (with analysis for chlorobenzene and benzene). The results of these monitoring activities are summarized in Section 9.2.

As part of the more recent MCP investigations associated with the GE facility, a year-long facility air monitoring program was conducted to assess ambient outdoor airborne PCB concentrations at the GE facility. These activities are discussed in Section 9.3.

9.2 Pre-MCP Air Monitoring

The ambient air in and around the former Interior Landfill was sampled for the presence of PCBs during the summer of 1983 in response to the 1981 Consent Order between GE, the MDEP, and the USEPA.

The protocol used for the air sampling was derived from previous air sampling work performed by GE in 1981 and upon previous air sampling performed by the USEPA in Pittsfield [Zorex Environmental Engineers Incorporated (Zorex), November 1983]. The sampling protocol anticipated possible interferences by requiring sampling to take place during a period when nearby GE operations were largely shut down for annual maintenance and summer vacations. In addition, the sampling protocol called for the three 8-hour sampling periods to be preceded by at least three days of hot, dry weather. This climatological requirement was implemented to ensure maximum generation of airborne contaminants during the sampling period. The recommendations for

these conditions were made by Dr. Volker A. Mohnen, Director, Atmospheric Sciences Research Center, State of New York. Sampling took place on July 18, and July 19, 1983.

In addition to the former Interior Landfill air sampling, VOC air sampling was conducted in the basement of a commercial building on Merrill Road on August 27, 1988.

The following sections describe the sampling and analysis methodology, and the results of these two sampling activities.

9.2.1 Sampling and Analytical Methodology for Air Sampling in Former Interior Landfill Area

Five locations were required by federal and state regulatory personnel to ensure the characterization of the ambient air in the former Interior Landfill area. Sampling locations were pre-selected, anticipating the tendency of summer winds to blow from the south to the north.

The locations of the air monitoring stations are described below:

- Station I was located on top of a soil embankment on the west side of Unkamet Brook;
- Station II was located in a clearing in a wooded area in the center of the landfill area;
- Station III was located on a grassy clearing at the edge of the landfill area;
- Station IV was located near the east bank of Unkamet Brook, approximately 20 feet from the water's edge; and
- Station V was located in the undisturbed swampy, floodplain area, about 200 feet due north from Station III.

The prevailing winds during the sampling period were expected to be in a northerly direction. Stations I, II, III, and V were located roughly on

a straight line that would catch the ambient air movement across the former Interior Landfill. Stations I, III, and IV were located on the perimeter of the former Interior landfill, while Station II was located in the center of the former Interior Landfill itself.

Each air monitoring station was equipped with a gas meter, an air pump driven by an electric motor, a 6-foot-long sampling hose connected to a glass ball joint, a glass sampling tube which contained two 3.5 gram layers of Florisil adsorbent separated by glass wool, and an inverted glass U-tube, which protected the entrance of the sampling tube from rain. The entrance into the sampling tube was 6 feet above ground level.

In addition, two meteorological stations were also set up to monitor the weather conditions before and during the air sampling period. The first station was located about 100 feet above ground level on the tallest building in the adjacent plant area. The second weather recording station was set up 50 feet north-by-northwest of Station III. The meteorological stations continuously recorded the ambient air temperature, wind velocity and wind direction.

9.2.2 Results of Ambient Air Sampling in Former Interior Landfill Area

A total of 15 ambient samples were collected during three 8-hour monitoring periods. Air sample sizes ranged in volume from 9.112 dry standard cubic meters (dscm) to 17.781 dscm, with an average sampling size being approximately 12 dscm.

Although precautions were taken to prevent interferences by choosing a sampling period when GE manufacturing operations were shut down, a potential interference to the measurement of low-level concentrations of airborne PCBs (i.e., concentrations below 10 ng/dscm) was noted as being the paving of a nearby parking lot (50 meters distant). Paving of the nearby parking lot is believed to be responsible for the presence of high

concentrations of hydrocarbons in the air samples (thousands of nanograms per cubic meter) (Zorex, November 1983). The interferences were visible chromatographically in the form of compounds fluorene and phenanthrene, which were observed at levels 10 to 100 times the concentrations of PCBs. These compounds are listed among several hundred other materials that are present in coal tar products and were reportedly not raw materials or products of any GE-Pittsfield operation.

PCB ambient air concentration ranged from "not detected" to 59.1 ng/dscm. The average concentration of all ambient samples in which PCBs were detected was 23.0 ng/dscm. Assuming that the lowest possible detection limit (4.3 ng/dscm) is applied to the values listed as "not detected", the average of all 15 samples would be 16.3 ng/dscm. The PCBs detected were found to be predominantly Aroclor 1242, accompanied by smaller amounts of Aroclor 1254. No Aroclor 1260 was found in any sample. Table 9-1 describes the individual sampling results, arranged by sampling station.

The above-described ambient air sampling conducted in 1983 did not use the sampling methodology for collection of PCB samples that is currently recommended by USEPA and would not meet current USEPA QA/QC criteria for comparability, representativeness, precision, and accuracy.

The current USEPA-recommended method for ambient air sampling of PCBs employs a high volume sampler to collect a relatively large volume sample (360 m^3) on a polyurethane foam media. The method used in 1983 employed a low volume pump to collect a relatively small sample (~12 m^3) on a florisil adsorbent. The two methods do not produce results that are directly comparable. In addition, the three 8-hour samples collected in 1983 at each station represented a total volume sampled of only 36 m^3 and only one 24-hour period. The concentration of PCBs in ambient air above

the former Interior Landfill cannot be appropriately characterized by such a small sample volume over one 24-hour period.

Other QA/QC controls that allow a determination of precision (repeatability) or accuracy (bias) also were not part of the 1983 sampling program. These include a lack of documentation of the following: co-located sampling locations, travel or trip blanks, analytical method blanks, sampling equipment calibration, and zero checks of sampling equipment.

Due to these problems with the 1983 sampling, there is a need for additional air monitoring that would provide valid and representative data on the current concentrations of PCBs in the ambient air at and near the former Interior Landfill. This has been identified as a data need in Section 14, and a proposal to address this data need is included in the Supplemental Phase II SOW/RFI Proposal.

9.2.3 Air VOC Sampling Results from Basement of Commercial Building

On August 27, 1988, six locations within the basement of a commercial building on Merrill Road (see Figure 1-1) were sampled for the VOC constituents benzene and chlorobenzene. This sampling location is significant because the VOC plume, emanating from the former waste stabilization basin, passes under the building. The results of the sampling are presented in Table 9-2. Benzene and chlorobenzene levels were not detected at any of these samples. (Detection limits were between 0.04 and 0.06 ppm for benzene, and 0.01 and 0.02 ppm for chlorobenzene.) As defined by the Occupational Safety and Health Administration, personal exposure limits for benzene and chlorobenzene are 10 and 75 ppm, respectively.

9.3 MCP Ambient Air Monitoring and Assessment

From August 1991 through August 1992, GE conducted a facility air monitoring program to quantify levels of PCBs in the ambient air at and near its Pittsfield facility. The monitoring program was conducted in accordance with the "Facility Air Monitoring MCP Scope of Work" (Blasland & Bouck, August 1990d). This program included an air monitoring station at Building OP-3 located within the Unkamet Brook Area/USEPA Area 1 Site (Station 005) and an air monitoring station (Station 004) located on Hill 78 to the west of the site.

The year-long program was performed by Zorex Environmental Engineers, Inc. of Pittsfield, Massachusetts, and involved the collection of a 24-hour sample every 12th day from 7 a.m. to 7 a.m. at each of the monitoring stations. The samples were collected according to the USEPA Compendium Method TO-4, Method for the Determination of Organochlorine Pesticides and Polychlorinated Biphenyls in Ambient Air. This method employs a General Metal Works Model PS-1 modified high-volume sampler consisting of a glass fiber filter with a polyurethane foam (PUF) backup absorbent cartridge.

The PCBs in the samples were recovered by Soxhlet extraction with 5% ether in hexane. The extracts were analyzed for individual PCB Aroclors using gas chromatography with electron capture detection (GC-ECD), as described in USEPA Method 608. The PCB detection limit (DL) for the project was approximately 0.0005 $\mu g/m^3$. Measured levels of PCB were successfully confirmed through analysis of selected samples by high resolution gas chromatography.

Meteorological data were collected concurrently with PCB monitoring from an on-site weather station installed in the area known as the East Street Area 2/USEPA Area 4 Site at the GE facility. The weather station monitored wind speed, wind direction, precipitation, temperature, relative humidity, and integrated solar radiation.

The results of this PCB sampling were submitted to the MDEP and USEPA on a quarterly basis and presented in a final report submitted in November 1992 (Zorex, November 1992). In that report, the results are summarized in Table 2, which has been reproduced as Table 9-3 of this report. As shown in Table 9-3, ambient air PCB concentrations during the year-long study averaged less than 0.0005 $\mu g/m^3$ at the Building OP-3 monitoring station and 0.0007 $\mu g/m^3$ at the Hill 78 location.

As noted in Section 9.2.2, additional air monitoring activities are anticipated for the Unkamet Brook Area/USEPA Area 1 Site to quantify the levels of PCBs in ambient air at and in proximity to the former Interior Landfill.

SECTION 10 - BUILDINGS 51/59 OIL PLUME INVESTIGATIONS

10.1 General

The occurrence of free-phase oil in the vicinity of Buildings 51 and 59 was initially investigated in 1986, due to the presence of oil in an excavation completed in conjunction with the renovation of Building 59. Initial investigation activities involved the placement of 13 soil borings and 3 monitoring wells in the area between Buildings 59 and 51, and inside Building 59 (Geraghty & Miller, September 1986). Although free-phase oil accumulated in the three monitoring wells, the source was not identified by this investigation.

In 1987, oil was observed in the discharge from a storm drain that transects the Building 51/59 area, and a second investigation was then implemented. This investigation involved several soil borings, the placement of a series of monitoring wells in the area northeast of Building 51 and the installation of a 4-inch well to recover oil from the subsurface (Geraghty & Miller, July 1987). Between 1988 and 1992, GE has periodically monitored the thickness of oil in 16 monitoring wells and manually bailed those wells with a significant accumulation of oil. In addition to performing the MCP activities described in the SOW for the Building 51/59 plume area, Groundwater Technology, Inc. has performed monthly monitoring of the groundwater elevation and oil thickness in select monitoring wells.

