REPORT

Housatonic River - Rest of River RCRA Facility Investigation Report

Volume 1. Report

General Electric Company
Pittsfield, Massachusetts

September 2003

Quantitative Environmental Analysis, LLC

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

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BLASAND, BOUCK & LEE, INC.
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ES. Executive Summary

ES.1 Introduction

This RCRA Facility Investigation Report (RFI Report) documents the results of a number of sampling and investigative activities conducted since the mid-1970s to delineate the nature and extent of polychlorinated biphenyls (PCBs) and other chemical constituents in a portion of the Housatonic River (River) located downstream of the General Electric Company (GE) facility in Pittsfield, Massachusetts. This portion of the River, known as the Rest of River, begins at the confluence of the East and West Branches of the River (the Confluence) (about two miles downstream of the GE facility) and flows through western Massachusetts and Connecticut until it reaches Long Island Sound (Figure ES-1).

This Rest of River RFI Report was prepared pursuant to a permit issued to GE by the United States Environmental Protection Agency (EPA) in 2000 under the corrective action provisions of the federal Resource Conservation and Recovery Act (RCRA). This permit constituted a reissuance of a prior RCRA permit issued to GE and is referred to herein as the Reissued RCRA Permit. It was part of a comprehensive settlement embodied in a Consent Decree (CD) executed by GE, EPA, the Massachusetts Department of Environmental Protection, the Connecticut Department of Environmental Protection, and other governmental entities, which became effective on October 27, 2000 and provides for further investigations, evaluations, and remediation of the GE Pittsfield facility, the Housatonic River, and other nearby areas (collectively known as the GE-Pittsfield/Housatonic River Site). This RFI Report has been prepared specifically to meet the requirements of Special Condition II.A of the Reissued RCRA Permit, which relate to the Rest of River area. This version of the RFI Report constitutes a revision of the RFI Report submitted by GE to EPA on January 3, 2003.

Over more than the past two decades, GE has undertaken numerous investigations of PCBs and other constituents in the sediments and water of the River, the soils of the River floodplain, and biota that inhabit the River and floodplain. GE has also undertaken source control and other remediation activities in and along the River. These have included: source control activities at and near the GE Pittsfield facility to prevent or control the migration of PCBs and other constituents in subsurface oil and groundwater into the River; dam reconstruction and maintenance projects in the Rest of River; soil removal and capping at a number of floodplain properties; and extensive sediment and bank soil removal projects in the ½-mile reach of the River adjacent to the GE facility. In addition, under the CD, EPA is undertaking an extensive sediment/bank soil remediation project in the next 1½-mile reach of the River (downstream to the Confluence), and GE is required to conduct additional investigation and remediation activities in areas adjacent to the River upstream of the Confluence. In the Rest of River area, EPA has supplemented the prior data with extensive additional investigations conducted between 1998 and 2003.

Based on all available data for the Rest of River area, and in accordance with the Reissued RCRA Permit, this RFI Report documents the nature, extent, fate, and transport of chemical constituents (notably PCBs) that have or may have migrated from the GE Pittsfield facility into the surface water, sediments, floodplain soils, and biota of the Rest of River area, and the concentrations of PCBs in the ambient air of the Rest of River area.

ES.2 Site Description

The Housatonic River's headwaters are located in the Berkshire Mountains of western Massachusetts. The Rest of River portion of the River is formed by the confluence of the East and West Branches in Pittsfield. The East Branch flows past GE's facility, approximately two miles above the Confluence. Below the Confluence, the River flows generally south for approximately 54 miles through Berkshire County in Western Massachusetts, and then continues another 81 miles through western Connecticut before emptying into Long Island Sound (Figure ES-1).

For purposes of evaluating data collected from the Rest of River portion of the Housatonic River, the River reach designations established by EPA have been incorporated throughout this RFI Report (Figure ES-1). The reaches are:

- Reach 5, from the Confluence downstream to the headwaters of Woods Pond (the first significant impoundment);
- Reach 6, Woods Pond;
- Reach 7, Woods Pond Dam to Rising Pond (the next significant impoundment);
- Reach 8, Rising Pond;
- Reach 9, Rising Pond Dam to the Connecticut border; and
- Connecticut portion of the River.

The primary focus of this RFI Report is the stretch of the River between the Confluence and Woods Pond Dam (Reaches 5 and 6; Figure ES-1), where PCBs are most prevalent. Reach 5 has been further divided into three subreaches: 5A, 5B, and 5C (Figure ES-1).

Section 2 of this RFI Report provides an overview of the Site's environmental setting, which includes a description of the regional climatic conditions, topography and land use characteristics within the watershed, as well as the physical and hydrologic characteristics of the River, its sediments, and its floodplain.

Hydrologically, the River near the Confluence is characterized as a headwaters system. Several tributaries enter the Housatonic River over its 135-mile length (Figure ES-1), causing the flow to increase with distance traveling downstream. The River is relatively steep and fast-moving near the Confluence, decreases to a more gentle gradient across Reaches 5C and 6 (Woods Pond), and then becomes generally steeper again downstream of Reach 6. These gradients are not uniform, however, because of the numerous dams that impound water on the River. Woods Pond Dam, located approximately 12 miles downstream from the GE Pittsfield facility, forms the first dammed impoundment downstream of the Confluence (Figure ES-1). Rising Pond, located approximately 18 miles downstream of Woods Pond Dam, is the last dammed impoundment on the River in Massachusetts (Figure ES-1). Three smaller dams are located along the Housatonic River between Woods Pond and Rising Pond, and a number of large dams and associated impoundments are located in the Connecticut portion of the River.

The River periodically floods, inundating portions of the adjacent floodplain. As defined in the CD, the Rest of River area includes portions of the Housatonic River floodplain (excluding certain parts of current residential properties). Specifically, between the Confluence and Woods Pond Dam, the Rest of River includes the floodplain area extending laterally to the 1 mg/kg PCB isopleth (Figure ES-1); and downstream of Woods Pond Dam, it includes floodplain areas that contain PCBs. The floodplain of the River is relatively narrow near the GE facility in Pittsfield, and is generally wider in the Rest of River area. Evidence of some River meandering in the past is indicated by the occurrence of oxbows and abandoned cutoffs in the floodplain. Furthermore, backwaters of various sizes are located in the floodplain, with the size and number of backwater areas generally increasing in Reach 5C.

ES.3 Summary of Results from Investigations

In January 1996, GE submitted a prior RFI Report for the River, pursuant to the previous RCRA permit. The 1996 RFI Report documented site investigations conducted by GE and others between the mid-1970s and 1996 and covered the Rest of River area as well as areas upstream of the Confluence. Since that time, GE has continued to perform sampling activities along the Rest of River. In 1998, in anticipation of the CD, EPA commenced an extensive multi-year sampling effort in the Rest of River area to further delineate the nature and extent of contaminants, and to support the modeling activities and human health and ecological risk assessments that EPA is conducting for the Rest of River.

These investigations indicate that the primary constituents of concern in the Rest of River are PCBs. In addition to PCBs, other chemical constituents have been analyzed for in samples of the various media, but, in general, these constituents have been detected at relatively low concentrations (in relation to background or screening levels) or have had relatively low frequencies of detection. In accordance with advice0 from EPA, this RFI Report focuses primarily on PCBs. However, data on other constituents are summarized in the Report's appendices, and summary information on polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) is also presented in the text, because those compounds may be included in EPA's risk assessments.

This RFI Report presents the investigation data according to the specific media: surface water (Section 3); sediments (Section 4); riverbank and floodplain soils (Section 5); biota (Section 6); and air (Section 7). These sections focus mainly on the most relevant subsets of the data for purposes of characterizing the extent of or trends in PCBs in the various media; all of the data are presented in Appendices in the form of maps, tables, and electronic databases. Evaluations of spatial PCB distribution, relationships among PCBs and other environmental factors, and temporal trends are included in the data assessments.

ES.3.1 Surface Water

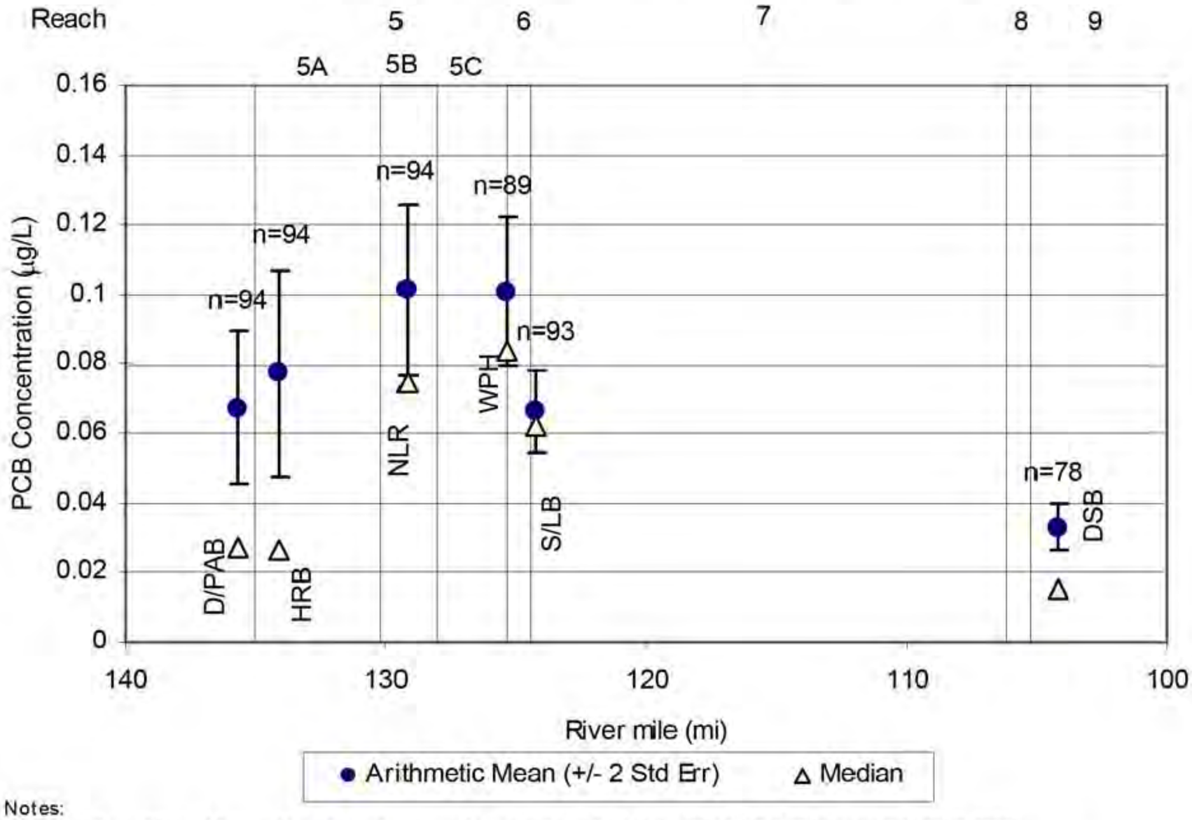
Numerous investigations have been conducted since the late 1970s to study the presence, extent, and transport of PCBs in the water column of the Housatonic River. Early surface water studies (prior to 1988) were conducted by GE and certain governmental agencies at a few sampling stations in both Massachusetts and Connecticut. Since 1988, broader surface water sampling investigations have been conducted, mainly by GE, and have focused primarily on the Massachusetts portion of the River.

Beginning in 1996, GE has been conducting monthly or bi-weekly surface water monitoring of PCBs at several locations between Pittsfield and Great Barrington, Massachusetts (approximately 31 miles downstream of the Confluence). During 1998 and 1999, EPA also collected monthly water column samples at a number of locations between Pittsfield and just downstream of Woods Pond Dam. EPA also collected high frequency water column samples at three locations over the course of several storm events during this period. Section 3 provides a summary and analysis of PCB concentrations measured in surface water samples collected by both GE and EPA since 1996.

Analyses of total suspended solids (TSS) data are included in the assessment of surface water PCBs. PCBs tend to adsorb onto solids. Therefore, understanding the movement of solids within the River helps to explain how PCBs move throughout the system. Solids within the River typically remain at low, nearly constant, levels throughout most of the year, with some decreases observed in the low-velocity regions upstream of Woods Pond Dam, where settling is promoted. When River flows become elevated during periods of snowmelt and rainstorms, large quantities of solids are introduced into the River as a result of inputs from tributaries and the watershed, as well as erosion of sediments and bank soils within the River. These solids are transported with the water through the system, and settle in areas where the current velocities are slower, such as within the backwater regions and behind the dams.

Between 1996 and 2002, PCBs were analyzed in a total of 542 water samples that were collected at six primary sampling locations: one located in the East Branch just upstream of the Confluence and five located in the Rest of River. The average PCB concentrations from these data are plotted against distance in Figure ES-2 below. Average water column PCB concentrations generally increase with distance downstream between the Confluence and Reach 5B, and then level off to the headwaters of Woods Pond. Declines in average PCB concentrations occur at the sampling station just downstream of Woods Pond Dam; the decline in average PCB concentration continues to the downstream-most station near Great Barrington, where the average concentration is reduced by nearly a factor of two. Median concentrations exhibit the same spatial patterns as the averages, but are generally lower.

Figure ES-2. PCB Concentrations in Housatonic River Surface Water



Notes:
Presents all monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999).
Does not include pre-1996 data, or data from stormwater sampling events or other specialized surface water sampling events.
D/PAB - Dawes/Pomeroy Avenue Bridge; HRB - Holmes Road Bridge; NLR - New Lenox Road Bridge; WPH - Woods Pond Headwaters; S/LB - Schweitzer Lenoxdale Bridge; DSB - Division Street Bridge
n= number of samples analyzed

Relationships among water column PCBs and other environmental variables have been observed. For example, substantially higher TSS and PCB concentrations are observed in the water column at higher flows. One reason for this is that higher flow rates tend to resuspend PCB-containing sediments from the bottom of the River into the water column.

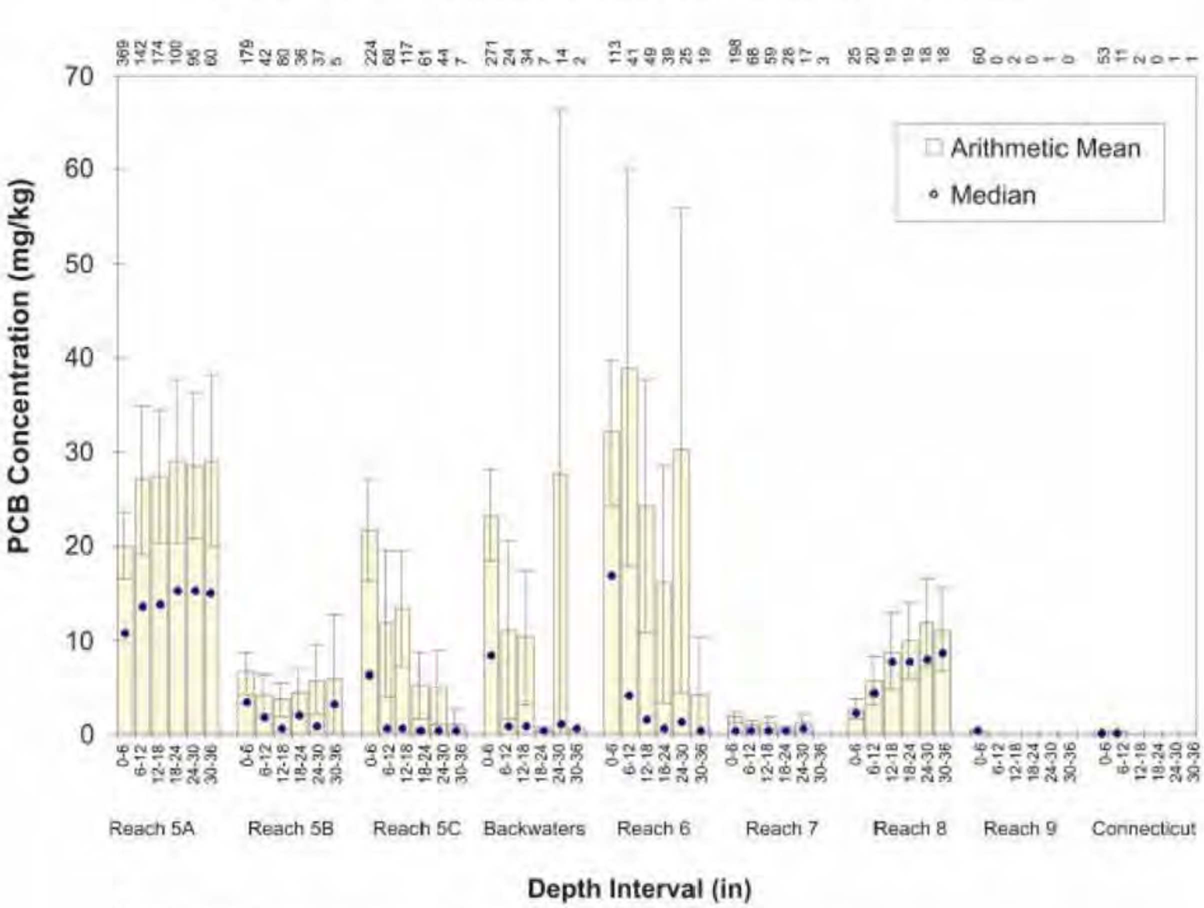
An analysis of water column data collected from 1989 to present was conducted to evaluate whether PCB concentrations in the surface water have changed over that period. Although there is a large amount of variability in the data, review and statistical analyses of the data suggest a declining trend in Housatonic River surface water PCB concentrations since the late 1980s. However, the variable nature of the data and the relatively weak fit of the trend lines at the sampling stations indicate the limited strength of this analysis.

ES.3.2 River Sediments

Numerous investigations have been conducted since the late 1970s to study the presence and extent of PCBs in the sediments of the Housatonic River. Between 1979 and 1998, 2172 sediment samples were collected within the Massachusetts and Connecticut portions of the River by GE, as well as the Connecticut Agricultural Experiment Station and USGS. Between 1998 and 2002, a more extensive sediment sampling program was conducted by EPA, resulting in the collection of an additional 4285 sediment samples. Section 4 provides an analysis of sediment PCB concentrations measured in samples collected by GE and EPA, focusing on the data from more recent years, primarily from 1997 to present.

The average and median PCB concentrations in the top three feet of sediments are shown, by reach, on Figure ES-3 below. In general, average sediment PCB concentrations are highest in Reaches 5A and 6 (Woods Pond), with somewhat lower average concentrations in Reaches 5B and 5C and the backwaters upstream of Woods Pond. Downstream of Woods Pond Dam, PCB concentrations generally decrease to lower average levels, except in Reach 8 (Rising Pond). In Rising Pond, average 0-6" sediment PCB concentrations are lower than those in Reach 5 and Woods Pond. However, unlike Reach 5 and Woods Pond, the average concentrations in Rising Pond sediments are higher in the deeper increments than in the shallow increments. The median concentrations are lower than the means in all reaches, but generally indicate spatial patterns similar to those of the means. Locally higher PCB concentrations occur in relatively slow-moving portions of the River such as some backwater areas in Reach 5C and areas immediately upstream of dammed portions of the channel such as Woods Pond (Reach 6) and Rising Pond (Reach 8). The reason for this difference is that these slower-moving areas tend to promote the deposition of fine sediments, and those fine sediments tend to have a higher concentration of organic carbon, to which PCBs preferentially bind.

Figure ES-3. PCB Concentrations in Housatonic River Sediment



Notes:
Includes EPA (1998-2002) and GE (Dec. 1997-1998) sampling data.
Presents arithmetic mean PCB concentration and median in the top 36 inches of sediment (see Table 4-8 for results from all depths). Error bars represent 2 standard errors about the mean. Numbers posted on top of panel represent sample size.

Sediment PCB concentrations in the Housatonic River also vary with depth. The PCB depth profiles of individual sediment cores are highly variable. In Reaches 5A and 5B, average PCB concentrations show no clear pattern in the top three feet. In Reach 5C, Woods Pond, and the backwaters, highest average PCB concentrations are generally observed in the top foot of sediments (0- to 6-inch and 6- to 12-inch depths), with lower concentrations observed in deeper intervals (except for the 24-30 inch depths in the backwaters and Woods Pond, where the large error bars indicate the significant variability in the data) (Figure ES-3). In Rising Pond (Reach 8), average PCB concentrations generally increase with depth within the top three feet of sediment (Figure ES-3); this vertical trend may be the result of relatively "cleaner" sediments depositing there over time. In addition, due to the increased deposition in slower-moving areas of the River (such as Woods Pond and Rising Pond), PCBs in these areas are found at greater depths than in other portions of the channel.

As expected, sediment PCB concentrations appear to relate to a number of variables, including percent solids, grain size, and total organic carbon (TOC). As a general matter, while there is considerable variability in the data, relatively higher PCB concentrations (considering distance downstream of the Confluence) tend to be present in areas with finer-grained sediments containing lower percent solids and higher TOC, such as areas behind dams and in backwater areas.

A time-trend analysis of sediment data collected between 1980 and 2002 from Woods Pond and Rising Pond was conducted to evaluate whether PCB concentrations in surface sediments have changed over that time period in these depositional areas. This analysis does not show any statistically significant temporal trend in surface (0-6") sediment PCB concentrations in Woods Pond and Rising Pond. Temporal trends in sediment PCBs were also evaluated using the results of the sediment dating analyses, based on data from finely segmented sediment cores that were analyzed for both radioisotopes and PCBs to provide estimates of sedimentation rates. This analysis indicates that the PCB concentration of particles that settled in depositional areas of Woods Pond and Rising Pond have significantly decreased since the 1960s. Due to their limited spatial extent, however, the results for these cores cannot be used to conclude that reach-wide sediment concentrations in these impoundments have significantly decreased during this period.

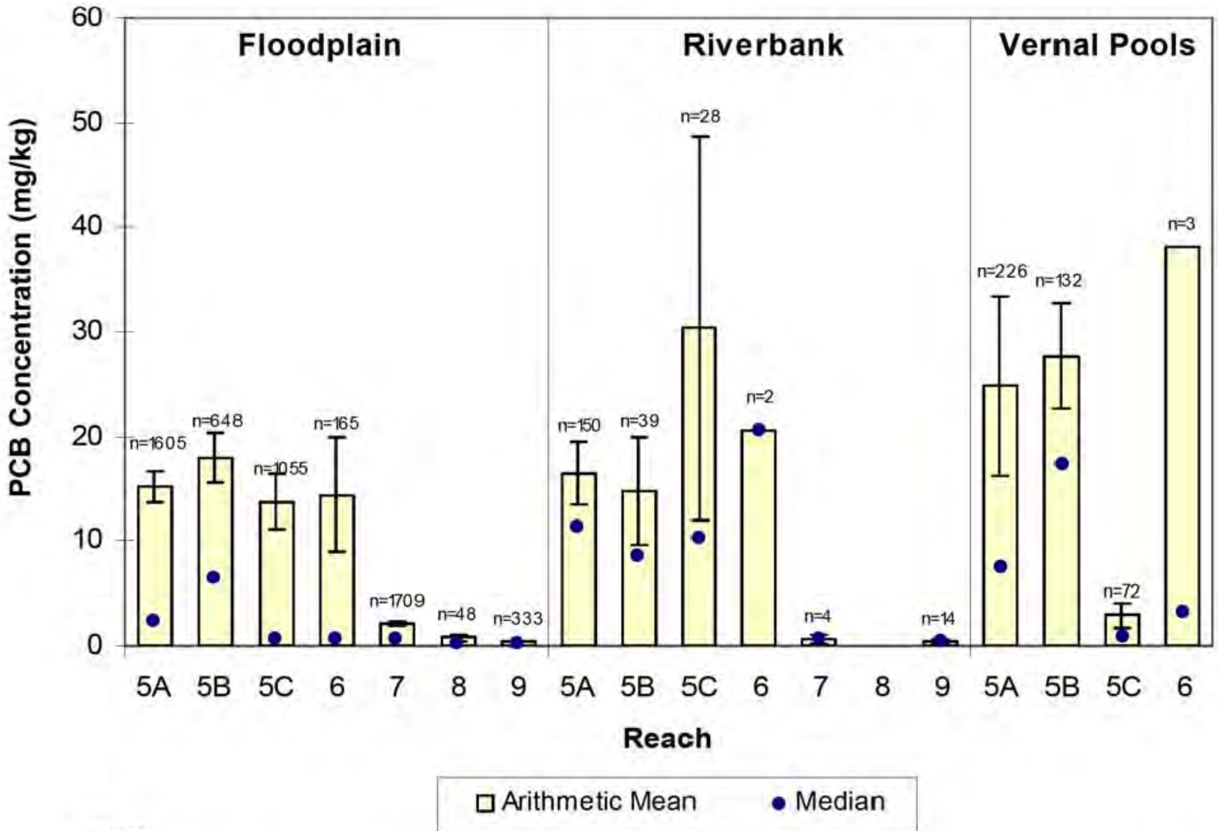
In Section 4 of this RFI Report, estimates of sediment PCB mass are also presented. Calculation of PCB mass in sediments is highly uncertain for a number of reasons; the estimates are therefore provided as ranges. Based on these estimates, the highest PCB mass in sediments is contained within Reach 5A, and approximately 80 to 90% of the mass is located upstream of Woods Pond Dam. Similar to trends in PCB concentration, PCB mass significantly decreases with distance downstream.

ES.3.3 Riverbank and Floodplain Soils

High-flow events in the River periodically cause flooding of certain portions of the Rest of River area. During these flood events, PCBs may be transported onto and over the upper portions of the riverbanks and into the floodplain, where they are deposited in the soils. A number of studies have been conducted since the late 1980s to characterize PCB concentrations in floodplain and riverbank soils adjacent to the Housatonic River. Between 1988 and 1998, GE collected 1290 floodplain soil samples along the Massachusetts portion of the River. Between 1998 and 2002, EPA conducted a more extensive sampling of the Massachusetts Rest of River floodplain and riverbank soils, resulting in the collection of 5027 samples. EPA's sampling in Reach 5 also included several vernal pools, which are poorly drained depressions in the floodplain that may become dry in summer.

The average and median floodplain, riverbank, and vernal pool soil PCB concentrations are shown, by reach, on Figure ES-4 below. The highest average PCB concentrations in floodplain and riverbank soils occur in Reaches 5 and 6 (Woods Pond), with substantially lower concentrations occurring downstream of Woods Pond Dam. PCB concentrations in vernal pool soil samples are generally higher in Reaches 5A and 5B than in Reach 5C, with only a few samples within Reach 6 and no samples collected downstream of Reach 6. Again, as with the surface water and sediment PCB data, the median PCB concentrations, especially in the floodplain soil in Reaches 5 and 6, are considerably lower than the averages.

Figure ES-4. PCB Concentrations in Housatonic River Floodplain, Riverbank, and Vernal Pool Soils



Notes:
Presents arithmetic mean and 2 standard errors for all EPA and GE floodplain, riverbank, and vernal pool soil PCB data.
n = number of samples.

As shown in Figure ES-4, average PCB concentrations in riverbank and floodplain soils in Reaches 5A and 5B are similar, but the average riverbank concentration in Reach 5C is considerably higher than the average floodplain concentration. Median values are higher in riverbank than in floodplain soil in all three of these subreaches. The presence of higher PCB concentrations in the riverbank soils is expected due to the increased contact that riverbanks have with the surface water. In most reaches, vernal pool PCB concentrations are higher than those in the floodplain and riverbank soils, likely due to the significantly higher organic carbon content of fine-grained deposits in the vernal pools. However, in Reach 5C, the vernal pool PCB concentrations are much lower than those in the floodplain and riverbank soils.

Moreover, as expected, PCB concentrations tend to decrease with distance from the river into the floodplain (excluding vernal pools), primarily due to decreased flood frequency in the more distant portions of the floodplain. For example, average PCB concentrations in the 2- to 10-year floodplain of Reaches 5 and 6 are substantially lower than those in the 2-year floodplain, and the great majority of PCB concentrations beyond the 10-year floodplain in those reaches are at or below 1 mg/kg.

Analysis of changes in PCB concentration with depth in floodplain soils was conducted by comparing the results in 6-inch depth increments. The majority of the PCB measurements were made within the top 2.5 feet of soil. With the exception of floodplain soils in Reach 6, PCB concentrations in the top 2.5 feet of soil show little variation with depth; average PCB concentrations in Reach 6 generally decrease with depth. Similarly, the limited vernal pool data at depth suggest that PCBs are highest in the upper 6 inches of soil, and generally decrease with depth.

Section 5 of this RFI Report also provides estimates of floodplain soil PCB mass. In these calculations, all data from floodplain, riverbank, and vernal pool samples were used. Similar to the calculation of PCB mass in sediments, calculation of PCB mass in floodplain soils is highly uncertain for a number of reasons, and therefore the estimates are provided as ranges. Also similar to sediment PCB mass estimates, these estimates indicate that the greatest PCB mass in floodplain soils is contained in Reach 5A and that PCB mass significantly decreases with distance downstream; nearly 90 to 95% of the PCB mass in floodplain soils is located upstream of Woods Pond Dam. The estimates also indicate that the majority of the PCB mass in floodplain soils is located within 50 feet of the River – approximately half in Reach 5A and more than 85% in the other reaches.

ES.3.4 Biota

Biota investigations within the Rest of River area have involved sampling of a wide range of organisms, including fish, invertebrates, reptiles and amphibians, birds, and small mammals, as well as naturally occurring and crop vegetation. The majority of these data have been collected between 1998 and 2001 in Reaches 5 and 6. In addition, there have been a few regular monitoring programs for PCBs in biota. In the Massachusetts portion of the Rest of River, GE has performed biennial sampling since 1994 for young-of-the-year (YOY) fish (fish in their first year of life). In the Connecticut portion of the River, long-term biennial monitoring programs have been conducted since the late 1970s for fish (primarily smallmouth bass at 4 locations and brown trout at one location) and benthic invertebrates (aquatic organisms and insect larvae living in river sediments, which have been sampled at one location at West Cornwall).

Section 6 of this RFI Report discusses the spatial and temporal trends in biota PCB concentrations, with a primary focus on fish tissue and benthic invertebrate data. Similar to the other media, the highest fish tissue PCB concentrations occur in Reach 5 and Reach 6 (Woods Pond). However, within these reaches, there is considerable variability among species, due at least in part to the variability in factors that affect PCBs in fish, such as tissue lipid content, size differences, and shifts in diet between sediment and water column food sources. In these reaches, average fish tissue concentrations in adult fish are generally in the range of 5 to 25 mg/kg in fillet samples, with significantly higher mean concentrations (32-110 mg/kg) in whole-body (both measured and reconstructed [fillet + offal]) samples of adult fish, and average concentrations in YOY whole-body samples are generally in the range of 20 to 35 mg/kg. In the reaches between Woods Pond Dam and the Connecticut border, fish tissue PCB concentrations decline, reaching average levels below 10 to 12 mg/kg in both adult fillets and YOY whole-body samples in Reaches 8 and 9 and less than 50 mg/kg in reconstructed adult whole body samples in Reach 8.

In the Connecticut reaches of the Housatonic River, average PCB concentrations in smallmouth bass fillets have been less than 2 mg/kg at each of the four monitoring locations since 1994. Smallmouth bass PCB concentrations decline between the two upstream locations (West Cornwall and Bulls Bridge) and the two downstream locations (Lakes Lillinonah and Zoar), where average values have been less than 1 mg/kg since 1994. The average PCB concentrations in brown trout fillets, which are sampled only at West Cornwall, have ranged from 1.5 to 2.7 mg/kg between 1994 and 2002.

With respect to temporal trends in PCB concentrations, the adult fish data from the Massachusetts portion of the River are insufficient to conduct a meaningful analysis of temporal trends. While the recent adult fish data are extensive, the older adult fish data are sparse, used different sampling and analytical techniques, and/or had varied or uncertain locations, thus precluding any reliable comparisons with the newer data. The YOY data that have been collected in Massachusetts since 1994 show no overall consistent temporal trends, which may be influenced by the fact that YOY fish are only exposed to local PCB sources for a short duration (between the onset of feeding in the spring and the sampling in the fall) and thus may show significant year-to year variability.

In Connecticut reaches, where there has been long-term biennial monitoring of adult fish, PCB concentrations have clearly declined since the late 1970s. The most recent data (2000 and 2002) show fish tissue PCB concentrations that are similar to or lower than those from 1994-1998 and well below those found in 1992 and prior years.

PCBs have also been detected in a variety of other biota, including reptiles and amphibians, aquatic invertebrates, terrestrial invertebrates, aquatic and terrestrial vegetation, birds, and small mammals, which have been sampled primarily in Reaches 5 and 6 between 1998 and 2002. There has also been a long-term monitoring program for benthic invertebrates at West Cornwall, Connecticut since 1978. The concentrations of PCBs vary greatly among species, sample locations, and sample years.

In benthic invertebrates, as expected, PCB concentrations are considerably higher in Reaches 5 and 6 than in Connecticut. For example, based on 1999 EPA data, the average PCB concentration for benthic predator species in Reach 5 is 19 mg/kg. In Connecticut, average predatory insect PCB concentrations were 1.2 mg/kg and 0.8 mg/kg in 2001 and 2002, respectively. The long term monitoring of benthic insects at West Cornwall, Connecticut, which is the only long-term monitoring program for non-fish biota in the Housatonic River, has shown significant decreases in PCB concentrations over the course of that program, with the 2001-2002 data being among the lowest ever observed. .

With respect to other biota, sampling conducted since 1998 has shown detected PCB concentrations in various species, with lower levels in plants and higher levels in animals (especially ducks, other birds, and small mammals). Results from the sampling of these other biota are described in Section 6.

ES.3.5 Ambient Air

Sampling of PCBs in air adjacent to the River was performed by GE in 1995 and EPA in 1999. Because of their low volatility, the PCBs found in the Housatonic River would not be expected to be present in the ambient air at significant concentrations. Indeed, concentrations in high-volume samples from 1995, while above background levels, were still low. PCBs were not detected in lower-volume samples from 1995, nor in any of EPA's 1999 samples.

ES.3.6 Fate and Transport Studies

Section 8 of this RFI Report provides an assessment of the sources, fate, and transport of PCBs within the Rest of River system. It includes data from studies that were not media-specific or those that did not produce PCB measurements, as well as calculations to help interpret the PCB data. Although numerous physical, chemical, and biological processes affect PCB fate and transport, not all of the processes are of primary importance. The purpose of Section 8 is to identify the most important processes in the Rest of River area.

Perhaps the most important physical factor affecting PCB fate and transport is movement of solids in the system. Because PCBs prefer to be bound to solid particles rather than dissolved in water, the fate and transport of PCBs are directly linked to the fate and transport of solids in the system. Several of the fate and transport investigations discussed in Section 8 were designed to better understand the nature of sources to, and the transport of, solids within the system. For example, solids loading calculations indicate that the amount of suspended sediment transported in the water column increases within the upstream portion of Reach 5 (likely due to factors such as tributary loading, bed erosion, and bank erosion) and then decreases within the downstream portion of Reach 5 and in Woods Pond (likely due to deposition).

The most important chemical parameter of the system that affects PCB fate and transport is organic carbon. PCBs preferentially bind either to organic carbon associated with sediment particles or to organic carbon dissolved in water. Solids generated within the system, resulting from the growth of algae in the water, tend to have relatively high organic carbon content. PCBs dissolved in the water bind to this organic carbon and are effectively removed from the water column when the algae die and settle to the sediment bed. Therefore, biological solids have the potential to play an important role in the fate and transport of PCBs in the system. For example, the average sediment organic carbon content increases from Reaches 5A and 5B (1.5%) to Reach 5C (2.6%), and then increases considerably again in the backwaters and Woods Pond (9-10%); this change is consistent with increases in the biomass of aquatic plants over this reach.

A number of biological characteristics of the system also affect PCB fate and transport. Understanding movement patterns and exposure areas within the River is an important part of assessing PCB bioaccumulation patterns. Also, understanding the fate of PCBs in fish requires an understanding of the various exposure routes and pathways through the riverine food web. Based on an assessment of the recent data, the PCBs accumulated by fish in the Housatonic River come from both the water column and the sediment. The relative importance of these two PCB sources depends upon their relative PCB concentrations and also upon the structure of the food web itself.

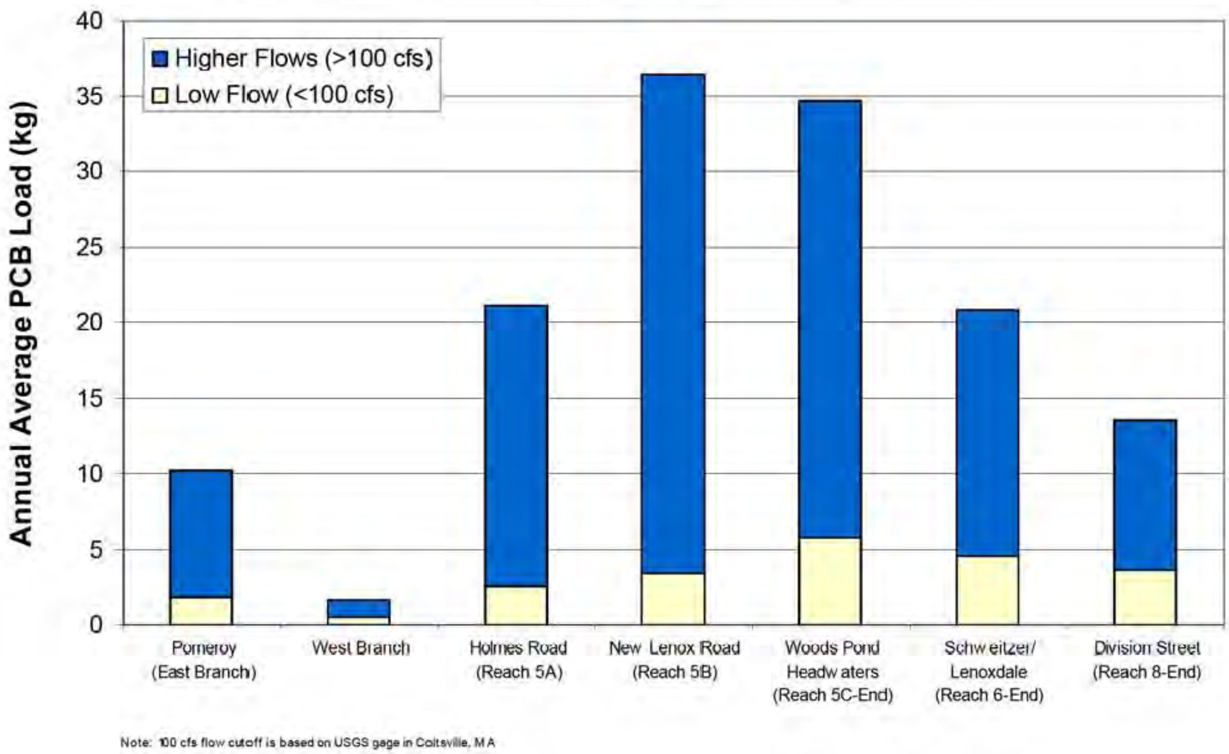
Section 8 of the RFI Report also presents an identification of external PCB sources to the Rest of River. The most significant external source of PCBs to the Rest of River is the water entering from the East

Branch. While the West Branch also contributes to the total PCB mass in the Rest of River, its contribution is substantially lower than that of the East Branch. Other external sources of PCBs to the system (e.g., tributaries, point sources, groundwater) within the Rest of River area appear to be negligible.

Developing an understanding of the movement of PCBs within the system also requires an understanding of the various mechanisms associated with fate and transport. The important mechanisms governing PCB fate and transport within the Housatonic River itself are advection (mass of PCBs transported with flow), partitioning of PCBs onto organic carbon, diffusion, resuspension, deposition, sedimentation, bed load (movement of coarse particles along the top of the sediment bed), and possibly bank erosion. Each of these mechanisms is evaluated through data analyses in Section 8 of the Report.

For example, the mass of PCB transported within the River is quantified through calculations of PCB loadings (the amount of PCBs transported in the water at a certain point in the River), which are summarized in Figure ES-5 below. These calculations indicate that, under low-flow conditions, there is an increase in the PCB loading in the River from upstream of the Confluence to the Woods Pond headwaters, followed by a decrease across and downstream of Woods Pond. They further show that PCB loadings under higher-flow conditions are significantly greater than at low flows, and that such loadings increase from upstream of the Confluence through Reach 5A and the upper portion of Reach 5B and then decrease (likely due to the depositional nature of Reach 5C and Woods Pond). These mass transport estimates help to understand the mechanisms that contribute to observed patterns in PCBs throughout the system.

Figure ES-5. Average PCB Loadings in the Housatonic River



In backwaters areas, the most significant mechanisms affecting PCB fate and transport are advection between the main channel and the backwaters, diffusion of PCBs from the sediments to the water column (within the backwaters), deposition, and volatilization. In floodplain areas, the principal mechanisms are advection between the main channel and the floodplain areas and deposition within the floodplain. Deposition is the predominant PCB fate and transport mechanism in backwaters and the floodplain, indicating that these areas serve as sinks for PCBs.

Finally, an evaluation of PCB uptake by organisms and transfer through the food web (termed bioaccumulation) was conducted by identifying PCB uptake and loss mechanisms and assessing the relative contributions of local sediments and the water column to PCB concentrations in invertebrates and fish of the River. These analyses indicate that the fish in Reaches 5 and 6 receive PCBs from a mixture of dietary sources based both in the sediments and in the water column, and that PCB bioaccumulation in Rising Pond fish may be tied more to water column-based sources than to sediment-based sources.

ES.4 Conceptual Site Model

Given historical releases from the GE Pittsfield facility, PCBs are distributed within the Housatonic River's sediments and floodplain. Currently, PCBs enter the Rest of River at the Confluence, primarily from the East Branch. Increases in surface water PCB concentrations across Reach 5 indicate that PCBs contained in the River's sediments and riverbank soils in these reaches move into the water column. Under lower flows, PCBs within the sediment pore waters diffuse up into the overlying water column, causing the PCB loading to increase between the Confluence and Woods Pond headwaters (Figure ES-5). At higher flows, erosional processes generally occur within Reach 5A and the upper portion of Reach 5B. PCBs are introduced into the water column when sediments and riverbank soils are resuspended from these areas as a result of faster current velocities. PCB mass transport during these periods is substantially higher than at lower flows (Figure ES-5). Analyses of solids and PCBs during higher flows indicate that the areas downstream, primarily in Reach 5C, the adjacent backwaters, and Woods Pond, are generally depositional. Deposition of PCBs and solids also occurs within the Reach 5 floodplains during higher flows when the River is over-bank.

Average water column PCB concentrations under all flow conditions decrease across Woods Pond, as a result of settling of particulate matter, including that associated with PCBs that bind to algae and other organic matter. Dilution from increased flows causes reductions in PCB concentrations, and other processes (such as deposition and volatilization) result in a further decrease in the mass of PCBs transported within reaches downstream of Woods Pond. "Clean" solids that enter the River in these downstream reaches and are deposited in quiescent areas act to dilute the concentrations of PCBs in the surface sediments.

PCBs in the water column and sediments of the system are taken up by organisms that feed in the River and its floodplains. Analysis of fish data collected from Reaches 5 and 6 indicates that PCB uptake in most fish species consists of a mixture of water column-based and sediment-based dietary sources. Data from Rising Pond suggest that PCB uptake of fish in this reach may be more linked to food sources based in the water column.

Overall, the processes discussed above govern the transport and transfer of PCBs within the water column, sediments, and biota of the system. Analyses of changes in PCB concentrations over time provide some evidence of a declining trend in PCB concentrations in the water column over the last 20 years. Similar analyses indicated no statistically significant trend in surface sediment PCB concentrations over the same period, although analyses based on dated sediment cores indicated that the PCB concentrations of sediments that settled in depositional areas of Woods Pond and Rising Pond have decreased since the 1960s. However, due to large variability in the data, no definitive conclusions can be drawn from these trend analyses. For fish, the data from Massachusetts are insufficient to make a temporal trend analysis over a comparable period, while the data from Connecticut show a declining trend in fish tissue PCB concentrations over the last 20 years.