10.2 Pre-MCP Monitoring Program

In 1986, Geraghty & Miller conducted an investigation of groundwater conditions in the vicinity of a renovation site at Building 59. Geraghty & Miller completed 13 soil borings and three monitoring wells in the area between Buildings 51 and 59. Significant amounts of free oil were found in the 3 monitoring wells. The investigation determined that the oil was centered in

coarse gravel, which may be fill for the foundation of Building 59. The source of the oil was not identified by this investigation (Geraghty & Miller, September 1986). Free-phase oil continued to accumulate in the three monitoring wells that were constructed during this investigation (59-7, 59-3, and 59-1). The locations of these wells are shown on Figure 2 of Appendix P.

Between April and June 1987, Geraghty & Miller conducted a hydrogeologic investigation in the area of Buildings 51, 59, and 119 to investigate possible sources of oil that had entered a storm drain that crosses the area. During this investigation Geraghty & Miller installed one 4-inch oil recovery well and 20 soil borings (51-1 through 51-20). Sixteen of the 20 soil borings were completed as 2-inch monitoring wells (51-3, 51-5 through 51-9, and 51-11 through 51-20). The locations of these wells are shown on Figure 2 of Appendix P. A detailed description of this investigation is contained in Geraghty & Miller's report entitled "Evaluation of Groundwater Conditions for the Building 51 Storm Drain Investigation," (Geraghty & Miller, July 1987). In general, the following observations were made based on this investigation:

- A north-south section of the storm drain that runs parallel and adjacent to the eastern edge of Building 51 was above the seasonal high water table in April 1987, with the exception of its juncture with the east-west section of the storm drain.
- The pipe inverts for the east-west section of the storm drain, which extends from Building 51 to the east between Buildings 108 and 53, were below the water table in April 1987. However, as water levels steadily declined from April through June 1987, the water table was at or below portions of the storm drain in June 1987.
- A groundwater mound exists in the vicinity of Building 59. It does not appear that this mound could have affected the water-table elevation along the east-west storm drain examined during this study.

- Free-phase oil was detected in all of the monitoring wells installed as part of this investigation, with the exception of wells 51-11 and 51-12. Free-phase oil was also detected in the three monitoring wells previously installed between Buildings 51 and 59.

The source of the oil detected in the area of Buildings 51/59 may be the result of leakage from underground storage tanks located on the northeast side of Building 51. In August 1987, a loss of 2,200 gallons of No.2 fuel oil from one underground tank in this area was detected (Valentine, August 31, 1987).

An unrelated investigation was completed in the vicinity of Buildings 51 and 59 in 1989, which provided some additional information on the distribution of free-phase oil in the subsurface. Six soil borings were completed to evaluate soils adjacent to Building 51 to allow for construction of an addition adjacent to Plastics Avenue. Evidence of oil was not noted in borings completed for this study, suggesting that, at least in 1989, oil had not migrated toward the east beyond Building 51 (Geraghty & Miller, November 1989).

10.3 MCP Oil Plume Investigation

As part of the MCP Phase II SOW, the following work activities were defined:

- Collection of oil thickness and water table measurements at 16 well locations in the area of observed free-phase oil,
- Monitoring of wells 34B, 35B, 37B, and 38B, for the presence of oil,
- Definition and mapping of the extent of free-phase oil in the subsurface, based on review of available data, and;
- Identification of areas where the extent of the oil plume has not been adequately defined.

The results of the 1991 monitoring efforts are presented in a report titled: "Summary of 1991 Activities - Building 51 and 59 Areas" (Groundwater

Technology, Inc., January 1992). The report is summarized below and is included as Appendix P to this document.

Each monthly monitoring event involved the measurement of groundwater elevation and oil thickness, and the subsequent manual bailing of those wells that contained a significant accumulation of oil. Tables of the monitoring data and potentiometric surface maps were prepared for each round of data collection (Appendix P). Potentiometric surface maps indicate that groundwater flow is generally toward the east, toward Unkamet Brook. However, localized components of flow toward the northeast and south have been noted periodically. Localized variations in groundwater flow appear to be related to the presence of pavement and building that impact the infiltration of precipitation.

A total of 32 gallons of oil were removed in 1991 from the monitoring wells via manual bailing. Measured thicknesses of oil have ranged from a sheen, commonly observed at monitoring well 51-3, to a maximum of 1.77 feet, observed at monitoring well 51-17. The thickness of oil in individual wells has remained relatively constant during 1991, with the exception of an increase in the oil thickness noted at monitoring wells 59-3 and 59-7.

The relatively constant distribution of oil in the subsurface is probably the result of generally low average hydraulic gradients (0.002 in March 1991). Variable content of the fill material that underlies the immediate area may be an additional factor controlling oil movement. A third factor that possibly affects the movement of the oil is the presence of coarse-grained backfill materials in utility trenches, which may provide preferential migration pathways. The possible impact of utility trenches on the movement of oil is discussed below .

The extent of free-phase oil in the ground has been well defined to the northeast and east. The northern, western, and southern boundaries of the oil are defined to a limited extent, as illustrated on Figure 14 of Appendix P which shows the maximum and minimum oil thickness measured at each monitoring well

during 1991. Monitoring wells 34B, 35B, 37B, and 38B, located along Merrill Road, downgradient of the oil plume, showed no evidence of oil during MCP work activities. However, the total depths of these wells range from between 15 and 25 feet, and are screened below the water table. Up to 0.99 feet of oil was measured in monitoring well 59-1 during 1991. This well is located at the southwestern edge of the monitored plume, and therefore, the plume limits are not well defined in this direction. Figure 10-1 illustrates the distribution of free-phase oil in the subsurface on December 20, 1991. The need for additional monitoring wells to allow for complete definition of plume extent is discussed in Section 14.

10.4 Preferential Pathway Analysis of Underground Utilities

An evaluation of the 1991 groundwater contour maps prepared by Groundwater Technology, Inc., and the corresponding oil thickness and location data, indicate that the greatest oil thicknesses have been observed in an elongated area northeast of Building 51 and in the area between Buildings 51 and 59 (Figure 10-1). It is not clear if the two areas of oil accumulation are connected or if they are separate, but perhaps related, occurrences.

An evaluation was performed to examine the subsurface conditions in the area of concern to identify the potential pathways of oil migration. Typically, oil that accumulates on the water-table migrates in the direction of groundwater flow. However, oil migration could be influenced by the presence of coarse-grained backfill materials in utility trenches and/or fill materials in the plume area. A complex network of utility trenches is present in the vicinity of the oil plume and the product storage tanks, as illustrated by an underground utility map, presented in Appendix B. In addition, the boring logs for wells installed in the vicinity of the plume indicate the presence of fill to a depth of up to 12 feet below grade at several locations.

In order for a utility trench or coarse fill material to impact oil migration once the oil has reached the water table, the higher permeable fill material must be within the seasonal range of water level fluctuation. The 1991 measurement data indicate that the depth to oil and/or groundwater ranges between approximately 10 to 13 feet in the plume area. Although construction details of the utility trenches were unavailable, invert elevations for a storm drain and sanitary sewer were noted on the site plans at several locations.

The invert depth of sanitary and storm water drain lines, northeast of Building 51, is approximately 10 feet below grade based on the available site plan (Appendix B). Therefore, in this area, the utility trenches may have allowed for preferential oil migration along the northeast to southwest trending utility lines, in the vicinity of monitoring wells 51-5, 51-17, 51-21, and 51-19. This pathway of oil movement may account for the somewhat elongated configuration of the plume perpendicular to the primary direction of groundwater flow. The invert depths of several utility lines in the area of oil accumulation between Buildings 51 and 59 are approximately 8 to 9 feet below grade (Appendix B). At this depth, the utilities are located above the water table, and therefore, would not influence oil migration. According to GE personnel, the inverts of the remaining utilities related to natural gas, water, and fire protection are located at a depth of less than 6 feet below ground surface. Therefore these utilities are well above the water table elevation, and would not influence oil migration.

The data suggest that oil thickness has remained relatively constant throughout 1991 in the monitored wells. However, when the 1991 data is compared to the measurements made in 1987, it becomes apparent that oil thickness has increased northeast of Building 51, and has remained relatively constant in the area between Buildings 51 and 59.

The need for additional analysis of preferential pathways on a more site-wide basis is discussed in Section 14.

SECTION 11 - MCP FISH INVESTIGATION

11.1 General

Fish were collected from Unkamet Brook in 1991 as part of the MCP Phase II activities. Collection efforts were intended to capture up to four trout or analogous fish species. Sampling activities targeted individuals of sufficient size to permit analysis of skin-on fillets for PCBs and lipids. The rationale for this sampling plan was the reported sighting of edible-size trout in Unkamet Brook by MDEP personnel.

11.2 Description of Investigation

Initial efforts to collect fish from Unkamet Brook occurred on November 1, 1990. The sampling area included the lower stretch of Unkamet Brook from the culvert under the Penn Central Railroad tracks to the confluence with the Housatonic River (see Figure 11-1; Reach A). In the morning, technicians attempted to collect fish using seine nets. This method was unproductive due to physical constraints of the brook, as evidenced by the collection of only a few minnows.

Later the same day, a portable electrofishing unit was used. The same area was sampled and no trout were observed, although a variety of other fish species were observed. These species are listed in Table 11-1. The most common species observed were sunfish, and the largest fish were white suckers, creek chubs, and brown bullhead. Specimens ranged in size from 3 to 14 cm, and were too small to accommodate analysis of skin-on fillets. Since these fish were not of filletable size, no fish were retained for analysis during this sampling event.

A second attempt to collect fish from Unkamet Brook was undertaken on May 6, 1991. Based upon the limited success of the previous sampling efforts,

upstream sections of the brook were targeted for sampling during this effort. These areas included a small stretch of the brook immediately downstream of the railroad storage yard culvert, and all accessible reaches of the brook between the railroad storage culvert and the abandoned railroad spur bridge adjacent to the former waste stabilization area. These areas are represented on Figure 11-1 as Reaches B, C, D, and E, respectively. A portable electrofishing unit was used to collect samples. Edible-size trout were not observed in any of the sampled locations. Two immature brook trout were captured directly below the railroad culvert (Figure 11-1; Reach B). However, these fishes were not retained for analysis of skin-on fillets due to their small size (less than 10 cm).