Executive Summary Figure

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

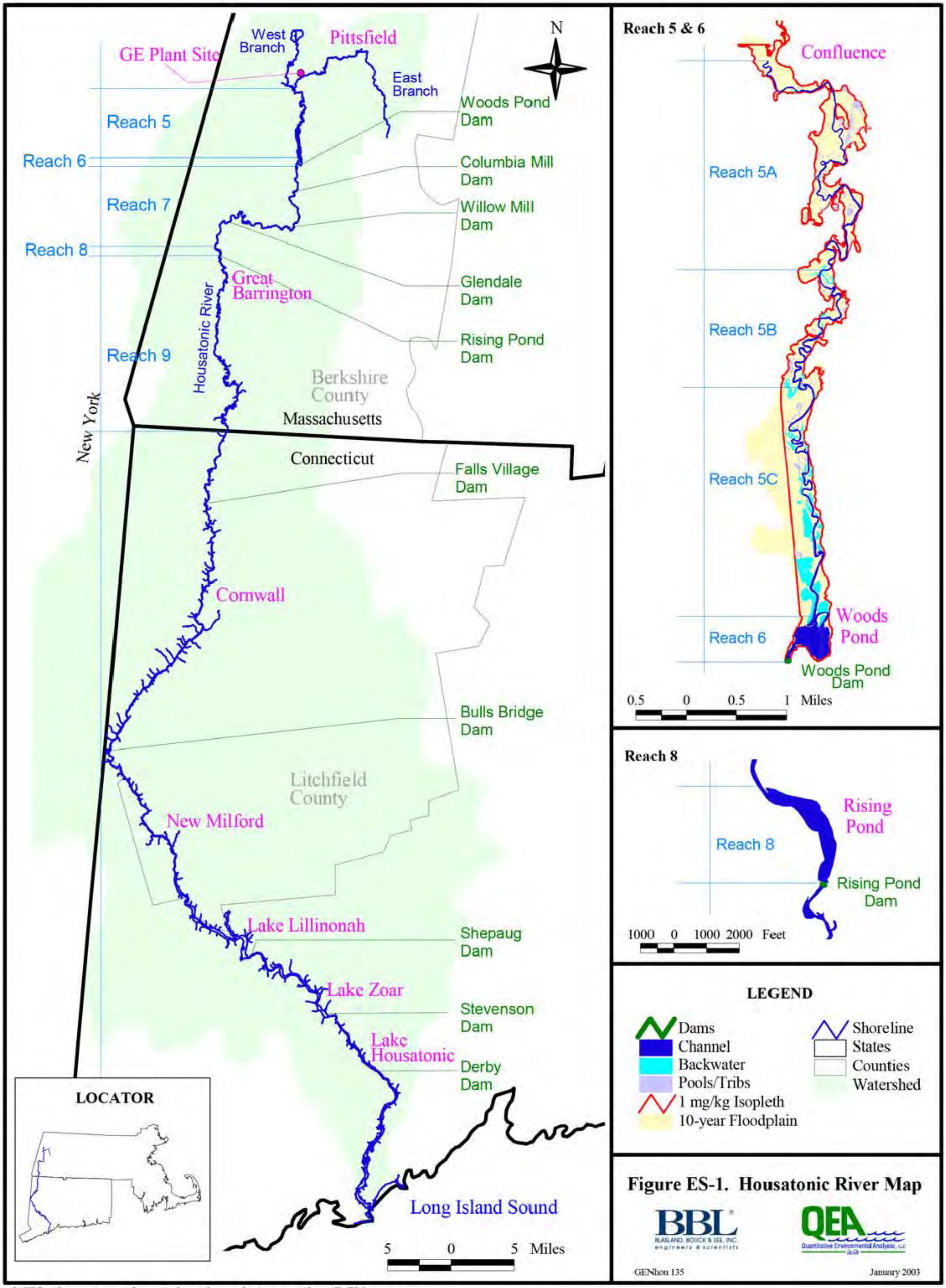


Figure ES-1. Housatonic River Map

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Section 1

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1. Introduction

1.1 Purpose and Scope

This *RCRA Facility Investigation Report* (RFI Report) documents the results of a number of sampling and investigative activities conducted since the mid 1970s to delineate the nature and extent of polychlorinated biphenyls (PCBs) and other chemical constituents in the Rest of River -- a portion of the Housatonic River located downstream of the confluence of the East and West Branches of the Housatonic River (the Confluence) in western Massachusetts and Connecticut (Figure 1-1). This RFI Report for the Rest of River was prepared pursuant to a permit issued to the General Electric Company (GE) by the United States Environmental Protection Agency (EPA) 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). This RCRA Permit (which constitutes a reissuance of a RCRA Permit previously issued to GE in February 1991, and reissued effective January 3, 1994) was reissued on July 18, 2000 and became effective on October 27, 2000 upon entry of the Consent Decree (CD) for the GE-Pittsfield/Housatonic River Site. (This permit is referred to herein as the "Reissued RCRA Permit.") The CD details the terms of an agreement among GE, EPA, the Massachusetts Department of Environmental Protection (MDEP), and a number of other governmental entities relating to the cleanup of GE's facility in Pittsfield, Massachusetts, the Housatonic River downstream of GE's facility, and other adjacent and nearby areas. This RFI Report has been prepared specifically to meet the requirements of Special Condition II.A of the Reissued RCRA Permit. This version of the RFI Report constitutes a revision of the RFI Report submitted by GE to EPA on January 3, 2003.

In the CD, the Rest of River is defined as follows:

> "...the Housatonic River and its sediments and floodplain areas downstream of the confluence of the East and West Branches of the Housatonic River, including backwaters, except for Actual/Potential Lawns, to the extent that such areas are areas to which Waste Materials that originated at the GE Plant Area have migrated and which are being investigated and/or remediated pursuant to this Consent Decree. Between the confluence of the East and West Branches of the River and Woods Pond Dam, the Rest of the River generally includes the Housatonic River and its sediments, as well as its floodplain

(except for Actual/Potential Lawns) extending laterally to the approximate 1 ppm PCB isopleth, as generally depicted on Figures 2 through 4 of Appendix A-1 [of the CD]. Downstream of Woods Pond Dam, the Rest of the River shall include those areas of the River and its sediments and floodplain (except for Actual/Potential Lawns) at which Waste Materials originating at the GE Plant Area have come to be located and which are being investigated and/or remediated pursuant to this Consent Decree."

Actual/Potential lawns, as defined in the CD, are "all areas of the Housatonic River Floodplain - Current Residential Properties except the riverbanks and those areas at which the wet nature or steep slope of the ground surface results in potential exposures that are inconsistent with residential use." These areas of current residential properties located in the floodplain of the River downstream of the Confluence that contain (or are likely to contain) PCBs at concentrations above 2 milligrams per kilogram (mg/kg) are being addressed separately, as described in Section 1.5.4, below.

In January 1996, GE submitted a prior RFI Report for the Housatonic River and Silver Lake, titled *Supplemental Phase II/RCRA Facility Investigation Report for Housatonic River and Silver Lake* (1996 RFI Report) (Blasland, Bouck & Lee, Inc. [BBL], 1996), pursuant to the previously issued RCRA Permit. The 1996 RFI Report covered the Rest of River area as well as areas upstream of the Confluence. Since that time, EPA and GE have continued to collect additional data from the Rest of River area for various purposes, including use in modeling the fate, transport, and bioaccumulation of PCBs, and in developing human health and ecological risk assessments. Investigations related to the nature and extent of chemical constituents in the River have also been carried out to provide data to assess biota consumption advisories that are currently in effect for specific reaches of the Housatonic River. The advisories in Massachusetts are based upon findings of PCBs in the tissues of certain biota, and the advisories in Connecticut are based upon the presence or potential presence of PCBs and/or mercury in certain fish.

As provided in the Reissued RCRA Permit and based on both recent and historical data, this RFI Report for the Rest of River area documents the nature, extent, fate, and transport of chemical constituents that have potentially migrated from the GE facility in Pittsfield into the surface water, sediments, floodplain soils, and biota of the Rest of River area, and the concentrations of PCBs in the ambient air of the Rest of River area. This RFI Report includes discussions of activities performed and data received for the Rest of River through November 2002, as supplemented by certain additional activities performed and data received since that time. Data previously reported in the 1996 RFI Report (BBL, 1996) and other GE documents have been cited, or when more appropriate for ease of data presentation/analysis, incorporated in this RFI Report.

Following GE's submittal of this revised RFI Report, EPA will approve, conditionally approve, or disapprove the Report. If EPA disapproves the Report, EPA may either specify deficiencies and establish a time frame for GE to submit a modified report, or EPA may make such modifications as it deems necessary to satisfy requirements of the revised RCRA permit. If EPA makes such modifications, the modified report will become the approved RFI Report. Also, if EPA's response concludes that further investigation is required, GE is required to implement the investigation in accordance with the implementation schedule provided by EPA.

1.2 Report Organization

The content and structure of this RFI Report are based on the requirements of Special Condition II.A of the Reissued RCRA Permit. Section 1 presents relevant background information, while Section 2 describes the environmental setting of the site, including an overview of the physical location and extent of the site and associated hydrology, hydrogeology, and regional climatic conditions. That section also identifies the primary constituents of concern associated with the Rest of River, which consist of PCBs and potentially, to a lesser extent, polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Sections 3 through 7 provide detailed discussions of investigation activities and results of data analyses to characterize the nature and extent of these constituents in affected media, including surface water (Section 3), sediment (Section 4), bank and floodplain soils (Section 5), biota (Section 6), and air (Section 7). Section 8 presents an assessment of the sources, fate, transport, and bioaccumulation of the key constituents of concern for the Rest of River and includes a presentation and discussion of modeling/fate and transport-related data collected from the Rest of River area. Finally, Section 9 presents a conceptual site model of the Rest of River area and includes several conclusions regarding the fate, transport, and bioaccumulation of the key constituents. Supporting documentation is provided in Appendices A through F, as well as the various tables, figures, and references included in this RFI Report. Appendix A provides a summary of the various sampling and analysis activities that have been conducted in the Rest of River area; Appendix B presents all PCB data for water, sediment, soil, and biota from this area; Appendix C presents a summary of non-PCB constituent data for these media;

Appendix D provides an evaluation of certain data quality/interpretation issues; Appendix E contains the mathematical equations for the fate and transport evaluation in Section 8; and Appendix F contains electronic versions of the EPA and GE Housatonic River databases used to generate this report, which include data for the Rest of River area as well as upstream of the Confluence.

When presenting the data collected and discussing constituent concentrations, the following units are used in this RFI Report.

- For water (as well as microorganisms) – milligrams per liter (mg/L, equivalent to parts per million), micrograms per liter (µg/L, equivalent to parts per billion), nanograms per liter (ng/L, equivalent to parts per trillion), or picograms per liter (pg/L, equivalent to parts per quadrillion);
- For solids – milligrams per kilogram (mg/kg, equivalent to parts per million), micrograms per kilogram (µg/kg, equivalent to parts per billion), or picograms per gram (pg/g, equivalent to parts per trillion); and
- For air – micrograms per cubic meter ($\mu g/m^3$).

1.3 Background and Overview of Housatonic River Investigation Activities

GE has owned and operated a manufacturing plant along the bank of the East Branch of the Housatonic River in Pittsfield, Massachusetts since the early 1900s (Figure 1-1). The primary industrial activities at this plant have included the manufacturing and servicing of power transformers (GE Transformer), defense and aerospace operations (GE Ordnance), and the manufacture of plastics (GE Plastics). The release of PCBs to the Housatonic River was primarily associated with the Transformer Division's activities that included the construction and repair of electrical transformers utilizing dielectric fluids containing PCBs. GE manufactured and serviced transformers containing PCBs at this facility from approximately 1932 through 1977. During this period, releases of PCBs reached the East Branch of the Housatonic River and Silver Lake through the facility's wastewater and stormwater systems.

In the late 1930s or early 1940s, approximately one mile of the River in Pittsfield was straightened and rechannelized by the City of Pittsfield and the US Army Corps of Engineers to reduce flooding. This resulted in the isolation of eleven former oxbows from the river channel. Some of these oxbows were filled with material from GE and others that was later found to contain PCBs.

PCBs were initially discovered in sediments and fish in impounded lakes along the Housatonic River in Connecticut in the mid-1970s. Since that time, numerous investigations have been conducted by GE and others to assess the presence and extent of PCBs and other hazardous substances in various media in both the Massachusetts and Connecticut portions of the Housatonic River, including the Rest of River area.

Major investigations undertaken along the Housatonic River include:

1. Studies performed during the 1970s by the Connecticut Department of Environmental Protection (CDEP), United States Geological Survey (USGS), and Connecticut Agricultural Experiment Station (CAES);
2. An investigation by GE in the early 1980s pursuant to Consent Orders executed by GE with EPA and the Commonwealth of Massachusetts in 1981;
3. Additional investigations by GE in the 1990s pursuant to an Administrative Consent Order (ACO) executed by GE and the MDEP in 1990 pursuant to the Massachusetts Contingency Plan (MCP) and the prior RCRA Permit issued by EPA to GE in February 1991 and reissued effective January 1994;
4. Ongoing investigations by GE in Massachusetts since 1996, including data collection to support modeling efforts, floodplain property characterization, young-of-year (YOY) fish monitoring, and sampling related to human health and ecological risk assessment activities.
5. Investigations performed by GE under 1984, 1990, and 1999 Cooperative Agreements between GE and CDEP; and
6. A multi-year sampling effort by EPA, which commenced in 1998, in anticipation of and pursuant to the CD.

As part of these investigations, sediment, surface water, floodplain soils, biota, and ambient air samples were collected from the Rest of River area for analyses of PCBs and other constituents. Extensive sediment reconnaissance and probing efforts were also undertaken, and samples were collected for geotechnical analyses to characterize sediment composition.

This section provides a brief chronological summary of the major Housatonic River investigation activities.

1.3.1 Studies Performed During the 1970s

Studies performed during the mid-1970s by CDEP and USGS identified and confirmed the presence of PCBs in the River sediments in Connecticut. In 1977, PCBs were detected in select fish collected from the Connecticut portion of the River. This finding led to a more thorough investigation of the River sediments in Connecticut. This investigation, performed jointly by CDEP, USGS, and CAES, included a study of PCB distribution in the River sediments in Massachusetts and Connecticut. The results of this investigation were presented in a document titled *Polychlorinated Biphenyls in Housatonic River Sediments in Massachusetts and Connecticut: Determination, Distribution, and Transport* (Frink et al., 1982).

1.3.2 GE Investigations in the Early 1980s

In May 1981, GE signed Consent Orders with the Massachusetts Department of Environmental Quality Engineering (now MDEP) and EPA to assess and characterize the presence and transport of PCBs in the Housatonic River system in Massachusetts, including Silver Lake, as well as to assess PCB levels in select biota in the River. These investigations were performed in 1980 and 1982 by Stewart Laboratories, Inc. (Stewart), and the results were documented in a report titled *Housatonic River Study - 1980 and 1982 Investigations* (Stewart, 1982).

1.3.3 GE Investigations in the 1990s

Pursuant to an ACO executed by GE and MDEP effective May 22, 1990, GE undertook an MCP Phase II Comprehensive Site Investigation of the Housatonic River and Silver Lake and submitted a report thereon to MDEP. In addition, pursuant to a RCRA Permit issued by EPA to GE in February 1991 and later reissued effective January 3, 1994, GE carried out investigations of releases from solid waste management units (SWMUs) at the GE Pittsfield facility. For this purpose, the RCRA Permit divided the

GE Pittsfield facility and other affected properties into various areas, one of which (Area 6) included the Housatonic River and Silver Lake. Under the RCRA Permit, in addition to submitting a proposal for an RFI for the various areas, GE submitted a Current Assessment Summary (CAS) describing all available data pertaining to site characteristics and nature and extent of contamination.

The proposed MCP Phase II Comprehensive Site Investigation was completed in September 1991. Objectives of these investigation were to: 1) provide additional sediment information to supplement the information that was generated during the Stewart studies; 2) assess the transport of PCBs and/or other chemical constituents in the River water column; 3) characterize the presence of PCBs within the floodplain areas of the River system; 4) provide a current assessment of a number of former River oxbow areas near the GE Pittsfield facility that were potentially utilized as disposal areas; 5) provide a current assessment of the extent of PCB bioaccumulation in select River biota; and 6) determine the extent and impacts of contaminants in the River system on human health and the environment. The results of these investigations were presented in a report titled *MCP Interim Phase II Report/Current Assessment Summary for Housatonic River* (Interim Phase II Report/CAS) (Blasland & Bouck Engineers, P.C. [Blasland & Bouck], 1991). That document, submitted to MDEP and EPA in December 1991, not only reported the results of the MCP Phase II Comprehensive Site Investigation, but also provided a summary of investigations performed prior to the 1990 ACO, as well as those performed in the Connecticut portion of the Housatonic River pursuant to the 1990 Cooperative Agreement between GE and CDEP. An Addendum to the Interim Phase II Report/CAS was subsequently submitted to MDEP and EPA on August 25, 1992 (Blasland & Bouck, 1992), which provided clarification to a number of comments made by MDEP on the original report, as well as the results of additional investigations conducted between December 1991 and August 1992.

In 1994, GE submitted, and MDEP and EPA conditionally approved, an *MCP Supplemental Phase II Scope of Work and Proposal for RCRA Facility Investigation of Housatonic River and Silver Lake* (Phase II SOW/RFI Proposal) (BBL, 1994), which addressed data gaps identified by MDEP in the Interim Phase II Report/CAS. GE commenced field activities shortly after receiving Agency approval. Additionally, GE proposed several additional activities to further expand the knowledge of various aspects of the site. These activities were presented in an Addendum to the 1994 Phase II SOW/RFI Proposal, which was submitted to the Agencies on November 17, 1995 (BBL, 1995).

In January 1996, GE submitted to EPA and MDEP an RFI Report (BBL, 1996), which was prepared to meet the two sets of requirements applicable to the GE Pittsfield facility. First, the document constituted a Supplemental Phase II Report on a Comprehensive Site Assessment of the Housatonic River and Silver Lake, as required by MDEP under the ACO executed by GE and MDEP in 1990. Second, the document constituted an RFI Report on the investigation of the Housatonic River and Silver Lake (jointly designated as Area 6 by EPA) pursuant to the January 1994 RCRA Permit issued to GE by EPA. The primary focus of the 1996 RFI Report was the presentation and evaluation of data received through the end of 1995.

1.3.4 Ongoing GE Investigations in Massachusetts

Since 1996, GE has continued to perform sampling activities along the Rest of River area of the Housatonic River. Activities have generally focused on collection of data relevant to the modeling efforts (e.g., monthly water column monitoring, storm-event sampling, sediment core sampling, and biota sampling), floodplain property characterization, and the ongoing biennial Massachusetts YOY fish monitoring program. In addition, GE collected split samples from EPA during EPA's field sampling activities, which are described below in Section 1.4.5, and has more recently updated sampling and performed studies for use in assessing human health/ecological risk (described in Section 6).

1.3.5 GE Investigations Under CDEP Cooperative Agreements

GE initially signed a Cooperative Agreement with CDEP in 1984, requiring, among other things, fish monitoring in the Housatonic River in Connecticut, as well as other evaluations and a public information program. In 1990, GE signed another Cooperative Agreement with CDEP to perform continued monitoring of fish in the Connecticut portion of the River, together with other evaluations relating to that portion of the River and a continuation of the public information program. These activities were carried out, and in October 1999, a new Cooperative Agreement was executed by GE and CDEP.

Since 1984, under these Cooperative Agreements, a Connecticut fish monitoring program has been conducted on a biennial basis on GE's behalf by the Academy of Natural Sciences of Philadelphia (ANSP). This program, which continued and built upon a study begun by CDEP in 1977, has been implemented to monitor PCB concentrations in selected fish, as well as benthic insects, in the Connecticut portion of the Housatonic River. The 1990 Cooperative Agreement with CDEP required performance of these biennial studies through 1994. Additional studies were conducted in 1996 and 1998, and the 1999 Cooperative Agreement required continuation of biennial biological monitoring studies in 2000, 2002, and 2004.

1.3.6 EPA Sampling and Investigation Activities in Connection with CD

In the fall of 1997, GE, EPA, MDEP, CDEP, and other governmental entities commenced negotiations on a comprehensive settlement that would provide for further investigations, evaluations, and remediation of the GE Pittsfield facility, the Housatonic River, and other nearby areas (collectively known as the GE-Pittsfield/ Housatonic River Site), as well as compensation for natural resource damages and reimbursement of past and future government response costs. The parties reached an agreement in principle in fall 1998 and executed a CD embodying the settlement agreement in October 1999. The CD was subsequently entered by the U.S. District Court and became effective on October 27, 2000.

The CD divided the Housatonic River into three reaches: 1) the Upper ½-Mile Reach, which is largely adjacent to the GE Pittsfield facility and several former oxbows of the River; 2) the 1½-Mile Reach, which extends from the downstream boundary of the Upper ½-Mile Reach to the Confluence; and 3) the Rest of River, which extends from the Confluence downstream. For the Rest of River area, the CD and the accompanying Reissued RCRA Permit specified a process that would lead to and include the selection of a Remedial Action. Among other things, that process provided that EPA would conduct additional sampling and perform human health and ecological risk assessments, as well as modeling of the fate, transport, and bioaccumulation of PCBs in the Rest of River area, with its risk assessments and modeling subject to independent peer review. It also provided that GE would compile all data collected from the Rest of River area into an RFI Report.

In 1998, in anticipation of reaching a final settlement, EPA commenced an extensive multi-year sampling effort in the Rest of River area of the Housatonic River. The *Final Supplemental Investigation Work Plan for the Lower Housatonic River* (SI Work Plan) (Weston, 2000) described the sampling to be undertaken by EPA to further delineate the nature and extent of contaminants, support its modeling activities, and support its human health and ecological risk assessments. EPA implemented both systematic sampling (i.e., along regularly spaced transects) and discrete sampling of the River sediments and floodplain soils. Systematic sampling was performed to obtain data to characterize the reach as a whole, and discrete sampling was performed to characterize unique areas (e.g., depositional areas behind dams, backwater pools, human-use areas/River areas adjacent to human-use areas, etc.). EPA also performed monthly water column and storm flow sampling, as well as an extensive amount of biological sampling to support its modeling and risk assessments. Ambient air sampling was performed to provide data for EPA's risk assessment evaluation. Data collection activities, tasks, and programs completed by EPA in accordance with the SI Work Plan were documented in EPA's *Rest of River Site Investigation Data Report* (SI Data Report) (Weston, 2002), along with the collected data. The SI Data Report accompanied EPA's August 8, 2002 letter notifying GE to proceed with preparation of this RFI Report.

The sampling programs outlined above are described in more detail in the appropriate media-specific sections of this RFI Report, along with summaries of the data and analyses of the results.

1.4 Overview of Housatonic River Source Control and Remediation Activities

GE has undertaken and will continue to undertake source control and other remediation activities in and along the Housatonic River. The activities that GE has undertaken to date include: source control activities at and near the GE facility to prevent or control the migration of PCBs and other chemical constituents present in non-aqueous-phase liquid (NAPL) into the River; dam reconstruction projects in the Rest of River; soil removal and capping activities at a number of floodplain properties; and sediment and bank soil remediation projects in the Upper ½-Mile Reach of the River, including the Building 68 Area Removal Action and the Upper ½-Mile Reach Removal Action. In addition, under the CD, EPA is undertaking an extensive sediment/bank soil remediation project in the 1½-Mile Reach of the River; and GE is required to conduct additional investigations and remediation activities in floodplain and former oxbow areas adjacent to the River as necessary to meet Performance Standards set forth in the CD, as well as to conduct sediment and bank soil removal and/or capping at Silver Lake (which discharges to the River). These activities are described further below.

1.4.1 NAPL Recovery and Control Activities at and near GE Plant

NAPL monitoring, recovery, and control activities have been performed by GE for over 40 years for some portions of the site adjacent to the Housatonic River. The results of those activities have been documented in numerous reports prepared under the MCP and RCRA Corrective Action Programs prior to fall 2000 and under the CD thereafter. More detailed information can be found in the document titled *Baseline Monitoring Program Proposal for Plant Site 1 Groundwater Management Area* (BBL, 2000a) and in subsequent reports submitted to EPA on the NAPL monitoring and recovery efforts (BBL, 2002a, covering fall 2001 activities; BBL, 2002b, covering spring 2002 activities).

In general, GE's NAPL recovery program includes operation of several automated hydraulic control and NAPL recovery systems, and routine manual monitoring and recovery operations for light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL). Automated recovery systems are operated in portions of the GE Plant adjacent to the Housatonic River (notably, the area referred to as East Street Area 2-South) and at certain former oxbow areas (notably, the Lyman Street Area and Newell Street Area II). The manual recovery program includes a combination of weekly to semi-annual groundwater and NAPL thickness measurements and manual removal of NAPL if the observed thickness is greater than location-specific criteria.

In addition to the NAPL monitoring and recovery operations, GE has installed a number of permanent sheetpile barrier walls adjacent to the River to prevent or control the migration of NAPL to the River. Certain of these sheetpile barriers were installed prior to, while others were installed during, the Building 68 Area and Upper ½-Mile Reach Removal Actions (discussed below). The monitoring and operation of the recovery systems in conjunction with the permanent sheetpile barrier walls limit the potential for movement of NAPL to the River.

Further, oil recovery facilities have been used to recover oil from oil plumes within East Street Area 2-South and another portion of the GE Plant known as East Street Area 1. Groundwater is pumped from each of the oil recovery facilities to provide more efficient oil recovery by establishing a cone of depression that provides oil movement to the recovery units. The groundwater recovered during this process (as well as groundwater from the Lyman Street Area recovery system) is pumped to the 64G groundwater treatment facility, which became operational in 1991. The 64G groundwater treatment facility, which accommodates a maximum influent flow of 600 gallons per minute (gpm), was designed to remove various chemical constituents, such as PCBs, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) as well as oil and grease, metals (soluble and insoluble), and other inorganics, from the groundwater. Treated groundwater is currently discharged from the 64G groundwater treatment facility to the River in accordance with GE's National Pollutant Discharge Elimination System (NPDES) permit (MA0003891, effective February 7, 1992). In addition, a portion of the treated groundwater is sometimes discharged to a groundwater recharge pond in East Street Area 2-South to maintain desirable hydraulic mounding associated with this pond.

1.4.2 Other Historical Remediation Activities

In addition to the above-described source control activities, GE conducted a number of remedial measures in the River and its floodplain in the late 1980s and early 1990s under EPA and/or MDEP oversight. These remedial measures included:

- Reconstruction of Woods Pond Dam in 1989;
- Assistance in the reconstruction of Rising Pond Dam in the early 1990s;
- Performance of short-term measures (STMs) and immediate response actions (IRAs) in the floodplain, which involved the posting of signs, installation of exposure barriers, and/or removal and replacement of PCB-containing soil at a number of residential and non-residential properties in the floodplain of the Housatonic River located primarily upstream of the Confluence; and
- Posting of warning signs at numerous locations along the riverbanks concerning potential exposures to PCBs and/or the biota consumption advisories issued by Massachusetts and Connecticut.

More detailed descriptions of these activities and associated results are provided in the 1996 RFI Report (BBL, 1996) and documents referenced therein.

1.4.3 Building 68 Area Removal Action

Between June 1997 and July 1999, GE implemented a Removal Action to address the presence of PCBs in the riverbanks and sediments at the Building 68 Area, which is located along the Housatonic River at the GE Pittsfield facility. This Removal Action was performed in accordance with the First Unilateral Administrative Order for Removal Action (the Building 68 Area Order), which was issued by EPA to GE on December 18, 1996 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Removal Action was also performed consistent with the procedures established in the May 1997 documents titled *Building 68 Removal Action Work Plan* (BBL, 1997) and *Removal Action Operations Plan* (Maxymillian Technologies, Inc. [MTI], 1997).

Pursuant to the Building 68 Area Order, GE removed certain River sediments from an approximate 500-foot stretch of the River generally located in the vicinity of Building 68. Prior to initiating removal activities, water column, biota, and air monitoring activities were performed within the vicinity of Building 68 to document "baseline" or pre-removal water and air quality conditions within and/or adjacent to the River. In all, approximately 5,000 in-place cubic yards (cy) of PCB-containing sediment were removed and disposed of off site. Sediment removal was performed while the River and groundwater were being actively diverted or extracted from the removal area. This approach involved the use of sheetpiling positioned within the River to isolate the sediment removal areas. Subsequent to sediment removal, the River bottom was restored to original grade using a multi-layer backfill system including geotextile, sand, and rip-rap.

Approximately 1,100 in-place cy of PCB-containing soil were removed from an approximate 170-foot portion of the riverbank in the vicinity of Building 68 and disposed of off site. In addition, in response to the presence of NAPL in the riverbank, approximately 180 feet of impermeable barrier sheetpile was installed in the riverbank, and lower bank soil and sediment were removed from the remaining bank area adjacent to the sediment removal area. Concurrently, certain areas of the upper bank were excavated to depths of 1 to 3 feet. These areas were excavated consistent with proposed bank soil removal activities associated with the Upper ½-Mile Reach of the River scheduled to begin in 1999. However, since GE was already performing lower bank soils removal activities in the Building 68 area, upper bank soil removal activities were performed at the same time. The total additional bank and sediment material removed during these two activities was 1,230 in-place cubic yards. The riverbank was restored, and run-off control and scour protection measures were installed to provide protection of the bank area in the vicinity of Building 68 adjacent to the sediment removal area.

In addition to the baseline monitoring conducted prior to removal activities, water column and biota monitoring activities were performed during and following implementation of the Removal Action, and air monitoring was performed during Removal Action implementation. Results of this monitoring, as well as documentation of the Building 68 area removal activities, are provided in the report titled *Completion of Work Report for Building 68 Removal Action* (BBL, 2000b).

1.4.4 Upper ½-Mile Reach Removal Action

Analytical results of sampling efforts undertaken by GE between 1981 and 1998 and by EPA in 1998 (which included the collection of more than 640 sediment samples from 228 locations and approximately 1,200 bank soil samples from 429 locations, excluding the previously remediated Building 68 Area at the GE Pittsfield facility) identified locations with elevated levels of PCBs within the Upper ½-Mile Reach located adjacent to the GE facility. The CD required GE to implement a Removal Action to remediate the sediments and bank soils in the Upper ½-Mile Reach (excluding the Building 68 Area). GE implemented this Removal Action in accordance with the *Removal Action Work Plan – Upper ½-Mile Reach of Housatonic River* (Upper ½-Mile Work Plan) (BBL, 1999a), which was an attachment to the CD. Work commenced during October 1999 and was substantially completed in August 2002. The final plantings were installed in September 2002 and long-term monitoring and maintenance activities will continue.

As described in the Upper ½-Mile Work Plan, the action involved removal and restoration of select sediments and bank soils from portions of the Upper ½-Mile Reach (BBL, 1999a). In the majority of areas where sediment removal was undertaken, the removal depth generally ranged from 1.5 to 2 feet, with removal to greater depths at a limited number of areas due primarily to the presence of NAPL. The general sediment removal and restoration approach involved diverting the River around established work areas in a phased, area-by-area approach using steel sheetpiling, dewatering the work cell in which work was to be performed, treating the water as required, and performing sediment removal, replacement, and restoration activities "in the dry." During these activities, NAPL was discovered in a number of areas, some containing PCBs and others containing coal-tar related constituents characteristic of wastes associated with a former Berkshire Gas manufactured gas plant (MGP) that had been located within an area of the GE facility near the Upper ½-Mile Reach. The removed sediment was permanently consolidated with other GE site-related materials at EPA-approved On-Plant Consolidation Areas (OPCAs) at the GE Pittsfield facility, with the exception of NAPL-impacted sediment, which was disposed of off-site at an approved disposal facility. Following removal, the sediment removal areas were capped and armored using a multi-layer cap system. Aquatic enhancement structures were also installed as part of the Upper ½-Mile Reach restoration activities to increase the variability in water flow and depth and to enhance in-stream habitat.

The spatial average PCB concentration for the top foot of sediment in the Upper ½-Mile Reach prior to commencement of removal activities was approximately 55 mg/kg. After removal and replacement of sediment with the highest PCB concentrations, the spatial average PCB concentration in the surficial sediment (top foot) was reduced to less than 1 mg/kg. Sediment replacement activities were designed to effectively isolate remaining PCB-containing sediment and to minimize the potential for resuspension of sediments, desorption of PCBs from the sediments into the water column, and direct contact of humans and biological receptors with PCB-containing sediment.

Bank soil removal activities were conducted in coordination with the sediment removal and restoration activities. Bank soil removal generally occurred to a maximum depth of 3 feet to achieve spatial average PCB concentrations less than 10 mg/kg in the top foot and less than 15 mg/kg in the 1- to 3-foot depth increment in each of the averaging areas specified by EPA. In a limited number of areas, NAPL was encountered and deeper excavation was required, while in other areas, permanent sheetpile barriers were installed for NAPL containment and monitoring systems were constructed. In total, approximately 1,600 linear feet of permanent sheetpile were installed along the north bank of the Upper ½-Mile Reach. In addition, GE removed and/or stabilized bank soil along portions of the bottom or the "toe of banks," as agreed to by GE, EPA, and MDEP. Following removal, impacted areas were backfilled and the bank habitat restored using an engineered soil and vegetative cover, except along the lower banks at the toe of the slope, where armor stone was placed on the bank surface for erosion protection. As with the sediments, the removed soil was permanently consolidated on-site with other GE site-related materials, with the exception of NAPL-impacted materials, which were disposed of off-site.

As with the sediment removal and restoration activities, the bank soil removal and restoration activities were designed to effectively isolate remaining PCB-containing bank soils from both erosion and direct contact by human or biological receptors.

It was originally estimated that approximately 8,100 cy of sediment and approximately 4,300 cy of bank soils would be removed, followed by the replacement and restoration of approximately 52,000 square feet of bank area. The removal of an additional 340 cy of bank soil was planned between the River and the source control sheetpiling that had previously been installed at East Street Area 2-South (at the GE Pittsfield facility) to help complete source control activities in that area. The actual quantities of sediment and bank soil removed were 11,800 cy and 6,700 cy, respectively, with the increase in removal volumes primarily attributable to additional removal associated with the occurrence of NAPL. NAPL was encountered in most of the work cells during removal activities. In general, when NAPL was encountered, efforts were undertaken to delineate the potential extent of NAPL and identify potential sources, and to the extent practical, additional removal activities were performed to remove the NAPL (resulting in as much as 8 to 9 feet of additional sediment excavation). The NAPL-impacted sediment was successfully removed in all but two locations. At these two locations, an impermeable cap and NAPL observation/recovery well were installed in the River. Since completion of restoration activities and return to normal hydraulic conditions, NAPL has not been recovered from the observation/recovery wells. In addition, including the source control sheetpile wall installed during the Building 68 work, a total of seven permanent source control sheetpile barriers were installed in the Upper ½-Mile Reach to control the migration of NAPL to the River.

During performance of the Upper ½-Mile Reach removal activities, water column monitoring was performed on a daily basis. Water column monitoring consisted of daily composite analyses for turbidity at both an upstream and downstream location, and bi-weekly grab sampling for PCBs (filtered and unfiltered) and total suspended solids (TSS) at the same locations, with the collection of additional PCB and TSS samples in the event that the turbidity action level (i.e., downstream measurement 50 NTU above upstream) was exceeded. Daily composite turbidity readings ranged from 1 to 141 NTU with an average of 6.2 NTU, and did not exceed the action level on any occasion. The unfiltered PCB results ranged from non-detect to 6.46 μg/L, with an average of 0.48 μg/L, and the filtered PCB results ranged from non-detect to 0.776 μg/L, with an average of 0.027 μg/L. The TSS results ranged from non-detect to 59.7 mg/L, with an average of 6.84 mg/L.

1.4.5 1½-Mile Reach Removal Action

For the 1½-Mile Reach, which is located between the Upper ½-Mile Reach and the Confluence, the CD provided that EPA would complete an Engineering Evaluation/Cost Analysis (EE/CA) under CERCLA to evaluate potential removal actions for the sediments and bank soils in this reach, and EPA would then conduct a Removal Action, as selected in an Action Memorandum, to address those sediments and bank soils. Land use along this reach is variable, with residential and commercial uses being predominant. Another former Berkshire Gas MGP site is located along this reach of the River. In addition to GE's historical sampling, to support the EE/CA, EPA conducted systematic sampling of the sediments and bank soils in the 1½-Mile Reach between October 1998 and July 1999, and collected additional samples for geotechnical analysis. EPA performed subsequent investigation activities during 2000 to collect data and information to further assess potential NAPL sources, obtain additional geotechnical data, and assess constituent concentrations in banks and sediments at depth. Data collected in the 1½-Mile Reach were reported in EPA's *Final Draft Engineering Evaluation/Cost Analysis for the Upper Reach of the Housatonic River* (EE/CA Report) (EPA, 2000a) and the *Final Addendum to the Engineering Evaluation/Cost Analysis for the Upper Reach of the Housatonic River* (EE/CA Addendum) (EPA, 2000b).

Based on the analyses results of 764 sediment samples and more than 1,500 bank soil samples collected during the 1½-Mile Reach investigations (which are presented in the EE/CA Report), the average PCB concentration for sediments within the 1½-Mile Reach, by subreach and by depth, ranges from 0.3 mg/kg to 312 mg/kg with an overall average concentration of 28.5 mg/kg for all subreaches and depths. The average PCB concentration for bank soils by subreach and by depth ranges from 1.2 mg/kg to 78.3 mg/kg.

In its EE/CA Report and EE/CA Addendum (EPA, 2000a, b), EPA used the data collected to formulate several remedial alternatives for the 1½-Mile Reach. Based on its evaluation, EPA issued an Action Memorandum, dated November 21, 2000, selecting a Removal Action that consisted of the excavation and disposal of approximately 95,000 cy of sediments and bank soils (EPA, 2000c). The selected remedy involves sediment and bank soil removal in-the-dry using sheetpiling and pump bypass, and disposal will consist of consolidation of 50,000 cy of material at GE's OPCAs and off-site disposal of the remaining material. Habitat restoration will include a combination of regrading, revegetation, bioengineering, and potential installation of habitat improvements such as low-stage dams and boulders. Excavation in the 1½-Mile Reach began in September 2002 upon completion of excavation and riverbed restoration activities in the Upper ½-Mile Reach. The 1½-Mile Reach Removal Action will be performed in phases and is currently anticipated to take approximately 5 to 6 years to complete.

1.4.6 Floodplain Properties Adjacent to 1½-Mile Reach

Several floodplain properties adjacent to the 1½-Mile Reach are also addressed in the CD. These properties are included in two Removal Action Areas (RAAs) designated in the CD and accompanying *Statement of Work for Removal Actions Outside the River* (SOW) (BBL, 1999b), which are:

- Floodplain Current Residential Properties Adjacent to 1½-Mile Reach - Actual/Potential Lawns; and
- Floodplain Non-Residential Properties Adjacent to 1½-Mile Reach (Excluding Banks).

Collectively, these areas are referred to as the 1½-Mile Floodplain RAAs. The 1½-Mile Floodplain RAAs cover portions of numerous floodplain properties located adjacent to or in close proximity to this River reach, but will not be addressed by EPA's 1½-Mile Reach Removal Action. For each Floodplain Removal Action, the CD and SOW establish Performance Standards that must be achieved, as well as specific work plans and other documents that must be prepared to support the response actions for each RAA.

The portions of the properties within the 1½-Mile Floodplain addressed under these RAAs consist of the Actual/Potential Lawns (as defined in the CD) of 35 current residential properties and the non-riverbank portions of 10 non-residential properties (consisting of eight recreational properties and two commercial/industrial properties). For the purposes of the removal actions for these RAAs, the SOW defines the "floodplain" of this reach as the area between the top of the riverbank and the approximate 1 mg/kg PCB isopleth.

As part of prior investigations performed by GE and/or EPA, 32 of the 34 current residential properties were subject to soil investigations. To date, more than 4,900 soil samples have been collected for PCB analysis, and more than 60 samples have been collected and analyzed for the other constituents listed in Appendix IX of 40 CFR Part 264 (Appendix IX constituents). In addition, 12 of these properties have been subject to separate response actions performed by GE as STMs or IRAs pursuant to the MCP and under the direction of MDEP. At eight of these residential properties, those prior response actions involved soil excavation, while at the other four properties, the prior response actions involved non-excavation activities (e.g., signs, access restrictions). Eight of the non-residential properties were subject to soil investigations as part of prior investigations performed by GE and/or EPA. In addition, GE excavated soil at one of these non-residential properties as an IRA pursuant to the MCP.

In January 2002, GE submitted a *Pre-Design Investigation Work Plan for Floodplain Properties Adjacent to the 1½-Mile Reach of the Housatonic River* (BBL, 2002c) to EPA, as required by the CD and SOW. This work plan described GE's proposed initial pre-design soil investigations for the 1½-Mile Floodplain RAAs. GE proposed to perform these pre-design activities in a phased manner to allow for general coordination with EPA's response actions in the corresponding sections of the River. EPA issued a conditional approval of this work plan on July 8, 2002, for the floodplain properties in the first phase of action. For the properties in this first phase, GE submitted an *Addendum to the Pre-Design Investigation Work Plan for Floodplain Properties Adjacent to the 1½-Mile Reach of the Housatonic River* (BBL, 2002d) on July 22, 2002, which was approved by EPA. The initial investigations of these properties, which focused on PCBs, were completed in November 2002, and the results will be presented in a *Second Addendum to the Pre-Design Work Plan* in early February 2003. Based on the results of the initial investigations, GE will evaluate the need for additional sampling. After completion of sampling for the properties in each phase, GE will submit a *Pre-Design Investigation Report* for that phase. The results of all pre-design investigations for each phase, in combination with usable prior data, will then be used to support the subsequent evaluation and design of any soil-related response actions that may be needed to achieve the Performance Standards at the floodplain properties within that phase.

1.4.7 Silver Lake Area

Silver Lake, which discharges to the East Branch of the Housatonic River through a 48-inch-diameter concrete pipe in the southwest portion of the lake, is located adjacent to the GE Pittsfield facility and is one of the RAAs designated in the CD and accompanying SOW. Included in the Silver Lake RAA are sediments within the lake and soils located in certain areas adjacent to the lake. The CD and SOW establish Performance Standards that must be achieved, as well as specific work plans and other documents that must be prepared to support the response actions for the Silver Lake RAA.

Between 1980 and 1995, sediment sampling for PCBs was performed on several occasions in Silver Lake, resulting in the collection of more than 200 samples at sediment depths up to 24 feet. The results of these analyses indicated that PCBs were present in lake sediments at concentrations ranging from non-detect to 6,350 mg/kg, with three higher concentrations between 11,000 and 20,689 mg/kg near an outfall in the northeast corner of Silver Lake. The spatial average PCB concentration in the top foot of sediments (excluding the highest concentration of 20,689 mg/kg) is approximately 330 mg/kg.

As described in the CD and SOW, the Silver Lake RAA includes bank soils related to several properties that are adjacent to the lake, including seven residential properties, nine separately owned commercial/industrial properties, and an unimproved strip of land (considered to be in "recreational" use) along the northern and eastern sides of the lake, most of which is owned by the City of Pittsfield. Investigations performed by GE and EPA (as part of its Superfund Technical Assessment and Response Team [START] Program) resulted in the collection of numerous soil samples from and adjacent to these properties. In summary, more than 400 soil samples have been collected and analyzed for PCBs at depths up to 16 feet with concentrations ranging from non-detect to 1,400 mg/kg. A total of 14 soil samples have also been analyzed for other Appendix IX+3 constituents. The results of these analyses indicate the presence, at varying concentrations, of certain SVOCs, polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and inorganics.

Based on the results of the sampling efforts, a series of response actions for sediments and bank soils was specified in the CD. The actions for bank soils are contingent upon further analysis and evaluation, and therefore will not be described here. The three primary response actions for sediments are summarized below:

1. Remove in-situ sediments from the lake in the general vicinity of the existing outfall from the GE Pittsfield facility, replace removed sediments, and restore and vegetate portions of the affected area that are not under water;
2. Install a cap over the entire bottom of Silver Lake; and
3. Periodically inspect and monitor the cap to assess effectiveness.