No edible-size sport fish were collected upstream of Merrill Road (Figure 11-1; Reach E), and the alternate species retained for PCB analysis was one white sucker. From downstream of Merrill Road to the railroad culvert, three edible-size rock bass were collected. Two rock bass (Sample ID Number 29 and 30) were collected from Reach D, and one rock bass (Sample ID Number 31) was collected from Reach C. Field measurements including length, weight, and the presence of any distinguishing features were recorded for each fish (Table 11-2). Specimens were sent to Hazleton Labs, Madison, Wisconsin for PCB and lipid analysis of skin-on fillets.

11.3 Analytical Results

Results of the 1991 Unkamet Brook fish monitoring are presented in Table 11-2. Total PCB concentrations for skin-on fillets were 3.0 ppm for the sucker, and 2.1, 3.8, and 3.3 ppm for the three rock bass. The PCB were reported by the lab to most closely resemble Aroclor 1260.

11.4 Interpretation of Results

Considerable effort has been expended to collect edible-size sport fish from Unkamet Brook. Efforts to collect edible-size trout have targeted the entire stretch of the brook below Merrill Road, and an additional section of the brook north of Merrill Road upstream to the abandoned railroad spur bridge adjacent to the former waste stabilization basin. Observations of fish populations indicate that edible-size trout do not reside in the lower reaches of Unkamet Brook and that the brook does not support large populations of edible-sized sport fish. Additional efforts to collect sport fish in this reach resulted in the collection of one species (rock bass).

The four fish submitted for PCB analysis showed relatively low concentrations of PCBs in skin-on fillets. It is possible that these individuals may have migrated into the brook from the Housatonic River, or alternatively they may have been residents of the sampling area. Although the results of this screening level investigation indicate that PCBs are available to the aquatic biota of Unkamet Brook, potential exposure from consuming Unkamet Brook fish is limited by the small sport fish populations present.

SECTION 12 - FATE AND TRANSPORT CHARACTERISTICS

12.1 General

Various chemical constituents have been detected in the soils, sediments, groundwater, and surface water at the Unkamet Brook Area. The information presented in this section provides a general characterization of the environmental fate and transport properties associated with the constituents observed in one or more of these media. This section discusses only those compounds that were found at levels above the quantitation limit or CLP-required detection limit, and excludes those that were found in associated blank samples (thus indicating laboratory contamination) or were detected in only isolated cases at low concentrations.

The fate and transport of compounds in the environment depend on a variety of chemical, physical, and biological processes. This section provides a brief summary of the potential fate and transport mechanisms associated with the release and dispersion of compounds detected at the Unkamet Brook Area. This summary does not mean that each of the mechanisms discussed is actually occurring in this area. The extent of hazardous materials actually found in this area has been discussed in previous sections, and potential migration pathways are discussed in Section 13.

12.2 Characterization of Detected Hazardous Materials

Due to the number of constituents detected, many of which were at low concentrations, discussions of compound-specific environmental fate and transport properties will address representative groups of chemicals. These groups of chemicals and the constituents within each group exhibit specific properties that determine their behavior in the environment. Constituents that were not detected above the detection limit are not included in this discussion. Discussions

regarding the range of detected concentrations and areas of distribution for compounds detected in groundwater, surface water, sediment, and soils are presented in Sections 4 through 8, respectively.

VOCs detected at the Unkamet Brook Area include ketones, aromatics, halogenated compounds, and carbon disulfide. Semivolatiles detected include polychlorinated benzenes, phenols, polynuclear aromatic hydrocarbons (PAHs), amines, and phthalate esters. In addition, PCBs, polychlorinated dibenzo-p-dioxin/dibenzofuran compounds, pesticides, and metals were detected and are discussed in the following sections.

Table 12-1 presents the water solubility, log octanol/water partitioning coefficient (log K_{ow}), vapor pressure, and Henry's Law Constant for organic compounds detected in the soils, sediment, surface water, and groundwater in the Unkamet Brook Area. These properties provide considerable insight into the fate and transport of a compound in the environment. Depending on their vapor pressure, highly water-soluble chemicals are less likely to volatilize and are generally more likely to biodegrade (Howard, 1989). Water solubility can also affect adsorption and desorption on soils. Compounds which are more soluble are more likely to desorb from soils. Water solubility can also affect possible transformation by hydrolysis, photolysis, oxidation, and reduction (Verschueren, 1983). The log octanol/water partition coefficient correlates well with a compound's tendency to bioconcentrate and adsorb to soil or sediment (Howard, 1989). Generally, the higher the compound's log octanol/water partitioning coefficient, the higher the compound's affinity for adsorption and the lower its mobility in groundwater. Henry's Law Constant provides an indication of the tendency of a compound to volatilize, and thus provides a means for ranking the relative volatilities of chemicals (Verschueren, 1983). Henry's Law Constants can be obtained from the literature or can be calculated by dividing a compound's vapor pressure by its water solubility. The Henry's Law Constant can be used

to calculate the rate of evaporation from water. The information presented in Table 12-1 will be referenced as appropriate during discussion of the various groups of compounds.

12.2.1 Volatiles

VOCs detected in the media at the Unkamet Brook Area include ketones, aromatics, halogenated compounds, and carbon disulfide. As indicated in Table 12-1, the water solubilities and vapor pressures of these compounds range from moderate to high and their log K_{ow} values are relatively low.

12.2.1.1 Ketones

Ketones are one class of volatile organics present at the Unkamet Brook Area. Investigations have detected low concentrations of acetone and 2-butanone in site soils, surface water, and groundwater. As a chemical class, ketones are characterized by moderate water solubility and high volatility.

In surface soils, ketones are subject to competing processes of dissolution and volatilization. As such, these substances are prone to dissolve into infiltrating precipitation and move into underlying soils or volatilize to the atmosphere. Transport in the soil-gas phase from deeper soils will be substantially limited, however, by partitioning of the gas phase into the soil water, biodegradation, and the general heterogeneous nature of soils (USEPA, 1989).

In subsurface environments, acetone and 2-butanone tend to be highly mobile. In moist environments or during heavy precipitation events, these compounds are prone to leaching mechanisms. Downward migration may occur as these substances dissolve into the soil water which is transported through the soil column. Biodegradation of acetone and 2-butanone can limit transport within

and to groundwater since these compounds biodegrade under both aerobic and anaerobic conditions (Howard, 1989).

In surface water, volatilization and biodegradation are important removal processes of acetone and 2-butanone. Bioconcentration in aquatic organisms and adsorption to sediments should not be significant (Howard, 1989).

12.2.1.2 Aromatics

Aromatic compounds detected at the Unkamet Brook Area include benzene, ethylbenzene, toluene, and xylenes. In the upper soil, the competing processes of volatilization to the atmosphere and downward migration with infiltrating precipitation are the dominant fate processes. Generally, aromatics are highly mobile (as liquid or gas) in soil (ATSDR, 1989a; 1989b; 1990; Swann et al., 1983). However, upward migration from subsurface soils in the soil-gas phase and subsequent volatilization to the atmosphere will be substantially limited by partitioning of the gas phase into the soil water, adsorption (to a small extent), biodegradation, and the general heterogeneous nature of soils (USEPA, 1989).

In deeper soil, the most likely transport mechanism is dissolution into soil water and downward migration through the soil. Competing processes of biodegradation and limited adsorption to soil organic matter may decrease the quantities of the chemicals released to groundwater. Aromatics are generally capable of biodegrading under both aerobic and anaerobic conditions. Ethylbenzene, however, has been found to be resistant to biodegradation under anaerobic conditions (Howard, 1989). Soil adsorption is expected to be moderate for ethylbenzene and xylenes, and low for benzene and toluene (Howard, 1989; 1990).

In surface waters, volatilization and biodegradation are generally expected to be the dominant removal mechanisms. Volatilization rates vary depending upon a number of environmental factors including temperature, water movement and depth, and wind speed (Howard, 1989). Aromatics do not have a high affinity for organic matter, and sediment concentrations would be expectedly low. Bioconcentration in aquatic organisms is generally not a significant fate process.

12.2.1.3 Halogenated Compounds

Halogenated VOCs detected at low concentrations at the Unkamet Brook Area include chlorobenzene, chloroform, 1,1-dichloroethane, 1,2-dichloroethene, 1,1,1-trichloroethane, trichloroethene, and vinyl chloride. Halogenated VOCs are characterized by their volatility and relatively high water solubility. In the surficial soil, volatilization into the atmosphere may be a significant transport mechanism. Halogenated VOCs are mobile in soil. Due to their high solubility in water, these compounds may leach downward through the soil column with percolating soil water. Biodegradation of the halogenated VOCs under aerobic conditions is generally regarded as being very slow to nonexistent. Biotransformation of halogenated organic compounds via reductive dehalogenation has been demonstrated under anaerobic conditions (Wilson et al., 1986). Slow biodegradation may occur under anaerobic conditions where acclimated microorganisms exist (Howard, 1990).

The transport of halogenated compounds in the aquatic environment is generally dominated by volatilization, and their ultimate fate typically involves atmospheric processes (USEPA, 1979a). Losses via biodegradation, chemical degradation, adsorption to sediments, and bioconcentration in aquatic organisms are expected to be minor.

12.2.1.4 Carbon Disulfide

Carbon disulfide was detected at low concentrations in the groundwater at the Unkamet Brook Area. Carbon disulfide has a moderately high water solubility and is highly volatile. In soil surface layers, the primary loss mechanism is volatilization to the atmosphere. Carbon disulfide will dissolve readily in soil water, and as a result is highly mobile in deeper soil layers. The chemical may percolate downward with soil water and be released to groundwater (HSDB, 1990a). Information on the persistence of carbon disulfides in soil/groundwater systems is not available.

In surface water, the primary fate process is generally volatilization. Actual volatilization rates vary depending on environmental factors such as temperature, water movement and depth, and wind speed. Adsorption to sediments and bioconcentration of carbon disulfide should not be significant (Howard, 1990).