In April 2002, as required by the CD and SOW, GE submitted to EPA a *Pre-Design Investigation Work Plan for the Silver Lake Area Removal Action* (BBL, 2002e), which described the pre-design activities proposed by GE for the Silver Lake RAA for both sediments and bank soils. In a letter dated November 21, 2002, EPA provided comments on that Work Plan, and a revised Work Plan will be submitted to EPA in January 2003. The results of the approved design activities, in combination with usable information from prior investigations for Silver Lake and any additional pre-design activities that may be performed in the future, will be used to support the subsequent evaluation and design of response actions necessary to achieve the Performance Standards for this RAA. The results of these evaluation and design activities will be presented in a *Conceptual RD/RA Work Plan*. Following EPA approval of that document, GE will then prepare a *Final RD/RA Work Plan* for the Silver Lake RAA.

1.4.8 Downstream Floodplain Residential Properties

In addition to the above-described activities, which mainly address response actions upstream of the Rest of River area, the CD requires GE to investigate and (as necessary) remediate certain floodplain residential properties located downstream of the Confluence separately from the Rest of River. Specifically, the CD requires GE to address the Actual/Potential Lawns (as defined in the CD) of current residential properties that are located, in part, in the floodplain of the Housatonic River downstream of the Confluence and that contain PCBs at concentrations above 2 mg/kg. These areas, known as the Housatonic River Floodplain Current Residential Properties Downstream of Confluence -- Actual/Potential Lawns RAA (hereafter referred to as "Downstream Floodplain Residential Properties"), will be addressed separately from response actions for the Rest of River. The SOW defines the "floodplain" between the Confluence and Woods Pond Dam as the area between the top of the riverbank and the approximate 1 mg/kg PCB isopleth line. The CD defines Actual/Potential Lawns as all areas of these current residential properties "except the riverbanks and those areas at which the wet nature or steep slope of the ground surface results in potential exposures that are inconsistent with residential use" (CD ¶ 4).

The CD and SOW establish Performance Standards that must be achieved at these properties, as well as specific work plans and other documents that must be prepared to support response actions at these properties. The CD and SOW also require, as part of the actions to address the Downstream Floodplain Residential Properties, that if PCB levels in the top 6 inches of soil in the non-Actual/Potential Lawns portions of such properties exceed certain trigger levels specified in the CD and SOW, GE must implement appropriate STMs, such as installation of warning signs, in such areas.

The SOW identifies the Actual/Potential Lawns of 12 residential properties located between the Confluence and Woods Pond Dam as falling within the Downstream Floodplain Residential Properties RAA. In addition, it provides that this RAA will include the Actual/Potential Lawns of residential properties downstream of Woods Pond Dam where PCBs have been found in excess of 2 mg/kg. In November 2001, EPA issued a final draft document titled *Phase 1 Human Health Risk Assessment for Rest of River* (Phase 1 HHRA Report) (EPA, 2001). In that report, based on a review and evaluation of EPA's soil sampling data from residential properties in the floodplain, EPA made certain modifications to the list of residential properties. Four of the 12 residential properties between the Confluence and Woods Pond Dam were eliminated from further consideration since PCB concentrations were less than EPA's residential floodplain soil screening risk-based concentration of 2 mg/kg. Further, EPA's Phase 1 HHRA Report identified 28 additional residential properties downstream of Woods Pond Dam (all located in the reach between Woods Pond Dam and Rising Pond Dam) as having (or potentially having) PCB concentrations greater than 2 mg/kg and thus as being "transferred to GE" for further evaluation in the RAA (a total of 36 properties). (The Phase 1 HHRA also identified five other residential properties between Woods Pond Dam and Rising Pond Dam that have not been sampled but will be transferred to GE if the sampling on adjacent properties indicates the presence of PCBs at concentrations greater than 2 mg/kg.) As part of prior investigations performed by GE and/or EPA, 32 of these 36 properties have been subject to prior soil investigations, resulting in the collection of approximately 270 samples for PCB analysis and eight samples for analysis for Appendix IX constituents.

In February 2002, GE submitted to EPA a *Pre-Design Investigation Work Plan for Floodplain Residential Properties Downstream of the Confluence* (BBL, 2002f), which described GE's proposed initial pre-design soil investigations for these 36 residential properties. The initial soil investigations are focused on PCBs and are designed to: 1) characterize the extent and concentrations of PCBs in the Actual/Potential Lawn portions of these properties; and 2) obtain data, where necessary, on the concentrations of PCBs in top 6 inches of soil in the other (non-Actual/Potential Lawn) portions of these properties so as to apply the STM trigger levels. In addition, following the initial investigations, GE will evaluate the need for and scope of additional sampling. After completion of any necessary additional sampling, GE will submit a *Pre-Design Investigation Report*. The results of all pre-design investigations, in combination with usable prior data, will then be used to support the subsequent evaluation and design of any soil-related response actions that may be needed to achieve the Performance Standards at the Downstream Floodplain Residential Properties.

1.5 Description of Statistical Procedures Used in this Report

In developing the subsequent sections of this RFI Report, a number of statistical procedures have been used to summarize the environmental data collected from the Rest of River area.[1] Arithmetic means and medians are generally presented for each medium, along with the standard error of the means. The arithmetic mean (average) and median are measures of central tendency of the data. For a normally distributed dataset, the mean and median will be similar to one another. When a dataset has some higher values, the arithmetic mean can be well above the median value for that dataset, indicating that the data are approaching a non-normal distribution. In such cases, the median can provide a useful measure of central tendency.

The degree of variability around each mean value is reflected in the standard error of the mean. The standard error of the mean is calculated from the standard deviation (s) and the number of samples (n) using the following formula:

$$s.e. = \frac{s}{n^{0.5}}$$

The standard error bars on plots of mean values (+/- 2 standard errors) show the range of most likely estimates of the mean value.

Additional statistical analyses are presented in this RFI Report where necessary to evaluate spatial and temporal trends and relationships among certain environmental variables. For example, relationships between two variables are examined through regression analyses in which a least squares fit line is plotted through the data. To support an evaluation of the regressions, the r^2 and p-values are provided for these analyses. The r^2 value quantifies how much of the variability in the dependent variable is explained by the independent variable (ranging from 0 to 1), while the p-value is the probability that the slope of the regression line is not different from zero (i.e., a horizontal line) with a slope of zero indicating that there is no relationship between the dependent and independent variables.

---

[1] In addition, as discussed in Appendix D.1, given the relatively long time period over which the data were collected, the Housatonic River database contains considerable inter-laboratory, and even intra-laboratory, variability, which contributes to some uncertainty in the data. This factor was considered in the data analyses in this RFI Report.

1.6 General Data Use Issues

In evaluating the different datasets in this RFI Report, consistent assumptions were made in how certain types of data were handled, including analytical data for duplicate and split samples, and non-detects. As discussed in Appendix D, duplicate samples represent sample aliquots analyzed by a single laboratory. In this RFI Report, analytical results for a duplicate sample were averaged with the results of its associated parent sample when evaluating the data. A split sample represents duplicate sample aliquots analyzed by two different laboratories (e.g., GE and EPA contracted laboratories). These samples were used to quantify the amount of inter-laboratory variability and identify potential biases between individual labs. As discussed in Appendix D, statistical tests were performed with the GE and EPA water, sediment, and fish split samples to provide a quantitative comparison of results generated by the different laboratories. GE and EPA split sample results were not combined in the RFI Report evaluations. The EPA data were generally used; GE split data served as a check on laboratory variability, as described above. Non-detect values were represented by one-half their detection limits in the RFI Report data evaluations.

In some cases, depth weighting of sediment and soil data was required when sample collection depths did not correspond to a specified depth increment of interest. For example, if two sediment samples were collected from the 0- to 0.8-inch and 0.8- to 6.3-inch depth intervals, and the increment of interest was 0- to 6-inches, the results for the two samples were depth-weighted to generate a representative value for the 0- to 6-inch depth interval. This involved calculating a concentration based on the percentage of each sample increment that fell within the 0- to 6-inch depth interval.

With regard to data presentation, there are some cases where the value reported in the text was rounded to simplify the discussion. In these instances, the value in the text will not precisely match the value on the associated data table.

Section 1 Figure

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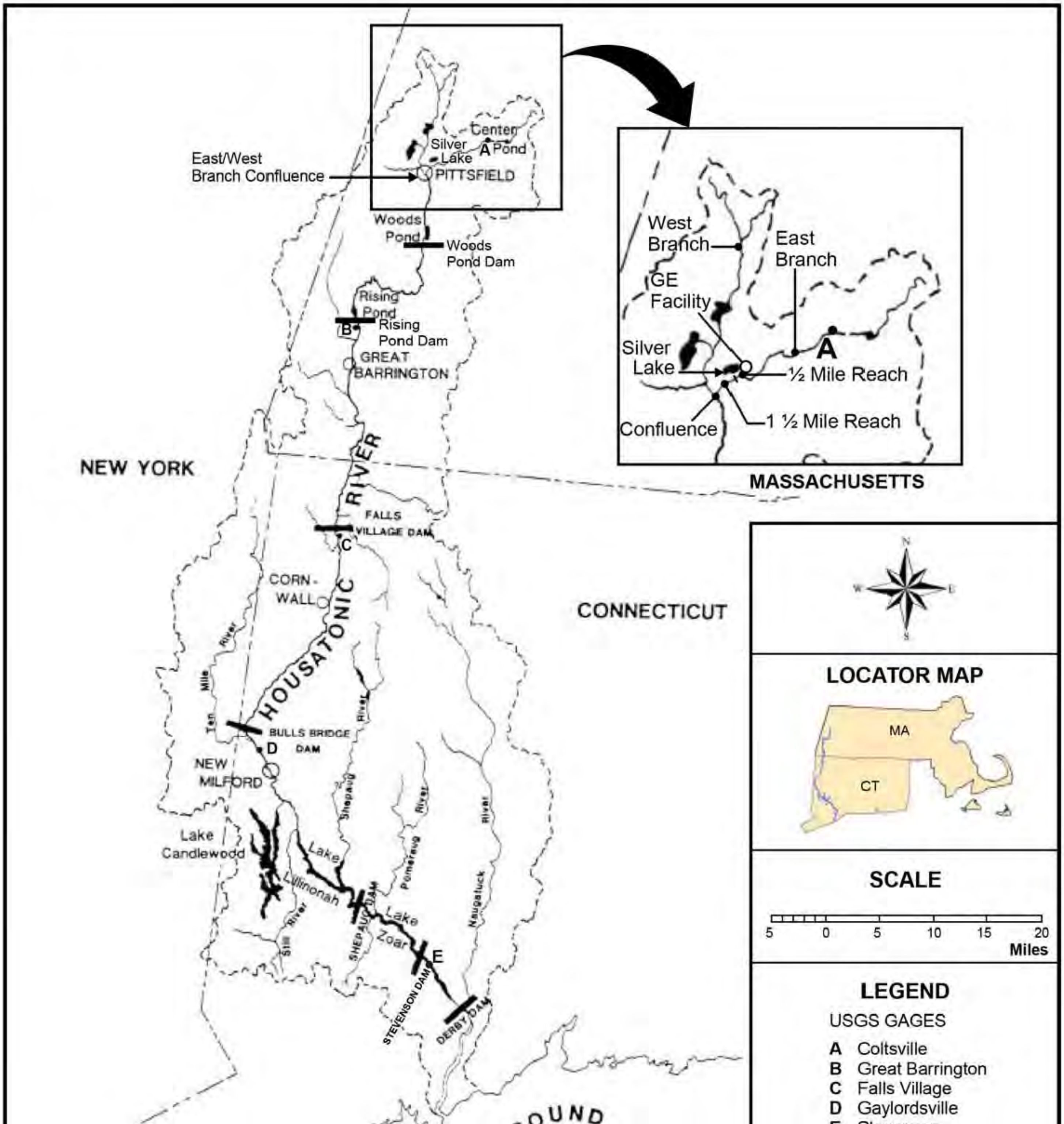

**FIGURE 1-1
HOUSATONIC RIVER
WATERSHED & SITE
LOCATION MAP**

Reference: Frink, et al., 1982

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Section 2

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2. Environmental Setting

2.1 General

This section provides a general overview of the environmental setting for the Rest of River area of the Housatonic River. Information previously presented in the 1996 RFI Report (BBL, 1996) is updated in this report with more recent data, where available.

Section 2.2 briefly describes the physical location and extent of the Rest of River area, including a description of the Rest of River channel itself, backwater areas, dams and impoundments, and floodplain areas. Section 2.3 provides a discussion of regional climatic conditions, and Sections 2.4 and 2.5 briefly describe the hydrology and hydrogeology, respectively, related to the Rest of River. Finally, the primary constituents in the Rest of River evaluated in this RFI Report are discussed in Section 2.6.

2.2 Location and Extent of Site

2.2.1 General

The headwaters of the Housatonic River are located in the Berkshire Mountains of western Massachusetts. The River is formed by the confluence of the East and West Branches (Confluence), which converge in the City of Pittsfield. The East Branch flows past GE's facility, approximately two miles above the Confluence. Below the Confluence, the River generally flows south through Berkshire County for approximately 10 miles to Woods Pond, the first significant impoundment. Downstream of Woods Pond, the River continues south/southeast through western Massachusetts and south/southeast through Connecticut before emptying into Long Island Sound at Stratford, Connecticut (Figures 1-1, 2-1, 2-2, and 2-3), a total of 135 miles.

The total watershed of the Housatonic River and its tributaries covers 1,950 square miles -- 500 in Massachusetts, 218 in New York, and 1,232 in Connecticut (Lawler, Matusky & Skelly [LMS], 1985). Figure 1-1 illustrates the watershed of the Housatonic River Basin in Massachusetts, New York, and

Connecticut. Housatonic River Basin elevations range from sea level at the mouth of the River to over 2,600 feet, based on National Geodetic Vertical Datum (NGVD) 1929 at Brodie Mountain, Massachusetts, in the northwest portion of the basin. The topography of the Housatonic River Basin in western Massachusetts is characterized by rough, glaciated terrain. The area contains highlands to the east, the Taconic Range to the west, and the main valley of the Housatonic River and its tributaries in the central portion of the basin (Norvitch et al., 1968). The topography of the basin in northwestern Connecticut is comparable to that in western Massachusetts. The region consists of hills and ridges aligned in a north-south orientation, with locally rugged areas along the major watercourses (Wilson et al., 1974). However, the extreme southern portion of the basin in Connecticut is characterized by flatlands of the Atlantic coastal plain.

The drainage area distribution represents an important feature of the system, as it largely controls the Housatonic River's hydrologic response to precipitation intercepted by the watershed. The drainage area upstream of the USGS gage at Great Barrington is approximately 282 square miles (mi^2). This area was delineated into 41 subwatersheds (Figure 2-4) based on main stem and majority tributary networks, topography, USGS gage station locations, and GE and EPA monitoring locations using watershed delineation tools in EPA's Basins software. These subwatersheds range in size from less than 1 to 24 mi^2. The drainage area upstream of the Confluence is 130 mi^2, which is 46% of the watershed upstream of Great Barrington. Drainage areas of the East and West Branches are similar in size (69 mi^2 and 61 mi^2, respectively). At Woods Pond Dam, the drainage area increases to 169 mi^2 and accounts for 60% of the drainage area upstream of Great Barrington. The Housatonic River watershed topography upstream of Great Barrington is shown on Figure 2-5.

For purposes of evaluating data collected from the Rest of River portion of the Housatonic River, the River reach designations established in the SI Work Plan (Weston, 2000) have been incorporated throughout this RFI Report. The reaches are:

- Reach 5, from the Confluence downstream to Woods Pond (the first significant impoundment);
- Reach 6, Woods Pond;
- Reach 7, Woods Pond Dam to Rising Pond (the next significant impoundment);
- Reach 8, Rising Pond;
- Reach 9, Rising Pond Dam to the Connecticut border; and

- Connecticut portion of the River.

Several landmarks, river mile (RM) points, and associated River reaches are shown in Table 2-1. Reach locations are also shown on Figures 2-1, 2-2, and 2-3. The RM index presented below uses the River mouth on Long Island Sound (RM 0.0) as a reference and provides a convenient means of locating various points of interest along the River.

Table 2-1. River Mile Locations of Landmarks[1]

Landmark	River Mile	EPA River Reach[2]
Coltsville USGS Gaging Station	140.6	Reach 1
Dawes/Pomeroy Avenue Bridge[3]	135.4	Reach 4
Confluence of East and West Branches (start of Reach 5/5A)	135.1	Reach 5
Holmes Road Bridge	134.1	
Pittsfield Wastewater Treatment Plant (WWTP) (start of Reach 5B)	130.1	
New Lenox Road Bridge	129.2	
Roaring Brook (start of Reach 5C)	128.0	
Woods Pond Headwaters (surface water sample location)	125.4	
Start of Woods Pond (start of Reach 6)	125.0	Reach 6
Woods Pond Footbridge	124.6	
Woods Pond Dam (start of Reach 7)	124.4	Reach 7
Schweitzer Bridge	124.2	
Columbia Mill Dam	122.1	
Willow Mill Dam	115.6	
Glendale Dam	109.0	
Rising Pond Headwaters (start of Reach 8)	106.0	Reach 8
Rising Pond Dam (start of Reach 9)	105.2	Reach 9
Great Barrington USGS Gaging Station	104.2	
MA/CT Border (start of Connecticut portion of River)	81.2	--
Falls Village Dam	74.0	
Bulls Bridge Dam	53.2	

Notes:

1. River miles measured in GIS, and represent distance from the River mouth on Long Island Sound.
2. From SI Work Plan (Weston, 2000).
3. Dawes Avenue Bridge is located at RM 135.7 and Pomeroy Avenue Bridge is located at RM 135.4. RM 135.4 has been assigned to the combined upstream data location.

The primary focus of this RFI Report is the reach of the River between the Confluence near Pittsfield (RM 135.1) and Woods Pond Dam (RM 124.4). The portion of the River from the Confluence to Woods Pond (Reach 5) was further divided into three subreaches: 5A, 5B, and 5C (Figure 2-3). Reach 5A is approximately 5 miles long and extends from the Confluence at RM 135.1 to the Pittsfield WWTP (RM 130.1). The second reach (5B) is about 2 miles long and defined as the region from the Pittsfield WWTP to Roaring Brook (RM 128.0). Reach 5C extends 3 miles from Roaring Brook to the start of Woods Pond at RM 125.0. The Woods Pond reach (Reach 6) extends to the dam, a distance of approximately one-half mile.

Between the Confluence and Woods Pond Dam, the River floodplain, defined generally by the 1 mg/kg PCB isopleth (see Figure 2-1), varies in width from approximately 100 feet to 3,700 feet and encompasses an area of approximately 750 acres. Backwaters are found in Reaches 5A, 5B, and 5C, with the number and size of backwaters generally increasing downstream from the Confluence. Within Reach 5, backwaters have a total area of approximately 125 acres, with about 60% of the total backwater area contained in Reach 5C. An additional 12 acres of backwater regions are located immediately adjacent to Woods Pond. The backwater areas include regions that are well connected to the River's main channel as well as those that are poorly connected, disconnected "pools," and tributary areas (i.e., all non-channel hydrography features [see Figure 2-3]).

2.2.2 River Channel

From the Confluence, the Housatonic River flows southward through Pittsfield and the towns of Lenox and Lee in Berkshire County approximately 10 miles to the first significant impoundment, Woods Pond (which covers approximately 60 acres). The River continues flowing south from Woods Pond and, between Lee and South Lee, turns and flows westward through the town of Stockbridge to Glendale. The flow of the River is slightly impeded by the Columbia Mill Dam in Lenoxdale, the Willow Mill Dam in Lee, and the Glendale Dam in Glendale (see Figure 2-1 for locations). From Glendale, the River flows south through Risingdale, where the next significant impoundment downstream of Woods Pond, Rising Pond, is located. Rising Pond is located approximately 18 miles downstream of Woods Pond, measures approximately 40 acres in size, and is impounded by Rising Pond Dam. Below Rising Pond Dam, the River continues to flow southward through the towns of Great Barrington and Sheffield, along a widened, relatively flat floodplain that includes many meanders and oxbows.

The River enters the state of Connecticut near Ashley Falls, Massachusetts, approximately 1 mile north of Canaan, Connecticut. The River continues to flow generally south approximately 86 river miles through Litchfield, Fairfield, and New Haven counties, including Falls Village, West Cornwall, Bulls Bridge, Derby, and Stratford, to the Long Island Sound. Impoundments along this stretch of the River in Connecticut include those at Falls Village and Bulls Bridge, as well as Lakes Lillinonah, Zoar, and Housatonic (these impoundments are further discussed in Section 2.2.4).

A number of tributaries enter the Housatonic River as it flows generally southward for 135 river miles from the Confluence in Pittsfield, Massachusetts, to its mouth at Long Island Sound. In addition to the East and West Branches (which drain the headwaters), the main tributaries to the River in Massachusetts are Hop Brook, Williams River, Green River, and Konkapot River. In Connecticut, the main tributaries are the Ten Mile, Still, Shepaug, Pomperaug, and Naugatuck Rivers.

Three small tributaries discharge to the Housatonic River in Massachusetts between the Confluence and Woods Pond Dam: Sackett Brook (11 mi^2 watershed), Roaring Brook (8 mi^2 watershed), and Yokun Brook (6 mi^2 watershed) (Figure 2-3). Additionally, the Pittsfield WWTP contributes a significant amount of discharge during low to moderate flow conditions in the River. The River in this approximately 10-mile reach is generally characterized as a sinuous or meandering channel within a relatively wide, vegetated floodplain that contains backwaters, oxbows, and other features of a meandering stream (Figure 2-3).

The elevation of the Housatonic River at the Confluence in Pittsfield is approximately 960 feet NGVD. Elevations are approximately 950 and 680 feet NGVD at Woods Pond Dam and the USGS gage at Great Barrington, respectively. The elevation at the Massachusetts-Connecticut state line, approximately 54 river miles downstream from the Confluence, is about 650 feet NGVD. The Housatonic River continues approximately 81 river miles through the state of Connecticut where it enters Long Island Sound at sea level. Overall, the elevation of the Housatonic River decreases approximately 960 feet over a distance of 135 river miles from the Confluence in Pittsfield to the mouth of the River at the Long Island Sound.

2.2.2.1 Bathymetry and Geometry

The 11 miles of the Housatonic River between the Confluence and Woods Pond Dam (the area that is the primary focus of this RFI Report) contain four main geometric features: main channel, backwaters, floodplain, and Woods Pond. The River has a meandering channel between the Confluence (RM 135.1) and the start of Woods Pond (RM 125.0; Figure 2-3). The River exhibits features typical of a meandering, sand-bed river: meanders of various sizes, oxbows, backwaters, and cutoffs. The occurrence of these physical features is spatially variable, with some portions of the River having a relatively high degree of meandering and other reaches being relatively straight channeled. Generally, the degree of meandering increases with distance downstream of the Confluence.

In 1999, EPA measured and quantified the channel cross-sectional geometry at approximately 200 locations between the Confluence and Woods Pond. Channel width varies from approximately 40 feet to 210 feet, with the width of the channel generally increasing between the Confluence and Woods Pond Headwaters (Figure 2-6). A useful geomorphologic measure is the ratio of channel width to bank-full water depth (the depth during conditions at which the water surface elevation at a particular channel location is at the same level as the river bank, but is confined to the river channel and has not spilled out onto the floodplain). Ratios greater than 12 generally correspond to meandering channels (Rosgen, 1996). The spatial distribution of the width:depth ratio is shown on Figure 2-7. Generally, this ratio is approximately 12 in many locations, with no clear trend observable in the data providing evidence that the River can be characterized as moderately meandering in this reach.

Detailed cross-section surveys were not performed downstream of Woods Pond Dam. However, CR Environmental, Inc. (CR), on behalf of EPA, performed a bathymetry survey in Rising Pond in December 1998. Water depths ranged from 1 foot to 15 feet, with the deeper locations following the former River channel (i.e., the course of the River prior to construction of the dam).

2.2.2.2 Water Depth

Water depth (bathymetry) varies both spatially and temporally, with depth increasing as flow rate in the River increases. To illustrate the spatial variability of water depth in the main channel of the River, water depth was estimated at bank-full discharge using EPA transect data (Figure 2-8). Water depths at the bank-full flow rate, which is approximately 1,100 cubic feet per second (cfs) at the Confluence (calculated based on channel geometry assuming uniform flow), range from about 3 feet to 15 feet. Water depths in Woods Pond range from about 3 feet to 15 feet, with a relatively deep hole in the southeast portion of the pond (Figure 2-9). Backwaters are generally 3 feet to 5 feet deep. A relatively shallow sill (~1 to 2 feet deep) typically separates backwater areas from the main channel.

2.2.2.3 Gradient

Several factors influence the water surface elevation changes that result from flows in the Housatonic River. In addition to the more visible natural and manmade features of the River such as tributaries, oxbows, dams, bridges, piers, and bypasses, the channel slope also has a major effect upon the resulting water surface profile.

Along the entire Massachusetts portion of the Rest of River, reaches with three distinct channel gradients have been identified: from the Coltsville USGS gaging station on the East Branch (located upstream of the Confluence) to the Schweitzer/Lenoxdale Bridge (located just downstream of Woods Pond Dam); Schweitzer/Lenoxdale Bridge to the Great Barrington USGS gaging station; and Great Barrington to the Connecticut border (see Figures 1-1 and 2-1) (Stewart, 1982). From the Coltsville gaging station to the Schweitzer/Lenoxdale Bridge, the average channel gradient is approximately 4.2 feet per mile or less than 1×10^{-3}; the gradient between the Schweitzer/ Lenoxdale Bridge and the Great Barrington gaging station is 12 feet per mile or 2×10^{-3}; and from Great Barrington to the Connecticut border, the channel gradient lessens to approximately 2 feet per mile or 4×10^{-4} (Stewart, 1982). Between the Connecticut border and the Long Island Sound, the River decreases approximately 650 feet over 81.2 miles, which equates to an average gradient of 8 feet per mile or 1.5×10^{-3}.

On a finer scale, changes in the River gradient between the Confluence and the Woods Pond Headwaters are also evident as shown on Figure 2-10. This plot illustrates average bed elevation at the various EPA transect locations. These data suggest that within Reach 5, three distinct regions exist with respect to the River gradient: 1) a relatively steep gradient of 8.8×10^{-4} (4.6 feet per mile) upstream of RM 134 (Holmes Road Bridge); 2) a moderate gradient of 3.7×10^{-4} (2.0 feet per mile) between RM 134 and 129 (New Lenox Road Bridge); and 3) a relatively low gradient of 1.1×10^{-4} (0.6 feet per mile) downstream of RM 129. The eight-fold decrease in river gradient from the upstream portion of the study area to the

Woods Pond Headwaters has a significant impact on hydrodynamics and transport processes. Spatial changes in current velocity and bed properties are related to the spatial variation in River gradient. In addition, the extent of meandering is affected by River gradient. As the gradient decreases between the Confluence and the Woods Pond Headwaters, meandering tends to increase, which is consistent with observed behavior in similar river systems (Leopold et al., 1964; Rosgen, 1996).

2.2.2.4 Sediment Depositional Areas

Sediment reconnaissance/probing activities conducted between the Confluence and Woods Pond (Reaches 5 to 6), as well as in Woods Pond (Reach 6) and Rising Pond (Reach 8), have provided information on sediment accumulation/deposition in these areas of the River. In October 1994, on behalf of GE, BBL performed reconnaissance/probing activities within Reach 5 and the upstream portion of Reach 6 as part of the MCP Phase II investigation/RFI, and documented the results in the 1996 RFI Report (BBL, 1996). CR performed sub-bottom profiling and bathymetric surveys at Woods Pond and Rising Pond in November/December 1998, in support of EPA's SI. Results of this work were documented in a report titled *Housatonic River Supplemental Investigation Sub-Bottom Profiling Woods and Rising Ponds* (CR, 1998). Based on the results of these studies, a description of sediment depositional areas and sediment thickness for each reach and subreach is provided below.

<u>Reaches 5 to 6</u>

The objective of BBL's sediment deposit probing activities was to identify significant depositional areas between the GE facility and Woods Pond. Depositional areas were identified by probing areas where visible accumulation of sediment had occurred. These areas were grouped into four general types of deposits:

- Channel – channel deposits typically occur in parts of the riverbed that are permanently inundated during low to moderate flow conditions;
- Terrace – terrace deposits occur in parts of the riverbed that are usually inundated during high-flow conditions, but are exposed during low-to-moderate flows;
- Aggrading bar – aggrading bar deposits, or small islands or mounds, are typically composed of coarse-grained material (i.e., sands and gravels) and usually occur along the convex sides of channel curves; and

- Backwater areas – backwater areas are quiescent areas adjacent to the main river channel that maintain a hydraulic connection to the River channel.

The results of this reconnaissance/probing effort, performed to characterize the physical depth of sediments only, are summarized in Table 2-2, below. It should be noted that other sediment deposits fitting one of these four categories may be present which were not visually noted during the reconnaissance.

Table 2-2. Summary of BBL Sediment Reconnaissance/Probing Efforts — Confluence to Woods Pond

	Channel Deposits		Terrace Deposits		Aggrading Bar Deposits		Backwater Areas		Overall	
Reach	No.	Sediment Depth Range (Avg) (ft)	No.	Sediment Depth Range (Avg) (ft)	No.	Sediment Depth Range (Avg) (ft)	No.	Sediment Depth Range (Avg) (ft)	No.	Sediment Depth Range (Avg) (ft)
5A[1]	18	3.0 - 9.0 (5.7)	38	2.0 - 9.0 (5.5)[2]	3	1.5 - 6.0 (4.5)[2]	1	13 (13)	60	1.5 - 13 (5.6)
5B	10	2.0 - 11 (7.4)	5	8.0 - 14 (10.3)	0	--	3	10.5 - 12.3 (11.1)	18	2.0 - 14 (8.8)
5C and backwaters	14	2.5 - 13 (7.0)	0	--	0	--	37	0.5+ - 16.5 (6.9)	51	0.5+ - 16.5 (6.9)
6 (upstream portion only)	1	3.6+	0	--	0	--	0	--	1	3.6+
Overall	43	2.0 - 13 (6.5)	43	2.0 - 14 (6.0)	3	1.5 - 6.0 (4.5)	41	0.5 - 16.5 (7.3)	130	0.5+ - 16.5 (6.6)

Notes:
1. One additional depositional area was noted in Reach 5A, and was described as a low-lying area at an oxbow with a measured sediment depth of approximately 7 feet.
2. Range and average based on average sediment depth for some deposit(s).

Overall, this reconnaissance/probing effort identified approximately 130 sediment deposits in the reach between the Confluence and Woods Pond, with the approximate sediment depths ranging from less than 1 foot to approximately 16 feet and with an average depth of approximately 6.6 feet. In general, just over half of the 60 sediment deposits identified in the uppermost subreach (Reach 5A, between the Confluence and the Pittsfield WWTP) were characterized as terrace deposits. Reach 5A was the only subreach between the Confluence and Woods Pond within which aggrading bar deposits were identified during the 1994 reconnaissance, however EPA has indicated that subsequent data collected by EPA and/or MDEP have indicated the presence of aggrading bars in Reaches 5B and 5C, as well as 5A. The overall depths of the sediment deposits (as measured to refusal by BBL) within Reach 5A ranged from approximately 1.5 feet to 13 feet, with an average depth of approximately 5.6 feet. Between the Pittsfield WWTP and

Roaring Brook (Reach 5B), 10 of the 18 sediment deposits identified were characterized as channel deposits, while the remainder were characterized as terrace (five) and backwater area deposits (three). The depths of all identified sediment deposits within Reach 5B were shown to range from approximately 2 feet to 14 feet, with an average depth of approximately 9 feet. Within Reach 5C and its adjacent backwaters, the majority of the 51 sediment deposits identified were characterized as backwater area deposits. The remaining deposits were characterized as channel deposits. The depths of the sediment deposits within Reach 5C were shown to range from less than 1 foot to approximately 16 feet, with an average depth of approximately 7 feet. Probing within the channel of the River just upstream of Woods Pond (Reach 6) indicated the presence of one channel deposit.

<u>Reaches 6 and 8</u>

Based on the work performed by CR, sediment thickness in Woods Pond ranged from 16 feet in a deep hole in the southeastern corner of the pond to areas of little accumulated sediment in the outflow above the spillway. Sediment thickness in Rising Pond was reported to range from 1 foot to 8 feet. CR noted that the accumulation of sediment in Rising Pond is very heterogeneous and does not always follow the bathymetric contours (CR, 1998). Sediment thickness for Woods Pond and Rising Pond are shown on Figures 2-11 and 2-12, respectively.

2.2.3 Backwaters

The majority of backwater areas, defined as quiescent areas adjacent and hydraulically connected to the main channel of the Housatonic River, lie within the lower half of Reach 5 of the Rest of River, between New Lenox Road and Woods Pond, as shown on Figure 2-3. This reach of the River (i.e., 5C) is dominated by a broad wetland floodplain, which ranges from 800 feet to 3,000 feet wide, and includes the numerous backwater areas, as well as side channels and meanders (Weston, 2000). The backwater areas along this reach of the River generally range from 3 feet to 5 feet in depth and cover a total area of approximately 80 acres. Widths of the backwaters vary from approximately 10 feet to 950 feet. The bed elevations along the section of the River where the backwaters are predominant generally range from approximately 948 feet NGVD at the upper end of the reach to approximately 940 feet NGVD at the lower end. The channel gradient increases significantly below Woods Pond, and fewer backwater areas are present in the stretch between Woods Pond and Great Barrington. The section of the River that stretches from the Great Barrington gaging station to just into Connecticut (Reach 9) flows along a relatively flat floodplain that includes many meanders and oxbows, as well as some backwater areas.

2.2.4 Dams and Impoundments

2.2.4.1 Massachusetts

Five dams of varying size are currently in place, impounding water on the Rest of River in Massachusetts between the Confluence and the Connecticut border. A number of previously existing structures have been removed. Of the remaining dams, the two of primary significance are Woods Pond Dam and Rising Pond Dam. Each of these two dams is briefly described below.

Woods Pond Dam is located approximately 12 miles downstream from the GE Pittsfield facility near the towns of Lee and Lenox and forms the first dammed impoundment downstream of the GE Pittsfield facility. The original dam was constructed in 1864 to convey flow to a small mill pond, which served as a fore bay for a hydro-powered mill that has since been retired (Harza, 2001a). The existing dam at Woods Pond, a concrete overflow weir dam located approximately 200 feet downstream of the original dam, was constructed in 1989 to replace the original structure. The existing Woods Pond Dam consists of a 140-foot-long concrete overflow spillway, a concrete non-overflow gravity section with sloped downstream face at the west abutment, and a concrete and steel sheetpile raceway closure structure at the east abutment. All the dam structures are founded in bedrock. The dam has a maximum height of approximately 14 feet. The ogee spillway has a crest elevation of 948.3 feet NGVD, and the top elevation of the west abutment is 954.0 feet NGVD (Harza, 2001a).

Rising Pond, located in the Risingdale section of Great Barrington, Massachusetts and upstream from the Great Barrington USGS gaging station, is the last dammed impoundment on the Housatonic River in Massachusetts. It is located approximately 18.4 miles downstream of Woods Pond Dam. Rising Pond Dam has an associated surface drainage area of approximately 279.2 square miles and a storage volume of 712 acre-feet at the spillway crest (Harza, 1991). Rising Pond Dam has a low embankment section on the left abutment, an intake structure, a rock-filled timber crib overflow structure forming the main dam and spillway, and a wide earth embankment dam on the right abutment (Harza, 2001b). The main spillway, elevation 716.7 NGVD, is 127 feet long and 29.8 feet high. The top right headwall is at elevation 726.2 feet and the top left headwall is at elevation 725.3 feet. At its lowest elevation, the headwall provides 8.6 feet of freeboard for the spillway at normal pool (Harza, 2001b). The original Rising Pond Dam was constructed in 1900 for hydroelectric power. Major renovations to the original structure, which included an increase in the spillway elevation, occurred in 1934. In 1979, the United States Army Corps of Engineers (USACE) reported structural deficiencies in the spillway and associated dam embankments (Harza, 1991). As a result, additional construction activities were performed in 1993 to comply with the Commonwealth of Massachusetts criteria for structural stability and spillway capacity (Harza, 2001b). The renovated dam has been modified through construction to withstand a 100-year flood event. As part of the rehabilitation, the left embankment was raised to a minimum elevation of 727 feet.

GE performed additional work at Woods Pond Dam and Rising Pond Dam in 2001 and 2002 to comply with Paragraph 123.a of the CD. This work began with assessments, conducted by Harza Engineering on GE's behalf, of the structural integrity of both dams. These assessments found both dams to be structurally sound and recommended some minor maintenance and improvements (Harza, 2001a,b). GE subsequently performed these maintenance and improvement activities, which included repairing concrete, placement of rip-rap, removal of obstructions from the River channel, and raceway embankment modifications. Additional structural integrity assessments of both of these dams were performed for GE in late 2002. These assessments confirmed that the dams continue to be structurally sound, and recommended a few additional minor maintenance and repair items (Montgomery Watson Harza, 2003a, b).

In addition to Woods Pond Dam and Rising Pond Dam, three dams of lesser significance are also located along the Housatonic River in Massachusetts between the Confluence and the Connecticut border: Columbia Mill Dam, Willow Mill Dam, and Glendale Dam. A description of these dams, together with a review of the available information on their stability and safety, is provided in 1991 and 1994 reports by Harza entitled *Report on Six Housatonic River Dams* (Harza, 1991) and *Inventory of Stability and Safety of Dams Along the Housatonic River* (Harza, 1994).

Figure 2-1 shows the locations of all five dams and impoundments in Massachusetts. Impoundment characteristics of the dams are summarized in Table 2-3.

2.2.4.2 Connecticut

The Falls Village impoundment in Falls Village, Connecticut, is the first dammed impoundment south of the Connecticut border. The dam was constructed in 1914 to provide hydroelectric power for the Hartford Electric Light Company (Frink et al., 1982). Downstream from Falls Village, the Housatonic River flows freely for approximately 20 miles to Kent, Connecticut. In Kent, the River flows through the Bulls Bridge Impoundment, which was constructed in 1903 to provide hydroelectric power for the Connecticut Light and Power Company (CL&P) (Frink et al., 1982). Both the Falls Village and Bulls Bridge Impoundments currently provide hydroelectric power to CL&P. Downstream of Kent, in New Milford, is the Bleachery Dam, a low dam that is mostly submerged throughout the year.

Downstream from New Milford, Connecticut, the Housatonic River is regulated by a series of dams that form three large impoundments. The first impoundment is Lake Lillinonah, which was formed by the construction of the Shepaug Dam in 1955 by CL&P to provide hydroelectric power. Lake Lillinonah measures approximately 1,900 acres, is 100 feet deep, and is used for recreational activities. Lake Zoar, the second large impoundment, was formed in 1919 following construction of the Stevenson Dam in Stevenson, Connecticut. Like the Shepaug Dam, the Stevenson Dam provides hydroelectric power to CL&P. Lake Zoar covers approximately 975 acres, with a maximum depth of 75 feet, and is also used for recreational activities (Frink et al., 1982). The final impoundment on the River is Lake Housatonic, formed by construction of the Derby Dam in 1870 by the Housatonic Water Company to provide hydroelectric power. Currently, the hydroelectric facility and Derby Dam are operated by Northeast Utilities. Lake Housatonic has a surface area of approximately 328 acres, a maximum depth of 26 feet, and is used for recreational activities (Frink et al., 1982).

Dam and impoundment locations in Connecticut are shown on Figure 2-2, and a summary of the characteristics of the impoundments is provided in Table 2-3.

2.2.5 Floodplain

As defined in the CD, the Rest of River includes portions of the River's floodplain. (For informational purposes, the 100-year floodplain is shown on Figures 2-1 and 2-2.) Between the Confluence and Woods

Pond Dam, the Rest of River floodplain is defined as the area extending laterally to the 1 mg/kg PCB isopleth. The 10-year floodplain in this stretch and the 1 mg/kg PCB isopleth are shown on Figure 2-3. As shown on Figures 2-1 and 2-3, the bed of the railroad line that runs north from Woods Pond forms a berm, limiting the western extent of the 1 mg/kg PCB isopleth along an approximately 2.5-mile reach of the River. The floodplain extends beyond the railroad bed due to the presence of several bridges and culverts along this reach that allow water to flow past the bed during flood conditions. Downstream of Woods Pond Dam, the Rest of River floodplain encompasses those floodplain areas containing PCBs.

The floodplain of the River is relatively narrow adjacent to the GE facility in Pittsfield, Massachusetts and begins to widen in the southern portions of Pittsfield near Pomeroy Avenue and the Confluence. Between Pomeroy Avenue and New Lenox Road, the floodplain widens significantly to follow the gentle slope of the local topography. South of New Lenox Road to Woods Pond Dam, the floodplain widens slightly again. Approximately 1/2 mile south of New Lenox Road, the floodplain along the east bank of the River is confined by October Mountain, while the west bank of the River has a relatively flat topography resulting in an extended floodplain. The floodplain between Woods Pond Dam and Rising Pond Dam is relatively wide, similar to that found between Pomeroy Avenue and New Lenox Road. South of Rising Pond to the Connecticut border, an extended floodplain is evident as a result of relatively flat topography. This type of floodplain continues south through Connecticut where it narrows as the River runs through hilly terrain until it widens again as it enters the tidal estuary in Stratford and Milford.

In the stretch between the Confluence and Woods Pond, evidence of River meandering in the past is indicated by the occurrence of oxbows and abandoned cutoffs in the floodplain. Backwaters of various sizes are located in the floodplain, with the size and number of backwaters generally increasing near the Woods Pond Headwaters (~RM 125).

The area and total width of the floodplain (i.e., 1 mg/kg PCB isopleth) in Reaches 5A, 5B, and 5C are listed in Table 2-4 (below). Floodplain topography is presented on Figure 2-13.

Table 2-4. Floodplain and Backwater Geometry

Reach	Backwater Area (acres)	Floodplain Area (acres)	Minimum Floodplain Width (ft)	Maximum Floodplain Width (ft)
5A	28	325	100	2,480
5B	20	146	110	2,060
5C	79	255	1,050	2,220

Notes:

Backwater areas consist of backwaters, ponds, and tributaries.

Values based upon the 1 mg/kg PCB isopleth.

Vegetation in the floodplain varies from short grasses to mature trees. Classification of floodplain vegetation results in eight primary categories of vegetation type: palustrine, emergent (PEM); palustrine, forested (PFO); palustrine, scrub-shrub (PSS); palustrine, forested/emergent (PFO/EM); palustrine, forested/scrub-shrub (PFO/SS); palustrine, scrub-shrub/emergent (PSS/EM); upland; and wet meadow. A survey of the distribution of floodplain vegetation was conducted by TechLaw on behalf of EPA in 1998 (TechLaw, 1998). The resulting vegetation distribution is shown on Figure 2-14. As part of a subsequent ecological characterization of the Housatonic River between the Confluence and Woods Pond Dam, performed by Woodlot Alternatives, Inc. (Woodlot) on behalf of EPA (Woodlot, 2002), 18 vegetation community types were identified within the study area. The communities and relative area of each type are listed in Table 2-5 (below). Palustrine communities cover approximately 67% of the floodplain between the Confluence and Woods Pond Dam, while riverine, terrestrial, and lacustrine communities cover approximately 21%, 10%, and 2% of the floodplain, respectively.

Table 2-5. Vegetation Coverage Between the Confluence and Woods Pond Dam

Vegetation Community Name	Total Area (acres)	Percent Area in Community Category	Percent Area in Floodplain
PALUSTRINE COMMUNITY CATEGORY			
Black ash-red maple-tamarack calcareous seepage swamp	117.13	12.76	8.60
Deep emergent marsh	53.13	5.79	3.90
High-terrace floodplain forest	10.87	1.18	0.80
Red maple swamp	151.23	16.47	11.11
Riverine pointbar and beach	0.99	0.11	0.07
Shallow emergent marsh	74.87	8.16	5.50
Shrub swamp	256.50	27.94	18.84
Transitional floodplain forest	207.82	22.64	15.26
Wet meadow	45.47	4.95	3.34
Total Palustrine Community Area	**918.01**	**100**	**67.43**
TERRESTRIAL COMMUNITY CATEGORY			
Cultural grassland	54.36	38.53	3.99
Northern hardwoods-hemlock-white pine forest	60.05	42.56	4.41
Red oak-sugar maple transitional forest	16.31	11.56	1.20
Rich mesic forest	4.94	3.50	0.36
Successional northern hardwoods	5.44	3.86	0.40
Total Terrestrial Community Category	**141.1**	**100**	**10.36**
RIVERINE COMMUNITY CATEGORY			
High-gradient stream	0.10	0.04	0.01
Low-gradient stream	262.92	94.04	19.31
Medium-gradient stream	16.56	5.92	1.22
Total Riverine Community Area	**279.58**	**100**	**20.54**
LACUSTRINE COMMUNITY CATEGORY			
Moderately alkaline lake/pond	22.73	100	1.67
Total Lacustrine Community Area	**22.73**	**100**	**1.67**

Note:
Table condensed from Table 1-2 in Woodlot's Ecological Characterization of the Housatonic River, September 2002.

On many rivers, bank-full flow has a recurrence interval in the range of 1 to 2 years (Leopold et al., 1964). Applying this approximation to the Housatonic River at the Confluence suggests that bank-full flow occurs for flows ranging from about 1,150 cfs to 2,290 cfs (or 520 cfs to 1,020 cfs at Coltsville), the lower end of this range being consistent with the 1,100 cfs estimate developed based on EPA transect data (see Section 2.2.2.2). Thus, portions of the floodplain will be inundated during floods that exceed this flow range. An example of floodplain inundation is provided by aerial photographs taken during a flood in August 1990. Figure 2-15 displays an aerial photograph taken in the vicinity of New Lenox Road during this event. The peak flow was 3,850 cfs at Coltsville on August 7, 1990 (daily average flow of 2,010 cfs). This peak flow rate corresponds to a recurrence interval of approximately 35 years. Using drainage area proration, flood estimates for August 7 at the Confluence are 8,600 cfs and 4,500 cfs for peak and daily average flow rates, respectively. The aerial photographs were taken on August 8, which was the day after the peak flow and the daily average flow rate at Coltsville had decreased by about a factor of four (555 cfs). Even though the flood had started to recede, extensive inundation of the floodplain is evident in an aerial photograph of the New Lenox Road area (Figure 2-15).

2.2.6 Land Use

Land use within the Housatonic River Basin in Massachusetts is, in general, typical of rural areas in the northeastern United States. Multi-Resolution Land Characterization (MRLC) data were used to specify land uses in the watershed upstream of Great Barrington. The MRLC land-use data, which have a resolution of 30 meters, were compiled in the early 1990s, and are defined by 21 land-use categories. The 21 MRLC land-use categories were grouped into four general categories of land use in the Housatonic River Basin: agricultural, forested, urban, and wetlands. The forested land-use category consists of forested and shrub land. Agricultural areas are a combination of orchards, cropland, and pasture. The urban land-use category is a grouping of all developed and barren land, as well as grassy areas in the urban sector. In addition, urban areas categories were subdivided into pervious (precipitation readily infiltrates) and impervious (precipitation does not easily infiltrate) land.

The Housatonic River watershed upstream of Great Barrington is heavily forested, with agriculture, forestry, outdoor recreation, and residential landholding comprising the principal land uses (Figure 2-16). In general, the same pattern of land use occurs in northwestern Connecticut, with increased emphasis on recreational uses and a continued general absence of significant industrialization. In the central portion of the basin, several large impoundments and state parks are used for recreation, while significant industrial areas are located in the vicinity of the Still River near Danbury, Connecticut (New England River Basins Commission [NERBC], 1980). By contrast, the lower basin, near the mouth of the Housatonic River, is heavily urbanized and industrialized (NERBC, 1980). A summary of land use along the River is presented in Table 2-6 (below). (Note that the summary presented for the Connecticut portion of the Housatonic River Basin reflects mostly forested land, as the urban/industrial corridor south of Danbury is a small percentage of the total land area.)

Table 2-6. Land Use Categories of the Housatonic River Basin

Reach	Percent Area				
	Urban	Agricultural	Forested	Wetlands	Other
Confluence to Woods Pond Dam[1]	13	7	68	9	3
Woods Pond Dam to Great Barrington[1]	9	8	74	6	3
Great Barrington to MA/CT Border[2]	7	21	68	3	1
MA/CT Border to Long Island Sound[2]	13	19	64	1	3

Notes:
1. Confluence to Great Barrington: MRLC Land Use Coverage (30 meter resolution); early 1990s.
2. Great Barrington to Long Island Sound: GIRAS Land Use Coverage (1:250000); mid 1970s to early 1980s.

2.3 Regional Climatic Conditions

The upper Housatonic River Basin in Massachusetts is generally characterized by a temperate climate with warm, humid summers and cold winters. Annual precipitation in the form of rain and snowfall averages approximately 46 inches per year, distributed fairly evenly from month to month. Prevailing winds are from the west. The mean annual temperature reported at the Pittsfield airport is approximately 46° Fahrenheit (F), while the mean summer and winter temperatures are 68°F and 28°F, respectively. The upper basin experiences an average growing season of 120 days (NERBC, 1980).

The climate of the lower basin in Connecticut is characterized by milder winters and hotter summers than those found in the upper basin. Annual precipitation varies throughout the lower basin from 46 to 58 inches per year (NERBC, 1980). The mean annual temperature of the lower basin is approximately 49°F, while the mean summer and winter temperatures are 71°F and 31°F, respectively. The lower basin experiences an average growing season of up to 180 days (NERBC, 1980). A summary of monthly and annual precipitation averages by location is presented in Tables 2-7 and 2-8. Monthly temperature averages and extremes are summarized in Table 2-9.

Several available sources of information provide varying levels of wind speed and direction data. Data were obtained from the document titled *Ambient Air Monitoring for PCB Study* (Zorex Environmental Engineers, 1992). During this study, wind speed and direction were periodically recorded at an on-site weather station located at the East Street Area 2-South site at the GE Pittsfield facility. Wind data were collected for 1 year, from August 1991 to August 1992. These data indicated that the maximum wind speed was 27.22 miles per hour and that the predominant wind direction was from the west.

A database of wind information was also developed based on data obtained from the National Climatic Data Center. The database consists of calculated minimum, maximum, and average daily wind speeds and wind directions for each month from each location, calculated from observations collected from January 1984 to October 1999. According to the database, the maximum average daily wind speed for each month ranged from 15.9 to 25.7 miles per hour at the Albany weather station, and from 15.2 to 27.9 miles per hour at the Hartford weather station. At both stations, the general wind direction was from the southwest.

2.4 Hydrology

The hydrologic characteristics of the Housatonic River have been documented in studies performed by Stewart, the Federal Emergency Management Agency (FEMA), USGS, NERBC, and CAES (Stewart, 1982; FEMA, 1981a, 1981b, 1982a, 1982b, 1982c, 1982d, and 1987; Norvitch et al., 1968; Wilson et al., 1974; NERBC, 1980; and Frink et al., 1982).

The Housatonic River system is fed primarily by runoff from rainfall and melting snow. As previously indicated, the annual precipitation in the drainage basin averages approximately 46 inches per year. Approximately 24 inches per year leave the basin as runoff through the Housatonic River, another 20 inches per year escape by evaporation and transpiration to the atmosphere, while the remaining 2 inches per year infiltrate into groundwater-bearing zones (Norvitch et al., 1968).

Manmade discharges to the Housatonic River contribute significant flow quantities. The average combined discharge from several industrial facilities located in Massachusetts amounts to approximately 26 cfs of wastewater into the River, and discharges from seven municipal treatment plants located in Massachusetts contribute an additional 22 cfs (Frink et al., 1982). Municipal/industrial discharges into the Connecticut portion of the Housatonic River amount to approximately 35 cfs (Frink et al., 1982).

2.4.1 Flow

The flow rate of the Housatonic River is monitored by USGS, which maintains a total of five flow gaging stations on the River (two in Massachusetts and three in Connecticut). The first station in Massachusetts, on the East Branch of the Housatonic River in Coltsville, is approximately 5.5 miles upstream of the Confluence and has an associated drainage area of 57.6 square miles (Bent, 1999). Hydrologic data recorded at Coltsville during the period of 1941 to 2000 (the common set of years between the five gaging stations) indicate a mean annual flow rate of 105 cfs, which corresponds to a runoff rate of 1.82 cfs/mi^2.

The second gaging station on the Housatonic River in Massachusetts is located in Great Barrington, approximately 20 miles downstream from Woods Pond. The River drains an area of approximately 282 square miles above this point (Bent, 1999). USGS reports a mean annual flow rate at 525 cfs for the Housatonic River at Great Barrington, based on data recorded from 1941 to 2000. Despite the five-fold increase in flow between Great Barrington and Coltsville, the runoff rate of Great Barrington is 1.86 cfs/mi^2, which is almost identical to the runoff rate for the Coltsville gage. This result indicates that the hydrologic response of the watershed is relatively uniform on annual timescales.

The flow rate in the River is variable, with the maximum recorded value at Coltsville being 6,400 cfs in September 1938. Typical flow rates at Coltsville during low-flow periods in the summer are approximately 20 cfs. The 7-day, 10-year (i.e., 7Q10) low-flow rate is 12 cfs at Coltsville. Variability in the Coltsville hydrograph is illustrated on Figure 2-17, which presents daily average flow rates from 1980 to 2000.

Annual maximum daily-average flow rates at Coltsville varied from 580 cfs to 2,860 cfs between 1980 and 2000. The maximum annual floods range from about five to 60 times greater than the mean flow rate at Coltsville. The relatively high variability in flood flow rate for the Housatonic River in the study area is typical of the headwater region of a river; variability in the range of flow rate tends to decrease as drainage area increases.

Flood frequency analyses were conducted using annual instantaneous peak flow rates measured by USGS at the Coltsville and Great Barrington gaging stations. The analyses were conducted based on the Log Pearson Type III distribution (e.g., Bedient and Huber, 1992). The results are summarized in Table 2-10 (below). Since 1980 at Coltsville, twelve 2- to 5-year floods, five 5- to 10-year floods, and four 10- to 25-year floods have occurred.

Table 2-10. Flood Frequencies at Coltsville and Great Barrington

Flood Return Period (years)	Flow Rate at Coltsville (cfs)	Flow Rate at Great Barrington (cfs)
1	520	1,710
1.5	840	3,150
2	1,020	3,720
5	1,360	5,340
10	1,710	6,570
25	2,770	8,320
50	5,810	9,770
100	6,920	11,350

Note:

Flows based on annual instantaneous peak flow rates (i.e., peak streamflow, as reported by USGS).

The three USGS flow gaging stations on the Housatonic River in Connecticut include one at Falls Village near the Massachusetts state line, one at Gaylordsville, and one at Stevenson. The mean annual flow rate at the Falls Village station is reported as 1,112 cfs during the period of 1941 to 2000, with an associated drainage area of 634 mi^2 (USGS, 2002).

The Gaylordsville station is located in Litchfield Connecticut, approximately 30 miles downstream of the Massachusetts state line. The River drains an area of approximately 996 mi^2 above this point (USGS, 2002). The mean annual flow rate at the Gaylordsville station is reported as 1,697 cfs during the period of 1941 to 2000.

The Stevenson station is located at the Stevenson Dam, which serves to impound Lake Zoar. The mean annual flow rate past the dam is reported as 2,668 cfs based on flows recorded from 1941 to 2000. The Stevenson gaging station has an associated drainage area of 1,544 mi^2 (USGS, 2002).

Variations in water surface elevation (i.e., stage height) with flow rate have been measured at different locations in the River and its tributaries. Of particular interest are the EPA data collected during a number of sampling events between 1998 and 2003, which were used to construct rating curves at four locations: Pomeroy Avenue Bridge, Holmes Road Bridge, New Lenox Road Bridge, and Woods Pond Footbridge. These rating curves are shown on Figure 2-18 and describe the stage-flow relationship at various points in the system. At all four locations, stage height increases with increasing flow rate.

To provide an indication of River flow variability, Table 2-11 (below) includes the average daily flow, the 90th percentile, 99th percentile, and maximum observed daily average flows for the USGS gage at Coltsville. The 90th and 99th percentile flows represent the daily average flows that have been exceeded 10% and 1% of the time, respectively, for a particular month, based on the period of record through September 30, 1997. For example, in the month of June, the long-term daily average flow is 56 cfs. However, on 10% of days in June, the daily average flow is expected to exceed 159 cfs, and 1% of the time it will exceed 609 cfs. The maximum daily average flow provides the upper bound of flow conditions for that month observed over the period of record through September 30, 1997.

Table 2-11. Daily Average Flows in the Housatonic River by Month[1]

	Average (cfs)	90 Percentile (cfs)	99 Percentile (cfs)	Maximum (cfs)
January	69	177	736	1820
February	73	191	503	1190
March	124	366	1060	4460
April	204	522	1220	2860
May	106	281	632	2750
June	56	159	609	1600
July	37	93	400	1500
August	33	84	337	2010
September	36	851	418	3110
October	50	133	526	1800
November	70	196	577	1900
December	75	191	567	4350

Note:
1. Flows based on time period from March 8, 1936 to September 30, 1997.

2.4.2 Velocity

EPA collected velocity data at three locations on the main stem of the River during the May 1999 flood: Pomeroy Avenue Bridge, New Lenox Road Bridge, and Woods Pond Footbridge. Current velocities were also measured near the mouths of three tributaries during this flood: West Branch, Sackett Brook, and Roaring Brook. Along the main stem of the River, maximum velocities at the peak of the flood ranged from 2 feet per second (ft/s) at New Lenox Road Bridge to about 5 ft/s at the Pomeroy Avenue Bridge. Minimum velocities at these two locations were less than 1 ft/s to 2 ft/s. Velocities in Sackett Brook ranged from 1 ft/s to 3 ft/s, while peak velocities in Roaring Brook were about 6 ft/s.

EPA obtained additional velocity data over a range of flow rates between 1998 and 2003. These data were used to construct velocity rating curves at four locations: Pomeroy Avenue Bridge, Holmes Road Bridge, New Lenox Road Bridge, and Woods Pond Footbridge. Cross-sectional average velocity as a function of flow rate at these four sites is presented on Figure 2-19. Generally, velocity increases with increasing flow rate at all four locations. Velocity at the local mean flow rate (shown as a vertical dashed line on the rating curve plots) varies among the different locations, ranging from 1.1 ft/s to 1.4 ft/s at Pomeroy Avenue and Holmes Road Bridges to 0.6 ft/s at New Lenox Road Bridge to about 0.25 ft/s at Woods Pond Footbridge. Generally, cross-sectional average velocity tends to decrease as one travels from the Confluence to Woods Pond. This spatial trend in velocity is consistent with the spatial trend in River gradient (Section 2.2.2.3 and Figure 2-10). The highest velocities are observed in the region with the highest River gradient and velocity decreases as the River gradient decreases, which is consistent with observed behavior on many other rivers (Leopold et al., 1964).

2.5 Hydrogeology

The hydrogeology of the Housatonic River Basin has been described in detail as part of several prior reports (Norvitch et al., 1968; Wilson et. al, 1974; NEBRC, 1980; EHC Corporation, 1991; and Harza, 1988) and was previously summarized in Section 2.5 of the 1996 RFI Report (BBL, 1996).

In general, the overburden material of the Housatonic River Basin has been identified chiefly as sedimentary rock, including mainly glacial till and stratified drift. Bedrock of the Housatonic River Basin is characterized primarily as metamorphic rock, such as quartzite, gneiss, and dolomite. Groundwater varies greatly throughout the basin in terms of both quality and available quantity. In areas where crystalline rock such as gneiss and granite occur, groundwater tends to be only slightly mineralized as a result of the relative insolubility of these rock types. Aquifer yield in these areas can be abundant where bedrock contains significant fractures. However, groundwater quantities are limited where fracturing is not prevalent. In areas where schist predominates, groundwater may contain significant levels of iron and manganese, and aquifer yields may be limited even where fracturing is extensive. Groundwater is typically mineralized in locations such as the lowlands and valleys of the Housatonic River Basin where soluble limestone and dolomitic bedrock predominate. These valleys are generally covered with deep glacial deposits composed of stratified drift. Where these coarse sands and gravels exist, aquifer yields can be significant.

As a result of the abundant surface water supplies in the upper Housatonic River Basin in Massachusetts, there is no known use of subsurface aquifers along the River in Massachusetts for municipal water supply, although a limited number of wells are used for private and industrial water supply. USGS has identified several concerns regarding the suitability of groundwater in the upper Housatonic River Basin in Massachusetts for municipal water supply (Norvitch et al., 1968). The main concerns expressed by USGS involve the storage capacity and land use associated with aquifers in certain areas throughout the basin; in terms of groundwater quality, high background levels of iron and manganese may be of concern (Norvitch et al., 1968; Wilson et al., 1974). For its water supply, the City of Pittsfield utilizes five surface water reservoirs, while the Town of Lenox depends primarily on two reservoirs and purchases some of its water supply from Pittsfield (ChemRisk, 1996). Although a limited number of residences in the Town of Lenox use private wells, review of available information indicated no such wells in the floodplain (ChemRisk, 1996). In short, groundwater within the Rest of River area in Massachusetts is not currently known to be used for drinking water supply nor is it likely to be used for this purpose in the foreseeable future (ChemRisk, 1996).

Moreover, the available information, as well as regional hydrogeologic conditions, indicate that there is unlikely to be any significant impact from PCBs in the River on adjacent groundwater (ChemRisk, 1996). For example, Gay and Frimpter (1984) evaluated the possible impacts of PCBs in the sediments of Woods Pond on adjacent groundwater. These investigators reported that PCBs from sediments in Woods Pond did not migrate into groundwater in the area despite the significant pumping of industrial water supply wells located immediately adjacent to Woods Pond. In addition, investigations at the GE Pittsfield facility areas located along the Housatonic River have identified those areas as a region of groundwater discharge to the River. In general, groundwater associated with the GE Pittsfield facility tends to be recharged by upland areas, with the Housatonic River being the final receptor of groundwater discharges. Similarly, as noted in the SI Work Plan (Weston, 2000), the Housatonic River is the predominant groundwater discharge point for the overall Rest of River area. This means that most groundwater in the Housatonic River Basin (which includes the GE Pittsfield facility) eventually discharges to the

Housatonic River, either by direct subsurface flow through the River bottom sediments, or by discharging into smaller tributaries, which then flow to the Housatonic River (Weston, 2000).

2.6 Primary Constituents

The primary constituents of concern in the Rest of River are PCBs. In addition to PCBs, various other chemical constituents, including SVOCs, VOCs, pesticides, herbicides, PCDDs/PCDFs, and metals, have been analyzed for in samples collected from the different media in the Rest of River area. Information on the frequency of detection and summary statistics on concentrations for these chemical constituents in surface water, sediments, floodplain/riverbank soils, and biota are presented in Appendix C. In general, these constituents have been detected at relatively low concentrations (in relation to background or screening levels) or have had relatively low frequencies of detection. EPA has advised GE that, based on its human health and ecological screening evaluations, while a limited number of these non-PCB constituents – notably, PCDDs/PCDFs -- may be carried through its human health and ecological risk assessments, PCBs should be considered the primary constituents of concern in the Rest of River and should be the focus of the data analysis in this RFI Report. As such, while all chemical data collected from the Rest of River are summarized in this RFI Report, the discussions in subsequent sections of this report, including the discussions of sources and fate and transport in Section 8, focus primarily on PCBs. However, to a lesser extent, these discussions also present summary information on PCDD/PCDF compounds, since they may be included in the risk assessments.

Section 2 Tables

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Table 2-3
Characteristics of Housatonic River Impoundments in Massachusetts and Connecticut

Dam/Impoundment	Dam Spillway Elevation	Impoundment Area (acres)	Impoundment Average Depth (ft)	Dam Freeboard (ft)	Impoundment Purpose
Woods Pond	948.3	60	3-15	--	Forebay for a hydro-powered mill[b]
Columbia Mill	907.8[a]	28[a]	3[d]	4.5[a]	Not available
Willow Mill	838.4[a]	14.2[e]	4.7[d]	7[a]	Hydroelectric Power
Glendale	--	5[a]	5.3[d]	6[a]	Hydro-power[f]
Rising Pond	716.6[a]	44[a]	3.8[d]	--	No longer used[g]
Falls Village	--	13.2[e]	7.6[d]	--	Hydroelectric Power[c]
Bulls Bridge	--	132.8[e]	5.1[d]	--	Hydroelectric Power[c]
Bleachery Dam	--	--	--	--	--
Shepaug Dam (Lake Lillinonah)	--	1900[c]	100[c]	--	Hydroelectric Power, Recreation[c]
Stevenson Dam (Lake Zoar)	--	975[c]	75[c]	--	Hydroelectric Power[c]
Derby Dam (Lake Housatonic)	--	328[c]	26[c]	--	Hydroelectric Power, Recreation[c]

Notes:
[a] Information obtained from *Report on Six Housatonic River Dams* (Harza, 1991).
[b] Retired, information obtained from *Woods Pond Dam, Structural Integrity Assessment* (Harza, 2001a).
[c] Information obtained from Frink et al., 1982
[d] The average depth of impoundment was calculated using average depth of each transect. Transect data taken from the "BATHYMETRY" table which is included as part of the GE Housatonic database (release 2/28/02).
[e] Area calculated using average width and average length estimated using GIS
[f] Retired, information obtained from *Report on Six Housatonic River Dams* (Harza, 1991).
[g] Abandoned, information obtained from *Rising Paper Dam, Structural Integrity Assessment* (Harza 2001b).
-- Information presently not available.

Table 2-7
Monthly Precipitation Averages by Location

Month	Stockbridge, MA 1/1970 - 9/1985	Great Barrington 5 SW, MA 12/1973 - 10/1999	Sheffield 3 SSW, MA 1/1979 - 3/1982	Norfolk 2 SW, CT 1/1970 - 10/1999
January	2.6	3.9	4.2	4.2
February	3.0	2.9	4.2	3.6
March	3.5	3.6	3.6	4.6
April	3.9	3.7	4.2	4.5
May	5.4	4.7	3.9	4.8
June	4.0	3.5	2.9	4.4
July	3.9	4.1	3.2	4.7
August	4.6	4.8	3.6	4.7
September	4.0	4.3	3.2	4.5
October	3.7	4.1	4.1	4.4
November	3.7	4.1	3.5	4.7
December	3.7	3.5	2.5	4.4
Total	**46.2**	**47.4**	**43.0**	**53.4**

Notes:
1. Numbers represent total monthly precipitation in inches.
2. Source of data: National Climatic Data Center, a branch of NOAA (www.ncdc.noaa.gov).

Table 2-8
Annual Precipitation Averages by Location

Year	Stockbridge, MA 1/1970 - 9/1985	Great Barrington 5 SW, MA 12/1973 - 10/1999	Sheffield 3 SSW, MA 1/1979 - 3/1982	Norfolk 2 SW, CT 1/1970 - 10/1999
1970	35	--	--	43
1971	39	--	--	48
1972	54	--	--	67
1973	50	--	--	60
1974	51	45	--	53
1975	54	61	--	64
1976	--	48	--	57
1977	--	57	--	65
1978	--	40	--	38
1979	51	56	54	61
1980	33	34	35	42
1981	40	42	40	46
1982	--	--	--	45
1983	--	54	--	63
1984	--	50	--	55
1985	--	37	--	47
1986	--	46	--	57
1987	--	42	--	48
1988	--	42	--	48
1989	--	51	--	57
1990	--	64	--	57
1991	--	48	--	49
1992	--	44	--	51
1993	--	47	--	49
1994	--	44	--	54
1995	--	39	--	48
1996	--	57	--	74
1997	--	35	--	47
1998	--	--	--	42
Average	**45**	**47**	**43**	**53**

Notes:

1. Numbers represent total annual precipitation in inches.
2. -- = Not Available.
3. Source of Data: National Climatic Data Center, a branch of NOAA (www.ncdc.noaa.gov).
4. Only includes years with at least 310 measurements.

Table 2-9
Monthly Temperature Averages and Extremes

Albany County Airport							
Month	Daily Minimum Temperature (^{0}F)			Daily Maximum Temperature (^{0}F)			Average Daily Temperature (^{0}F)
	1/1970 - 10/1999			1/1970 - 10/1999			1/1970 - 10/1999
	Minimum	Maximum	Average	Minimum	Maximum	Average	
January	-28	56	13	-2	65	31	--
February	-21	50	15	4	67	34	--
March	-6	56	25	13	86	44	--
April	13	63	36	25	92	58	--
May	28	68	46	42	94	70	--
June	36	72	55	55	96	78	--
July	40	74	60	60	99	83	--
August	34	74	58	58	97	80	--
September	28	71	50	52	93	72	--
October	17	64	39	37	86	60	--
November	5	61	31	22	81	48	--
December	-20	52	20	3	71	36	--
Average	11	63	37	31	86	58	
Hartford-Bradley International Airport							
Month	Daily Minimum Temperature (^{0}F)			Daily Maximum Temperature (^{0}F)			Average Daily Temperature (^{0}F)
	1/1970 - 10/1999			1/1970 - 10/1999			1/1970 - 10/1999
	Minimum	Maximum	Average	Minimum	Maximum	Average	
January	-21	53	17	3	64	34	--
February	-13	50	20	8	73	38	--
March	1	56	28	22	87	47	--
April	9	62	38	24	96	60	--
May	28	69	48	44	99	72	--
June	37	73	57	52	98	80	--
July	46	78	63	62	101	85	--
August	39	77	61	60	101	83	--
September	30	72	52	52	99	74	--
October	17	69	41	38	86	63	--
November	1	65	33	24	81	51	--
December	-14	49	23	8	74	39	--
Average	13	64	40	33	88	61	

Note:
1. All data downloaded from www.ncdc.noaa.gov.
2. -- = Not Available.

Section 2 Figures

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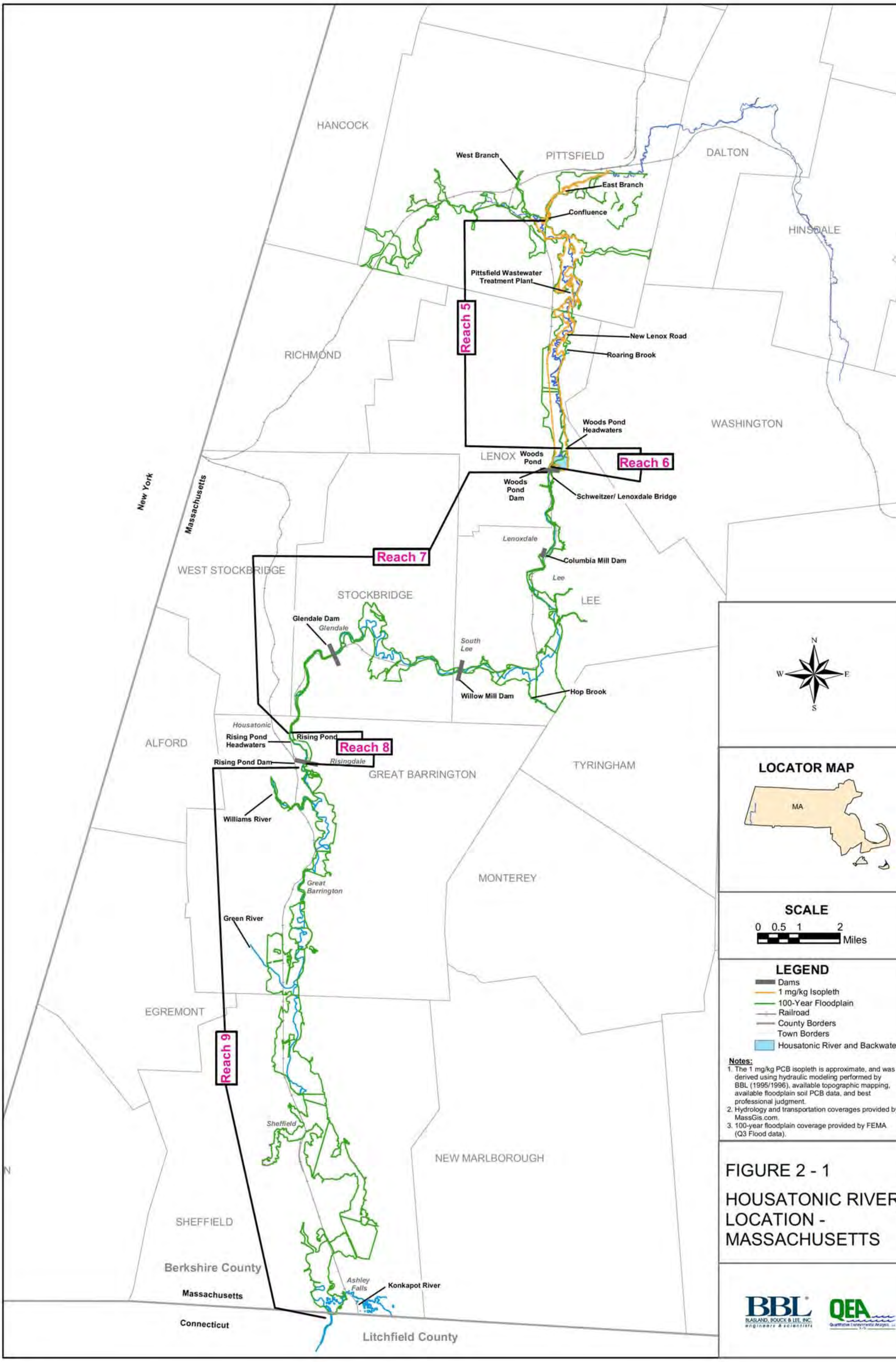

FIGURE 2 - 1

HOUSATONIC RIVER LOCATION - MASSACHUSETTS

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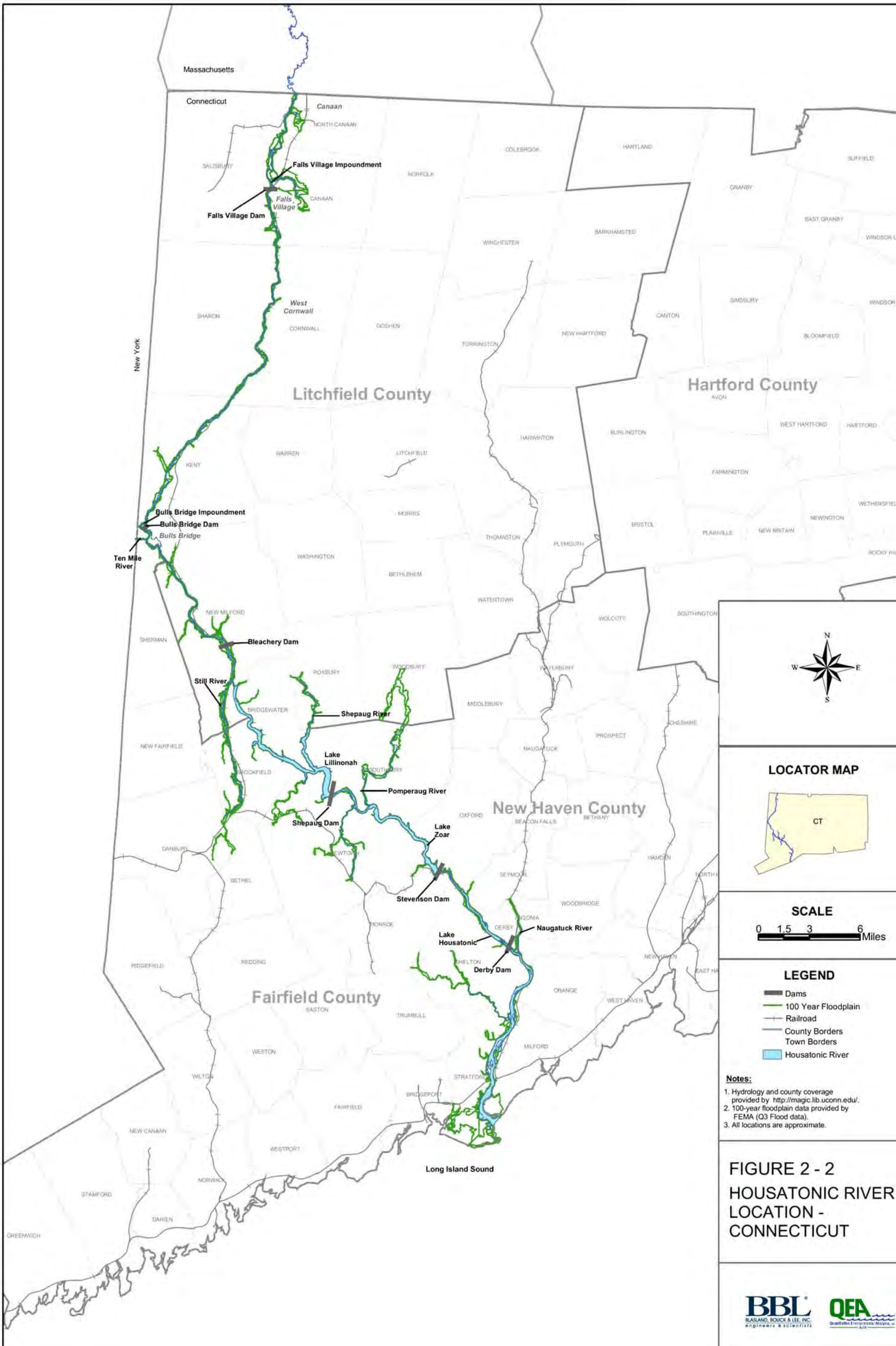

FIGURE 2 - 2
HOUSATONIC RIVER LOCATION - CONNECTICUT

07/28/03 SYR-85 TBR
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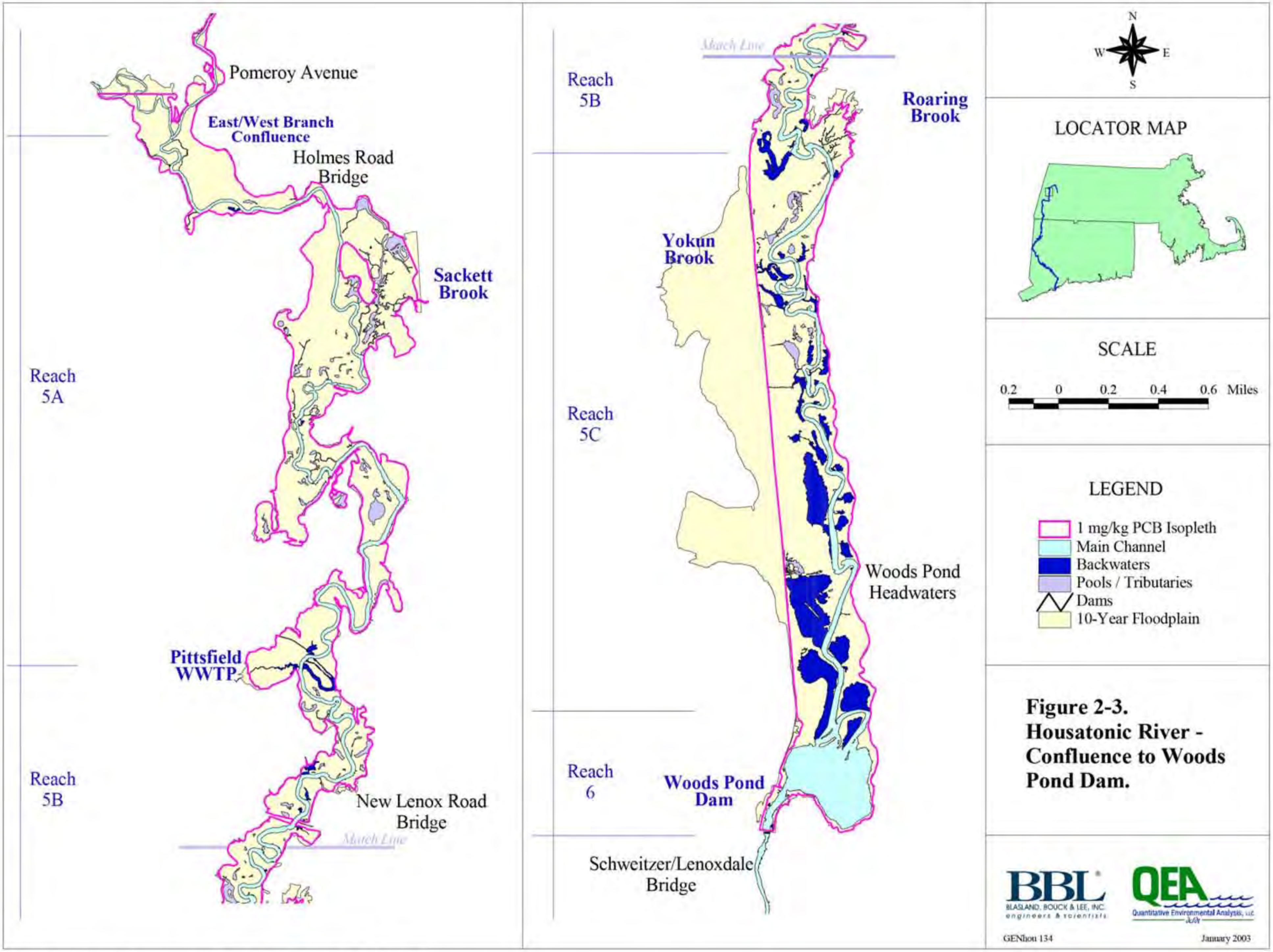

Figure 2-3. Housatonic River - Confluence to Woods Pond Dam.

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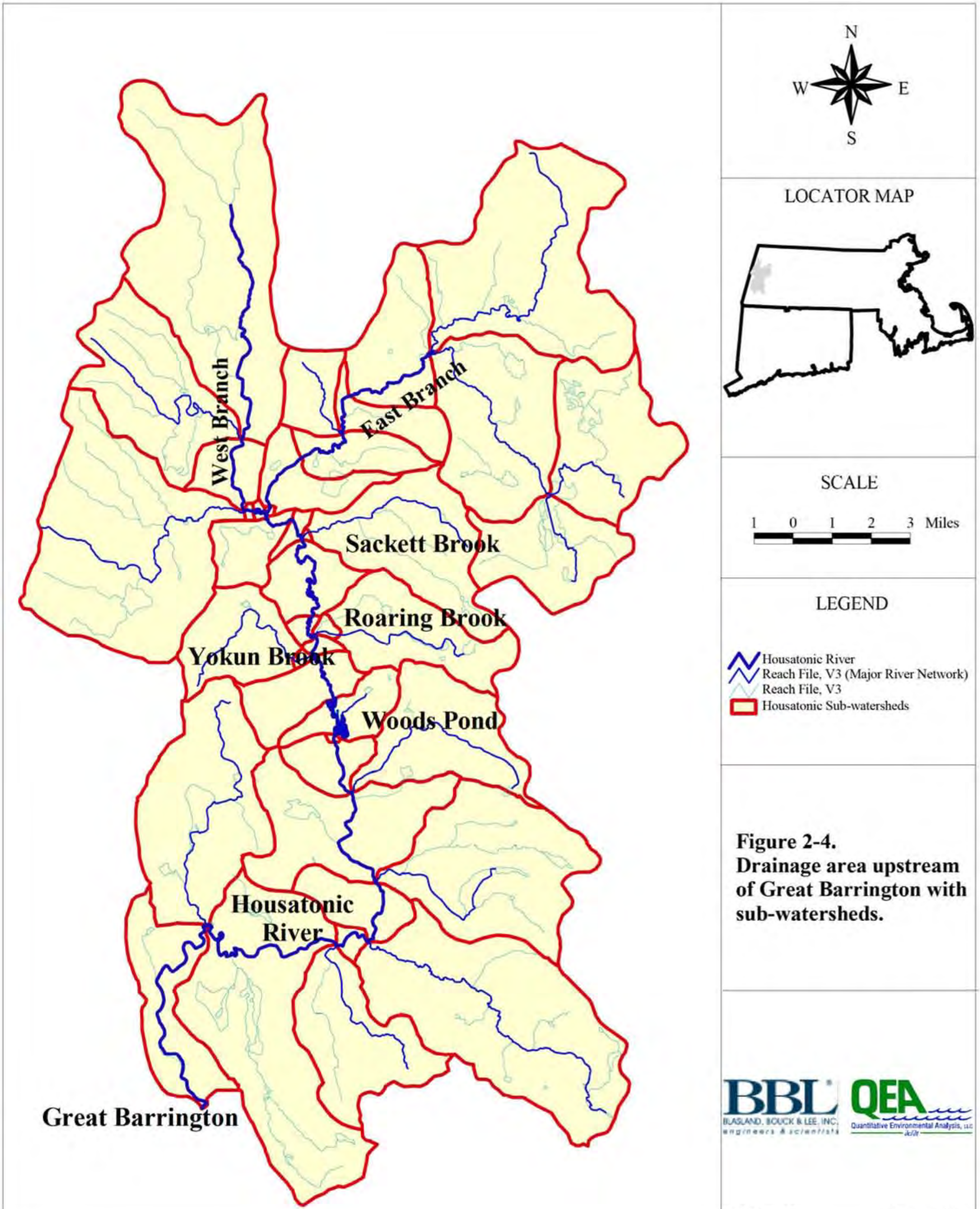

Figure 2-4. Drainage area upstream of Great Barrington with sub-watersheds.

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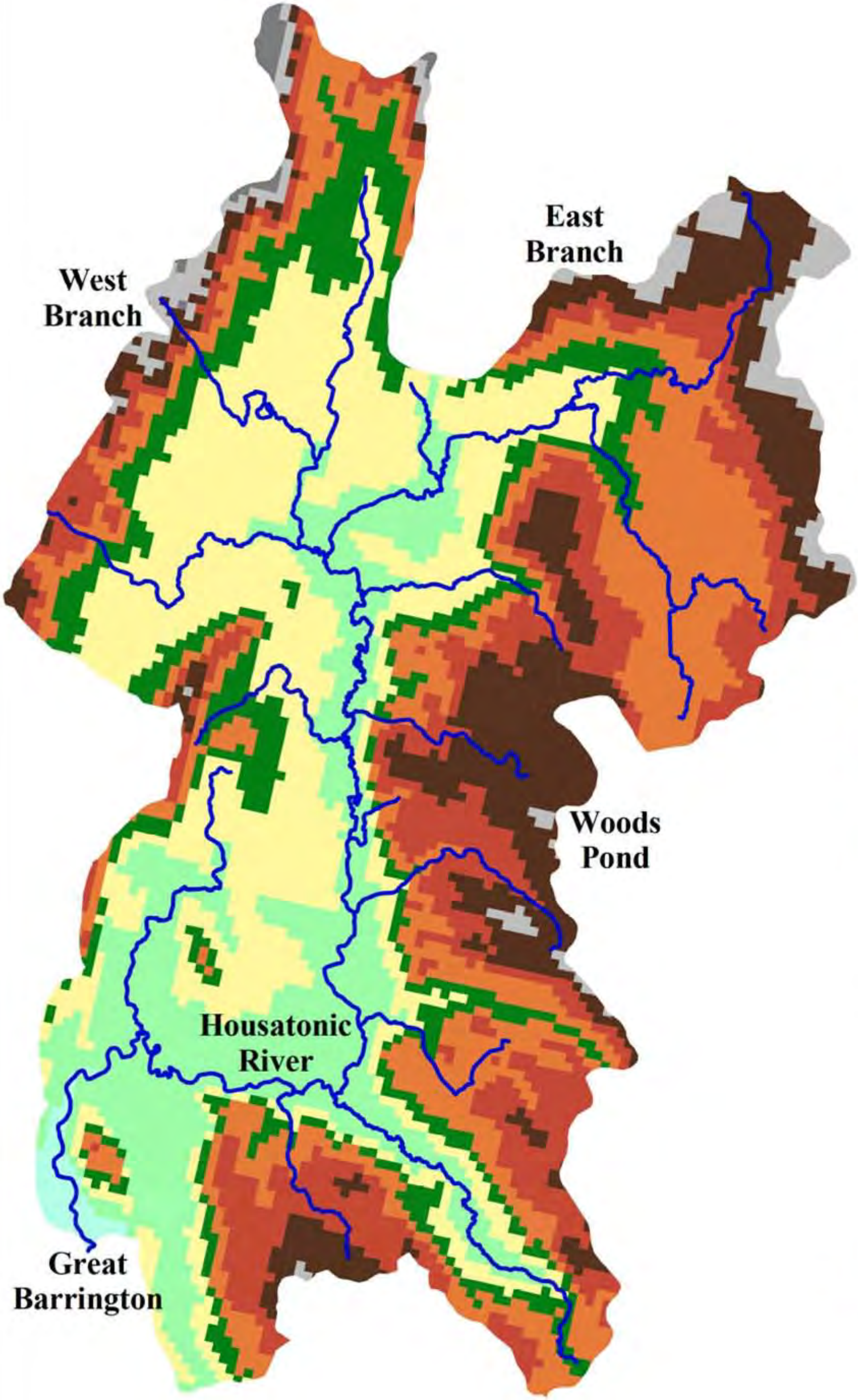
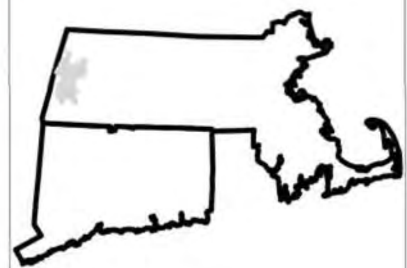


LOCATOR MAP



SCALE

LEGEND

Reach File, V3 (Major River Network)

Topography (feet)

- 600 - 800
- 800 - 1000
- 1000 - 1200
- 1200 - 1400
- 1400 - 1600
- 1600 - 1800
- 1800 - 2000
- 2000 - 2200
- > 2200

Figure 2-5. Housatonic River watershed topography upstream of Great Barrington.