12.2.2 Semivolatiles

Semivolatiles detected at the Unkamet Brook Area include polychlorinated benzenes, phenols, PAHs, amines, and phthalate esters.

12.2.2.1 Polychlorinated Benzenes

The polychlorinated benzenes detected at the Unkamet Brook Site include pentachlorobenzene; 1,2,3,4-, 1,2,3,5-, and 1,2,4,5-tetrachlorobenzene; 1,2,3-, and 1,2,4-trichlorobenzene; and 1,2-, 1,3-, and 1,4-dichlorobenzene.

Polychlorinated benzenes exhibit moderate volatility. In surface soils volatilization into the atmosphere is expected to occur. Adsorption to soil particles and residence within the soil matrix is also a dominant fate of polychlorinated benzenes. The potential for dissolution of these compounds into soil water and possible transport

to underlying soils or groundwater may occur under certain circumstances (CHEMFATE, 1989). In sandy or mineral soils with low organic content, polychlorinated benzenes are more likely to leach through the soil, whereas in organic soils mobility should be greatly reduced. Biodegradation in soil and water is generally expected to be quite slow, but loss via this route may be significant in situations where acclimation of the microbial population has taken place (HSDB, 1990b).

In surface waters, the loss mechanisms for the polychlorinated benzenes include volatilization, adsorption to suspended solids and sediments, and, to a limited extent, bioaccumulation in aquatic organisms. Volatilization is likely to be of greater importance for the lower molecular weight compounds. Polychlorinated benzenes found in the sediments may be subject to slow biodegradation (Howard, 1989).

12.2.2.2 Phenols

Phenols detected at low concentrations at the Unkamet Brook Area are 2-chlorophenol, 4,6-dinitro-2-methylphenol, 2-, 3-, and 4-methylphenol, and phenol. In the terrestrial environment, phenols exhibit low to moderate adsorption to soils and most biodegrade rapidly. Exceptions include those situations where the concentration of phenols is sufficient to inhibit or reduce microbial growth (Howard, 1989). Phenols are not expected to significantly hydrolyze under natural environmental conditions (Howard, 1989).

In the aquatic environment, photo-oxidation, metal-catalyzed oxidation, and biodegradation all contribute to the aquatic degradation of phenol (USEPA, 1979b). Volatilization may occur, and any phenols that pass into the atmosphere would be rapidly destroyed by oxidation.

Neither adsorption to sediments nor bioaccumulation appear to be significant processes in the fate of phenols (USEPA, 1979b).

12.2.2.3 PAHs

At the Unkamet Brook Area, a variety of PAHs were detected at low concentrations in soils and sediments. PAHs are semi-volatile compounds that have low water solubilities (Table 12-1), and have a strong tendency to adsorb to soil particles and organic matter. The PAHs with higher molecular weights tend to be less water soluble and have higher octanol/water partitioning coefficients, and thus have a higher affinity for adsorption to soil. Within the soil environment, biodegradation of PAHs is also related to molecular weight. PAHs with lower molecular weights tend to undergo microbial degradation more rapidly than the PAHs with higher molecular weights. The lower molecular weight PAHs may also be subject to volatilization, but to a much lesser extent than VOCs.

In surface water, adsorption onto particulate matter and volatilization are competitive processes for the lower molecular weight PAHs, with the dominant fate process dictated by environmental conditions. For example, high winds would enhance losses through volatilization, while turbid waters with high organic content would promote adsorption, sedimentation, and biodegradation. Adsorption onto particulate matter with ultimate deposition in sediment is the dominant fate process for the higher molecular weight PAHs. Bioaccumulation in aquatic organisms is generally not considered to be an important fate process for PAHs. Despite their lipophilic nature, the metabolism of PAHs is typically rapid and extensive, especially in vertebrates (e.g., fish). Rapid elimination from aquatic organisms has

also been observed in organisms placed in "clean" water (Howard, 1989; USEPA, 1979a).

12.2.2.4 Amines

Semi-volatile aromatic amines detected at low concentrations at the Unkamet Brook Area include aniline in the soil and sediments, and diphenylamine and n-nitrosodiphenylamine in soils. In soil, loss of amines occurs through a combination of aerobic biodegradation, oxidation, and chemical binding with soil components. Amines are readily biodegraded, and substantial loss can be expected by this means (Howard, 1989; 1990).

In the terrestrial environment, amines exhibit low to moderate sorption to soils, especially at lower pH, and undergo slow oxidation. This is a significant fate process in soils with high organic content. The amount of amines entering groundwater by desorption from soils is limited by biodegradation in the soil column. Once in groundwater, amines are fairly mobile and degrade slowly (HSDB, 1989). Releases to the atmosphere via volatilization from soil are expected to be minimal (HSDB, 1989).

In surface waters, amines are subject to biodegradation and photodegradation, and to some extent, adsorption to sediments and suspended solids in the water column (especially under acidic conditions). Photodegradation occurs only at the water surface where light can penetrate. Amines do not bioconcentrate significantly in fish (Howard, 1989).

12.2.2.5 Phthalate Esters

Phthalate esters detected at low concentrations at the Unkamet Brook Area include bis(2-ethylhexyl)phthalate in soils and sediments, and di-n-butylphthalate in soils. The relatively low solubility and low

volatility of bis(2-ethylhexyl)phthalate and di-n-butylphthalate should limit their mobility in soils, with the lower molecular weight phthalate being somewhat more mobile. Adsorption onto organic soil constituents is reported to be especially strong for bis(2-ethylhexyl)phthalate. Biodegradation screening studies indicate that bis(2-ethylhexyl)phthalate and di-n-butylphthalate readily biodegrade in soil under aerobic conditions. However, under anaerobic conditions bis(2-ethylhexyl)phthalate is reportedly non-biodegradable, whereas di-n-butylphthalate may biodegrade (Howard, 1989).

Bioaccumulation, biotransformation, and biodegradation are probably the most significant processes in determining the aquatic fate of phthalate esters (USEPA, 1979a). A variety of organisms have demonstrated the ability to accumulate phthalate esters, probably due to the esters' lipophilic nature (USEPA, 1979a). The susceptibility of phthalate esters to enzymatic degradation significantly reduces the potential to biomagnify in the food chain (ATSDR, 1989c; Autian, 1973). In the water column, phthalate esters are readily adsorbed onto suspended particulates and under certain circumstances are likely to form a water-soluble complex with humic substances (USEPA, 1979a).

12.2.3 PCBs

PCBs have been detected at varying concentrations in the groundwater, surface water, sediments, and soils at the Unkamet Brook Area. Low concentrations of Aroclors 1242 and 1260 have been detected in the low- and high-flow surface water samples. The highest PCB concentrations in sediments is between Dalton Avenue and the entrance to the culvert under Merrill Road. At most sediment sampling locations, PCB concentrations detected in the 0- to 6-inch sample were higher than those detected in the

6- to 12-inch increment. PCB concentrations in sediment were identified as predominantly consisting of Aroclor 1260, although Aroclors 1242 and 1254 were also identified. Aroclors 1242 and 1254 were generally detected in the 0- to 6-inch samples.

The fate and transport of PCBs in the environment are greatly influenced by their low water solubility and high affinity for soil organic matter. This generally limits aqueous-phase concentrations to low parts-per-billion levels unless significant amounts of solvents, oils, or colloids are present (Baker et al., 1986; Dragun, 1989). In general, the adsorption of PCBs to soils and sediments increases with increasing soil organic content, decreasing soil particle size, and increasing congener chlorination (Lyman et al., 1982; Pignatello, 1989). PCBs could potentially volatilize from soil, but strong adsorption to soils tends to limit the extent of volatilization (ATSDR, 1989d).

PCBs are fairly persistent in the environment, and degradation via chemical oxidation, hydrolysis, and photolysis in soil or aquatic systems is generally insignificant. PCBs may, however, be subject to loss via biotransformation and biodegradation. Experimental evidence indicates that PCBs are susceptible to biodegradation under both aerobic and anaerobic conditions. In general, the degradability of PCB congeners under aerobic conditions increases as the degree of chlorination decreases. Variations in this trend exist and are attributed to preferential degradation of meta- and para-substituted PCBs.

Laboratory research has shown that the lesser chlorinated PCB congeners are subject to aerobic biodegradation by microorganisms indigenous to soils and sediments. Aerobic biodegradation results in a complete breakdown of PCBs, causing a net decrease in total PCB concentration. Various breakdown products have been identified, and

include chlorinated catechol, chlorobenzoic acid, and carbon dioxide (Bedard et al., 1987a; 1987b; Hankin and Sawhney, 1984; Fries and Marrow, 1984).

As with aerobic biodegradation, preferential degradation of meta- and para-substituted congeners has been observed under anaerobic conditions (Quensen et al., 1988). Laboratory research has shown that PCBs undergo reductive dechlorination under anaerobic conditions by indigenous microorganisms. Study results indicate that the more highly chlorinated PCBs are transformed to less chlorinated congeners by anaerobes (Quensen et al., 1988) and that the lower chlorinated PCBs may be further degraded to carbon dioxide, water, and chloride by aerobes (Chen et al., 1988).

Plant uptake and translocation of PCBs by crops is generally not significant (Bacci and Gaggi, 1985; O'Connor et al., 1991; Fries and Marrow, 1981; Iwata and Gunther, 1976; Weber and Mrozek, 1979; Webber et al., 1983).

PCBs in aquatic systems tend to concentrate in the sediments. The affinity of PCBs for sediments is a function of chemical-specific factors (e.g., degree of chlorination) and site-specific factors (e.g., sediment grain size, organic content). PCBs generally adsorb more strongly to fine grain, highly organic sediment than to coarse, low organic sediments (Lyman et al., 1982; Pignatello, 1989).

PCBs in aquatic environments have been shown to bioaccumulate in some aquatic organisms. Due to the lipophilic nature of PCBs, those which accumulate in aquatic organisms are likely to biomagnify within the food chain. Notable factors influencing the extent of bioaccumulation and biomagnification include the degree of chlorination, biotic community structure, and water temperature.

PCBs may also be removed from the water column via volatilization to the atmosphere. However, their volatilization rates are generally limited by

their low solubility and tendency to remain adsorbed to sediments and suspended solids. The lesser chlorinated congeners (tetrachlorobiphenyl and lower) have greater potential to volatilize than the highly chlorinated congeners (ATSDR, 1989d).