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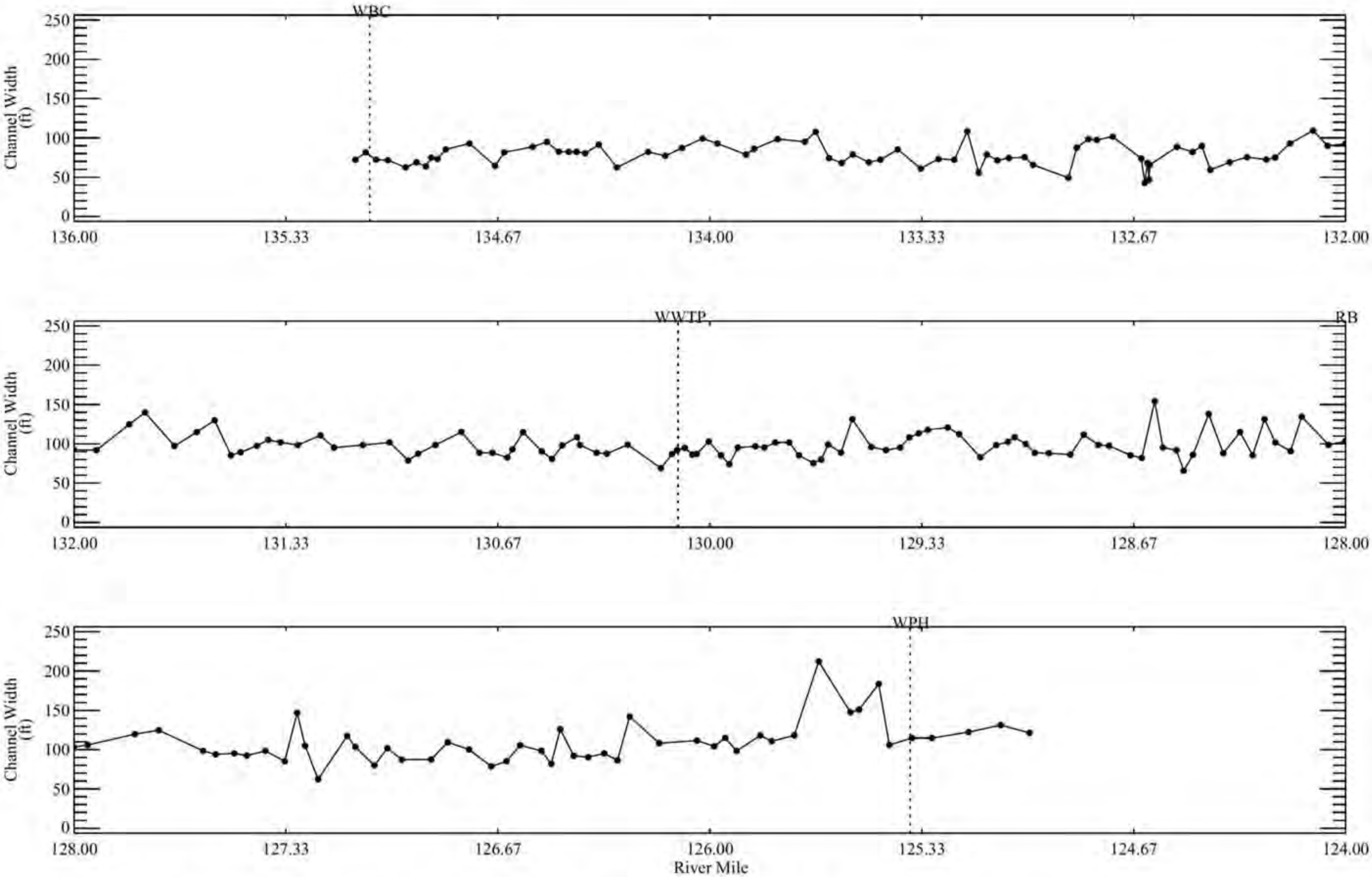

Figure 2-6. Spatial distribution of channel width from the Confluence to Woods Pond Dam.

Data set included: 1999 USEPA data.

Abbreviations: West Branch Confluence (WBC), Wastewater Treatment Plant (WWTP), Roaring Brook (RB), Woods Pond Headwaters (WPH)

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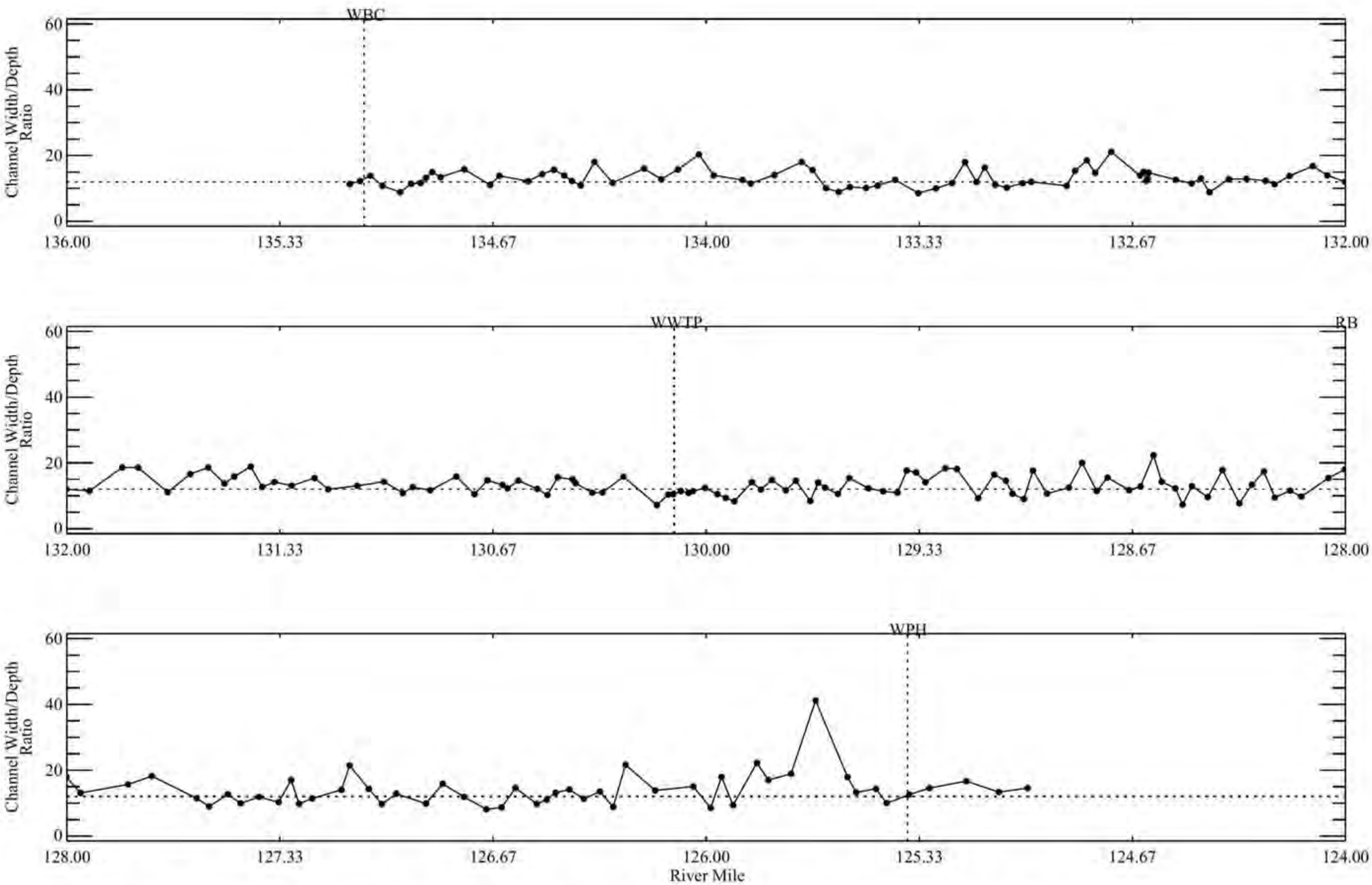

Figure 2-7. Spatial distribution of width:depth ratio from the Confluence to Woods Pond Dam.

Data set included: 1999 USEPA data.

Abbreviations: West Branch Confluence (WBC), Wastewater Treatment Plant (WWTP), Roaring Brook (RB), Woods Pond Headwaters (WPH)

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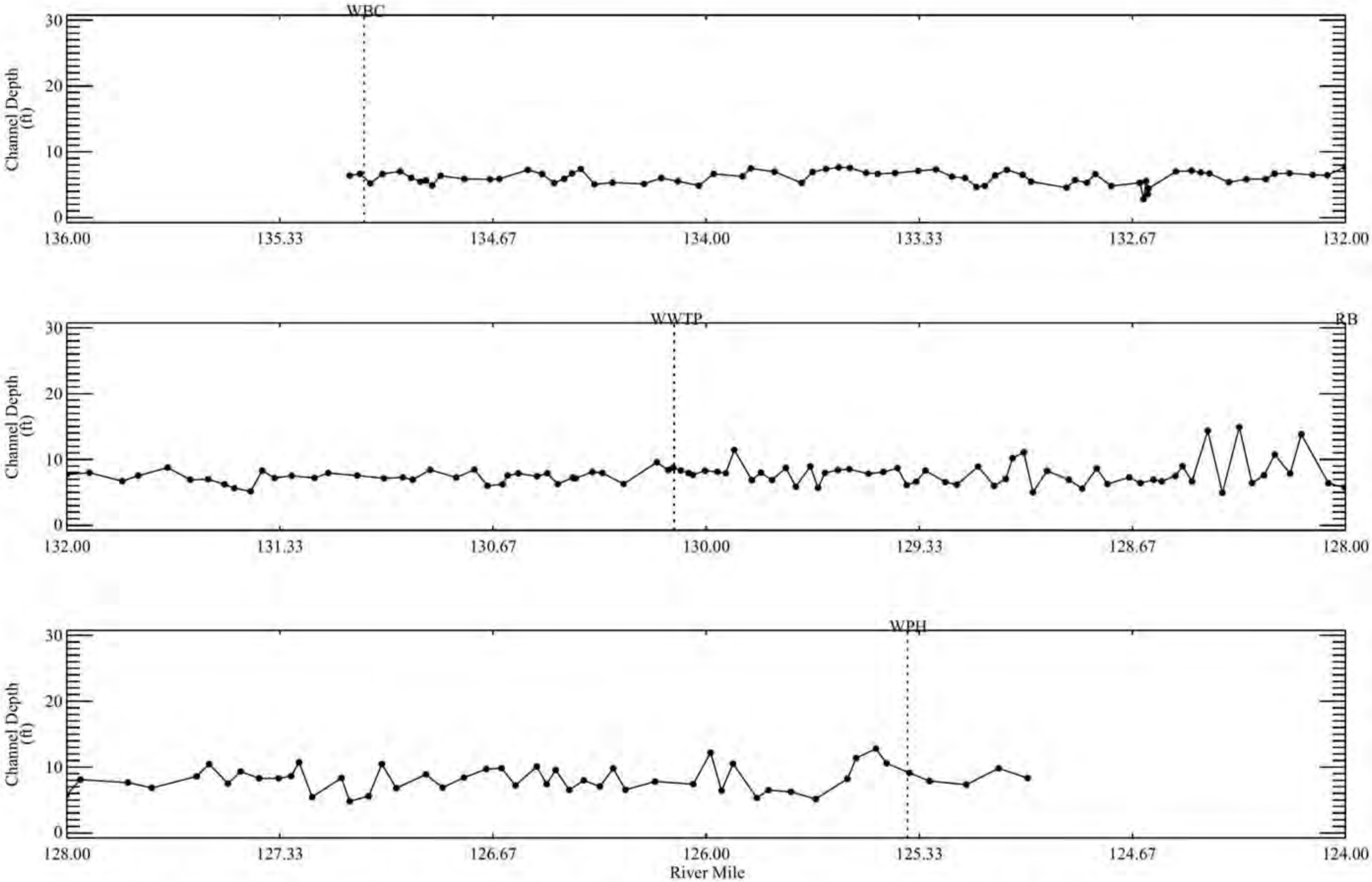

Figure 2-8. Spatial distribution of bankfull water depth from the Confluence to Woods Pond Dam.

Data set included: 1999 USEPA data.

Abbreviations: West Branch Confluence (WBC), Wastewater Treatment Plant (WWTP), Roaring Brook (RB), Woods Pond Headwaters (WPH)

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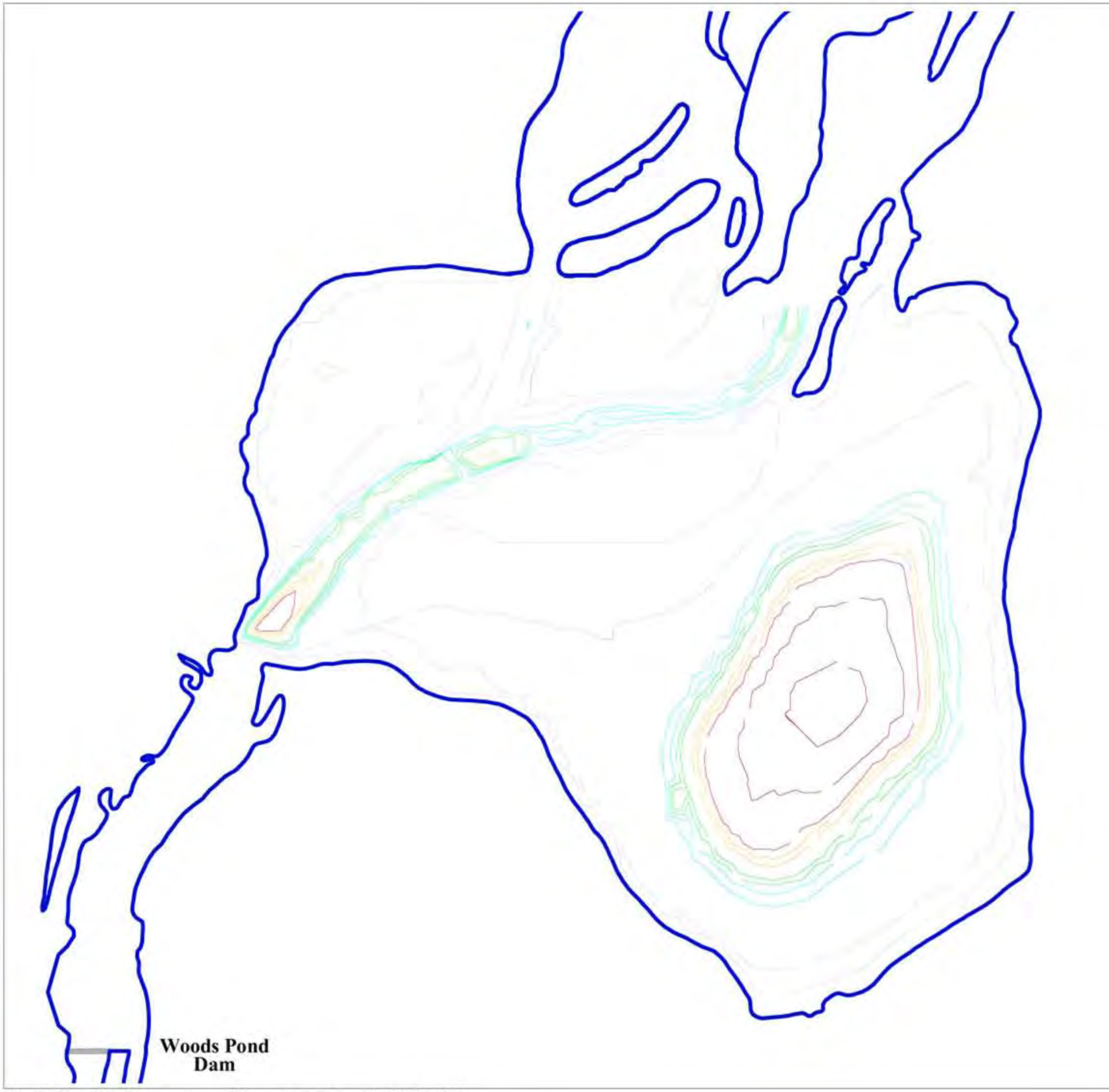

LOCATOR MAP

SCALE

100 0 100 200 300 400 Feet

LEGEND

Housatonic River Shoreline
Dam
Elevation (ft above MSL)
> 945
943 - 945
941 - 943
939 - 941
937 - 939
935 - 937
933 - 935

Figure 2-9.
Woods Pond bathymetry.

Data source: BBL, 1990.

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Quantitative Environmental Analysis, LLC

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January 2003

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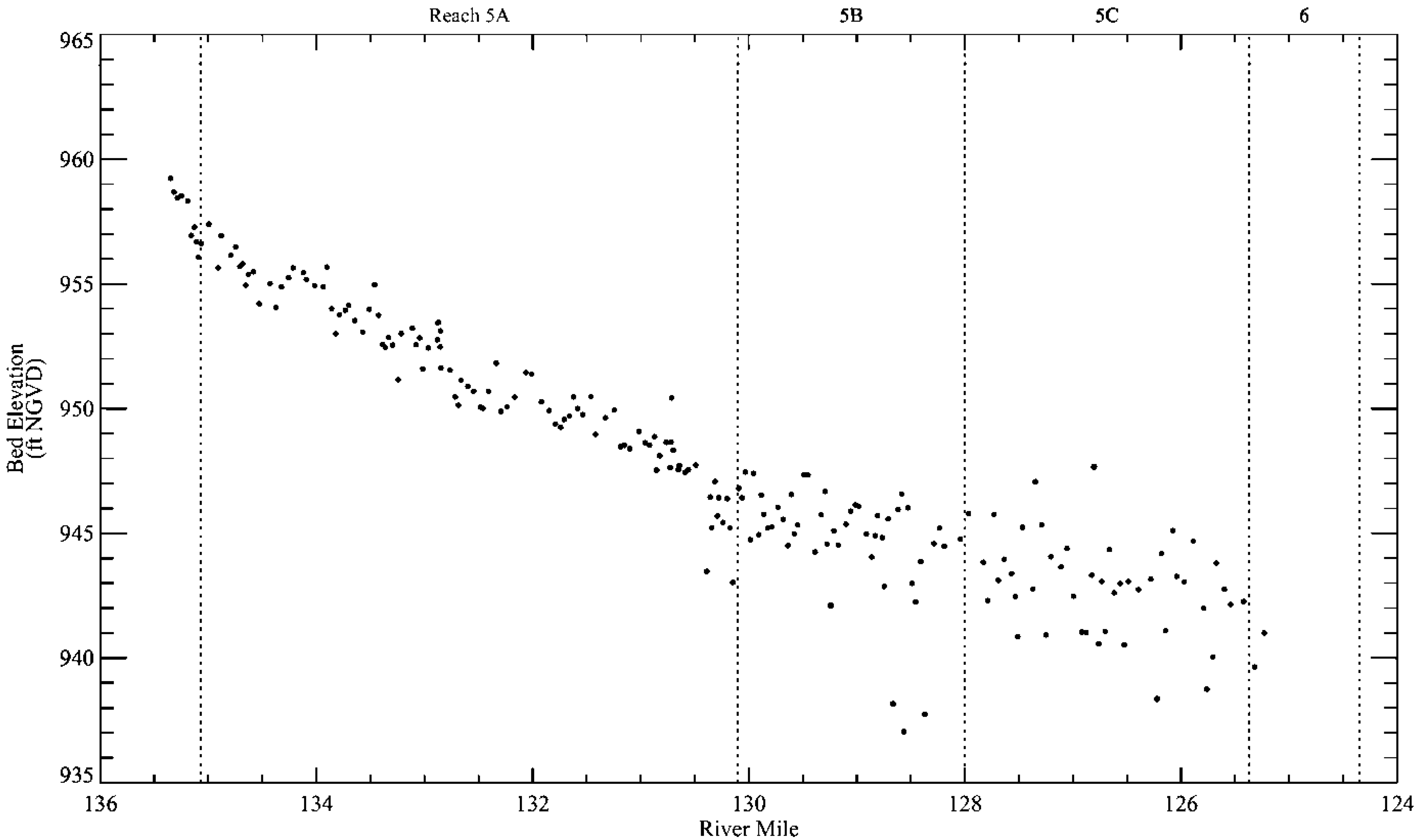

Figure 2-10. Spatial distribution of channel gradient from the Confluence to Woods Pond Dam.

Data sets included: 1999 USEPA data

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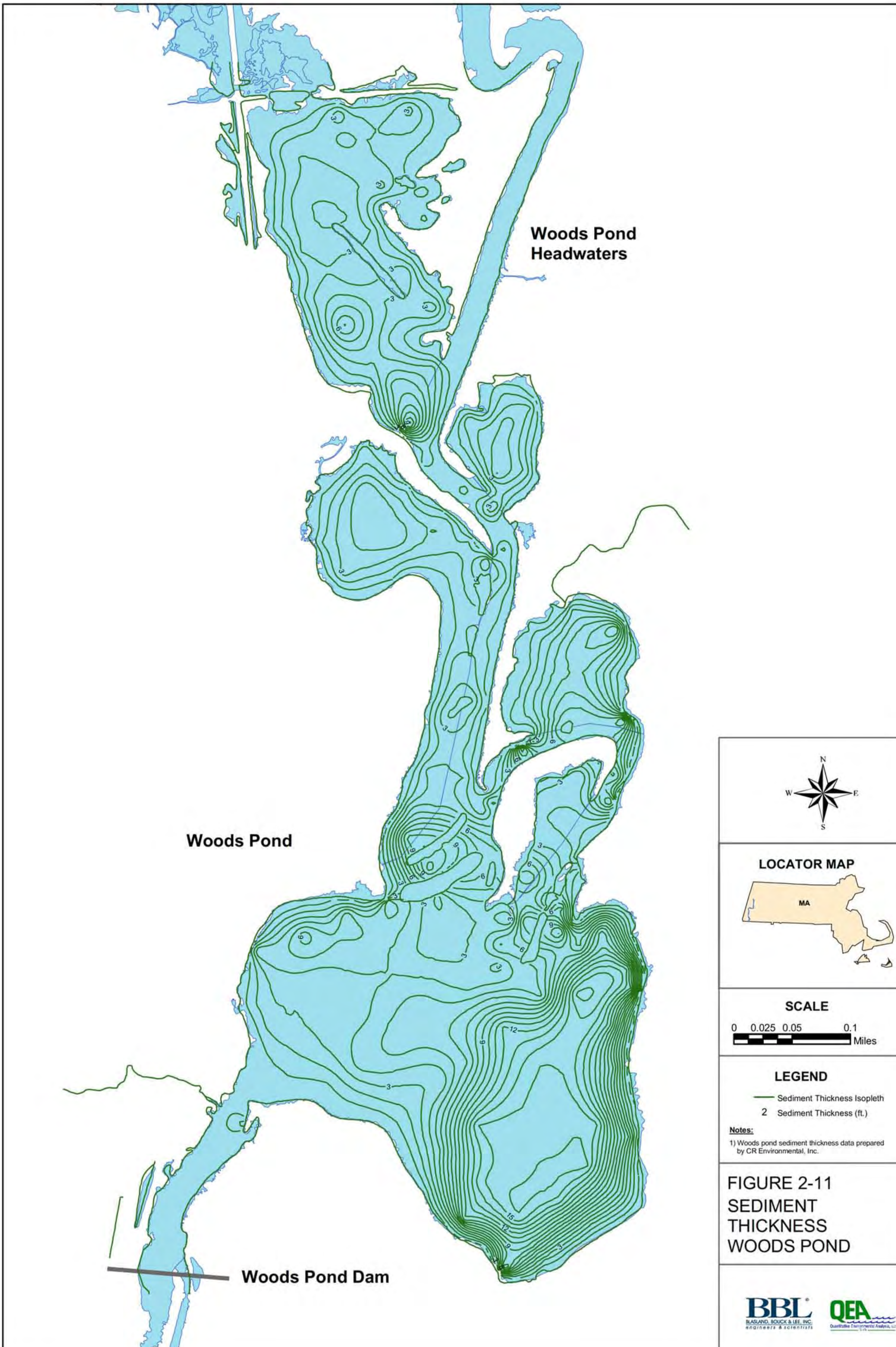
Woods Pond
Headwaters
Woods Pond
Woods Pond Dam
N
W
E
S
LOCATOR MAP
MA
SCALE
0 0.025 0.05 0.1
Miles
LEGEND
Sediment Thickness Isopleth
2 Sediment Thickness (ft.)
Notes:
1) Woods pond sediment thickness data prepared by CR Environmental, Inc.
FIGURE 2-11
SEDIMENT
THICKNESS
WOODS POND
BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists
QEA

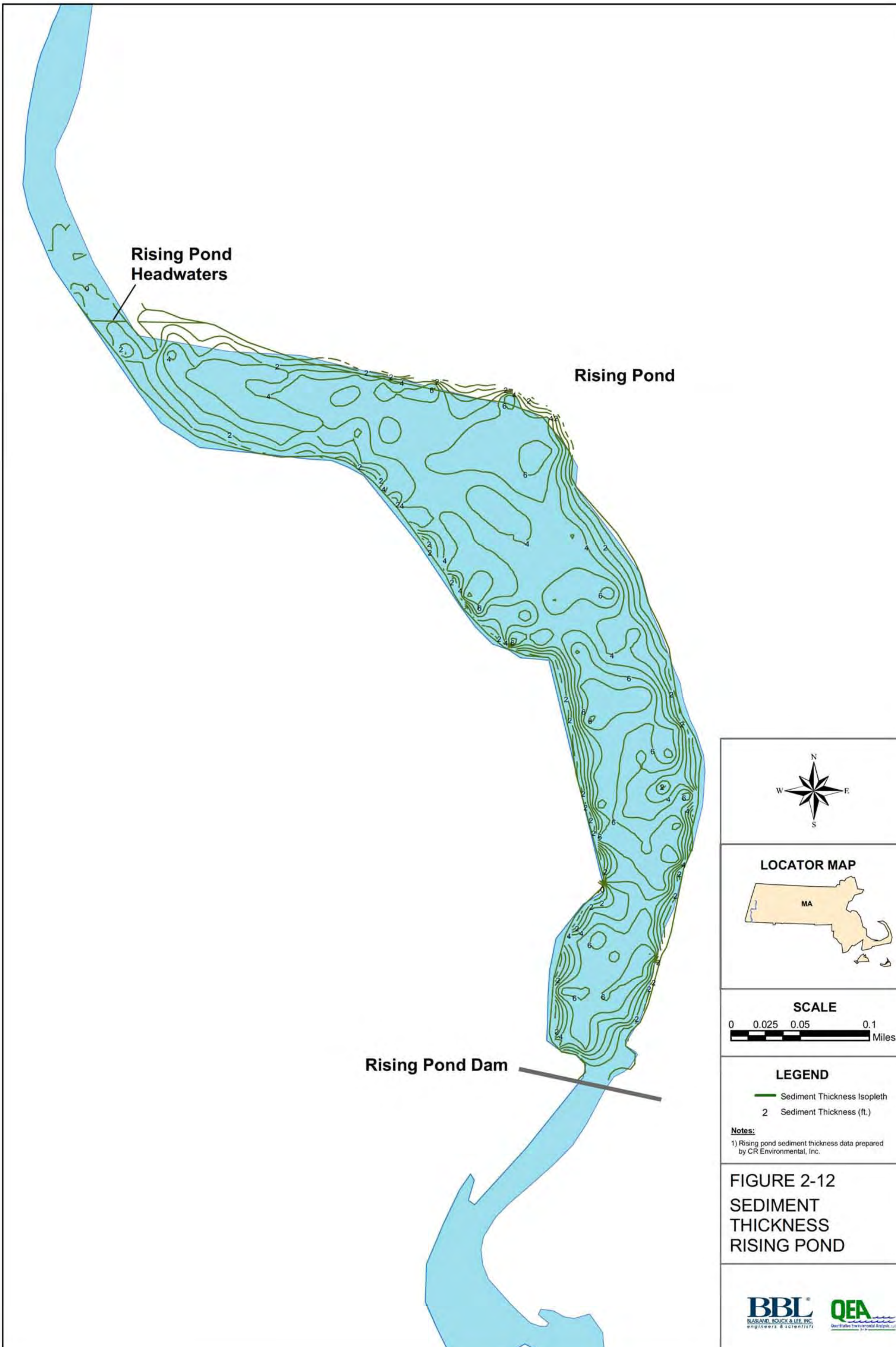

FIGURE 2-12
SEDIMENT THICKNESS RISING POND

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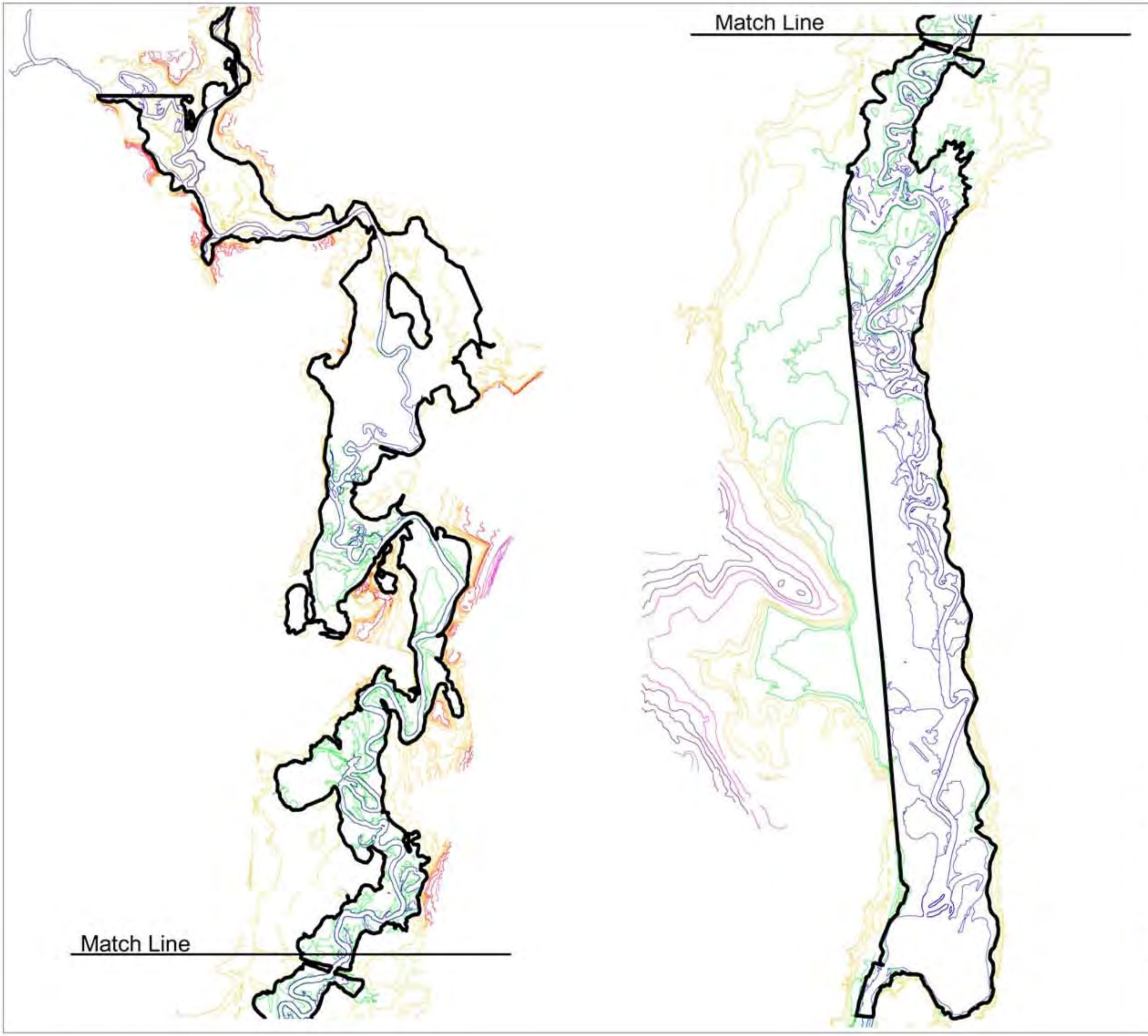

Figure 2-13. Floodplain topography between the Confluence and Woods Pond Dam.

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

QEA Quantitative Environmental Analysis, LLC

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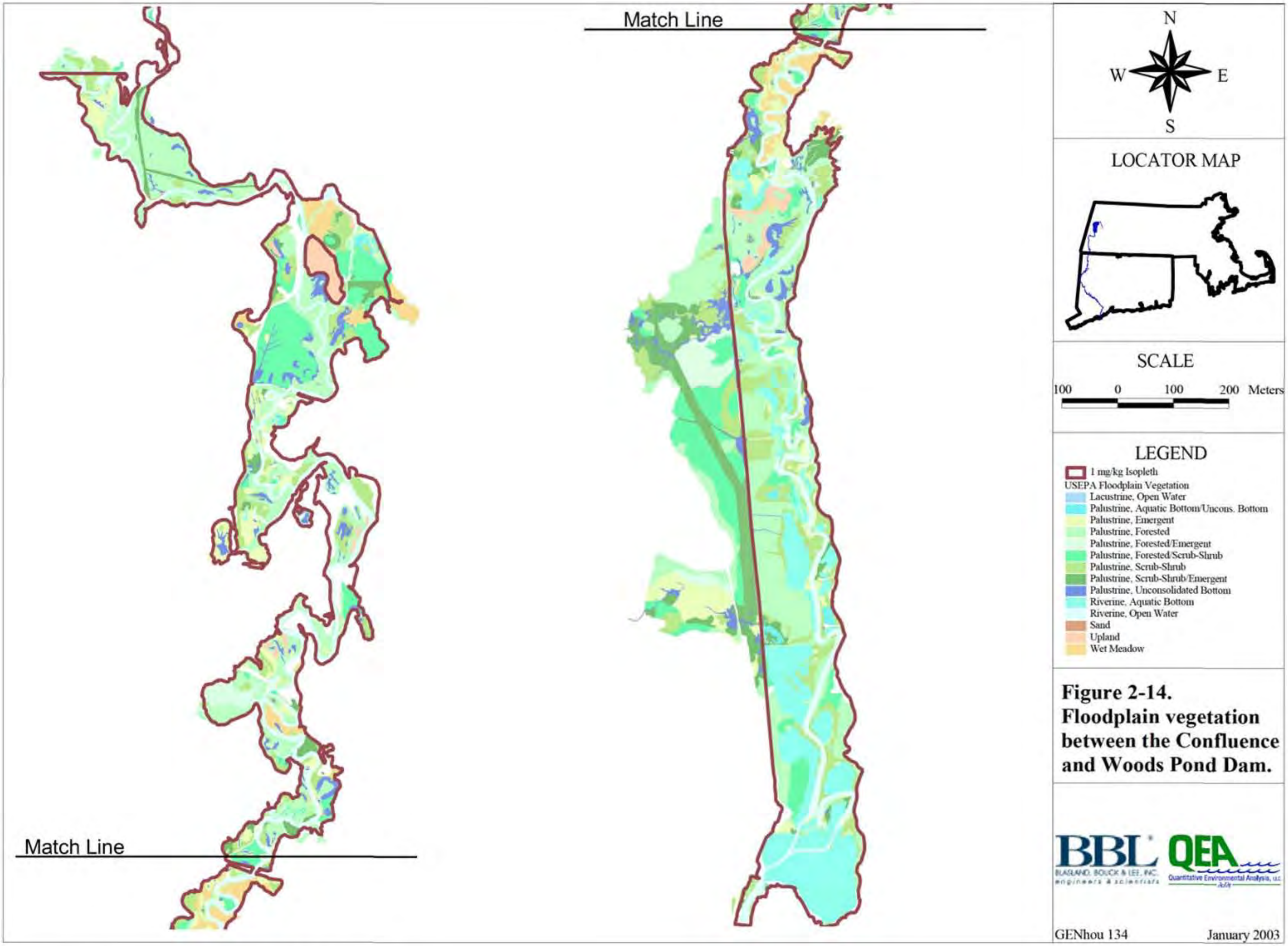

Figure 2-14. Floodplain vegetation between the Confluence and Woods Pond Dam.

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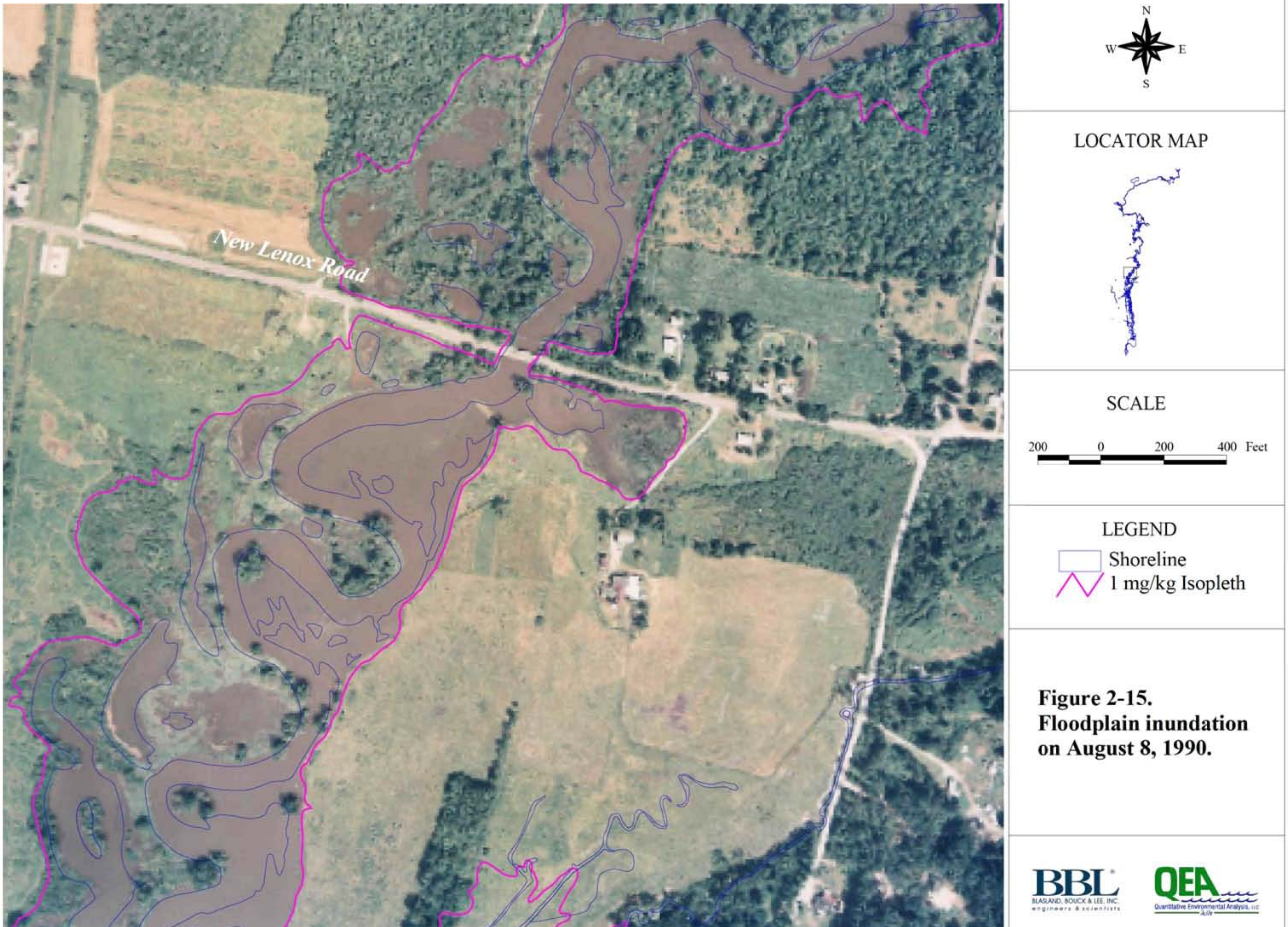

Figure 2-15. Floodplain inundation on August 8, 1990.

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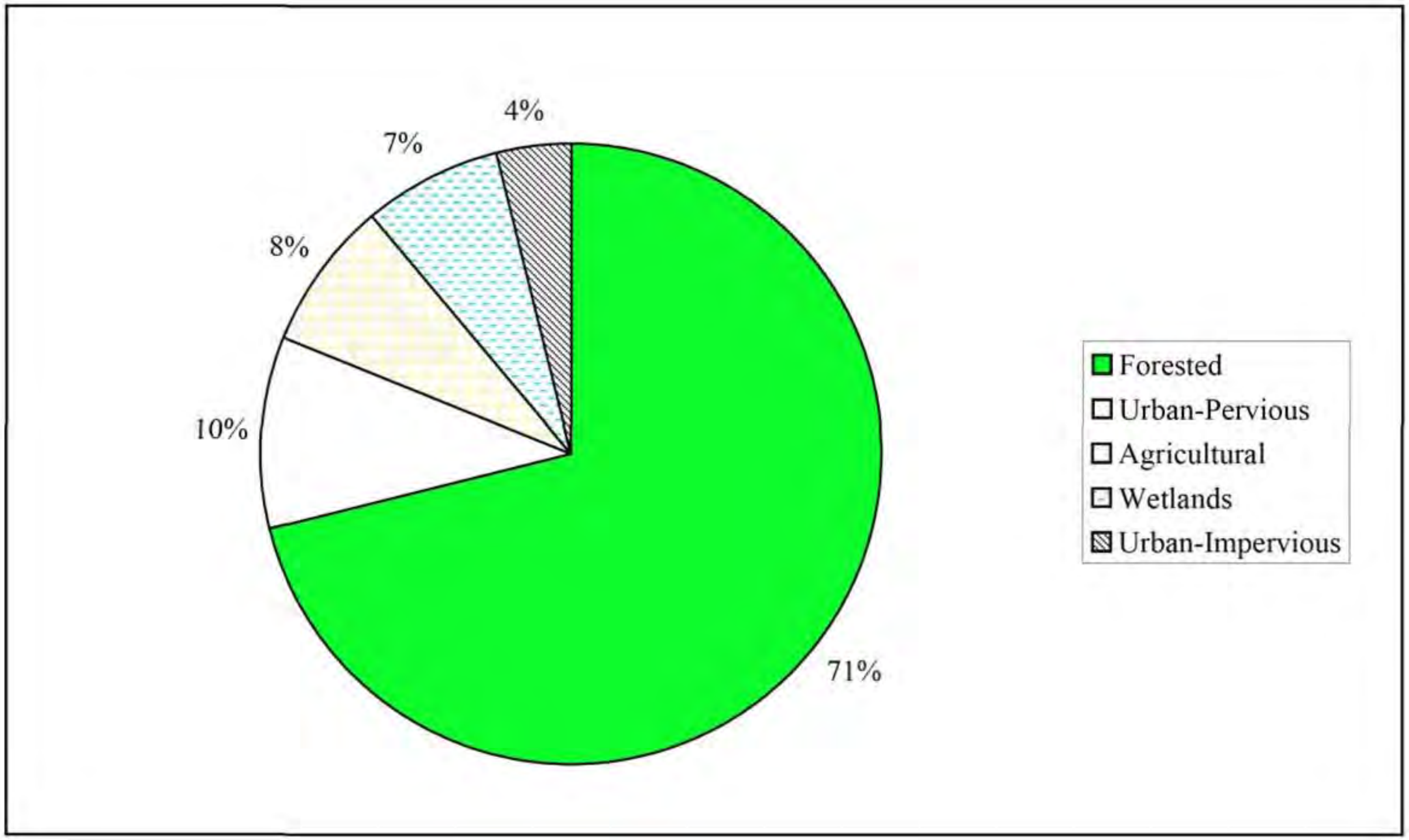

Figure 2-16. Land use distribution for the watershed upstream of Great Barrington.