12.2.4 Polychlorinated Dibenzo-p-dioxin/Dibenzofuran Compounds (PCDD/PCDF)

At the Unkamet Brook Area, a number of low-level and PCDD and PCDF congeners were detected in sediments.

The majority of information available on the environmental fate and transport of PCDDs and PCDFs is specific to 2,3,7,8-TCDD, while some information is also available for 2,3,7,8-TCDF. Although there are significant differences in toxicity between these congeners and other PCDD/PCDF congeners, the environmental fate and transport data on 2,3,7,8-TCDD and 2,3,7,8-TCDF may be regarded as generally representative of the entire class of PCDDs and PCDFs due to similarities in physical/chemical properties. (It should be noted that neither 2,3,7,8-TCDD or 2,3,7,8-TCDF were detected at this site.)

Based on their very low water solubilities and consequently high organic carbon adsorption coefficients (K_{oc} values), PCDDs and PCDFs are expected to strongly adsorb to most soils, thereby limiting migration of the compounds (HSDB, 1990c).

PCDDs and PCDFs in aquatic systems are likely to be found in association with sediments or suspended particulates. In the near-surface water column, dissolved-phase PCDDs may undergo photolysis and low-level volatilization. PCDDs and PCDFs in bottom sediments may be transported through sediment resuspension. Partitioning to the water column is generally not a significant fate process (ATSDR, 1989e).

12.2.5 Pesticides

Pesticides detected at the Unkamet Brook Area at low concentrations include 4,4'-DDE and 4,4'-DDT in soils, and sulfotepp and 2,4,5-T in sediments. The fate and transport properties of these compounds are likely to vary due to differences in their chemical and physical properties. 4,4'-DDT is an organochlorine insecticide, 4,4'-DDE is a chlorinated degradation product of 4,4'-DDT, 2,4,5-T is an aryloxyalkanoic acid herbicide, and sulfotepp is an organophosphorus insecticide.

In soil, 4,4'-DDE and 4,4'-DDT are expected to be essentially immobile; whereas, sulfotepp and 2,4,5-T are somewhat mobile and may enter groundwater under certain conditions. Migration of sulfotepp and 2,4,5-T may be limited, however, by biotransformation and biodegradation, depending on whether a suitable microbial population is present. Volatilization from soils is not expected to be significant for any of these pesticides (Hartley and Kidd, 1987; Howard, 1991).

In the aquatic environment, the fate of these pesticides may be determined by adsorption, bioaccumulation, photodegradation, chemical hydrolysis, or biotransformation/biodegradation (Hartley and Kidd, 1987; USEPA, 1979b). The dominant fate processes would depend upon the chemical and environmental conditions. None of these compounds are likely to volatilize significantly from water to air.

12.2.6 Metals

A number of naturally occurring metals were detected in the soils, sediments, groundwater, and surface water at the Unkamet Brook Area. Metals are cycled within the environment, forming various species with different physical and chemical properties. Metal species may be transformed from one inorganic or organometallic species to another, but the inorganic element itself does not degrade.

Certain organic species are highly water soluble, while others are extremely insoluble. The movement of a particular metal into and within groundwater is determined by the amount and form of the metal, the groundwater's chemical and physical properties, and the composition of the soil or waste solution with which the metal is associated (USEPA, 1988). The soil properties affecting metal retention/release and transport include bulk density, surface area, particle-size distribution, pH, redox conditions, ion exchange capacity, amount of organic matter, type and amount of metal oxides, and type and amount of clay minerals (USEPA, 1988). Adsorption to soil organic matter, at levels commonly found in surface soils and sediments, is one of the primary immobilizing processes for metals (USEPA, 1988). The form in which an inorganic element exists is highly dependent upon the chemical characteristics of the site such as pH, oxygen level, and ionic characteristics.

In the aquatic environment, the fate and transport of metals are, in general, controlled by sorption processes in the sediments. The metal-organic relationships in sediments and the water column strongly affect metal transport. Volatilization of most metals is not significant, and some metals may bioconcentrate.

SECTION 13 - POTENTIAL MIGRATION PATHWAYS AND EXPOSURE POTENTIAL INFORMATION

13.1 General

This section discusses potential migration pathways associated with the chemical constituents observed at the Unkamet Brook Area/USEPA Area 1 Site based on the investigations described in Sections 4 through 11. In addition, information is presented on the potential for exposure of human and environmental receptors to hazardous constituents at the site.

13.2 Potential Migration Pathways

This section focuses on the principal groups of chemicals found at the site above the detection/quantitation limit. To determine the potential migration pathways for these chemicals, this section takes into account the physical characteristics and environmental setting of the site (presented in Section 2), the results of current and past investigations (presented in Sections 4 through 11), and the fate and transport characteristics of the chemicals observed (presented in Section 12).

For a human or environmental receptor to be exposed to a given chemical, a transport pathway by which the chemical migrates from its source to a point of potential exposure must exist. A migration pathway includes the following three components: 1) a source of a chemical; 2) potential mechanisms of release from the source; and 3) a transport medium by which the chemical may potentially travel from the source to a potential receptor. Identification of potential migration pathways allows for an overall understanding of exposure potential and serves to direct the scope of subsequent exposure evaluations.

The following subsections present information describing potential migration pathways specific to four areas within the Unkamet Brook Area/USEPA Area 1

Site: 1) within the GE facility (including both the industrial facility west of the brook and the marshy, undeveloped area east of the brook); 2) the commercial area; 3) the area surrounding Building OP-3; and 4) the lowland area. These areas are described in more detail in Section 1.2.

13.2.1 Within the GE Facility

Based upon the available information, the following potential migration pathways have been identified for chemicals detected in media at the GE facility area:

- Subsurface soils: leaching to groundwater or surface water, direct releases to ground water, and to surface water (former Interior Landfill only), and volatilization;
- Groundwater: subsurface transport via groundwater flow, and volatilization.
- Surficial soils: volatilization, dust migration, surface runoff, and surface water transport (i.e., flooding events).
- Sediments: dissolution into, and suspension by surface water.
- Surface water: transport of dissolved and suspended phase constituents with brook flow.

These potential migration pathways are discussed in the following subsections.

13.2.1.1 Migration from Subsurface Soils

Potential subsurface sources at the GE facility include site soils and a number of former or existing subsurface SWMUs. A discussion and characterization of the SWMUs identified in the GE facility is presented in Section 3. Historical investigations have identified the former Interior Landfill and the former waste stabilization basin as the most significant subsurface source areas at the site. The waste

stabilization basin underwent extensive remediation in 1981, and has been removed from the site (O'Brien & Gere, August 1981).

Soil borings were installed to characterize subsurface soils at the GE facility. Results of these Phase II subsurface investigations identified the presence of primarily PCBs, VOCs, and SVOCs in site soils.

Site characteristics that currently influence the potential migration pathways for chemical hazardous constituents identified in subsurface soils include the following: 1) the type and concentration of the hazardous constituents present; 2) vertical distribution of hazardous constituents; and 3) site activities.

The migration of hazardous constituents from subsurface soils in the GE facility area is primarily the result of direct contact with, and dissolution of hazardous constituents into, groundwater. Although some leaching of VOCs may occur at the site, characterizations of groundwater hydrology (Section 4) and water table elevations (Table 4-7) indicate that a variable water table occasionally in contact with chemicals present in subsurface soils exerts the greatest influence upon the movement of chemicals into groundwater. Additionally, the hydrophobic nature of PCBs and SVOCs also decrease the potential that leaching will release significant quantities of these chemicals from subsurface soils.

Within the GE facility, the direct contribution of chemical constituents (in both the suspended and dissolved phases) from subsurface soils to surface waters describes a potential migration pathway where the former Interior Landfill "straddles" Unkamet Brook. This potential migration pathway was addressed directly in the surface water and sediment investigations that have been conducted in

Unkamet Brook. The sediment investigations indicated the presence of PCBs and concentrations of a limited number of VOCs and SVOCs at sampling stations corresponding to the former fill area. Analysis of surface water, however, did not indicate associated increases in water column concentrations of these constituents directly downstream of the former landfill. Evidence indicates that in the absence of stream bed disturbances, it is unlikely that the former Interior Landfill will contribute significant quantities of VOCs, SVOCs, or PCBs to the water column of Unkamet Brook.

If soils were disturbed during excavation activities, the potential for transport via volatilization or dusting would be greater. However, excavation activities are of limited frequency and duration, and are unlikely to contribute significantly to the migration of chemical compounds within or from the site. In addition, GE's excavation protocols address releases of vapors and dusts from on-site excavations. These protocols define appropriate measures to mitigate potential chemical migration associated with on-site excavations.

13.2.1.2 Migration via Groundwater

The results of the numerous groundwater investigations at the GE facility have confirmed the presence of elevated concentrations of VOCs primarily emanating from the former waste stabilization basin. Additional constituents in groundwater include low concentrations of PCBs and SVOCs and the presence of a localized oil plume in the vicinity of Buildings 51, 59, and 119.

Hydrogeological studies indicate that the GE facility is situated in a recharge zone. Groundwater flow patterns at the site tend to dip downward from the GE portion to a depth of approximately 150 feet below the surface before rising again and discharging to the

Housatonic River and the lower reach of Unkamet Brook. However, to verify these preliminary findings, an additional study was undertaken to further the understanding of the groundwater migration pathways at the site (refer to Section 4.5.5). In addition, a Preferential Pathway Analysis was conducted to evaluate the potential influence of select buried utilities upon groundwater flow and migration within the GE facility. The Preferential Pathway Analysis concluded that contaminant migration associated with the select utilities is not influenced (i.e. facilitated) to a significant extent by the site utilities.

An additional migration pathway for those chemicals present in site groundwater includes the volatilization of VOCs. In an undisturbed state, volatilization from groundwater may occur at the saturated/unsaturated interface where VOCs may migrate upward into interstitial soil gas. Subsequent migration of VOCs in soil gas may be limited, however, by the partitioning of the gas-phase into interstitial soil water, adsorption processes, and biodegradation (USEPA, 1989). An additional volatilization pathway is available during excavations which extend to, or below, the water table. Although extended excavation events may facilitate the release of VOCs from groundwater, it is not likely to be a significant migration pathway at this site due to the relatively infrequent occurrences of this activity at the GE facility. The site-wide excavation protocols also address releases of vapors and dusts from on-site excavations.

13.2.1.3 Migration from Surficial Soils

Historical investigations of surficial soils in the GE facility are limited to various miscellaneous investigations described in Section 8. A Phase II investigation was undertaken to generate additional information regarding the distribution of PCBs and select Appendix

IX+3 constituents in surficial soils of the Unkamet Brook floodplain. Surficial soil samples were collected from the northern part of the Unkamet Brook floodplain within the GE facility near the former Interior Landfill. Results of these investigations indicate the presence of low concentrations of VOCs and SVOCs and the presence of PCBs in surficial soils adjacent to Unkamet Brook.

The topography of this portion of the GE facility is characterized as densely vegetated wetland areas having little or no slope, except along the brook itself. The well vegetated state of these soils will minimize the potential for transport of soil constituents with any floodwaters. In addition, because of the saturated condition and the high organic content of these soils, it is also unlikely that migration via volatilization or dusting mechanisms would occur to any significant extent. As such, migration of surface soil constituents via volatilization, dusting, or with surface water runoff is unlikely to occur in the floodplain adjacent to Unkamet Brook in this area of the site, with the possible exception of the floodplain soils that form the banks of Unkamet Brook itself.

The chemical content of surficial soils has not to date been characterized for the ROGEF at the Unkamet Brook Area. However, several factors contribute to the probable elimination of soil-based migration pathways within this area. The existence of many buildings and large expanses of paved areas significantly reduces the potential for volatilization and dusting. In addition, on-site control of surface drainage eliminates the translocation of surface soils to adjacent areas.

To evaluate the effectiveness of the above controls upon the potential release of PCBs through volatilization, an air monitoring program was conducted during the summer of 1983. This program is

described in detail in Section 9. In 1991 and 1992, additional air monitoring activities associated with the site were conducted as part of the MCP Phase II investigations. These activities, also described in Section 9, show ambient air PCB concentrations at the site are less, on average, than 0.0005 ug/m^3. Additional air monitoring activities associated with the site are being proposed as part of Supplemental Phase II/RFI activities as described in Section 14.

13.2.1.4 Migration from Sediments

Historical investigations were conducted to determine the extent of PCBs and chlorobenzene in Unkamet Brook sediments, and former brook sediments now located in the bog area to the east of the former waste stabilization basin and adjacent to Unkamet Brook. These two constituents were selected due to their significance with respect to remediation of the waste stabilization basin as discussed in Section 3. Additional Phase II investigations were conducted to characterize the chemical content of Unkamet Brook sediments and to evaluate the potential for sediment migration with brook flow.

Results of the Phase II investigation indicated the presence of metals and low concentrations of SVOCs in addition to PCBs and chlorobenzene detected in earlier sediment investigations. As noted in prior sections of this report, evaluations of Unkamet Brook sediment data indicate that significant transport of suspended-phase sediments with brook flow has not occurred in the past and does not appear to be occurring at the present time. Dissolution of these constituents into overlying brook waters may be occurring to some extent, however. Section 13.2.1.5 discusses this pathway in more detail.

13.2.1.5 Migration via Surface Water

Phase II investigations have determined that groundwater flow in the vicinity of the GE facility has predominantly vertical components. Furthermore, results of Phase II investigations of the chemical content of Unkamet Brook water show low VOC concentrations indicating that groundwater contributions to the brook in this area are not significant. Surface water investigations immediately downstream of the former Interior Landfill have detected low concentrations of VOCs and PCBs in Unkamet Brook surface water. The source of these constituents is uncertain at present, and may be due to direct dissolution from stream-bank soils or underlying sediments. Phase II investigations have also detected the presence of Appendix IX constituents in surficial soils and sediments adjacent to Unkamet Brook.

Although the data do not indicate significant contributions of PCBs and Appendix IX+3 constituents from the GE area to Unkamet Brook surface waters, the concentrations of these substances observed does indicate limited potential for transport of these substances with Unkamet Brook flow.

13.2.2 Commercial Area

At the present time, no specific source areas have been identified within the commercial area of the site. However, this area of the site is influenced by chemical migration from sources within the GE facility. These include the transport of select VOCs and SVOCs with groundwater, or select Appendix IX+3 constituents with Unkamet Brook surface water. These pathways continue to influence contaminant migration within the commercial area. Two additional potential migration pathways within the commercial area include the potential volatilization of VOCs from groundwater and the possible transport of PCBs into the area via volatilization/dusting

mechanisms affecting off-site soils. These four migration pathways are discussed below.

Migration pathways associated with groundwater include continued transport of the VOC plume to downgradient areas (Unkamet Brook lowlands area) and the possible volatilization during instances of groundwater exposure to the atmosphere, such as seepage of groundwater into building foundations or the excavation of soils to depths below the water table. Phase II investigations have confirmed the presence of VOCs and SVOCs in groundwater in this area. A discussion of the vertical and horizontal extent of the underlying VOC plume is presented in Section 4.7.2.

Because a variety of buildings are situated directly over the VOC plume, the potential for groundwater infiltration or chemical volatilization into the commercial area building basements was investigated in 1988. During this study, air samples were collected from the basement of a commercial building in this area and analyzed for select VOCs. The results of this investigation are presented in Table 9.2. They indicated no detectable VOCs in the basement tested.

Additionally, the potential for VOC volatilization from exposed groundwater remains a potential migration pathway should excavations be advanced to depths below the water table. This migration pathway is mitigated by the limited horizontal extent of the groundwater plume and the depth to groundwater (6 to 8.5 feet) in the commercial area.

Results of historical and MCP Phase II investigations to determine the chemical content of Unkamet Brook sediments indicate elevated PCB concentrations in sediment samples taken from the brook immediately upstream and downstream of the commercial area culvert. Corresponding increases in surface water PCB concentrations were also observed immediately downstream of the commercial area indicating that sediment in

this area may be contributing PCBs to the water column. Concentrations of select VOCs, SVOCs, and Appendix IX+3 metals in Unkamet Brook surface water did not increase immediately below the commercial area, thus indicating that groundwater discharge to the brook is not significant in this area of the site and that no additional sources of these chemicals exist within the commercial area. It appears that commercial area contributions to chemical migration with Unkamet Brook waters will be limited to contributions of dissolved/suspended phase PCBs from brook sediments.

To evaluate the potential for release of PCBs to the ambient air, air monitoring activities have been conducted. As shown in Section 9, the results of the recent PCB air monitoring indicate relatively low-level concentrations of PCBs in the ambient air.

13.2.3 Area Surrounding Building OP-3

Based upon the information available for this area, two potential migration pathways have been identified. These pathways include migration from subsurface soils associated with former USTs OP3-01 and OP3-02, which were removed in July and August 1992, and UST OP3-03 removed in December 1992, and migration from surficial soils.

Subsurface soils samples collected and analyzed from the excavation walls associated with the removal of USTs OP3-01 and OP3-02 exhibited relatively high TPH concentrations and indicated the presence of several VOCs (toluene, ethylbenzene, xylene, and dichlorobenzene). PCBs were not detected. The potential for migration of these materials from subsurface soils in this area is primarily the result of direct contact with, and dissolution of materials into, groundwater. Although free-product was visible within the excavation pits associated with these USTs, all practical means were used at the time of tank removal to recover this material (O'Brien & Gere, March 1993). Further, three groundwater monitoring wells were

installed and sampled to assess impacts (if any) to surrounding groundwater. The results of these analyses showed only limited impact (see Section 4.2.3) to area groundwater. Since the depth to groundwater in this area is approximately 6 feet, it is unlikely that this exposure pathway is significant.

As for surficial soils related to the areas surrounding Building OP-3, the present MCP Phase II data base shows the presence of relatively low concentrations of PCBs and other select Appendix IX+3 constituents near Building OP-3. The potential for migration of these materials from surficial soils in this area is primarily the result of volatization and dusting; however, these mechanisms are directly related to soil disturbances at the site (e.g., excavations of the surface soil matrix). These instances are related to construction or repair activities (e.g., utilities), and as such, will be limited in frequency and duration, and are unlikely to contribute significantly to the migration of chemical constituents.

13.2.4 Unkamet Brook Lowlands

Historical and MCP Phase II investigations of environmental media (groundwater, surface water, sediment, and surficial soils) of this area were conducted to evaluate the impacts on this lowlands area from the migration pathways identified in the GE facility portion of the site. A concurrent objective of these studies was to confirm the existence or absence of any source areas in this portion of the site.

These studies have verified that no source areas are located in the lowlands area. As such, this section will not discuss potential migration pathways in terms of release from an established source area, but rather, will discuss those migration pathways established for the entire Unkamet Brook Area. The following potential source areas and potential migration

pathways have been investigated or characterized in the lowlands area of the site:

- Groundwater: subsurface transport via groundwater flow, and volatilization;
- Surface Water: transport of dissolved and suspended phase constituents with brook flow;
- Sediments: transport of suspended sediments with surface water flow; and
- Floodplain Soils: surface runoff, erosion via flood waters, volatilization, and dust migration.

These potential pathways are discussed in the following subsections.

13.2.4.1 Migration via Groundwater

Previous investigations have confirmed the presence of a VOC plume migrating downgradient from the GE facility portion of the site. Characterizations of groundwater flow (Section 4.5) indicate that both Unkamet Brook and the Housatonic River receive groundwater discharge in the lowlands area. As noted earlier, the Groundwater Divide Study (described in Section 4.5.5) has determined that the Housatonic River functions as a groundwater divide, capturing groundwater flow from the saturated thickness of the unconsolidated deposits underlying the lowlands area.

A remaining potential migration pathway for VOCs in groundwater underlying this portion of the site includes: 1) volatilization and migration upward into interstitial soil gas, and 2) volatilization to the atmosphere during excavations extending beyond the water table. Water table depths (Table 4-7) in this area of the site range from 3 to 9 feet with shallower areas in the vicinity of the brook. Significant instances of excavation-based VOC migration from groundwater in the

lowlands area are unlikely due to restrictions on the future development of wetlands areas. Although a sanitary sewer line is present within this area, occasional excavations associated with repair activities to this line are unlikely to result in substantial contributions to the migration of VOCs via volatilization from lowland area groundwater.