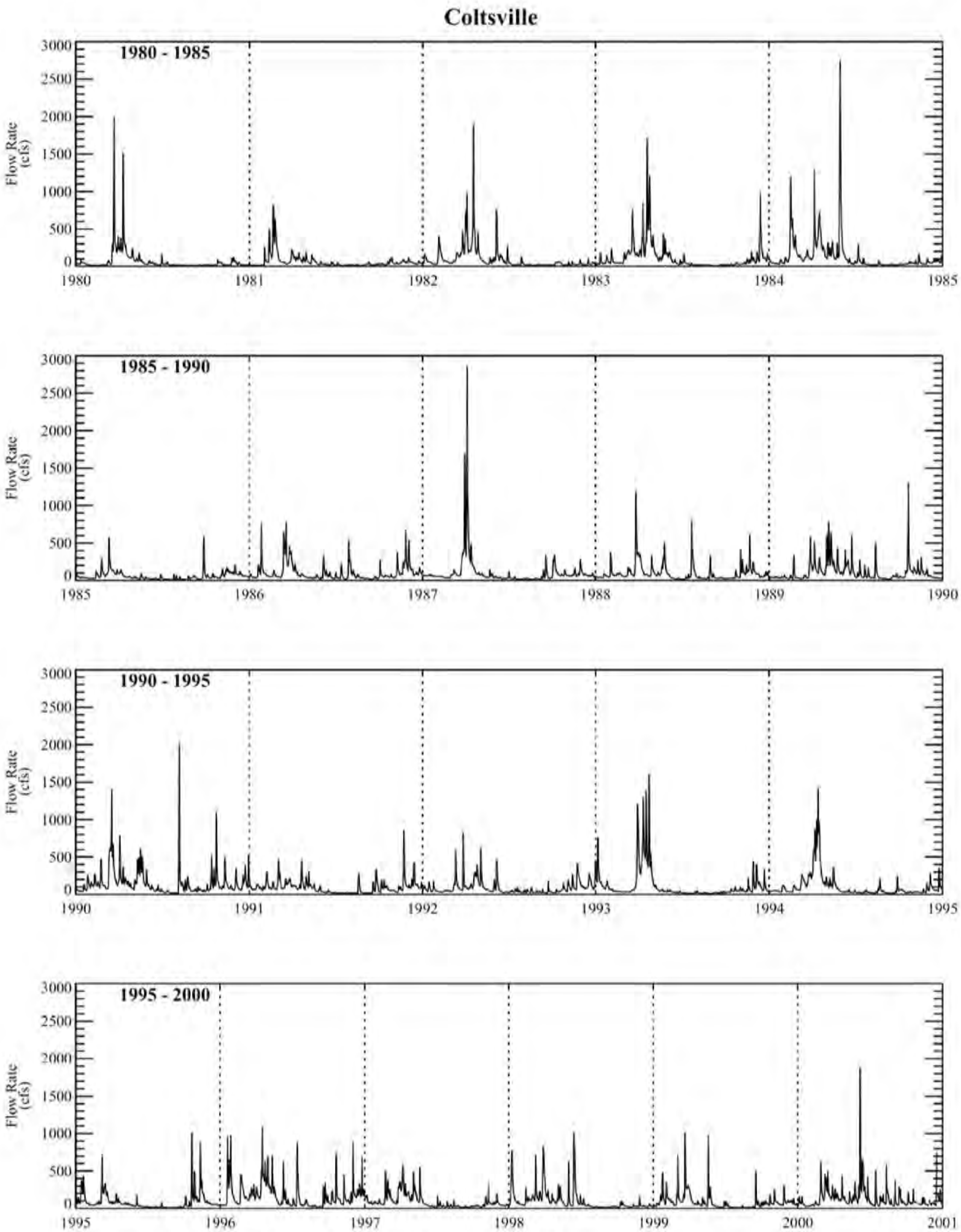

Figure 2-17. Daily average flow rate measured at USGS Coltsville gauging station for 1980-2000.

Note: Vertical lines correspond to January 1st of each year.

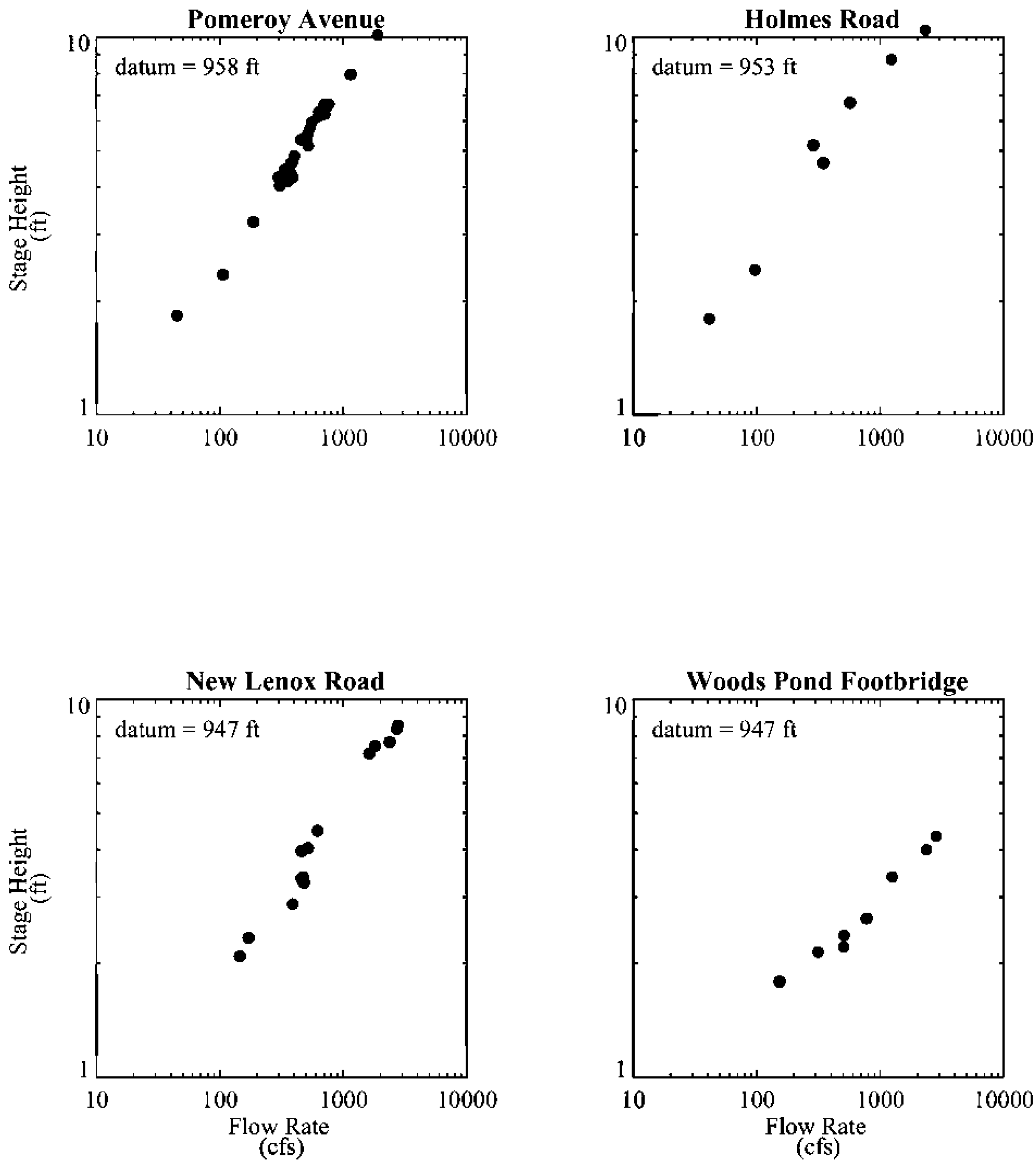

Figure 2-18. Stage height rating curves at Pomeroy Avenue, Holmes Road, New Lenox Road, and Woods Pond Footbridge.

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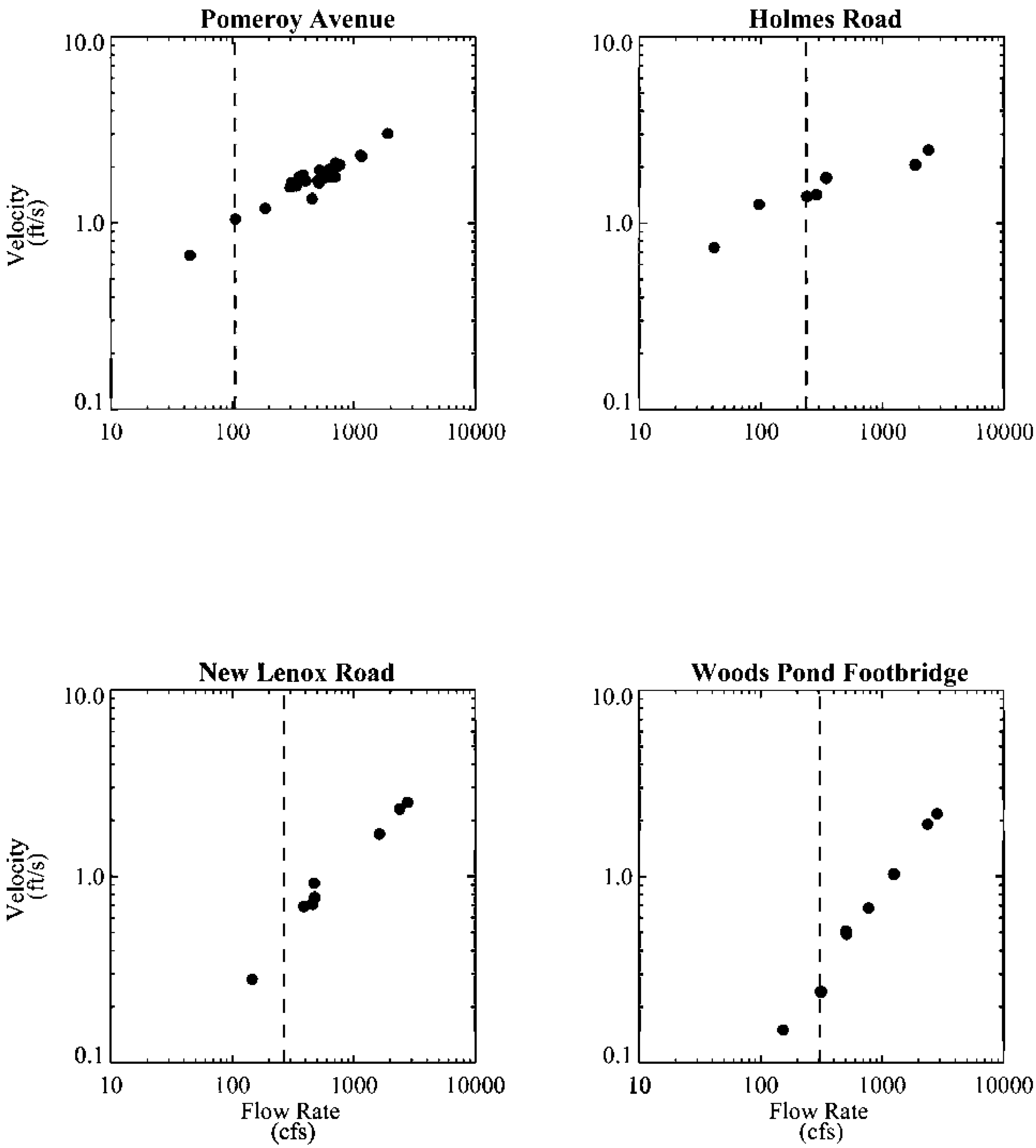

Figure 2-19. Velocity rating curves at Pomeroy Avenue, Holmes Road, New Lenox Road, and Woods Pond Footbridge.

Note: Vertical lines correspond to estimated mean flow rates.

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Section 3

3. Surface Water and Transport Investigations

3.1 General

Surface water is the primary conduit of PCB transport in the Housatonic River system. The environmental factors that control the concentration and mass of PCBs in surface water will therefore determine, in part, the transport and ultimate fate of PCBs in the Rest of River. To assess the distribution of PCBs and other constituents in surface water, this section provides:

- A description of water quality and hydrologic characteristics in the Housatonic River; and
- A description of the nature and extent of chemical constituents in surface water, including spatial and temporal trends in PCB concentrations, a brief evaluation of the chemical characteristics of PCBs detected in surface water that impact environmental transport and fate, and a brief presentation of data on other chemical constituents.

Section 3.2 describes the surface water sampling and analysis activities that have been conducted since the 1970s at the Housatonic River. Section 3.3 provides the basis for identification of a data subset for more detailed trend evaluations. Section 3.4 presents surface water characteristics and water quality, including an evaluation of suspended solids concentrations. Section 3.5 describes the nature and extent of PCBs in surface water of the Housatonic River. Section 3.6 discusses the relationships between PCB concentrations and other environmental variables. Section 3.7 presents temporal PCB concentration trends. Section 3.8 briefly discusses PCB composition and chemical properties. Section 3.9 summarizes the nature and extent of other chemical constituents in surface water. Finally, Section 3.10 summarizes the conclusions reached from surface water and transport investigations.

3.2 Description of Sampling and Analysis Activities

Numerous surface water investigations have been conducted since the late 1970s to study relevant surface water characteristics as well as the presence, extent, and transport of PCBs and other chemical constituents in the water column of the Housatonic River. Early surface water studies (late 1970s through

1988) were conducted at a few sampling stations spread over large sections of the River in Massachusetts and Connecticut. Since 1988, surface water sampling investigations have primarily focused on the Massachusetts portion of the Housatonic River. A brief summary of surface water investigations/sampling activities is provided below, with details presented in Table 3-1 and more thoroughly described in Appendix A.

3.2.1 1970s to 1988

Surface water sampling in the late 1970s (from 1978 through 1980) was conducted by CAES, in conjunction with CDEP and USGS. The purpose of these sampling activities was to determine the presence and distribution of PCBs in the Housatonic River. To satisfy this objective, three locations were sampled during five high-flow events between 1979 and 1980. Sampling stations included USGS gaging stations near Great Barrington, Massachusetts, as well as Falls Village and Gaylordsville in Connecticut (see Figure 1-1 for sampling locations). Water column samples were analyzed for TSS and total and dissolved PCBs. In addition, daily average TSS sampling was conducted over an 18-month period.

Subsequently, on behalf of GE, Stewart collected surface water samples in 1982 at three Massachusetts locations: the Schweitzer/Lenoxdale Bridge, Division Street Bridge (see Figure 3-1), and Andrus Road Bridge (in Massachusetts, approximately one mile north of the Massachusetts/Connecticut border). The objective of the Stewart investigation was to assess the transport of PCBs in the Massachusetts portion of the Housatonic River. Water column samples were collected during three distinct flow events: normal winter conditions (representative of background stream flow), snow melt, and stormflow. Water column samples were analyzed for TSS and total and dissolved PCBs.

The Stewart investigation was followed by a study conducted by CDEP and USGS between 1984 and 1988. Five USGS gaging stations were sampled during five high-flow events. Two of these stations were in Massachusetts (near Great Barrington and Ashley Falls) and three were in Connecticut (near Canaan, near Falls Village, and Kent). Water column samples were analyzed for TSS and total and dissolved PCBs.

3.2.2 1989 to 1994

Between 1989 and 1991, Blasland & Bouck, on behalf of GE, collected water column samples on approximately a monthly basis at five locations within the Massachusetts portion of the Rest of River in support of the MCP Phase II investigation. Surface water sampling locations were the New Lenox Road Bridge, Woods Pond Headwaters, Former Housatonic Street Abutment (above Woods Pond Dam), Schweitzer/Lenoxdale Bridge, and Division Street Bridge. In addition, seven locations upstream of the Confluence were sampled, although typically not as frequently. Water column samples were analyzed for chlorophyll-*a*, total and dissolved PCBs, and TSS.

Between 1991 and 1993, LMS, on behalf of GE, collected surface water samples at seven locations within the Massachusetts and Connecticut portions of the Housatonic River. Massachusetts sampling locations were Division Street Bridge, Kellogg Road Bridge, Maple Avenue Bridge, and Andrus Road Bridge, while Connecticut sampling locations were Falls Village Route 7 Bridge, Route 133 Bridge, and Glen Road Bridge. Data collected during eight high-flow events were used to develop a PCB fate and transport model. Water column samples were analyzed for total and dissolved PCBs, total organic carbon (TOC), and TSS.

3.2.3 1995 to Present

In 1995 and 1996, on behalf of GE, BBL collected water column samples at as many as 14 locations within the Massachusetts portion of the Housatonic River as part of the MCP Supplemental Phase II/RFI activities (see Table 3-1 for locations). Water column samples collected were analyzed for total and dissolved PCBs and TSS.

In 1995, on behalf of GE, BBL sampled one sediment trap in Woods Pond, and collected suspended sediment samples and corresponding surface water samples during high-flow conditions from five locations between Dawes/Pomeroy Avenue Bridge and Schweitzer/Lenoxdale Bridge. The same five locations were again sampled in 1996.

The most comprehensive and consistent sampling of the Housatonic River began with the 1996 MCP Supplemental Phase II/RFI activities. On behalf of GE, BBL conducted monthly or bi-weekly surface water monitoring of TSS, total and dissolved PCBs, particulate organic carbon (POC), and chlorophyll-*a* at variable time periods at more than 10 locations between Pittsfield and Great Barrington in Massachusetts, with most locations occurring upstream of the Schweitzer/Lenoxdale Bridge (see Table 3-1 for listing of locations sampled by year). This sampling effort has continued through the present time.

BBL made specific efforts in 1995 (8 locations) and 1996 (13 locations) to gather data during high-flow conditions, which are expected to mobilize fine particulate sediment. In 1997 and 1998, on behalf of GE, BBL collected daily water column composite samples to provide suspended solids data in support of the Housatonic River High-Flow Sediment Loading Study. Samples were collected by an automated TSS sampler at several locations along the River and at select tributaries.

In addition, on behalf of EPA, Weston has collected surface water samples since 1998 from a number of locations between Pittsfield and the Schweitzer/Lenoxdale Bridge. Water column samples were collected at specified monitoring stations (e.g., New Lenox Road Bridge, Woods Pond Headwaters) along with other discrete sampling locations associated with EPA's human health and ecological risk assessments. This work included routine monthly sampling for approximately one year (1998-1999), at eight Rest of River locations, storm flow sampling during seven storm events at three Rest of River locations (1999), and collecting discrete samples from specific habitat areas within the system (1998-2000). Additionally, EPA conducted a surface water partitioning study and a bed load sampling study, which are discussed in Section 8. Water column samples were typically analyzed for PCBs, TSS, and chlorophyll-*a*; however, Appendix IX constituents, TOC, grain size of suspended material, and other parameters have also been analyzed.

Finally, in 2000 and 2001, R2 Resource Consultants, Inc. (R2), on behalf of GE, collected water temperature, dissolved oxygen (DO), and pH data from various locations in Reaches 5 and 6 (see Figure 3-2) as part of a largemouth bass reproduction and population structure study.

3.3 Identification of Datasets for Trend Analyses

As evidenced by the descriptions of current and previous surface water investigations provided in Section 3.2, the water column of the Housatonic River has been sampled at a variety of locations since the 1970s to satisfy many different objectives. Moreover, surface water investigations over the years have been conducted with different analytical methods, detection limits, data quality assurance/quality control (QA/QC) procedures, and collection methods. In addition, surface water is a highly dynamic medium; therefore, location- and time-specific conditions can have a significant effect on measured results.

The potential influence of the variables inherent with the Housatonic River surface water database must be carefully considered when selecting a dataset(s) to perform spatial and temporal trend analyses. The monthly and bi-weekly water column data collected from 1996 through 2002 by GE and EPA have been selected to evaluate spatial trends in PCBs and other chemical/physical surface water parameters. These 1996-2002 data, collected routinely at up to 14 locations, provide a current, comprehensive, and reliable dataset for the analysis of spatial trends in the Massachusetts portion of the Housatonic River. To analyze temporal trends in PCB concentrations, the data collected by Blasland & Bouck between 1989 and 1991 were combined with the monthly and bi-weekly monitoring data collected by GE and EPA, because the 1989-1991 data were collected from comparable locations under a similar program (i.e., monthly sampling). These datasets are discussed in detail in the following sections. Because a consistent, comparable dataset is not available for the downstream reaches of Massachusetts or for Connecticut, the spatial and temporal trend analyses were performed using only data collected between the Dawes/Pomeroy Avenue Bridge and the Division Street Bridge. The datasets used in the surface water trend evaluations are highlighted in Table 3-1.

While some of the temporal changes discussed in Section 3.7 are likely the result of actual changes in surface water concentrations over time, it is important to recognize that some of the differences may be attributed to variation in analytical method, detection limit, and data QA/QC procedure from one sampling effort to another. Although some laboratory procedures have varied historically, a paired t-test comparison of the split surface water samples collected by GE and EPA during the 1998-1999 sampling program indicated that the PCB results of the GE and EPA split sample analyses were not statistically different from one another (see Appendix D). As a result, the use of the combined dataset is considered appropriate for temporal analyses.

The storm event water column PCB data collected by EPA in 1999 were not used in either the spatial or temporal distribution analysis. These data were collected at a high frequency during seven distinct events to characterize storm-related PCB transport. As such, these data have the potential to bias the characterization of general conditions in the Housatonic River water column on an annual basis. These storm flow data are presented separately in Section 3.4.3.2.

For informational purposes, the historical (pre-1996) data not used in the trend evaluations (which have been reported in previous documents – see Table 3-1 for references) may be summarized as follows:

- Surface water total PCB data collected in the late 1970s through 1988 from the Massachusetts and Connecticut portions of the Housatonic River yielded a maximum detection of 0.6 μg/L collected at Division Street in 1980. Total PCBs were detected in approximately 60% of the samples. For dissolved PCBs, approximately 70% of the samples collected between the late 1970s and 1988 resulted in non-detect PCBs. Of the data collected in Connecticut, total PCBs were only detected in 29% (14/49) of the samples, with a maximum value of 0.2 μg/L (in two samples from Falls Village and one sample at Kent).

- Between 1991 and 1993, maximum water column PCB concentrations detected were 1.1 μg/L and 0.08 μg/L for total and dissolved PCBs, respectively -- both from samples collected at the Division Street Bridge. (Note that a detection of total PCBs at 21 μg/L at the Division Street Bridge on March 11, 1991 was considered an outlier and thus not included in this statement.) Approximately 50% of samples collected for total PCB analysis and 98% of samples collected for dissolved PCB analysis resulted in non-detect PCBs. Of the data collected from Falls Village in Connecticut, total PCBs were only detected in 15% (5/33) of the samples with a maximum value of 0.15 μg/L.

- During high-flow sampling events in 1995 and 1996, approximately 30% of the water column samples analyzed for total PCBs and 65% of samples analyzed for dissolved PCBs resulted in non-detects. Samples were collected in Massachusetts from 14 locations in 1995 and 13 locations in 1996 (see Table 3-1 for locations). Maximum PCB concentrations detected were 1.0 μg/L and 0.35 μg/L for total and dissolved PCBs, respectively – both from samples collected at the Division Street Bridge.

All surface water PCB data available from the Housatonic River below the Confluence, including both the data used in the trend analyses and the historical data not used in these analyses, are presented in Appendix B. The GE and EPA databases, which include all historical and recent data, are included in Appendix F. Figures B.1-1 through B.1-3 (Appendix B) depict all surface water sampling locations.

Based on the datasets identified for trend analyses (as described above), the following sections summarize general surface water characteristics and chemistry, transport patterns of suspended solids, spatial and temporal patterns in PCB concentrations, and the relationships between PCBs and other environmental variables (e.g., flow, TSS, temperature, etc.) at a number of locations in the Rest of River area. For reference, the water sample locations are shown on Figure 3-1.

3.4 Chemistry of Surface Water

As part of the Housatonic River surface water assessment, samples were collected and analyzed for constituents that help to define the status and health of the aquatic ecosystem and in some cases control the distribution and fate of PCBs and other chemical constituents in surface water. Water quality data collected include field measurements (i.e., pH, temperature, DO, conductance) and laboratory analyses (i.e., nutrients, chemical oxygen demand, biological oxygen demand) for samples collected as part of the monthly and bi-weekly surface water sampling programs. These data are discussed below.

3.4.1 Temperature, pH, DO, and Conductance

Temperature, pH, DO, and/or conductance were periodically measured at several locations between the Dawes/Pomeroy Avenue Bridge, upstream of the Confluence, and the Division Street Bridge. As discussed in Section 3.3, the evaluation of these data is drawn from the 1996-2002 monthly and bi-weekly GE (1996-2002) and EPA (1998-1999) dataset, while data from specific storm event sampling and other specialized surface water sampling events are not included for reason discussed above. A summary of the 1996-2002 data is included in Table 3-2. Because the number of samples collected from each location varied greatly over time, results from all years from 1996-2002 were combined to form a more comprehensive dataset, which is summarized by month in Table 3-3. The summary data show that average values and ranges for conductance, pH, DO, and water temperature are, in general, similar among the most frequently sampled locations. The Dawes/Pomeroy Avenue Bridge location, which is representative of upstream conditions for the Rest of River, exhibits, on average, water temperatures generally similar to the other frequently sampled locations, ranging from 0° Celsius (C) in January to approximately 24°C in the summer months (June to August), reflecting the temperate climate at this latitude. Conductance values at Dawes/Pomeroy peak in August (1.0 mS/cm), and pH values are most basic (8.2) in August and most acidic (6.3) in February. A similar pattern is seen among water quality parameters at locations downstream of the Confluence. As summarized in Table 3-3, water temperatures downstream of the Confluence range from 0°C in the winter months to approximately 25°C in the summer months (June to July). Conductance values downstream of the Confluence typically peak in August, and pH values are most acidic (5.7) in the winter months (December to February) and most basic (8.6) in late summer (July to September).

On behalf of GE, R2 collected water temperature, DO, and pH data from locations along the Housatonic River as part of a largemouth bass reproduction and population structure study conducted during 2000 and 2001 (R2, 2002). In 2000, measurements of DO concentrations, pH, conductivity, and water temperature were collected using hand-held digital meters at 13 locations along the River (shown on Figure 3-2). In addition, continuous water temperature recorders were installed at each of the 13 locations and used from May through September 2000. In 2001, temperature recorders were installed at 12 locations from late March or mid-April to mid-October (also shown on Figure 3-2). Nine continuous DO recorders were deployed in three backwater areas (one unit in the main channel and two within the backwater in each area) in June 2001 and maintained through mid-October. These recorders measured DO as well as water temperature and pH. The water temperature data recorded in 2000 and 2001 are summarized by month in Table 3-4, while the DO data from the three backwater areas (nine sampling locations) are provided in Table 3-5. In summary, temperature measurements were similar to results reported during monthly water column monitoring. Average monthly water temperatures reported during the continuous temperature measurement period were highest in the summer months of July and August (maximums of 23°C and 24°C, respectively) and coolest in the early spring (average March temperatures range between 1.7°C and 2.7°C). Water temperatures measured in backwater areas were higher than temperatures measured in the channel proper during comparable months. Average monthly DO concentrations near Woods Pond were generally higher and less variable on average in the main channel (ranging between 4.8 mg/L and 7.7 mg/L) than measured by the middle and near-shore probes in the backwater areas (ranging between 0.2 mg/L and 8.7 mg/L). Average monthly DO concentrations were typically higher in the cooler months of September and October (maximums of 7.7 mg/L and 8.7 mg/L). Measured pH results were relatively consistent during the 5-month sampling period, with average pH readings ranging between 7.2 and 8.4.

3.4.2 Conventional Water Quality Measurements

Between 1996 and 2002, GE and EPA collected monthly or bi-weekly surface water samples from multiple locations upstream of and within the Rest of River area and analyzed them for one or more commonly measured water quality parameters, including:

- Alkalinity;
- Ammonia as N;
- Chlorophyll-*a*;
- Cyanide;
- Dissolved organic carbon (DOC);
- 5-day biochemical oxygen demand;
- Hardness;
- Hardness, dissolved;
- Nitrate and nitrite as N;
- Nitrite as N;
- Orthophosphate as P;
- POC;
- Total phosphate as P;
- Sulfide;
- Total Kjeldahl nitrogen (TKN);
- Total dissolved solids;
- TOC; and
- TSS.

The results of these analyses are summarized in Tables 3-6 for inorganic constituents and 3-7 for organic constituents. The most notable trends are increases in nitrate/nitrite, orthophosphate, and total phosphate downstream of the Pittsfield WWTP, generally by a factor of four or more (Table 3-6). Results for alkalinity, 5-day biochemical oxygen demand, dissolved hardness, hardness, nitrite as N, sulfide, and TKN are generally similar among locations. Average ammonia (as N) concentrations are also not significantly different among locations, but a single observance of 3 milligrams per liter (mg/L) measured at the Pittsfield WWTP outfall was notably higher than concentrations both upstream and downstream and was likely due to the influence of the WWTP effluent plume. Cyanide was not detected at any locations within the Rest of River. Like many of the other constituents, total dissolved solids values are consistent from location to location, with the exception of a much higher maximum value of 813 mg/L measured at the Holmes Road Bridge than was observed at the other locations. Average TSS concentrations decrease downstream of Holmes Road Bridge (TSS is further discussed in Section 3.4.3, below). Average chlorophyll-*a* values (Table 3-7), as expected, are higher in and downstream of Woods Pond and Rising Pond, with lower concentrations in the steeper, free-flowing sections of Reach5, upstream of impounded areas. Results for TOC, POC, and DOC are generally similar among locations.

3.4.3 Nature and Extent of TSS in Surface Water

PCBs are hydrophobic; in aquatic environments they tend to be associated with sediment and/or suspended particles. Therefore, understanding the behavior of TSS in the Housatonic River is important to understanding the distribution, fate, and transport of PCBs and other hydrophobic constituents. In Section 3.4.3.1, spatial trends in TSS concentrations in the Housatonic River water column are evaluated using the monthly and bi-weekly data from samples collected by EPA in 1998-1999 and GE between 1996 and 2002 at locations between the Dawes/Pomeroy Avenue Bridge and Great Barrington, Massachusetts. (Data from the Dawes/Pomeroy Avenue Bridge, located upstream of the Confluence, are presented to quantify TSS sources upstream of and entering into the Rest of River area.) These stations (shown on Figure 3-1) consist of the following:

- Dawes/Pomeroy Avenue Bridge;
- Holmes Road Bridge;
- New Lenox Road Bridge;
- Woods Pond Headwaters;
- Schweitzer/Lenoxdale Bridge; and
- Division Street Bridge.

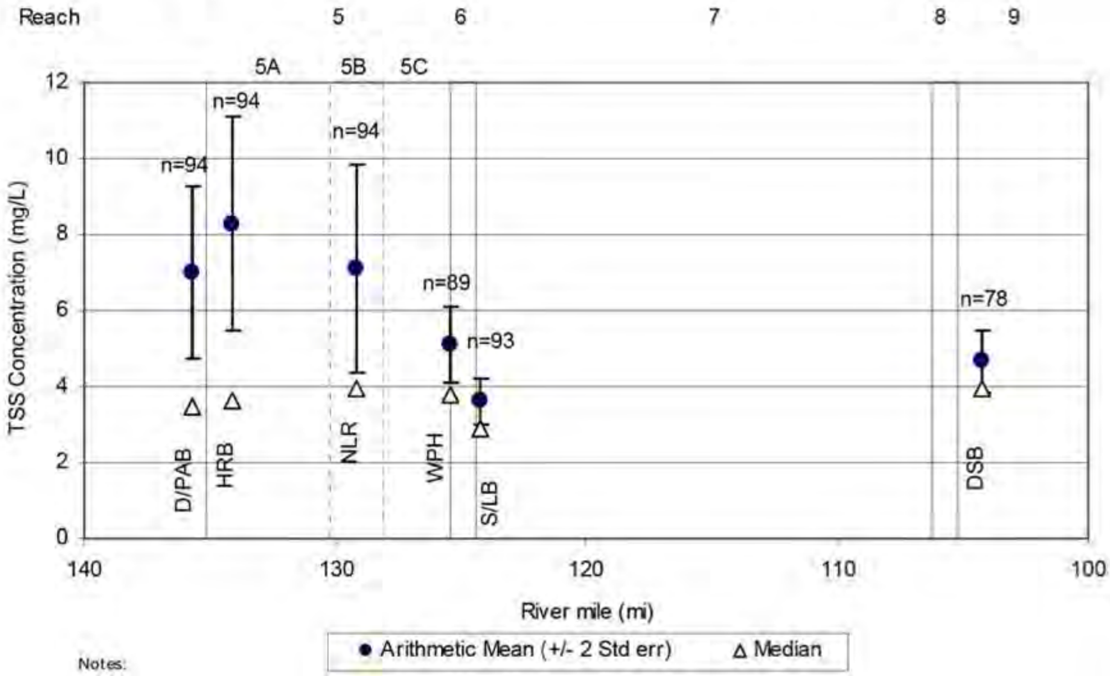
Data from these primary locations are included and summarized by sampling location and year in Table 3-8.

3.4.3.1 Spatial Distribution of TSS in Surface Water

The TSS data collected monthly or bi-weekly from the six locations listed above from 1996-2002 comprise a total of 542 surface water samples. As shown in Table 3-8, concentrations ranged from non-detect to 111 mg/L (at New Lenox Road Bridge in 1999). To assess the spatial distribution of TSS, arithmetic means (with +/2 standard errors) and medians for the six locations were plotted, as shown on Figure 3-3 (below).

The arithmetic mean TSS concentrations are generally higher upstream of Woods Pond (Reach 6) and lower downstream of Woods Pond Dam, as shown on Figure 3-3. Within the reach from the Confluence to Woods Pond Dam, average TSS concentrations show a decreasing pattern. The median TSS concentrations are consistently lower than the arithmetic means, and are relatively consistent throughout all sample locations, suggesting that the central tendency of all TSS values is relatively the same. The most notable change in the median TSS concentration occurs downstream of Woods Pond, where the median TSS concentration decreases by almost 25% from the median concentration at the headwaters (Figure 3-3). The decrease in median TSS concentrations across Woods Pond may be a result of the settling of solids from the water column in the impoundment.

Figure 3-3. TSS Concentration in Housatonic River Surface Water

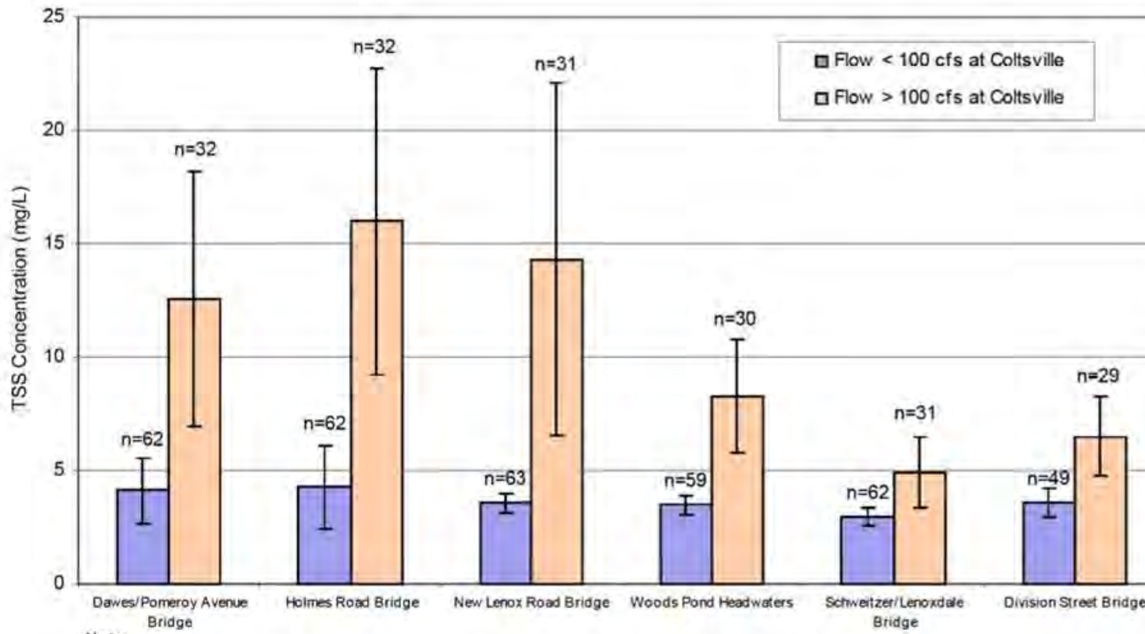


Notes:
Presents all monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999).
Does not include pre-1996 data, or data from stormwater sampling events or other specialized surface water sampling events.
D/PAB - Dawes/Pomeroy Avenue Bridge; HRB - Holmes Road Bridge; NLR - New Lenox Road Bridge; WPH - Woods Pond Headwaters; S/LB -Schweitzer Lenoxdale Bridge; DSB - Division Street Bridge
n= number of samples analyzed

To assess the relationship between TSS and season, the 1996-2002 monthly and bi-weekly surface water data from the sampling stations were compiled and plotted by station and month (Figure 3-4). Figure 3-4 highlights the seasonal component of solids transport in the Housatonic River and shows that, as expected, the highest TSS concentrations occur in the late winter-early spring. Specifically, TSS concentrations at sampling locations upstream of the Schweitzer/Lenoxdale Bridge are highest in March, and for the remainder of the year, TSS concentrations are lower and relatively consistent. The higher concentrations observed in the early spring months, March in particular, are likely caused by erosion of soils and/or sediments associated with increases in flow due to snow melt and increased precipitation which skews high the average TSS concentrations in Reaches 5 and 6. As depicted on Figure 3-4, a substantial decrease in TSS in March between the New Lenox Road Bridge and Woods Pond Headwaters is evident (decrease of 60%), and again between the Woods Pond Headwaters and the Schweitzer/Lenoxdale Bridge (decrease of 60%). In months other than March, average TSS values are generally the same upstream and downstream of Woods Pond, around 5.0 mg/L, although TSS is generally higher in January and February at locations upstream of New Lenox Road.

To further assess the relationship between River flow and TSS, the same 1996-2002 monthly and bi-weekly TSS data presented in Figures 3-3 and 3-4 were compiled and evaluated for flows above and below 100 cfs, as measured at the Coltsville gaging station (the average measured flow at Coltsville). The results of this evaluation are depicted on Figure 3-5 (below).

Figure 3-5. Arithmetic Mean TSS Concentrations in the Housatonic River



Note:
Presents the arithmetic mean TSS concentration and 2 standard errors for all monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999).
Insufficient data collected in the Connecticut portion of the River.
Does not include pre-1996 data, or data from stormwater sampling events or other specialized surface water sampling events
n= number of samples analyzed

As shown on Figure 3-5, and as would be expected, average TSS concentrations are higher at all locations during times when flow conditions were greater than 100 cfs at Coltsville, compared to TSS concentrations reported when flows were less than 100 cfs. It should be noted that the selection of flow greater than/less than 100 cfs at Coltsville is used due to an observed break in the flow/TSS relationship at 100 cfs at Coltsville (see Section 8 for further explanation). The difference in TSS at flows above and below the 100 cfs flow criterion suggests a positive relationship between flow and TSS. This is evidenced by lack of overlap between the 2 standard error ranges of the high and low flow average TSS concentrations at most locations shown in Figure 3-5, above. At most locations, TSS concentrations, when plotted against corresponding flow values (Figures 3-6a through 3-6c), are relatively constant at flows less than 100 cfs and tend to show a more positive response to flows greater than 100 cfs. These positive relationships at higher flow suggest the presence of a source of solids (through runoff, resuspension, and/or erosion) upstream of Woods Pond -- most prevalent in Reach 5A -- that is responsive to increased flow. Downstream of Woods Pond, at the Schweitzer/Lenoxdale and Division Street Bridges, TSS does not appear to respond as strongly to higher flows. These observations may be due in part to the changes in channel gradient (which control surface water velocities) and the presence of impoundments, which act as sediment traps that may dampen downstream fluctuations of TSS.

3.4.3.2 Stormflow Event TSS Sampling

The results of EPA's storm event monitoring at Pomeroy Avenue Bridge, New Lenox Road Bridge, and Woods Pond Footbridge in 1999 are summarized on Figures 3-14a through 3-14g. A review of the plots generally shows a positive relationship between TSS and flow during the higher-flow events (i.e., events 1, 5, 6, and 7, it should be noted that for events 2, 3, and 4, the flows did not exceed 100 cfs at Coltsville) at Pomeroy Avenue and New Lenox Road. The magnitude of the increases in solids was variable across the various storm sampling events, although the higher flow events generally corresponded to higher concentrations of solids. At Woods Pond Footbridge, the response over the course of the hydrograph, while positive, is minimal, possibly due to solids settling within Woods Pond.

3.5 Nature and Extent of PCBs in Surface Water

The nature and extent of PCBs in the surface water of the Housatonic River can be affected by a myriad of variables at any given time. However, the relatively extensive Rest of River database allows for a characterization of the spatial distribution of PCBs within the River. This section discusses surface water PCB concentrations observed within the Housatonic River.

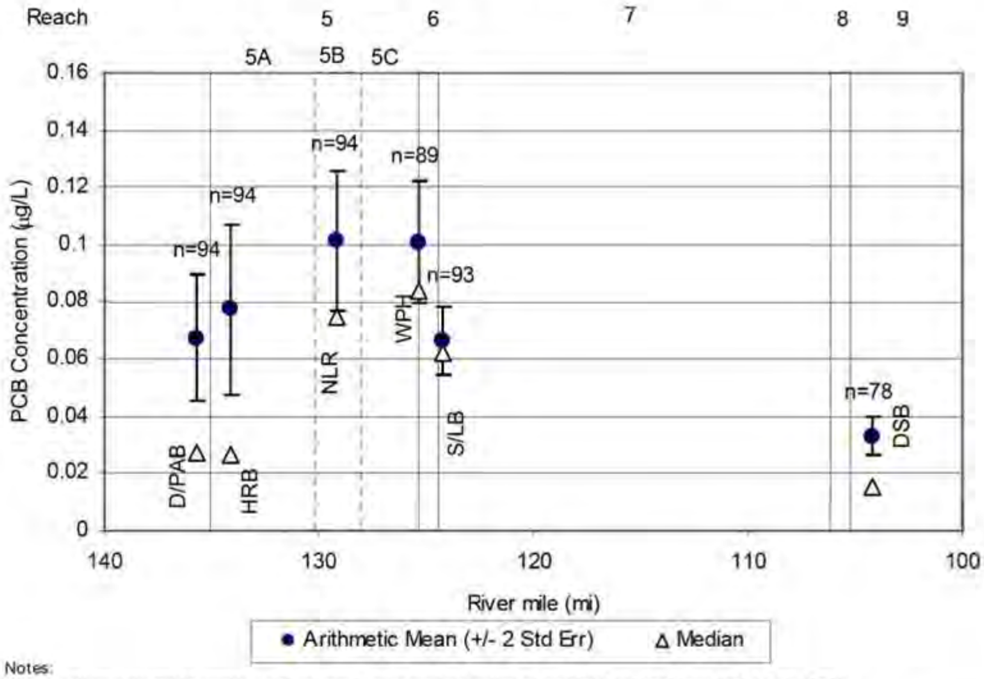
To evaluate the spatial distribution of PCBs in the Housatonic River water column, the monthly and bi-weekly water column monitoring PCB data collected by GE and EPA from 1996 to 2002 between the Dawes/Pomeroy Avenue Bridge and Great Barrington, Massachusetts were evaluated. As noted above, although periodic water column monitoring was conducted at numerous locations within the Housatonic River between 1996 and 2002, the five locations listed below provide the most consistent, comparable, and broadest sampling record for Reaches 5 through 9, with good spatial coverage between the Confluence and Woods Pond Dam, the stretch of the River that is the primary focus of this RFI Report:

- Holmes Road Bridge;
- New Lenox Road Bridge;
- Woods Pond Headwaters;
- Schweitzer/Lenoxdale Bridge; and
- Division Street Bridge.