13.2.4.2 Migration via Surface Water

As noted in the previous section, characterizations of groundwater flow indicate that groundwater discharges to Unkamet Brook in the vicinity of the Unkamet Brook/Housatonic River confluence. Historical studies conducted on this flow identified relatively low concentrations of PCBs and VOCs in brook water. More recent MCP Phase II studies of brook surface water including both high-flow and low-flow conditions, show variations in chemical concentrations detected over time, and variations in the species of chemicals detected between sampling events. These results appear to confirm that the main sources of these constituents to Unkamet Brook are groundwater discharge and partitioning from sediments (in the case of PCBs).

13.2.4.3 Migration from Sediments

As discussed in Section 13.2.2, previous studies have identified elevated PCB concentrations in Unkamet Brook sediments at sampling stations downstream of the GE facility. Phase II investigations were conducted to evaluate the significance of Unkamet Brook as a pathway for sediment migration to the Housatonic River.

The results of the Phase II investigation identified the presence of PCBs and select Appendix IX+3 constituents in Unkamet Brook sediments. However, the range of concentrations detected in the two sediment sample stations furthest downstream indicate that Unkamet

Brook sediments are not a significant source of metals or VOCs to the Housatonic River. Also, upon review of the MCP Phase II surface water data for Unkamet Brook and the Housatonic River, it is apparent that the constituents associated with Unkamet Brook have an overall negligible effect upon the water quality of the Housatonic River (see Section 5.4).

13.2.4.4 Migration from Floodplain Soils

Floodplain soils were sampled to investigate the presence of PCBs in the floodplain of Unkamet Brook, and VOC and SVOC analyses were also performed, based on the PID screening. Results of these studies indicate that PCBs and low concentrations of VOCs and SVOCs are present relatively close to Unkamet Brook. The highest concentrations of these constituents were consistently located immediately adjacent to the brook channel with the exception of some SVOCs near the railroad tracks to the west of Unkamet Brook (see Section 7.3).

Based on these results, it again appears that brook flow is not acting as a significant contributor to PCB distribution over the lowland area. Migration of PCBs with floodwaters of Unkamet Brook does not appear to have occurred to any significant extent in the past. Furthermore, the relatively low concentrations of PCBs detected in surficial soils serve to limit the potential for future migration with Housatonic River floodwaters.

Additional surficial soil migration pathways of volatilization, dusting and surface water runoff are severely limited in the lowlands area. Because of its flat topography and depressed (water holding) nature, the area does not produce appreciable quantities of stormwater runoff. In addition, the area's semi-saturated state, highly organic soils, and

dense vegetative growth combine to minimize the potential for migration of PCBs from floodplain surficial soils to the atmosphere.

13.3 Potential for Human Exposure

The potential for human exposure to hazardous constituents at the various subareas of Unkamet Brook Area/USEPA Area 1 Site is discussed in Section 2.3 of the Preliminary HEA Proposal (PHEAP), which is being submitted concurrently with this report. As shown there, potential human receptors who could be exposed to affected media at or from the site include: GE and Martin Marietta workers and contract employees; employees of commercial businesses along Merrill Road; excavation/utility maintenance workers; road repair crews; and individuals passing through unrestricted areas at the site.

13.4 Potential Impacts to Environmental Receptors

The environmental conditions at the Unkamet Brook Area/USEPA Area 1 Site are discussed in Section 2.4 of the PHEAP, which is being submitted concurrently with this report. In addition, the PHEAP presents in Section 3.0 (Task 8.0) a proposed procedure for evaluating risks to environmental receptors at the site.

SECTION 14 - REMAINING DATA NEEDS

14.1 General

Results from the prior site investigations summarized in Sections 3 through 11 of this document have satisfied many of the requirements for an MCP Phase II - Comprehensive Site Assessment. In addition, the existing information documented herein fulfills many of the requirements for an RFI for USEPA Area 1 pursuant to the Corrective-Action Permit.

Several data needs have been identified based on a comparison of existing site information with the remaining MCP Phase II requirements and the RFI requirements of the USEPA Permit. These data needs will be addressed through activities described in the separately bound MCP Supplemental Phase II SOW/RFI Proposal for the Unkamet Brook Area/USEPA Area 1 Site (Supplemental Phase II SOW/RFI Proposal) being submitted concurrently with this document. These data needs do not cover potential data needs identified related to the performance of an ecological risk assessment. This topic is covered in the PHEAP being submitted concurrently with this document and the Supplemental Phase II SOW/RFI Proposal.

14.2 Additional Soil Sampling and Analysis for GE Facility and Commercial Area

A number of soil samples have been collected in the Unkamet Brook Area/USEPA Area 1 Site as part of various investigative activities. These results have been useful in determining the presence of hazardous constituents at portions of the site. However, the Permit requires soil sampling at or near certain SWMUs at the site to assess potential releases from those SWMUs. Specifically, the Permit requires soil sampling at or near the former Interior Landfill (SWMU G-11), the waste stabilization basin (SWMU G-12), and the

Building 109 Wastewater Tank Farm (SWMU P-4). Proposals to address these requirements through the use of existing data or through soil sampling activities are included in the Supplemental Phase II SOW/RFI Proposal.

In addition, other areas at the site require additional soil sampling. These areas include locations near Buildings OP-1 and OP-2 where soils have not been previously characterized, and, for risk assessment purposes, areas near Merrill Road (for road repair and utility maintenance scenarios) and exposed or grass covered areas of the site. Additional PCDD/PCDF (congener-specific) data are also needed in the vicinity of the former Interior Landfill because existing PCDD/PCDF data from this area are not congener-specific. The Supplemental Phase II SOW/RFI Proposal includes proposals for collecting these additional data.

14.3 Additional Sampling and Analysis of Floodplain Soils in the Lowland Area

During Phase II activities, surficial soils at the Unkamet Brook Area/USEPA Area 1 Site were sampled and analyzed for PCBs and, based on PID screening, for VOCs and SVOCs, at three transects and at 20 locations south of Building OP-3. PCBs were detected at a number of locations generally in close proximity to the brook. However, PCBs and a number of SVOCs were also detected along the western side of transect UFP2. Further sampling and analysis activities (including some samples at depth below the surface) are warranted to help define the extent of these SVOCs and PCBs along the western edge of UFP2 and their potential source.

Additional PCDD/PCDF (congener-specific) data are also needed in the vicinity of Building OP-3 and at two floodplain transects in this area. Existing PCDD/PCDF data from this area are not congener-specific.

A proposal to address these data needs is included in the Supplemental Phase II SOW/RFI Proposal.

14.4 Hydrogeologic Data Gaps

14.4.1 Groundwater Monitoring

Groundwater samples have been collected and analyzed from numerous monitoring wells at the Unkamet Brook Area/USEPA Area 1 Site during previous investigations, as described in Section 4.2. While data collected at a variety of monitoring wells have yielded information on the extent of hazardous constituents present in groundwater, additional groundwater sampling would be appropriate to obtain more information on the potential presence and nature of hazardous constituents in site groundwater on an area-wide basis. Such additional sampling will be carried out at select wells (existing and new wells), as described in the Supplemental Phase II SOW/RFI Proposal.

In general, these activities will include the sampling and analysis of several existing monitoring wells in order to assess the concentrations of dissolved constituents associated with the VOC plume present at the site (see Section 14.4.2). Also, four new monitoring wells will be installed, sampled, and analyzed to better characterize the groundwater in the vicinity of Buildings OP-1 and OP-2.

Finally, in order to better characterize hydrogeologic conditions at the site, additional information will be collected on groundwater elevation, groundwater flow patterns and rates, and seasonal variations in groundwater elevations and flow patterns.

14.4.2 Quantitative Assessment of VOC Plume Discharge

As described in Sections 4 and 5, groundwater and surface water sampling during prior investigations and Phase II investigations have

indicated that the VOC plume was discharging into the lower section of Unkamet Brook, and possibly into the Housatonic River. Additional groundwater and surface water data are needed, however, to track the attenuation of the plume and to quantitatively evaluate the effects of that plume (if any) upon Unkamet Brook and/or the Housatonic River. Accordingly, the Supplemental Phase II SOW/RFI Proposal includes a proposal for the collection of surface water samples and stream/river flow rate data at four locations in the brook, the collection of groundwater samples (to be analyzed for VOCs) and groundwater elevation data from select monitoring wells in the vicinity of the brook, and the analysis of these data to determine the quantitative effects of the plume (if any) upon Unkamet Brook and/or the Housatonic River.

In addition, surface water and sediment data are needed for Unkamet Brook corresponding with a location upstream of the site. These data will provide background information to be used for comparative purposes. A proposal for the collection of this information is also included in the Supplemental Phase II SOW/RFI Proposal.

14.4.3 Building 51/59 Oil Plume

As discussed in Section 10, the pocket of oil between Buildings 51 and 59 is generally well defined, particularly along the eastern and northern borders. However, the extent of oil is not well defined along the western border. In addition, it would be desirable to confirm that the southern boundary of the oil has not extended into the area just north of Merrill Road adjacent to Building 59. Accordingly, a proposal to address these data gaps concerning the Building 51/59 oil pocket is included in the Supplemental Phase II SOW/RFI Proposal.

14.4.4 Additional Preferential Pathway Analysis

As discussed in Section 4.7, although the results of the preferential pathway analysis generally illustrate that the sanitary sewer pipeline and the 119W oil/water separator effluent pipe and storm drain are not acting as preferential pathways, the well point data associated with one sampling round (out of three) at one location along the sanitary sewer pipeline (which runs northwest to southwest from Dalton Avenue to Merrill Road through the location of the former Interior Landfill) did potentially show preferential migration. To better assess this phenomenon, it would be appropriate to conduct additional rounds of well point elevation monitoring along the sanitary sewer pipeline.

In addition, further evaluation is needed to determine if any other underground pipe and/or tunnels associated with the Unkamet Brook Area/USEPA Area 1 Site are acting as preferential pathways for transport of hazardous constituents.

A proposal to fill both these data needs is included in the Supplemental Phase II SOW/RFI Proposal.