Data from the Dawes/Pomeroy Avenue Bridge sampling location (upstream of the Confluence) were also analyzed to provide insight on the PCB concentrations entering the Rest of River. Data from the Connecticut portion of the Rest of River area were insufficient to provide appropriate spatial comparisons. Summary statistics of the PCB data from the six above-mentioned sampling locations, as well as three other locations (Adjacent to Joseph Drive, Pittsfield WWTP, and Above Woods Pond Dam), sampled less frequently, but included to verify spatial trends and relationships, are provided in Table 3-9 and presented by year in Table 3-10.

Between 1996 and 2002, a total of 542 samples were collected from the six primary sample locations, with PCB concentrations ranging from non-detect to a maximum of 0.95 μg/L in a sample collected at the Holmes Road Bridge. Average and median total PCB concentrations are shown by location on Figure 3-7 (below). Highest arithmetic mean and maximum concentrations tend to occur at sampling stations within Reach 5 (i.e., Holmes Road Bridge downstream to the Woods Pond Headwaters), where average PCB concentrations (from the 1996-2002 dataset) range from 0.077 μg/L at the Holmes Road Bridge to 0.10 μg/L at the New Lenox Road Bridge and the Woods Pond Headwaters. The average PCB concentration observed at the Dawes/Pomeroy Avenue Bridge, upstream of the Rest of River, is 0.063 μg/L, slightly lower than the average concentration at the Holmes Road Bridge. Immediately downstream of Woods Pond Dam, average PCB concentrations are similar to concentrations noted above the Confluence; and at the Division Street Bridge, the average PCB concentration is about half of the average concentration noted above the Confluence. As depicted on Figure 3-7, median PCB values are lower than the arithmetic means at all locations. A slight deviation between the general spatial trend represented by the arithmetic mean and that represented by the median is apparent in the increase in the median PCB concentration of approximately 12% between New Lenox Road and the Woods Pond Headwaters.

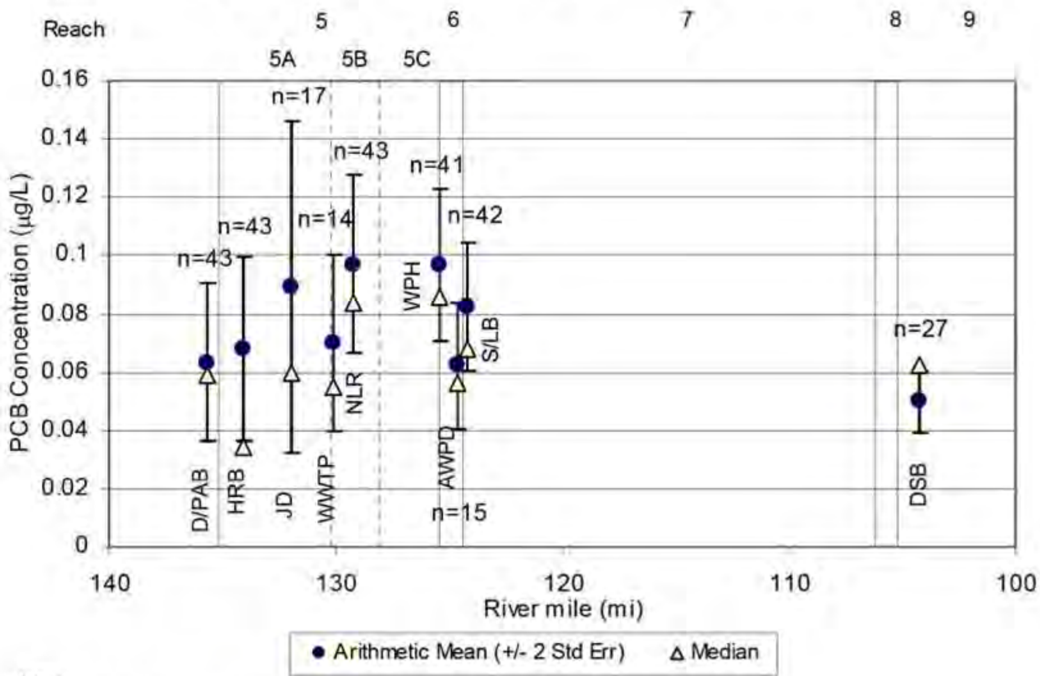
Figure 3-7. PCB Concentration in Housatonic River Surface Water



Notes:
Presents all monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999).
Does not include pre-1996 data, or data from stormwater sampling events or other specialized surface water sampling events.
D/PAB - Dawes/Pomeroy Avenue Bridge; HRB - Holmes Road Bridge; NLR - New Lenox Road Bridge; WPH - Woods Pond Headwaters; S/LB -Schweitzer Lenoxdale Bridge; DSB - Division Street Bridge
n= number of samples analyzed

In 1998 and 1999, a more intensive sampling effort was performed, providing total PCB data from the six above-mentioned stations as well as three additional stations -- near Joseph Drive, near the Pittsfield WWTP, and Woods Pond just upstream of the Woods Pond Dam. The data from this sampling effort are summarized on Figure 3-8 (below).

Figure 3-8. 1998-1999 Average PCB Concentrations



Notes:
Includes all monthly and bi-weekly water column monitoring data collected by GE and EPA (1998-1999).
Does not include pre-1996 data, or data from stormwater sampling events or other specialized surface water sampling events.
D/PAB - Dawes/Pomeroy Avenue Bridge; HRB - Holmes Road Bridge; JD - Joseph Drive; WWTP - Pittsfield WWTP; NLR - New Lenox Road Bridge; WPH - Woods Pond Headwaters; AWPD - Above Woods Pond Dam; S/LB -Schweitzer Lenoxdale Bridge; DSB - Division Street Bridge
n = number of samples analyzed

The 1998-1999 data show the same general trend as the 1996-2002 dataset for the six most consistently sampled locations. However, decreases in arithmetic mean PCB concentrations are seen at the locations near the Pittsfield WWTP and above Woods Pond Dam. These deviations in the 1998-1999 dataset from the general trend observed in the 1996-2002 dataset are likely attributed to smaller sample size and increased variability (as evidenced by the span of the error bars). Note that at the Division Street Bridge, the median is higher than the arithmetic mean since the majority of samples were reported as non-detect for PCBs.

With respect to dissolved PCBs, the low frequency of detection precludes meaningful analysis of spatial trends. Since 1996, only 16% of samples collected within the Rest of River resulted in detectable concentrations of dissolved PCBs (see Table 3-9).

3.6 Comparison of PCB Concentration to Other Environmental Variables

Many factors may influence the magnitude and trends of observed PCB concentrations in the Housatonic River water column. The following section presents an evaluation of several of these factors including flow, TSS, TOC, and water temperature. Although each factor is discussed independently of the others using the monthly and bi-weekly data collected by GE and EPA between 1996 and 2002, covariance exists among the variables that can affect the individual relationships, and is noted when appropriate.

3.6.1 PCB Concentration vs. Flow

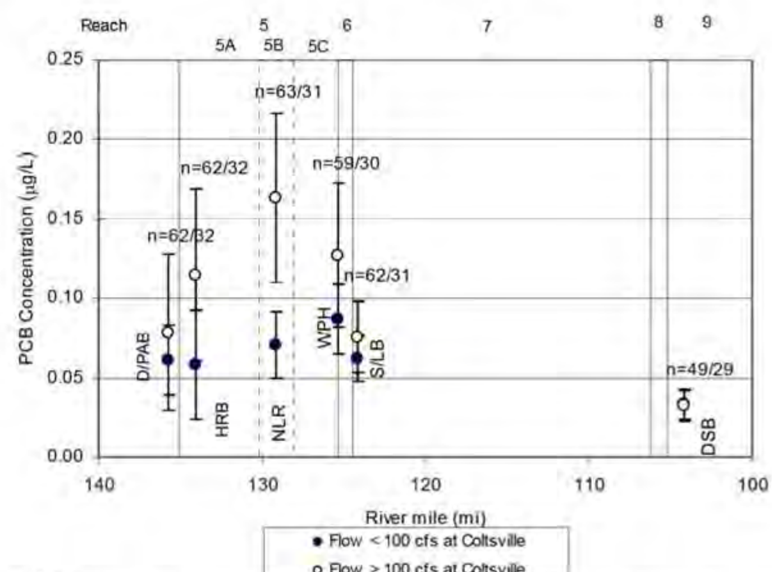
The relationship between PCB transport in a river and fluctuations in flow depends on the mechanisms by which PCBs enter the water column. Where sediments are the predominant source of PCBs to the water column, PCBs can enter the water column in two general ways: 1) chemically, through desorption, diffusion, and/or advection of porewater PCBs from sediments; or 2) physically, through resuspension of sediments. At lower flows, the residence time of the water increases, and desorption, diffusion, and biotic activity have a greater impact on water column PCB concentrations. Further, PCB diffusion from sediments is a relatively constant process under a given set of environmental conditions (e.g., water temperature), so an increase in flow will often provide dilution of dissolved PCBs (USGS, 1983). On the other hand, PCB concentrations may increase in response to increases in flow due to the erosion of PCB-containing sediments, and potentially riverbanks, during high-flow events.

Figures 3-9a through 3-9c show observed PCB concentrations and corresponding flows for all monthly and bi-weekly samples collected between 1996 and 2002 at the Dawes/Pomeroy Avenue Bridge, Holmes Road Bridge, New Lenox Road Bridge, Woods Pond Headwaters, Schweitzer/Lenoxdale Bridge, and Division Street Bridge. As shown on Figures 3-9a through 3-9c, when flows were greater than 100 cfs at Coltsville, PCB concentrations generally increase with increasing flow. At Holmes Road, New Lenox Road, Woods Pond Headwaters, and Division Street, the PCB-flow relationships are statistically significant ($p < 0.05$), with r^2 values between 0.18 and 0.31. This relationship with flow may be the result of sediment scour and resuspension and/or erosion of riverbanks (i.e., physical processes) that may contribute to PCB transport at flows greater than 100 cfs. At flows less than 100 cfs, statistically significant inverse relationships ($p < 0.05$) were observed only at the New Lenox Road and Schweitzer/Lenoxdale Bridge locations, and those relationships were relatively weak (r^2 values of 0.15

and 0.066, respectively). Accounting for all data above and below 100 cfs, only Holmes Road and New Lenox Road exhibited statistically significant relationships ($p < 0.05$), but in both cases flow explains less than 10% of the variability in the PCB data.

The effect of flow on average PCB concentration by sample location is depicted on Figure 3-10 (below). Average PCB concentrations increase between the Confluence and New Lenox Road at flows above 100 cfs, increasing by approximately two times between the Dawes/Pomeroy Avenue Bridge and the New Lenox Road Bridge locations. During lower flow conditions, the increase in average PCB concentrations over distance is more gradual, increasing approximately 22% from Holmes Road to New Lenox Road and approximately 23% from New Lenox Road to the Woods Pond Headwaters. In addition, at flows both above and below 100 cfs, decreases are noted in average water column PCB concentrations across Woods Pond, as exhibited by the lower average PCB concentrations observed at the Schweitzer/Lenoxdale Bridge. An additional decrease in average concentrations is observed from the Schweitzer/Lenoxdale Bridge to the Division Street Bridge.

Figure 3-10. PCB Concentration Below and Above 100 cfs in the Housatonic River



Notes:
Presents the arithmetic mean PCB concentration and 2 standard errors for all monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Insufficient data collected in the Connecticut portion of the River.
Does not include pre-1996 data, or data from stormwater sampling events or other specialized surface water sampling events.
D/PAB - Dawes/Pomeroy Avenue Bridge; HRB - Holmes Road Bridge; NLR - New Lenox Road Bridge; WPH - Woods Pond Headwaters; S/LB - Schweitzer/Lenoxdale Bridge; DSB - Division Street Bridge
n=62/32 indicates 62 samples for flows <100 cfs and 32 samples for flows > 100 cfs at Coltville.
Sample BBLID 1543, collected at Division Street Bridge, excluded due to an anomalously high total PCB detection of 21ng/L

3.6.1.1 Stormflow Event PCB Sampling

The results of EPA's stormflow monitoring at Pomeroy Avenue Bridge, New Lenox Road Bridge, and Woods Pond Footbridge in 1999 are presented in Figures 3-14a through 3-14f. The data show a positive relationship between PCB and flow during the more significant storm events (i.e., events 1, 5, 6, and 7) at the Pomeroy Avenue Bridge and New Lenox Road Bridge, where PCB concentrations increase during the rising limb and decrease during the falling limb of the hydrograph. Also, at these two locations the magnitude of PCB response appears directly related to flow, where the larger storm events produce higher PCB concentrations. At the Woods Pond Footbridge location, neither of these trends is readily apparent. This may be due to solids with associated PCBs settling in Woods Pond.

3.6.2 PCB Concentration vs. TSS Concentration

In theory, if sediment resuspension is an important determinant of PCB concentration in surface water, a positive relationship should exist between water column PCBs and TSS. To assess this relationship, plots of PCB versus TSS concentration from 1996 through 2002 were prepared for the Dawes/Pomeroy Avenue Bridge location and the five other consistently sampled locations within the Rest of River (Figures 3-11a through 3-11c). All 6 locations produced a positive and statistically significant relationship ($p < 0.05$) between TSS and PCB concentrations, with r^2 values ranging from 0.061 for the Division Street location to 0.29 at New Lenox Road. These relationships are presented in Figures 3-11a through 3-11c. While the r^2 for the Division Street location is low, TSS concentration at all other locations explains 15-29% of the variability observed in the PCB concentrations.

At flows greater than 100 cfs (at Coltsville), PCBs and TSS are both correlated in varying degrees to flow. To account for the effect of TSS on the relationship between PCB concentration and flow, the concentrations of PCBs per unit of TSS (i.e., TSS-adjusted PCB concentrations) have been calculated, and these calculated concentrations are plotted against flow on Figures 3-12a through 3-12c. As shown, the calculated PCB concentrations per unit of TSS are significantly ($p < 0.05$) related to flow at all locations, except at the Schweitzer/Lenoxdale Bridge and the Division Street Bridge, where no significant relationships exist. However, the strength of the relationships, which were statistically significant, is very weak with r^2 values of 0.05 to 0.08, indicating that flow only explains 5% to 8% of the variability observed in the TOC-adjusted PCB data. The TSS-adjusted PCB results are consistent with the results of both the suspended sediment harvesting and Woods Pond sediment trap studies discussed in the 1996 RFI Report (BBL, 1996) and in Appendix A of this RFI Report. Figure 3-13 presents the particulate PCB concentration data over time for sampling stations in the vicinity of Woods Pond. TSS-adjusted PCB data collected at the Woods Pond Headwaters and the Schweitzer/Lenoxdale Bridge are within the same range as PCB concentrations from both the suspended sediment harvesting and the sediment trap studies, suggesting that the calculated PCB-per-TSS concentration may be a useful measure of PCB transport and PCBs potentially deposited from the water column.

3.6.2.1 PCB Concentration vs. TSS Concentration During Storm Events

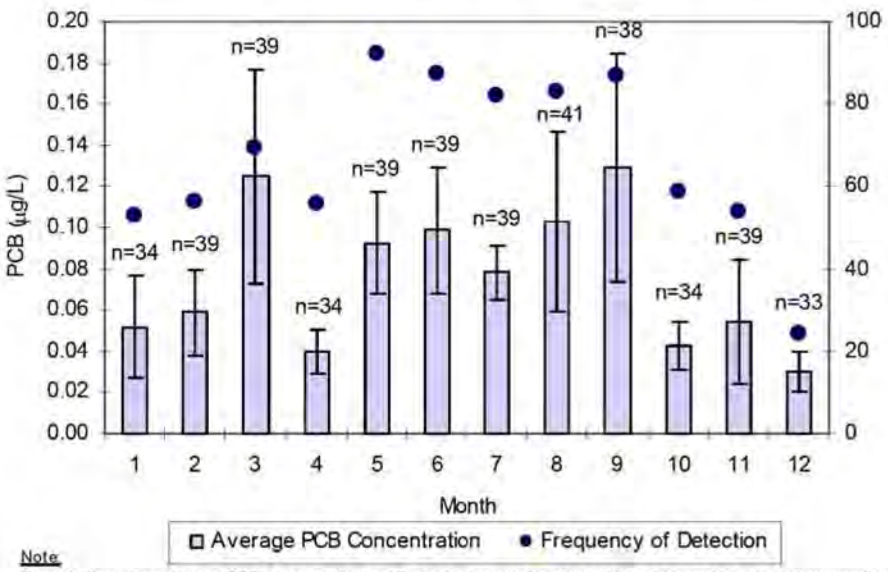
Further evidence of the positive relationships among PCB, TSS, and river flow can be seen in the results of EPA's stormflow monitoring in 1999 (Figures 3-14a to 3-14g). A review of these plots shows a positive relationship between PCB and TSS with increasing flow conditions during the higher-flow events (i.e., flow events 1, 5, 6, and 7) at Pomeroy Avenue and New Lenox Road. During the larger storm events (e.g., May and September 1999; Figures 3-14a and 3-14f), prominent increases in TSS and PCB concentrations occurred during the rising limb of the hydrograph. PCB and TSS concentrations then decreased toward the end of the event, as the hydrograph declined. The magnitude of this response was greatest at the Dawes/Pomeroy Avenue Bridge and New Lenox Road locations and almost non-existent at the Woods Pond Footbridge.

3.6.3 PCB Concentration vs. Season/Temperature

Based on partitioning theory, increases in water temperature are expected to increase the rate and extent of desorption of PCBs from sediment. Warmer temperatures also promote increased biological activity (such as sediment organic matter decomposition, algae growth, and benthic fish spawning and feeding) and lower flows, which limit dilution of PCB flux. To assess the general relationship between surface water PCB concentration and temperature within the Rest of River, monthly and bi-weekly water column monitoring data collected by GE and EPA between 1996 and 2002 from Dawes/Pomeroy Avenue, Holmes Road, New Lenox Road, Woods Pond Headwaters, Schweitzer/Lenoxdale Bridge, and Division Street were compiled and analyzed by month. Shown on Figure 3-15 (below), the relationship between

PCB concentration and water temperature is reflected in the general seasonal trend in surface water PCB concentrations in the Rest of River. Average total PCB concentrations in surface water samples collected within the Rest of River area are highest during warmer months, with the exception of March, which is likely associated with higher flows due to spring precipitation and snow melt. PCBs were also detected more frequently during warmer months (May to September). Conversely, during the cooler months (October to April [with the exception of March]) PCB concentrations tend to be lower, and detections were less frequent.

Figure 3-15. PCB Concentration and Frequency of Detection in Rest of River Surface Water Samples



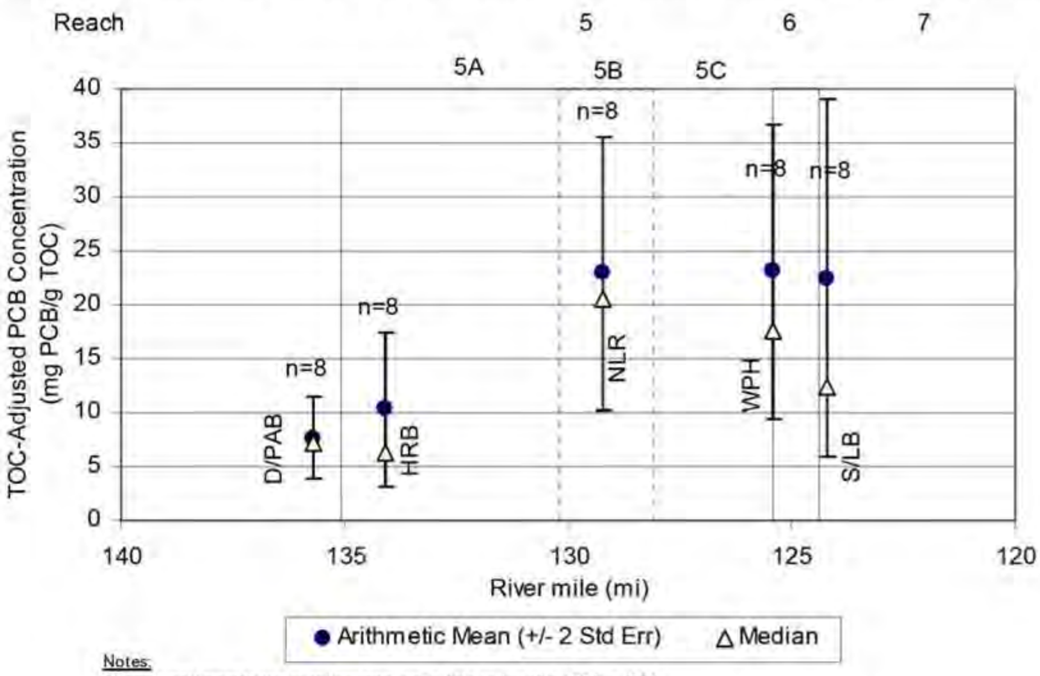
Note:
Presents the arithmetic mean PCB concentration and 2 standard errors for all monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999) within the Rest of River area.
Does not include pre-1996 data, or data from stormwater sampling events or other specialized surface water sampling events.
n = number of samples analyzed

3.6.4 PCB Concentration vs. TOC Concentration

Given the tendency of PCBs to sorb to organic materials, it is expected that higher water column TOC concentrations would produce higher water column PCB concentrations. To assess this relationship, surface water data collected monthly by EPA in 1999 (the most recent year when surface water samples were most consistently analyzed for both PCBs and TOC) between the Dawes/Pomeroy Avenue and Schweitzer/Lenoxdale Bridges were analyzed. As shown in Table 3-7, the 1999 TOC concentrations in the water column were relatively consistent downstream of the Confluence, with averages ranging from

4.2 mg/L at the Schweitzer/Lenoxdale Bridge to 4.9 mg/L at the New Lenox Road Bridge. To further assess the TOC/PCB relationship, a plot of average and median TOC-adjusted PCB concentrations by primary sampling station was generated using the sample-specific PCB results corresponding with these TOC samples (Figure 3-16 below). Consistent with the previous observation of increasing average water column PCB concentrations through Reach 5 (see Figure 3-7), the average TOC-adjusted PCB concentrations (the ratio of PCB and TOC concentrations in each sample) increase in Reach 5A and are highest at the New Lenox Road Bridge and Woods Pond Headwaters sampling locations (Figure 3-16, below).

Figure 3-16. TOC-Adjusted PCB Concentration in Housatonic River Surface Water



Notes:
Presents only monthly water column monitoring data collected by EPA in 1999.
D/PAB - Dawes/Pomeroy Avenue Bridge; HRB - Holmes Road Bridge; NLR - New Lenox Road Bridge; WPH - Woods Pond Headwaters; S/LB -Schweitzer/Lenoxdale Bridge
n = number of samples analyzed

Due to the limited number of TOC results collected at each sampling location (eight per location), further analysis was not conducted. Partitioning of PCBs to organic carbon is discussed in more detail in Section 8.

3.6.5 PCBs vs. Chlorophyll-*a*

Chlorophyll-*a* may be an important determinant of water column PCB concentrations. Because PCBs tend to sorb strongly to organics in the environment such as soil, suspended sediments, bottom sediments, and biotic material, and because algae and other aquatic vegetation have been shown to accumulate PCBs from the water column, the relationship between PCBs and chlorophyll-*a* may indicate PCB sorption to and/or accumulation by algae. Chlorophyll-*a* concentrations are plotted against PCB concentrations for the primary sampling stations on Figures 3-17a through 3-17c. The data presented are the monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999).

Between 1996 and 2002, PCBs exhibit a statistically significant ($p < 0.05$) positive relationship with chlorophyll-*a* at the Dawes/Pomeroy Avenue, Holmes Road, Schweitzer/Lenoxdale Bridge, and Division Street Bridge locations. The relationships were strongest at Dawes/Pomeroy Avenue and Holmes Road (r^2 of 0.25 and 0.19, respectively) and very weak at the Schweitzer Bridge and Division Street Bridge (r^2 of 0.067 and 0.069, respectively) (Figures 3-17a and 3-17b). No statistically significant relationship between PCB and chlorophyll-*a* concentrations is evident at New Lenox Road or the headwaters of Woods Pond.

3.7 Temporal PCB Concentration Trends in Surface Water

The significant body of historical water column data from the Housatonic River allows for the assessment of PCB trends over time. However, as noted in Section 3.3, changes in sampling methods and detection limits, along with differences in flow and other physical parameters, can add uncertainty to the analysis of temporal trends and need to be considered when interpreting differences in datasets collected over time. As discussed in section 3.3 and Appendix D, no systematic bias was detected among the inter-laboratory split samples analyzed by GE and EPA.

To assess changes in PCB concentration over time, the monthly and bi-weekly monitoring data collected between 1989 and 1991 were used for comparison to the 1996-2002 monthly and bi-weekly dataset, as discussed in Section 3.3. A summary of the 1989-1991 data is shown in Table 3-11, along with the 1996-2002 results for comparison. The 1989-1991 and 1996-2002 PCB data are plotted on Figures 3-18a through 3-18c for the primary stations sampled in both of these time periods, along with best fit lines and the results of regression analyses of temporal trends (performed on log-transformed PCB data due to the fact that the distribution of these data is closer to lognormal than normal). Despite the large within-year variability shown on Figures 3-18a through 3-18c, PCB concentrations in the Housatonic River surface water at these stations appear to have decreased over time, as noted by the negative slope of the best fit line. In most cases, a downward trend of PCB concentrations is apparent, as well as an increase in the frequency of non-detections. The results of the regression analyses for all stations except the Dawes/Pomeroy Avenue Bridge indicate that the downward trends over time are significant ($p < 0.05$, r^2 values ranging from 0.12 at New Lenox Road Bridge to 0.35 at Division Street).

Temporal trends of surface water PCB contamination are more visually apparent when the data are averaged and plotted by locations and grouped by years. Data for this analysis included the monthly and bi-weekly water column monitoring data collected between 1989 and 2002 at both low and higher flows. The distributions of flows during these two time periods were similar (as shown on Figure 3-19a, below), mitigating any impact of flow on the comparison of PCB concentrations. The changes in average PCB concentrations between the 1989-1991 and 1996-2002 datasets at the key sample locations are shown on Figure 3-19b (below). This comparison shows no real change in concentrations at the Dawes/Pomeroy Avenue Bridge. However, at all other locations plotted, although the data are highly variable, apparent declines in average water column PCB concentrations are noted. At New Lenox Road, these data suggest that the average PCB concentration decreased by half, from approximately 0.20 µg/L to 0.10 µg/L, during the roughly 9-year period between sampling events. Similarly, at the Schweitzer/Lenoxdale and Division Street Bridges, average PCB concentrations dropped by more than 50%, from approximately 0.17 µg/L to 0.07 µg/L and from approximately 0.11 µg/L to 0.035 µg/L, respectively, over the same period of time.

Figure 3-19a. Probability Distribution of Flows on Days of Sampling (1989-1991 and 1996-2002)

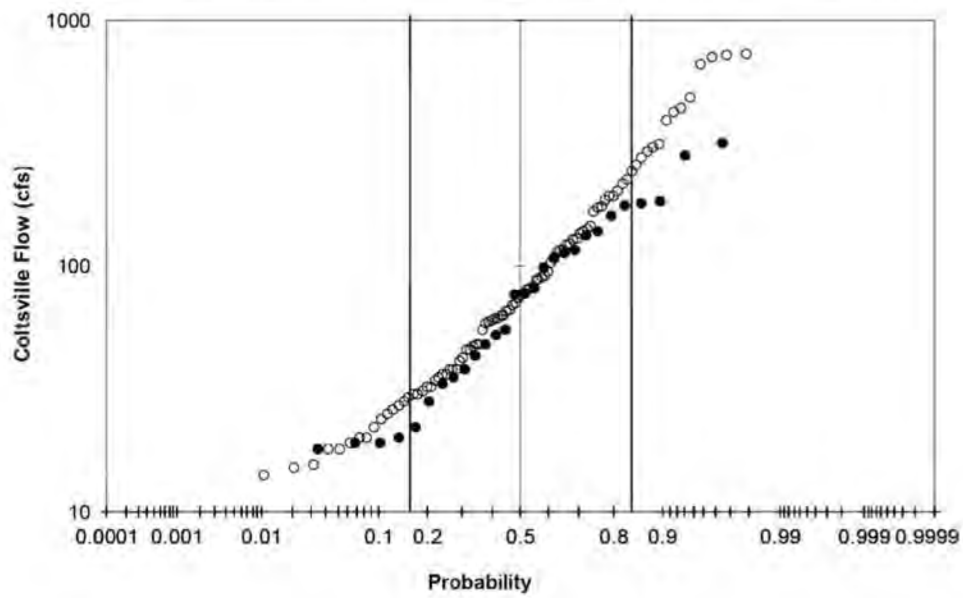
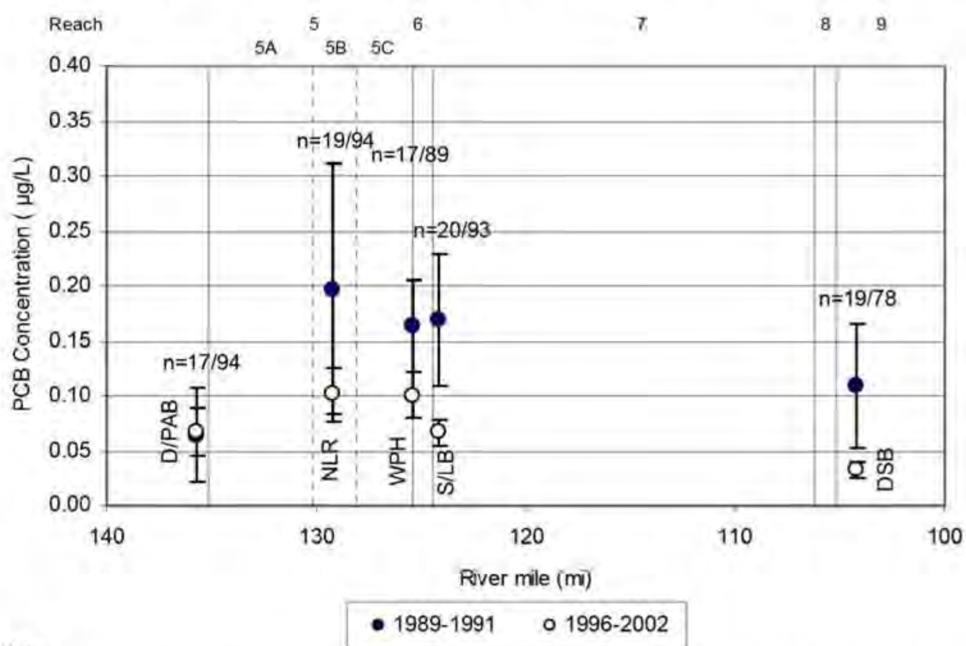


Figure 3-19b. Changes in Average PCB Concentrations Over Time



Notes:
Presents the arithmetic mean PCB concentration and 2 standard errors for all monthly and bi-weekly water column monitoring data collected by GE (1989-1991 and 1996-2002) and EPA (1998-1999). Insufficient data collected in the Connecticut portion of the River. Does not include data from stormwater sampling events or other specialized surface water sampling events.
D/PAB - Dawes/Pomeroy Avenue Bridge; NLR - New Lenox Road Bridge; WPH - Woods Pond Headwaters; S/LB - Schweitzer Lenoxdale Bridge; DSB - Division Street Bridge
n=17/94 indicates that 17 samples were collected from 1989-1991 and 94 samples were collected from 1996-2002.

3.8 Chemical Properties and PCB Composition

Chemical characteristics of PCBs determine the behavior of PCBs in the environment. For example, among the 209 PCB congeners, chemical properties such as water solubility and the octanol-water partition coefficient can vary by several orders of magnitude. Therefore, chemical characteristics of the specific PCB congeners found in the water column are important considerations in the assessment of transport and fate of PCBs in surface water, sediment, and biota.

PCB mixtures were produced under the trade name Aroclor, and different Aroclors were composed of various combinations of chlorobiphenyls. As shown in Table 3-12 (below), Aroclors 1254 and 1260 generally contain a greater proportion of higher-chlorinated chlorobiphenyls (i.e., penta-, hexa-, hepta-, octa-, and nona-chlorobiphenyls) than do Aroclors 1242 and 1248. During the period when GE used PCBs at its Pittsfield facility (1932-1977), Aroclor 1260 and, to a lesser extent, Aroclor 1254 were the Aroclors used in GE's manufacturing operations in Pittsfield.

Table 3-12. PCB Quantitation

Chlorobiphenyl	% of Aroclor, by weight			
	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Mono-	1	--	--	--
Di-	13	1	--	--
Tri-	45	22	1	--
Tetra-	31	49	15	--
Penta-	10	27	53	12
Hexa-	--	2	26	42
Hepta-	--	--	4	38
Octa-	--	--	--	7
Nona-	--	--	--	1

Reference: Erickson, 1997.

The presence of higher-chlorinated PCB Aroclors (i.e., Aroclor 1254 and Aroclor 1260) is evident in the Housatonic River water column data (Table 3-13, below), with a majority of PCBs quantified as Aroclor 1260. Relative to other PCB mixtures, these Aroclors have a lower solubility, lower volatilization, and higher affinity for organic material, including lipids. This suggests that higher-chlorinated PCBs would be more prone to be transported in the particulate phase and more likely to bioaccumulate than less-chlorinated PCBs (i.e., Aroclors 1242 and 1248), all else being equal.

Table 3-13. Summary of PCB Aroclor Quantification

Reach	N	Mean Aroclor Quantitation by Location (%)		
		Aroclor 1248	Aroclor 1254	Aroclor 1260
Dawes/Pomeroy Avenue Bridge	51	4.2	38.0	53.8
Holmes Road Bridge	53	3.4	33.6	61.4
New Lenox Road Bridge	75	2.1	31.9	63.5
Woods Pond Headwaters	79	2.6	33.5	63.1
Schweitzer/Lenoxdale Bridge	69	1.3	34.9	62.4
Division Street Bridge	28	2.4	32.5	65.1

Notes:
Results determined as the average of the percent Aroclor divided by the sum of the individual Aroclor results.
Includes all data from the monthly and bi-weekly water column monitoring data with detectable concentrations of PCB collected by GE (1996-2000) and EPA (1998-1999).

To further evaluate composition of PCBs in surface water, data from EPA's PCB congener analyses were used to calculate homolog distributions for both total and dissolved PCB congener data. These distributions are shown on Figure 3-20. By comparing Table 3-12 to Figure 3-20, it is apparent that total PCBs in the water column downstream of the Confluence resemble Aroclor 1254 and/or Aroclor 1260.

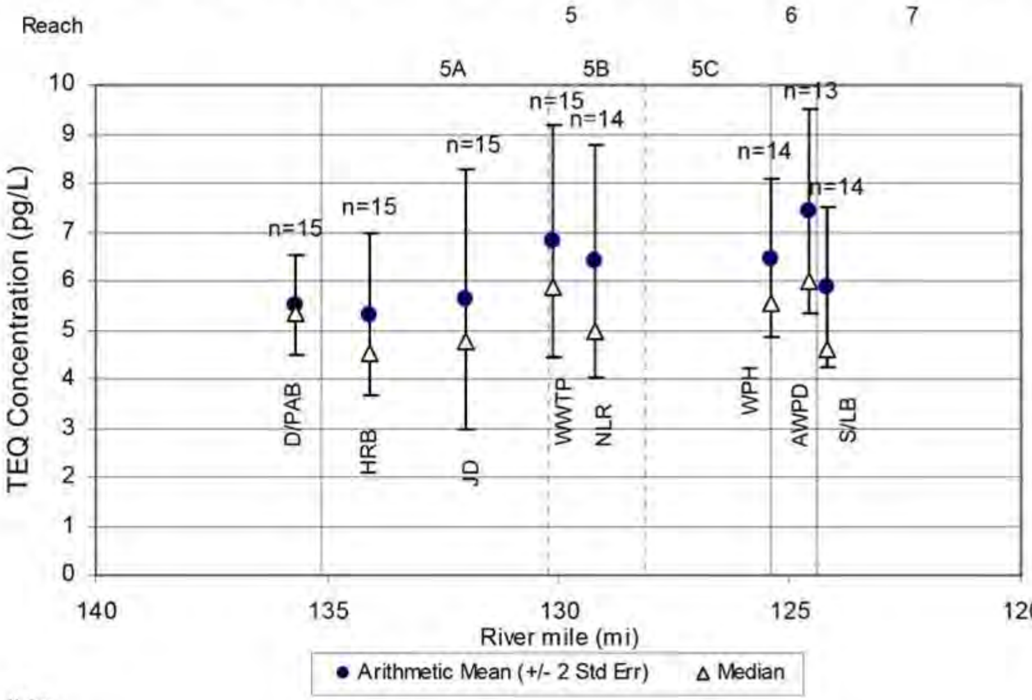
3.9 Nature and Extent of Other Chemical Constituents in Surface Water

In addition to PCBs, non-PCB constituents were also quantified in surface water samples collected by EPA from 1998 to 1999 at a number of locations in the Rest of River from the Holmes Road Bridge to the Schweitzer/Lenoxdale Bridge. Compounds analyzed for included SVOCs, VOCs, pesticides, herbicides, PCDDs/PCDFs, and metals. Information on frequency of detection and summary statistics on concentrations for these constituents are included in Appendix C.

As discussed in Section 2.6, EPA has advised GE that, based on its human health and ecological screening evaluations, the non-PCB constituents, other than potentially PCDDs/PCDFs, are not key constituents of concern in the Rest of River. As a result, the nature and extent of these constituents in the Rest of River surface water will not be evaluated further, except for a brief discussion of PCDD/PCDF compounds.

A review of the data indicates that various PCDD/PCDF compounds were detected in surface water samples. To evaluate these data further, the Toxicity Equivalency Quotient (TEQ) concentration was calculated for each sample using the mammalian Toxicity Equivalency Factors (TEFs) published by the World Health Organization (WHO) (van den Berg et al., 1998) and representing non-detected compounds as one-half the analytical detection limit. In summary, TEQ values calculated for samples collected by EPA during the 1998-99 monthly water column monitoring between the Dawes/Pomeroy Avenue and Schweitzer/Lenoxdale Bridges range from 1.6 pg/L to 23 pg/L (both at Holmes Road Bridge). Arithmetic means range from 5.3 pg/L (Holmes Road Bridge) to 7.4 pg/L (above Woods Pond). Average TEQ concentrations are presented with standard errors on Figure 3-21 (below). Given the relative variability observed at these locations, no distinct trend can be discerned from the data, although it does appear that on average, concentrations are higher downstream of the Pittsfield WWTP than upstream of the WWTP.

Figure 3-21. Average TEQ Concentration at Monthly Surface Water Sampling Locations



Notes:
Presents all monthly water column monitoring data collected by EPA (1998-1999). Data were not collected downstream of the Schweitzer/Lenoxdale Bridge.
D/PAB - Dawes/Pomeroy Avenue Bridge; HRB - Holmes Road Bridge; JD - Joseph Drive; WWTP - Pittsfield WWTP; NLR - New Lenox Road Bridge; WPH - Woods Pond Headwaters; AWPD - Above Woods Pond Dam; S/LB -Schweitzer Lenoxdale Bridge
n = number of samples analyzed

In addition, EPA collected discrete samples associated with its risk assessment work. The discrete sampling programs are summarized in Table 3-1. TEQs for the discrete samples range from 1.5 pg/L to 71 pg/L (reported for a sample collected within a backwater area in Reach 5C, approximately 1 mile upstream of Woods Pond), and the arithmetic means by program range from 4.3 pg/L to 12 pg/L.

3.10 Summary

Average water column PCB concentrations generally increase with distance downstream of the Confluence to New Lenox Road, then level off to the Woods Pond Headwaters and decline across Woods Pond Dam. Median PCB concentrations exhibit the same spatial pattern, but are generally lower than the averages.

Surface water PCB concentration results are related in varying degrees to a number of physical parameters, including flow, water temperature, chlorophyll-*a* (upstream of Woods Pond Dam), and most notably TSS. Surface water investigation results show increases in average TSS concentrations among stations located within Reaches 5A and 5B (i.e., between the Confluence and New Lenox Road Bridge) that are prominent during flows greater than 100 cfs (at Coltsville). PCB concentrations also increase over this portion of the River, with the overall increase being greater at higher flows than at lower flows. Together, these observations suggest that erosion of bed sediments and/or riverbanks from specific areas of Reaches 5A and 5B may be occurring during higher flows and contributing PCBs to the River. Similar to PCBs, average TSS concentrations generally level off in Reach 5C and decrease across Woods Pond (Reach 6), which may indicate that suspended solids, along with PCBs, are deposited in this portion of the River. Surface water PCB concentrations are lowest downstream of Woods Pond, while TSS concentrations remain relatively constant, and even increase in some locations. This suggests that additional solids may be entering the River from the watershed within Reach 7.

Analysis of the PCB concentration data from the primary surface water sampling stations in Massachusetts indicates a statistically significant ($p < 0.05$) declining trend in surface water PCB concentrations over time at several of those stations, although the data are highly variable and the relatively low r^2 values indicate that such trends are not strong. In addition, the frequency of non-detectable concentrations of PCBs at these stations has increased over time. The data collected from the

Connecticut portion of the River are not directly comparable to the 1996-2002 dataset because they were collected during different sampling programs; nevertheless, the historical data indicated that PCB concentrations in Connecticut surface water were low and frequently not detected (see Section 3.3). The low PCB concentrations in Connecticut are consistent with the spatial trend observed in Massachusetts, which showed concentrations declining downstream of Woods Pond Dam. The composition of PCBs in surface water is most consistent with that of Aroclors 1254 and 1260.

Other chemical constituents have also been detected in surface water samples. However, the non-PCB constituents are not the focus of this RFI Report, except for a brief discussion of PCDDs/PCDFs. PCDDs/PCDFs were detected in surface water samples, with TEQs averaging up to 12 pg/L by sampling program and reported up to 71 pg/L in a discrete sample collected from a backwater area within Reach 5C. For PCDD/PCDFs, the calculated TEQ values suggest a slight increase across Reaches 5 and 6.