14.5 Estimation of Volumes

Under the MCP and the Corrective-Action Permit, it will be necessary, upon completion of data-gathering efforts, to estimate the volumes of materials affected by hazardous constituents at the site. A proposal for these activities is included in the Supplemental Phase II SOW/RFI Proposal.

14.6 Air Monitoring

As discussed in Section 9.2.2, the ambient air sampling conducted in 1983 in the former Interior Landfill area did not use current USEPA-recommended sampling methodology for air sampling of PCBs and would not meet current

USEPA QA/QC criteria. Moreover, the samples collected represented only a small volume of air and only one 24-hour period. For these reasons, the results of that sampling cannot be considered to characterize the actual concentrations of PCBs in ambient air above or near the former Interior Landfill. Accordingly, it is necessary to conduct additional ambient air monitoring for PCBs in order to provide valid and representative data on current PCB concentrations in the ambient air at and near the former Interior Landfill. A proposal for such monitoring is included in the Supplemental Phase II SOW/RFI Proposal.

14.7 Risk Assessment

Under the MCP and the Correction-Action Permit, it will also be necessary, upon completion of data-gathering efforts, to evaluate the potential risks to human health and the environment associated with constituents present at this site, given the current and reasonably foreseeable uses of the site and the surrounding areas. A more detailed overview concerning this evaluation is provided in the separately bound PHEAP, submitted concurrently with this document.

SECTION 15 - CONCLUSIONS AND FUTURE ACTIVITIES

15.1 Conclusions

A number of conclusions have been presented in Sections 4 through 11 of this report. Although several data needs have been described in Section 14, it is helpful to summarize the preliminary key findings and conclusions to date associated with the various site investigations. These conclusions are summarized below:

- An analysis of groundwater trends related to the VOC plume emanating from the former waste stabilization basin indicates that the plume is stable and has not migrated beyond the previously defined plume boundaries. Portions of the plume with high concentrations of various constituents are not migrating downgradient. Additionally, deep soil borings which were performed to assess the possible presence of DNAPLs were successful in demonstrating that these materials are not present. The stable plume condition exists as a result of the source removal performed in the early 1980s, as well as the natural processes (i.e., attenuation, adsorption, and hydrogeologic dynamics including the flushing of soils near the river due to periodic reversals of the hydraulic gradient during times of high river flow) which affect the plume. Based on interpretation of the past 10 years of groundwater monitoring data, the plume configuration is expected to remain stable into the future.
- The VOC plume appears to be discharging to Unkamet Brook just upstream of the confluence with the Housatonic River, and some VOCs have been detected in the surface water both in the brook and, at low levels, in the river just downstream of the confluence with the brook. It is not clear whether if the presence of low levels of VOCs (benzene

and chlorobenzene) in the river water immediately downstream of the confluence is the result of Unkamet Brook surface water discharge or a combination of groundwater and surface water discharge to the Housatonic River. This topic will be addressed further during Supplemental Phase II/RFI activities, as discussed in the Supplemental Phase II SOW/RFI Proposal.

- An evaluation of the concentrations of VOCs detected in the surface water of Unkamet Brook and the Housatonic River reveals the following:
  - The VOCs detected in the Unkamet Brook surface water were generally at higher concentrations near the confluence with the Housatonic River. This conclusion is thought to be the result of groundwater discharge to the brook, as noted above. The VOCs detected were all below USEPA ambient water quality criteria (AWQC) with one exception: chlorobenzene was detected in two brook samples in one of two sampling rounds at concentrations exceeding the chronic freshwater AWQC for chlorinated benzenes for protection of aquatic life (0.050 ppm). However, there were no exceedances of any acute AWQC for VOCs. Further, the VOC data show no exceedances of AWQC for consumption of aquatic organisms, which, in any event, should not be relevant since the brook lacks any appreciable population of edible-size fish of the type consumed by humans. The brook sustains only a limited aquatic population due to its small size.
  - The VOC data from the Housatonic River surface water investigation indicate that any contribution of VOCs from the Unkamet Brook Area/USEPA Area 1 Site to the river (whether via surface water or groundwater) has no significant impact on the

water quality of the river. The data on VOC concentrations in the river water below the confluence with the brook show no concentrations in excess of either the acute or the chronic AWQC for protection of aquatic life or of the AWQC for consumption of aquatic organisms.

- Upon comparing the historical database of VOCs detected in the Unkamet Brook surface water between 1981 and 1989 to the results obtained during MCP Phase II activities, it is apparent that several VOCs that were detected in the past were not detected during Phase II activities, and that the remaining VOCs were within the range of concentrations observed in the past. Hence, the plume is not having an increasing impact on the brook, and, in fact, that impact is either stable or diminishing.
- The groundwater divide study has shown that, based upon 12 months of monitoring data, Unkamet Brook and the Housatonic River act as discharge points for groundwater in the Unkamet Brook Area. It has been demonstrated that the plume does not pass under the Housatonic River, and that, therefore, concerns regarding that potential issue can be dismissed.
- The preferential pathway analysis performed in the Unkamet Brook Area indicates that, in general, preferential migration of groundwater is not occurring in the vicinity of the former Interior Landfill or the former waste stabilization basin. One set of anomalous results, as well as an assessment of other potential preferential pathways at the site, will be examined further during Supplemental Phase II/RFI activities, as described in the Supplemental Phase II SOW/RFI Proposal.
- PCBs were detected in the Unkamet Brook surface water, and at low flow generally increase in concentration from the former Interior Landfill

to the confluence with the Housatonic River. At high flow, the data appears more variable. Evaluation of these data indicates the following:

- The PCB concentrations detected were above the freshwater chronic AWQC, but below the acute AWQC. In any event, as noted above, the brook sustains only a limited aquatic population due to its small size.
- The PCBs in Unkamet Brook surface water appear to have no significant impact on the water quality of the Housatonic River. Surface water sampling and analysis of the Housatonic River above and below the confluence at similar timeframes as the brook sampling indicated that PCBs were not detected in the river above the detection limit.
- The PCB concentrations observed in Unkamet Brook surface water during MCP Phase II activities are within the range of PCB concentrations detected in the brook during monitoring rounds between 1981 and 1989. Thus, the PCB levels in the surface water do not appear to be increasing.

- PCBs were detected in Unkamet Brook sediments at each of seven locations that were sampled during Phase II activities. The highest concentrations were detected in the vicinity of the former Interior Landfill, while much lower concentrations were detected below Merrill Road. The distribution of PCBs below Merrill Road was generally consistent with results obtained from this stretch of brook in the past. This distribution, coupled with the vertical distribution of PCBs in the sediments, and the surface water PCB data described above, indicates that minimal transport of sediments, and therefore PCBs, is occurring in the brook. The sediment data obtained during the Housatonic River

Phase II activities at the location in the river below the Unkamet Brook confluence, which were analyzed for hazardous constituents including PCBs, indicated that PCBs were not found at that location, thus further supporting the conclusion of minimal PCB transport in Unkamet Brook.

- Sediments from Unkamet Brook within the former Interior Landfill were analyzed for Appendix IX+3 constituents and sediments from five other locations in the brook were analyzed for VOCs, SVOCs, and metals. The results of these analyses indicate that VOCs and SVOCs are generally present within the former Interior Landfill at relatively low concentrations and then decrease in concentration downstream. No VOCs were detected above the detection limit in sediments just upstream of the Housatonic River confluence. SVOCs also decreased in concentration below the former Interior Landfill, except that they increased in concentration in the vicinity of the railroad tracks (unrelated to GE) below Merrill Road. This occurrence will be investigated further, as described in Section 14.
- VOCs and SVOCs are detected at three floodplain transects and near Building OP-3, generally at low concentrations. These data indicate that little transport of these constituents from the GE facility to the floodplain has occurred. Although some VOCs were detected in floodplain soil samples collected near the railroad tracks below Merrill Road, this occurrence is most likely unrelated to GE activities and will be further investigated as noted above.
- PCBs were detected at each of the three floodplain transects and at low but detectable concentrations in all 20 of the surficial soil samples collected, south of Building OP-3. The highest PCB concentration detected south of Building OP-3 was 14.3 ppm, and 18 of the 20 samples had PCB concentrations of less than 2.9 ppm. Along the

floodplain transects, the PCBs were detected in relatively close proximity to Unkamet Brook (in all cases less than 275 feet and in most cases much less). A more detailed evaluation of the extent of PCBs in the Unkamet Brook floodplain will be undertaken as part of Supplemental Phase II/RFI activities, as described in Section 7-4.

- The results of the Building 51/59 oil plume monitoring indicate that the extent of the oil is fairly well defined, particularly to the north and east. Information supporting the definition of the plume boundary to the west and south is limited, and, therefore, additional work is necessary to confirm the existing information in those areas, as described in Section 14. The preferential pathway analysis related to the Building 51/59 oil plume indicates that preferential migration along utility trenches occurs only in limited areas for short periods of time, if at all. In general, it can be concluded that utilities have little or no impact on the migration of the oil plume.
- During two separate sampling events, a total of four fish of filletable size were collected from Unkamet Brook and analyzed for PCBs and lipids. The fish contained PCB concentrations ranging from 2.1 to 3.8 ppm. Although the results of this screening-level investigation indicate that PCBs are available to the aquatic biota of Unkamet Brook, human consumption of Unkamet Brook fish is highly unlikely to be an exposure route of concern (if it occurs at all), since the small size of the brook severely limits the population of edible-size fish of the type commonly consumed by humans.

15.2 Future Activities

Section 14 of this document has identified several data needs concerning the presence and extent of hazardous materials at the Unkamet Brook

Area/USEPA Area 1 Site. Following the MDEP's review and approval of this Interim Phase II Report/CAS and the Supplemental Phase II SOW/RFI Proposal, the activities described in the latter document will be performed. Some of the additional field activities would be contingent on obtaining access agreements with associated property owners. After the performance of these activities, the results will be presented and interpreted in a Supplemental Phase II/RFI Report which will be submitted for MDEP/USEPA review and approval. At the same time, a Risk Assessment SOW/Supplemental HEA Proposal (which will be more detailed than the PHEAP being submitted concurrently with this document) will be submitted for MDEP/USEPA review and approval. After performance of the risk assessment activities, a report thereon will be submitted, together with a Media Protection Standards Proposal for this site.

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