Section 3 Tables

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
CAES, CDEP, and USGS - Cooperative PCB Investigation					
1978-80	CAES, CDEP, and USGS performed water column monitoring studies at three locations to determine the presence and distribution of PCBs in the Housatonic River.	Near Great Barrington, MA	26	Dissolved PCB (13), Flow (16), Total PCB (22), TSS (16)	Frink et al., 1982; Blasland & Bouck, 1991
		Falls Village, CT	18		
		Gaylordsville, CT	7		
Stewart Investigation					
1982	Stewart conducted an analysis of surface water PCB concentrations at three locations on the Housatonic River during three flow events (i.e., winter, snow melt, and storm flow).	Schweitzer/Lenoxdale Bridge	33	Dissolved PCB (40), Flow (40), Total PCB (40), TSS (40)	Stewart, 1982; Blasland & Bouck, 1991
		Division Street Bridge	39		
		Andrus Road Bridge	48		
USGS and CDEP Water Column PCB Investigation					
1984-88	CDEP, in cooperation with USGS, performed water column monitoring during five high-flow events at five USGS gauging stations.	Near Great Barrington, MA	15	Dissolved PCB (30), Flow (25), Total PCB (32), TSS (32)	Kulp, 1991; Blasland & Bouck, 1991
		Ashley Falls, MA	12		
		Near Canaan, CT	9		
		Near Falls Village, CT	12		
		Kent, CT	46		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Phase II Investigation					
1989-92	Between 7/20/89 and 2/6/92, Blasland & Bouck collected water column samples on approximately a monthly basis at 12 locations along the Housatonic River. Samples were collected in support of the MCP Phase II Investigation.	Hubbard Road Avenue Bridge	12	Chlorophyll *a* (63), Dissolved PCB (136), Total PCB (137), TSS (209), Water Temp (92), Conductance (165), pH (173), Flow (80)	Blasland & Bouck, 1991; BBL, 1996
		Upstream of Unkamet Brook Confluence	6		
		Downstream of Unkamet Brook Confluence	6		
		Newell Street Bridge	6		
		Midpoint Near East Street Area 2 (Boomed)	6		
		Lyman Street Bridge	6		
		Dawes/Pomeroy Avenue Bridge	80		
		New Lenox Road Bridge	83		
		Woods Pond Headwaters	74		
		Former Housatonic Street Abutment	87		
		Schweitzer/Lenoxdale Bridge	95		
		Division Street Bridge	84		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
LMS Fate and Transport Model					
1991-93	Between 3/5/91 and 4/23/93, LMS collected composite water column samples during eight specific flow events at a total of seven locations along the Housatonic River. Samples were used for the Ambient Trend Monitoring and PCB Fate and Transport Model.	Division Street Bridge	216	Dissolved PCB (53), TOC (89), Total PCB (87), TSS (197), Flow (113)	LMS, 1991; Blasland & Bouck, 1991; BBL, 1996
		Kellogg Road Bridge	22		
		Maple Avenue Bridge	22		
		Andrus Road Bridge	22		
		Falls Village Route 7 Bridge	128		
		Lake Lillinonah at Route 133 Bridge	8		
		Lake Zoar at Glen Road Bridge	8		
MCP Supplemental Phase II/RFI					
1995	As part of the MCP Supplemental Phase II/RFI activities, BBL collected water column samples at 14 locations under low-flow and high-flow conditions.	Dawes/Pomeroy Avenue Bridge	7	Conductance (28), Dissolved PCB (12), Flow (7), pH (28), Total PCB (28), TSS (28), Water Temp (23)	BBL, 1996
		Division Street Bridge	6		
		Downstream of Unkamet Brook Confluence	4		
		Elm Street Bridge	7		
		Former Housatonic Street Abutment	3		
		Woods Pond Headwaters	3		
		Holmes Road Bridge	3		
		Hubbard Avenue Bridge	7		
		Lyman Street Bridge	4		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Supplemental Phase II/RFI (cont'd)					
1995		New Lenox Road Bridge	3		
		Newell Street Bridge	7		
		Newell Street Parking Lot Footbridge	7		
		Schweitzer/Lenoxdale Bridge	3		
		Upstream of Unkamet Brook Confluence	4		
	As part of the transport investigation, three sediment traps were placed in Woods Pond in October 1994 and sampled in 1995. Two of three traps were lost or displaced; therefore, they were not sampled. The two lost or displaced traps were returned along with the sampled trap.	Woods Pond	2	PCBs (2), TOC (2), Grain Size (2)	
	Per the Phase II SOW/RFI Proposal, suspended sediment samples and corresponding surface water samples were collected during high-flow conditions from four Lenoxdale locations in October 1995 and five locations (Schweitzer/Lenoxdale Bridge was added) in November 1995.	Dawes/Pomeroy Avenue Bridge	6	Conductance (15), pH (15), Total PCB (15), TSS (15), Water Temp (15)	
		Woods Pond Headwaters	8		
		New Lenox Road Bridge	6		
		Newell Street Bridge	6		
		Schweitzer/Lenoxdale Bridge	4		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Supplemental Phase II/RFI (cont'd)					
1996	BBL conducted water column monitoring as part of the MCP Supplemental Phase II/RFI Investigations. Samples were collected on approximately a monthly basis.	Across from EPRI Facility	8	Dissolved PCB (75), Flow (41), Total PCB (141), TSS (106), Water Temp (112)	GE database (November 2002 release)
		Adjacent to Joseph Drive	34		
		Dawes/Pomeroy Avenue Bridge	21		
		Division Street Bridge	22		
		Elm Street Bridge	21		
		Former Housatonic Street Abutment	22		
		Woods Pond Headwaters	22		
		Holmes Road Bridge	21		
		Hubbard Avenue Bridge	21		
		Just Upstream of WWTP	8		
		Lyman Street Bridge	21		
		New Lenox Road Bridge	28		
		Newell Street Bridge	21		
		Newell Street Parking Lot Footbridge	21		
		Schweitzer/Lenoxdale Bridge	21		
		West Branch	10		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Supplemental Phase II/RFI (cont'd)					
1996	As part of the MCP Supplemental Phase II/RFI activities, BBL collected water column samples at 13 locations under storm flow conditions.	Adjacent to Joseph Drive	9	Conductance (14), Dissolved PCB (28), Flow (8), pH (14), Total PCB (28), TSS (28), Water Temp (28)	GE database (November 2002 release)
		Dawes/Pomeroy Avenue Bridge	6		
		Division Street Bridge	9		
		Elm Street Bridge	6		
		Former Housatonic Street Abutment	6		
		Woods Pond Headwaters	6		
		Holmes Road Bridge	6		
		Hubbard Avenue Bridge	6		
		Lyman Street Bridge	6		
		New Lenox Road Bridge	6		
		Newell Street Bridge	6		
		Newell Street Parking Lot Footbridge	6		
		Schweitzer/Lenoxdale Bridge	6		
	Per the Phase II SOW/RFI Proposal, suspended sediment samples and corresponding surface water samples were collected during storm-flow conditions from five locations in November 1996.	Dawes/Pomeroy Avenue Bridge	6	Conductance (16), Flow (2), pH (16), Total PCB (16), TSS (16), Water Temp (16)	
		Woods Pond Headwaters	6		
		New Lenox Road Bridge	6		
		Newell Street Bridge	8		
		Schweitzer/Lenoxdale Bridge	6		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Supplemental Phase II/RFI (cont'd)					
1997	BBL conducted water column monitoring as part of the MCP Supplemental Phase II Investigations. Samples were collected on approximately a monthly basis.	Adjacent to Joseph Drive	44	Chlorophyll a (138), Flow (52), POC (138), Total PCB (185), TSS (165), Water Temp (173)	GE database (November 2002 release)
		Andrus Road Bridge	16		
		Bulls Bridge Dam	16		
		Dawes/Pomeroy Avenue Bridge	44		
		Division Street Bridge	46		
		Elm Street Bridge	52		
		Former Housatonic Street Abutment	48		
		Woods Pond Headwaters	43		
		Holmes Road Bridge	45		
		Hubbard Avenue Bridge	48		
		Lyman Street Bridge	64		
		New Lenox Road Bridge	48		
		Newell Street Bridge	24		
		Newell Street Parking Lot Footbridge	28		
		Schweitzer/Lenoxdale Bridge	60		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Supplemental Phase II/RFI (cont'd)					
1998	BBL conducted water column monitoring as part of the MCP Supplemental Phase II Investigations. Samples were collected on approximately a monthly basis until February 1998, after which a bi-weekly sampling schedule was enacted.	Adjacent to Joseph Drive	8	Chlorophyll a (171), Conductance (32), Flow (80), pH (32), POC (172), Total PCB (172), TSS (172), Water Temp (156)	GE database (November 2002 release)
		Dawes/Pomeroy Avenue Bridge	88		
		Division Street Bridge	80		
		Elm Street Bridge	8		
		Former Housatonic Street Abutment	8		
		Woods Pond Headwaters	79		
		Holmes Road Bridge	84		
		Hubbard Avenue Bridge	140		
		Lyman Street Bridge	16		
		New Lenox Road Bridge	80		
		Newell Street Bridge	8		
		Newell Street Parking Lot Footbridge	8		
		Schweitzer/Lenoxdale Bridge	80		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Supplemental Phase II/RFI (cont'd)					
1998	Between 8/3/98 and 10/27/98, BBL obtained water column split samples from EPA.	Adjacent to Joseph Drive	8	Chlorophyll a (33), Conductance (17), Dissolved PCB (16), pH (17), POC (17), Total PCB (33), TSS (33), Water Temp (17)	GE database (November 2002 release)
		Crane Paper Company (Dalton, MA)	8		
		Dawes/Pomeroy Avenue Bridge	8		
		Elm Street Bridge	8		
		Former Housatonic Street Abutment	8		
		Woods Pond Headwaters	8		
		Holmes Road Bridge	8		
		Hubbard Avenue Bridge	12		
		Lyman Street Bridge	12		
		New Lenox Road Bridge	8		
		Newell Street Bridge	8		
		Newell Street Parking Lot Footbridge	8		
		Pittsfield WWTP	4		
		Schweitzer/Lenoxdale Bridge	8		
		Upstream of Unkamet Brook Confluence	8		
		West Branch Confluence	8		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Supplemental Phase II/RFI (cont'd)					
1999	BBL conducted water column monitoring as part of the MCP Supplemental Phase II Investigations. Samples were collected on a bi-weekly basis at seven key locations.	Dawes/Pomeroy Avenue Bridge	32	Chlorophyll a (61), Conductance (62), Flow (30), pH (62), POC (61), Total PCB (62), TSS (61), Water Temp (61)	GE database (November 2002 release)
		Division Street Bridge	28		
		Woods Pond Headwaters	28		
		Holmes Road Bridge	32		
		Hubbard Avenue Bridge	61		
		New Lenox Road Bridge	32		
		Schweitzer/Lenoxdale Bridge	32		
1999	Between 3/22/99 and 9/29/99, BBL obtained water column split samples from EPA.	Adjacent to Joseph Drive	30	Chlorophyll a (120), Conductance (118), Dissolved PCB (17), pH (118), POC (120), TOC (17), Total PCB (120), TSS (120), Water Temp (118)	
		Crane Paper Company (Dalton, MA)	30		
		Dawes/Pomeroy Avenue Bridge	30		
		Elm Street Bridge	30		
		Goodrich Pond Tributary	4		
		Woods Pond Headwaters	30		
		Holmes Road Bridge	56		
		Hubbard Avenue Bridge	30		
		Lyman Street Bridge	30		
		New Lenox Road Bridge	30		
		Newell Street Bridge	30		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Supplemental Phase II/RFI (cont'd)					
1999		Newell Street Parking Lot Footbridge	34		GE database (November 2002 release)
		Pittsfield WWTP	30		
		Schweitzer/Lenoxdale Bridge	30		
		Unkamet Brook Confluence	8		
		Upstream of Unkamet Brook Confluence	22		
		Upstream of Woods Pond Dam	30		
		West Street Branch Confluence	30		
1999	BBL collected split samples during EPA's sampling of two stormflow events on 5/19/99 and 9/18/99.	Dawes/Pomeroy Avenue Bridge	100	Total PCB (99), TSS (99)	
		New Lenox Road Bridge	98		
2000	BBL conducted water column monitoring as part of the MCP Supplemental Phase II Investigations. Samples were collected at seven key locations.	Dawes/Pomeroy Avenue Bridge	48	Chlorophyll a (96), Conductance (88), Flow (48), pH (88), POC (96), Total PCB (96), TSS (96), Water Temp (96)	GE database (November 2002 release)
		Division Street Bridge	48		
		Woods Pond Headwaters	48		
		Holmes Road Bridge	48		
		Hubbard Avenue Bridge	96		
		New Lenox Road Bridge	48		
		Schweitzer/Lenoxdale Bridge	48		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
MCP Supplemental Phase II/RFI (cont'd)					
2001	BBL conducted water column monitoring as part of the MCP Supplemental Phase II Investigations. Samples were collected at seven key locations.	Dawes/Pomeroy Avenue Bridge	46	Chlorophyll a (79), Conductance (71), Flow (39), pH (71), POC (94), Total PCB (94), TSS (94), Water Temp (79)	GE database (November 2002 release)
		Division Street Bridge	46		
		Woods Pond Headwaters	39		
		Holmes Road Bridge	46		
		Hubbard Avenue Bridge	92		
		New Lenox Road Bridge	46		
		Schweitzer/Lenoxdale Bridge	46		
2002	BBL conducted water column monitoring as part of the MCP Supplemental Phase II Investigations. Samples were collected at seven key locations.	Dawes/Pomeroy Avenue Bridge	19	Chlorophyll a (32), Conductance (32), Flow (15), pH (32), POC (40), Total PCB (40), TSS (40), Water Temp (32)	GE database (November 2002 release)
		Division Street Bridge	19		
		Woods Pond Headwaters	19		
		Holmes Road Bridge	19		
		Hubbard Avenue Bridge	38		
		New Lenox Road Bridge	19		
		Schweitzer/Lenoxdale Bridge	19		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
Housatonic River High-Flow Sediment Loading Study					
1997	Daily water column composite samples were collected in 1997 to provide suspended solids data in support of the Housatonic River high-flow sediment loading study. The daily composite samples were collected by an automated TSS sampler at several locations along the Housatonic River and at select tributaries.	Woods Pond Headwaters	87	TSS (541)	GE database (November 2002 release)
		Hubbard Avenue Bridge	75		
		Konkapot River	82		
		Rising Pond Dam	72		
		Sackett Brook	76		
		West Branch	68		
		Woods Pond Dam	81		
1998	Daily water column composite samples were collected in 1998 to provide suspended solids data in support of the Housatonic River high-flow sediment loading study. The daily composite samples were collected by an automated TSS sampler at several locations along the Housatonic River and at select tributaries.	Bulls Bridge Dam	12	TSS (102)	
		Woods Pond Headwaters	13		
		Hubbard Avenue Bridge	13		
		Konkapot River	13		
		Rising Pond Dam	12		
		Sackett Brook	13		
		West Branch	13		
		Woods Pond Dam	13		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
R2 Largemouth Bass Reproduction and Population Structure Study					
2000-2001	During 2000, continuous water temperature recorders were used to record temperatures at 13 locations from May through September 2000 (hand-held digital meters were also used to measure DO, pH, conductivity, and water temperature). During 2001, temperature recorders were used at 12 locations from late March or mid-April to mid-October, and nine continuous DO recorders were used to record DO, water temperature, and pH in the three backwater areas from June to mid-October 2001.	OM8-Mainchannel	3,403	DO (47,513), pH (47,513), Temperature (186,611)	R2, 2002
		OM8-Middle	5,570		
		OM8-Nearshore	4,601		
		UWP-Mainchannel	5,554		
		UWP-Middle	5,741		
		UWP-Nearshore	5,848		
		UWP2-Mainchannel	5,505		
		UWP2-Middle	5,553		
		UWP2-Nearshore	5,738		
		East Branch	13,838		
		West Branch	13,166		
		Morewood Brook	5,347		
		Holmes Road	13,185		
		Sackett Brook	5,154		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
R2 Largemouth Bass Reproduction and Population Structure Study (cont'd)					
2000-2001		Upstream of New Lenox-Main Channel	2,268		R2, 2002
		Upstream of New Lenox-Backwater	11,837		
		New Lenox Road	7,798		
		Upstream of Mill Brook	6,374		
		Lower Mill Brook	5,312		
		Upper Mill Brook	5,315		
		Downstream of Mill Brook	6,390		
		Roaring Brook	5,275		
		Yokun Brook Outlet	6,333		
		OM8-Backwater	6,403		
		HRDSOM8	6,428		
		Felton Brook	5,311		
		Lower Woods Pond	13,364		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
EPA Monthly Water Column, Discrete, and Stormflow Sampling					
1998-99	Weston collected monthly water column samples at 17 locations along the Housatonic River. Samples were collected between 8/98 and 9/99.	Crane Paper Company	185	Appendix IX Pesticides (250), Appendix IX SVOCs (250), Appendix IX VOCs (81), Dioxins/Furans (250), Herbicides (243), Inorganics (275), Metals (250), Metals-Filtered (251), OP Pesticides (250), Organics (253), PAHs (30), PCB Congeners (223), PCBs (250), PCBs-Filtered (251), Conductance (619), Dissolved Oxygen (547), pH (596), Turbidity (349), Water Temp (537)	Weston, 2002
		Hubbard Avenue Bridge	208		
		Unkamet Brook Confluence	176		
		Goodrich Pond Tributary	12		
		Lyman Street Bridge	210		
		Elm Street Bridge	184		
		Newell Street Bridge	185		
		Newell Street Footbridge	222		
		Above the West Branch	186		
		Dawes/Pomeroy Avenue Bridge	197		
		Holmes Road Bridge	277		
		Adjacent to Joseph Drive	187		
		Pittsfield WWTP	174		
		New Lenox Road Bridge	187		
		Woods Pond Headwaters	176		
		Above Woods Pond Dam	166		
		Schweitzer/Lenoxdale Bridge	175		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
EPA Monthly Water Column, Discrete, and Stormflow Sampling (cont'd)					
1999	Weston collected stormflow samples at eight locations within the Housatonic River and its tributaries. Samples were collected to assist in the determination of re-suspension and redistribution of PCB-containing sediment and the effects of storms on water quality and hydrodynamics.	Hubbard Avenue Bridge	236	Inorganics (2560), Organics (237), PCB Congeners (24), PCBs (136), PCBs-Filtered (89)	Weston, 2002
		Unkamet Brook	257		
		West Branch Confluence	263		
		Dawes/Pomeroy Avenue Bridge	542		
		Sackett Brook	202		
		New Lenox Road Bridge	654		
		Roaring Brook	214		
		Woods Pond Footbridge	678		
1998-2002	Weston conducted discrete water column sampling at 41 selected locations within the Housatonic River (i.e., channel) and floodplain (i.e., vernal pools). Data were collected during nine designated sampling programs to satisfy human health and ecological risk assessment endpoints.	Program 3: Discrete River Sampling	13	Appendix IX Pesticides (48), Appendix IX SVOCs (18), Appendix IX VOCs (1), Dioxins/Furans (48), Herbicides (16), Inorganics (50), Metals (17), Metals-Filtered (1), OP Pesticides (16), Organics (46), PAHs (0), PCB Congeners (23), PCBs (65), PCBs-Filtered (11), Conductance (6), Dissolved Oxygen (6), Water Temp (6)	Weston, 2002
		Program 8: Non-Routine Surface Water	4		
		Program 15: Sediment Toxicity	54		
		Program 16: Mussel Exposure	14		
		Program 28: Long-Term Remediation Monitoring	38		
		Program 32: Leopard / Wood / Bull Frogs	78		
		Program 77: (Not specified)	37		
		Program 79: Amphibian Vernal Pool Study (Wood)	92		
		Program 82: (Not specified)	30		

(See notes on page 18)

Table 3-1
Summary of Surface Water Sampling Activities/Investigations

Year[4]	Description and Purpose[4]	Location	Sample Analyses[1]	Analytical Parameters[2,3]	Report Citation
Investigation of Other Hazardous Constituents					
1990-91	Water column samples were collected during one high-flow and one low-flow event, respectively, at six locations on the Housatonic River and two in Silver Lake as part of the MCP Phase II Investigation.	Downstream of the Hubbard Avenue Bridge	4	Appendix IX+3 Constituents (14)	Blasland & Bouck, 1991
		Upstream of the Unkamet Confluence	2		
		Downstream of the Unkamet Confluence	2		
		Newell Street Bridge	2		
		Near the Mid-Point of East Street Area 2 (boomed)	2		
		Lyman Street Bridge	2		
1995	As part of the Supplemental Phase II/RFI activities, additional samples were collected by BBL at eight locations (Hubbard Avenue Bridge, Upstream and Downstream of the Unkamet Confluence, Newell Street Bridge, Near the mid-point of East Street Area 2, Elm Street Bridge, Dawes/Pomeroy Avenue Bridge, and Lyman Street Bridge) under low-flow and high-flow conditions.	Downstream of the Hubbard Avenue Bridge	6	Appendix IX+3 VOCs (16), SVOCs (16), Inorganics (16)	BBL, 1996
		Upstream of the Unkamet Confluence	6		
		Downstream of the Unkamet Confluence	6		
		Newell Street Bridge	6		
		Near the Mid-Point of East Street Area 2 (boomed)	6		
		Lyman Street Bridge	6		
		Elm Street Bridge	6		
		Dawes/Pomeroy Avenue Bridge	6		

Notes:

1. Sample Analyses counts represent total number of analyses conducted on samples collected at each location. These numbers are based on data as reported in the GE database (November release) and EPA database (November release).
2. Includes field measurements (i.e., temperature, conductance, flow, pH, etc.)
3. Numbers in parentheses indicate number of analyses completed for each parameter.
4. Highlighted programs indicate post-1996 monthly/biweekly programs from which data were used in surface water trend evaluations.

Table 3-2
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results -- 1996-2002

Location/ Constituent	Sample Number	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Dawes/Pomeroy Avenue Bridge							
Conductance (mS/cm)	53	0.28	0.30	0.34	0.26	0.0040	1.0
Dissolved Oxygen (mg/L)	12	9.9	9.7	13	6.8	0.092	19
pH (standard units)	52	7.6	7.6	7.7	7.4	6.3	9.3
Temperature (^oC)	89	12	12	13	10	0.80	24
Turbidity (NTU)	4	7.4	14	31	< 0	1.1	39
Holmes Road Bridge							
Conductance (mS/cm)	53	0.26	0.29	0.33	0.25	0.0050	0.94
Dissolved Oxygen (mg/L)	13	11	12	15	9.5	7.9	26
pH (standard units)	54	7.8	7.7	7.9	7.5	6.2	10
Temperature (^oC)	89	12	12	13	10	0.30	25
Turbidity (NTU)	3	1.4	2.5	5.1	< 0	1.0	5.1
Adjacent to Joseph Drive							
Conductance (mS/cm)	14	0.38	0.39	0.45	0.33	0.20	0.67
Dissolved Oxygen (mg/L)	12	11	13	16	9.7	8.4	27
pH (standard units)	13	7.6	7.6	7.8	7.4	6.8	8.1
Temperature (^oC)	34	12	12	14	9.2	0.86	25
Turbidity (NTU)	4	2.9	2.8	3.1	2.4	2.3	3.1
Pittsfield WWTP							
Conductance (mS/cm)	14	0.43	0.48	0.57	0.39	0.34	0.97
Dissolved Oxygen (mg/L)	11	10	12	14	9.2	8.0	23
pH (standard units)	13	7.8	7.6	7.8	7.3	6.6	8.1
Temperature (^oC)	17	12	11	15	7.7	0.80	23
Turbidity (NTU)	3	3.6	27	75	< 0	3.2	75
New Lenox Road Bridge							
Conductance (mS/cm)	54	0.29	0.33	0.38	0.28	0.0030	0.93
Dissolved Oxygen (mg/L)	13	9.5	11	14	8.6	7.2	26
pH (standard units)	52	7.6	7.5	7.7	7.3	6.2	9.4
Temperature (^oC)	90	11	11	13	9.8	0.50	25
Turbidity (NTU)	3	2.9	2.4	4.3	0.54	0.60	3.7

Table 3-2
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results -- 1996-2002

Location/ Constituent	Sample Number	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Woods Pond Headwaters							
Conductance (mS/cm)	50	0.27	0.38	0.54	0.22	0.13	4.2
Dissolved Oxygen (mg/L)	10	10	17	27	7.0	5.5	56
pH (standard units)	50	7.6	7.4	7.6	7.3	6.0	8.8
Temperature (°C)	85	12	12	14	10	0.20	25
Turbidity (NTU)	2	19	19	NA	NA	4.1	35
Above Woods Pond Dam							
Conductance (mS/cm)	14	0.42	0.47	0.59	0.35	0.19	1.1
Dissolved Oxygen (mg/L)	13	9	12	15	8.1	5.6	25
pH (standard units)	11	7.7	7.6	7.8	7.3	6.8	8.0
Temperature (°C)	35	13	12	15	9.8	0.40	25
Turbidity (NTU)	3	3.1	3.1	5.8	0.35	0.70	5.4
Schweitzer/Lenoxdale Bridge							
Conductance (mS/cm)	54	0.28	0.31	0.35	0.26	0.022	1.2
Dissolved Oxygen (mg/L)	13	10	14	20	8.2	6.9	46
pH (standard units)	54	7.7	7.5	7.7	7.3	5.5	8.7
Temperature (°C)	89	12	12	13	9.9	0.20	25
Turbidity (NTU)	4	2.6	3.1	4.5	1.8	2.2	5.1
Division Street Bridge							
Conductance (mS/cm)	38	0.25	0.26	0.29	0.23	0.14	0.55
pH (standard units)	38	7.6	7.6	7.9	7.4	5.7	8.9
Temperature (°C)	74	11	12	13	9.7	0.20	25

Notes:

1. Includes all monthly and bi-weekly monitoring data collected by GE (1996-2002) and EPA (1998-1999) as reported in the GE and EPA databases, respectively. Does not include data from stormwater sampling events or other specialized surface water sampling events.
2. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).

Table 3-3
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results By Month Sampled -- 1996-2002

Location/ Constituent	Month	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Dawes/Pomeroy Avenue Bridge								
Conductance (mS/cm)	Jan	4	0.24	0.25	0.36	0.13	0.11	0.38
	Feb	6	0.23	0.25	0.34	0.16	0.11	0.38
	Mar	5	0.27	0.25	0.37	0.13	0.11	0.43
	Apr	3	0.20	0.24	0.33	0.15	0.19	0.33
	May	4	0.18	0.17	0.20	0.14	0.13	0.20
	Jun	4	0.26	0.32	0.46	0.17	0.21	0.53
	Jul	4	0.35	0.36	0.55	0.17	0.15	0.61
	Aug	5	0.45	0.52	0.78	0.26	0.28	1.0
	Sep	4	0.37	0.38	0.55	0.20	0.17	0.58
	Oct	4	0.26	0.29	0.39	0.19	0.21	0.43
	Nov	5	0.28	0.29	0.39	0.20	0.21	0.47
	Dec	5	0.32	0.26	0.39	0.12	0.0040	0.37
Dissolved Oxygen (mg/L)	Feb	1	NA	15	NA	NA	NA	NA
	Apr	1	NA	0.092	NA	NA	NA	NA
	May	1	NA	10	NA	NA	NA	NA
	Jun	1	NA	9.7	NA	NA	NA	NA
	Jul	1	NA	7.4	NA	NA	NA	NA
	Aug	2	6.3	6.3	NA	NA	3.9	8.8
	Sep	2	8.1	8.1	NA	NA	6.2	10
	Oct	1	NA	19	NA	NA	NA	NA
	Nov	1	NA	14	NA	NA	NA	NA
	Dec	1	NA	13	NA	NA	NA	NA
pH (standard units)	Jan	5	7.3	7.5	8.3	6.6	6.4	8.9
	Feb	5	7.2	6.9	7.4	6.5	6.3	7.4
	Mar	5	7.3	7.3	7.8	6.7	6.4	8.0
	Apr	3	7.7	7.6	8.0	7.3	7.3	7.9
	May	4	7.8	8.1	8.9	7.4	7.6	9.3
	Jun	4	7.8	7.8	8.0	7.7	7.7	8.0
	Jul	4	8.0	7.9	8.2	7.6	7.5	8.1
	Aug	5	7.7	7.7	8.0	7.5	7.5	8.2
	Sep	3	7.4	7.5	8.2	6.8	7.0	8.1
	Oct	4	7.8	7.8	8.0	7.6	7.6	8.1
	Nov	5	7.5	7.4	7.7	7.2	7.1	7.7
	Dec	5	7.7	7.6	7.8	7.4	7.3	7.9
Temperature (^{o}C)	Jan	6	1.0	1.9	3.2	0.49	0.80	5.0
	Feb	8	2.8	3.1	4.3	1.9	0.86	6.4
	Mar	7	5.0	4.1	5.8	2.3	0.89	7.0
	Apr	7	10	11	12	9.1	7.6	13
	May	8	16	16	18	13	10	21
	Jun	8	21	21	22	20	18	23
	Jul	9	22	22	23	20	19	24
	Aug	7	20	20	22	18	17	24
	Sep	9	17	16	19	14	12	23
	Oct	7	11	11	13	9.2	8.0	15
	Nov	7	4.0	5.0	6.3	3.8	3.0	7.0
	Dec	6	2.5	3.2	5.1	1.3	1.0	7.0
Turbidity (NTU)	Jun	1	NA	2.5	NA	NA	NA	NA
	Jul	1	NA	12	NA	NA	NA	NA
	Aug	1	NA	39	NA	NA	NA	NA
	Sep	1	NA	1.1	NA	NA	NA	NA

Table 3-3
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results By Month Sampled -- 1996-2002

Location/ Constituent	Month	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Holmes Road Bridge								
Conductance (mS/cm)	Jan	4	0.24	0.29	0.45	0.13	0.15	0.52
	Feb	6	0.23	0.24	0.28	0.19	0.15	0.32
	Mar	5	0.30	0.30	0.46	0.14	0.13	0.59
	Apr	3	0.26	0.26	0.33	0.19	0.20	0.33
	May	4	0.20	0.20	0.23	0.17	0.17	0.24
	Jun	4	0.26	0.29	0.40	0.18	0.20	0.44
	Jul	4	0.33	0.32	0.44	0.19	0.16	0.46
	Aug	6	0.44	0.48	0.69	0.27	0.24	0.94
	Sep	3	0.40	0.36	0.50	0.21	0.21	0.46
	Oct	4	0.25	0.25	0.31	0.19	0.20	0.31
	Nov	5	0.24	0.26	0.31	0.21	0.22	0.36
	Dec	5	0.28	0.24	0.37	0.11	0.0050	0.37
Dissolved Oxygen (mg/L)	Feb	1	NA	16	NA	NA	NA	NA
	Apr	1	NA	12	NA	NA	NA	NA
	May	1	NA	11	NA	NA	NA	NA
	Jun	1	NA	8.2	NA	NA	NA	NA
	Jul	1	NA	8.9	NA	NA	NA	NA
	Aug	3	8.0	8.9	11	7.1	7.9	11
	Sep	2	15	15	NA	NA	11	19
	Oct	1	NA	9.9	NA	NA	NA	NA
	Nov	1	NA	13	NA	NA	NA	NA
	Dec	1	NA	26	NA	NA	NA	NA
pH (standard units)	Jan	5	7.2	7.5	8.4	6.7	6.6	9.1
	Feb	6	7.0	6.9	7.3	6.5	6.2	7.4
	Mar	5	7.5	7.4	7.9	6.8	6.5	8.1
	Apr	3	7.9	7.6	8.2	7.1	7.1	7.9
	May	4	7.9	8.5	9.7	7.3	7.7	10
	Jun	4	7.9	7.9	8.0	7.7	7.6	8.1
	Jul	4	8.2	8.2	8.3	8.1	8.0	8.3
	Aug	6	8.0	7.9	8.2	7.7	7.5	8.3
	Sep	3	8.1	7.9	8.3	7.4	7.4	8.1
	Oct	4	7.8	7.8	8.1	7.5	7.4	8.1
	Nov	5	7.3	7.4	7.8	7.0	6.8	7.9
	Dec	5	7.8	7.8	8.0	7.5	7.3	8.2
Temperature (^{o}C)	Jan	6	1.0	1.4	2.5	0.27	0.30	4.0
	Feb	8	2.8	3.0	4.1	1.9	1.2	6.4
	Mar	7	5.0	4.4	5.9	2.9	1.3	6.0
	Apr	7	11	11	12	9.6	8.2	13
	May	8	16	16	18	14	10	21
	Jun	8	21	21	22	19	17	24
	Jul	9	23	23	24	21	19	25
	Aug	8	20	20	22	19	17	24
	Sep	8	16	16	19	14	13	23
	Oct	7	11	11	12	9.1	8.1	14
	Nov	7	5.0	4.7	5.7	3.7	3.0	6.0
	Dec	6	2.0	2.7	4.2	1.1	1.0	6.0
Turbidity (NTU)	Jul	1	NA	5.1	NA	NA	NA	NA
	Aug	1	NA	1.4	NA	NA	NA	NA
	Sep	1	NA	1.0	NA	NA	NA	NA

Table 3-3
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results By Month Sampled -- 1996-2002

Location/ Constituent	Month	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Adjacent to Joseph Drive								
Conductance (mS/cm)	Jan	1	NA	0.38	NA	NA	NA	NA
	Feb	1	NA	0.30	NA	NA	NA	NA
	Mar	1	NA	0.67	NA	NA	NA	NA
	Apr	1	NA	0.26	NA	NA	NA	NA
	May	1	NA	0.20	NA	NA	NA	NA
	Jun	1	NA	0.43	NA	NA	NA	NA
	Jul	1	NA	0.45	NA	NA	NA	NA
	Aug	2	0.48	0.48	NA	NA	0.44	0.51
	Sep	2	0.37	0.37	NA	NA	0.36	0.37
	Oct	1	NA	0.31	NA	NA	NA	NA
	Nov	1	NA	0.37	NA	NA	NA	NA
	Dec	1	NA	0.39	NA	NA	NA	NA
Dissolved Oxygen (mg/L)	Feb	1	NA	16	NA	NA	NA	NA
	Apr	1	NA	11	NA	NA	NA	NA
	May	1	NA	9.9	NA	NA	NA	NA
	Jun	1	NA	8.4	NA	NA	NA	NA
	Jul	1	NA	9.1	NA	NA	NA	NA
	Aug	2	11	11	NA	NA	10	12
	Sep	2	12	12	NA	NA	9.8	14
	Oct	1	NA	12	NA	NA	NA	NA
	Nov	1	NA	12	NA	NA	NA	NA
	Dec	1	NA	27	NA	NA	NA	NA
pH (standard units)	Jan	1	NA	6.8	NA	NA	NA	NA
	Feb	1	NA	7.1	NA	NA	NA	NA
	Mar	1	NA	7.6	NA	NA	NA	NA
	Apr	1	NA	8.0	NA	NA	NA	NA
	May	1	NA	7.7	NA	NA	NA	NA
	Jun	1	NA	7.9	NA	NA	NA	NA
	Jul	1	NA	8.1	NA	NA	NA	NA
	Aug	2	7.7	7.7	NA	NA	7.4	8.1
	Sep	1	NA	7.3	NA	NA	NA	NA
	Oct	1	NA	7.5	NA	NA	NA	NA
	Nov	1	NA	7.3	NA	NA	NA	NA
	Dec	1	NA	8.0	NA	NA	NA	NA
Temperature (^oC)	Jan	2	3.5	3.5	NA	NA	1.0	6.0
	Feb	3	2.5	2.5	4.3	0.64	0.86	4.0
	Mar	2	3.4	3.4	NA	NA	1.8	5.0
	Apr	2	9.7	9.7	NA	NA	9.5	10
	May	3	14	14	17	11	11	16
	Jun	3	20	20	22	19	19	22
	Jul	4	21	21	24	19	19	25
	Aug	3	21	21	22	19	20	22
	Sep	4	15	15	16	13	13	16
	Oct	3	11	11	12	11	11	12
	Nov	3	4.0	4.2	5.6	2.7	3.0	5.5
	Dec	2	2.4	2.4	NA	NA	1.0	3.7
Turbidity (NTU)	Jun	1	NA	3.0	NA	NA	NA	NA
	Jul	1	NA	2.7	NA	NA	NA	NA
	Aug	1	NA	2.3	NA	NA	NA	NA
	Sep	1	NA	3.1	NA	NA	NA	NA

Table 3-3
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results By Month Sampled -- 1996-2002

Location/ Constituent	Month	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Pittsfield WWTP								
Conductance (mS/cm)	Jan	1	NA	0.41	NA	NA	NA	NA
	Feb	1	NA	0.35	NA	NA	NA	NA
	Mar	1	NA	0.73	NA	NA	NA	NA
	Apr	1	NA	0.40	NA	NA	NA	NA
	May	1	NA	0.97	NA	NA	NA	NA
	Jun	1	NA	0.48	NA	NA	NA	NA
	Jul	1	NA	0.45	NA	NA	NA	NA
	Aug	2	0.49	0.49	NA	NA	0.48	0.50
	Sep	2	0.42	0.42	NA	NA	0.38	0.45
	Oct	1	NA	0.34	NA	NA	NA	NA
	Nov	1	NA	0.41	NA	NA	NA	NA
	Dec	1	NA	0.41	NA	NA	NA	NA
Dissolved Oxygen (mg/L)	Feb	1	NA	12	NA	NA	NA	NA
	Apr	1	NA	14	NA	NA	NA	NA
	May	1	NA	10	NA	NA	NA	NA
	Jun	1	NA	9.3	NA	NA	NA	NA
	Jul	1	NA	8.9	NA	NA	NA	NA
	Aug	2	8.7	8.7	NA	NA	8.0	9.5
	Sep	2	11	11	NA	NA	9.8	12
	Nov	1	NA	12	NA	NA	NA	NA
	Dec	1	NA	23	NA	NA	NA	NA
pH (standard units)	Jan	1	NA	6.6	NA	NA	NA	NA
	Feb	1	NA	7.6	NA	NA	NA	NA
	Mar	1	NA	7.7	NA	NA	NA	NA
	May	1	NA	7.7	NA	NA	NA	NA
	Jun	1	NA	7.8	NA	NA	NA	NA
	Jul	1	NA	7.9	NA	NA	NA	NA
	Aug	2	7.9	7.9	NA	NA	7.9	7.9
	Sep	2	7.3	7.3	NA	NA	6.8	7.8
	Oct	1	NA	7.8	NA	NA	NA	NA
	Nov	1	NA	7.2	NA	NA	NA	NA
	Dec	1	NA	8.1	NA	NA	NA	NA
Temperature (°C)	Jan	1	NA	0.80	NA	NA	NA	NA
	Feb	1	NA	1.6	NA	NA	NA	NA
	Mar	1	NA	2.5	NA	NA	NA	NA
	Apr	1	NA	10	NA	NA	NA	NA
	May	1	NA	14	NA	NA	NA	NA
	Jun	1	NA	19	NA	NA	NA	NA
	Jul	1	NA	23	NA	NA	NA	NA
	Aug	2	19	19	NA	NA	19	20
	Sep	3	15	15	16.86	12.88	13	16
	Oct	2	11	11	NA	NA	10	11.9
	Nov	2	4.7	4.7	NA	NA	4	5.4
	Dec	1	NA	4.3	NA	NA	NA	NA
Turbidity (NTU)	Jul	1	NA	75	NA	NA	NA	NA
	Aug	1	NA	3.6	NA	NA	NA	NA
	Sep	1	NA	3.2	NA	NA	NA	NA

Table 3-3
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results By Month Sampled -- 1996-2002

Location/ Constituent	Month	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
New Lenox Road Bridge								
Conductance (mS/cm)	Jan	5	0.30	0.29	0.40	0.19	0.16	0.46
	Feb	6	0.21	0.19	0.28	0.10	0.0030	0.29
	Mar	5	0.32	0.36	0.62	0.11	0.14	0.84
	Apr	3	0.27	0.27	0.34	0.21	0.22	0.33
	May	4	0.20	0.23	0.29	0.16	0.18	0.33
	Jun	4	0.27	0.30	0.40	0.21	0.22	0.45
	Jul	4	0.35	0.34	0.44	0.23	0.20	0.44
	Aug	6	0.52	0.57	0.78	0.36	0.27	0.93
	Sep	3	0.40	0.37	0.45	0.29	0.29	0.42
	Oct	4	0.27	0.27	0.32	0.23	0.23	0.32
	Nov	5	0.25	0.28	0.36	0.20	0.22	0.43
	Dec	5	0.30	0.39	0.57	0.21	0.22	0.72
Dissolved Oxygen (mg/L)	Feb	1	NA	13	NA	NA	NA	NA
	Apr	1	NA	13	NA	NA	NA	NA
	May	1	NA	9.3	NA	NA	NA	NA
	Jun	1	NA	7.2	NA	NA	NA	NA
	Jul	1	NA	7.8	NA	NA	NA	NA
	Aug	3	8.0	7.8	8.3	7.4	7.4	8.1
	Sep	2	13	13	NA	NA	9.5	16
	Oct	1	NA	11	NA	NA	NA	NA
	Nov	1	NA	13	NA	NA	NA	NA
	Dec	1	NA	26	NA	NA	NA	NA
pH (standard units)	Jan	5	7.1	7.3	8.0	6.6	6.7	8.6
	Feb	6	6.9	6.8	7.2	6.4	6.2	7.4
	Mar	5	7.3	7.2	7.8	6.5	6.2	7.9
	Apr	3	7.8	7.6	8.1	7.1	7.1	7.9
	May	4	7.8	8.2	9.0	7.3	7.7	9.4
	Jun	3	7.8	7.7	8.0	7.4	7.4	7.9
	Jul	4	7.8	7.8	7.9	7.7	7.6	8.0
	Aug	6	7.6	7.7	7.9	7.5	7.4	8.1
	Sep	3	7.8	7.7	7.9	7.5	7.5	7.8
	Oct	4	7.8	7.7	7.9	7.5	7.5	7.9
	Nov	5	7.2	7.4	7.7	7.1	7.1	7.8
	Dec	4	7.8	7.6	8.0	7.3	7.1	7.9
Temperature (^{o}C)	Jan	6	0.85	1.2	1.9	0.45	0.70	3.0
	Feb	8	2.8	2.9	4.0	1.7	0.50	5.8
	Mar	7	5.0	4.3	5.2	3.3	2.0	5.0
	Apr	7	10.0	10.0	11	8.8	7.5	13
	May	8	15	15	17	14	11	20
	Jun	8	20	20	21	19	17	22
	Jul	9	21	22	23	21	20	25
	Aug	8	19	20	22	18	17	25
	Sep	8	15	16	18	13	11	23
	Oct	7	12	11	12	9.4	8.8	14
	Nov	8	4.5	4.7	5.4	3.9	3.0	6
	Dec	6	2.9	3.0	4.3	1.6	1.1	6.0
Turbidity (NTU)	Jul	1	NA	3.7	NA	NA	NA	NA
	Aug	1	NA	2.9	NA	NA	NA	NA
	Sep	1	NA	0.60	NA	NA	NA	NA

Table 3-3
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results By Month Sampled -- 1996-2002

Location/ Constituent	Month	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Woods Pond Headwaters								
Conductance (mS/cm)	Jan	2	0.22	0.22	NA	NA	0.20	0.24
	Feb	6	0.27	0.26	0.32	0.19	0.13	0.36
	Mar	5	0.33	0.39	0.68	0.10	0.16	0.95
	Apr	3	0.26	0.27	0.33	0.20	0.21	0.33
	May	4	0.19	0.22	0.30	0.14	0.17	0.33
	Jun	4	0.25	0.29	0.38	0.19	0.21	0.43
	Jul	4	0.34	0.32	0.43	0.22	0.18	0.43
	Aug	6	0.47	0.44	0.53	0.35	0.26	0.57
	Sep	2	0.32	0.32	NA	NA	0.24	0.39
	Oct	4	0.27	0.26	0.32	0.20	0.19	0.32
	Nov	5	0.24	1.01	2.6	< 0	0.17	4.2
	Dec	5	0.27	0.29	0.37	0.21	0.20	0.43
Dissolved Oxygen (mg/L)	Mar	1	NA	56	NA	NA	NA	NA
	Apr	1	NA	19	NA	NA	NA	NA
	May	1	NA	8.8	NA	NA	NA	NA
	Jun	1	NA	7.1	NA	NA	NA	NA
	Jul	1	NA	8.7	NA	NA	NA	NA
	Aug	2	8.4	8.4	NA	NA	5.5	11
	Oct	1	NA	8.5	NA	NA	NA	NA
	Nov	1	NA	12	NA	NA	NA	NA
	Dec	1	NA	33	NA	NA	NA	NA
pH (standard units)	Jan	2	7.9	7.9	NA	NA	7.3	8.5
	Feb	6	7.1	7.1	7.7	6.5	6.4	8.4
	Mar	5	7.3	7.1	7.8	6.4	6.0	8.0
	Apr	3	7.6	7.5	7.9	7.1	7.1	7.8
	May	4	7.6	7.8	8.5	7.2	7.3	8.8
	Jun	4	7.7	7.7	7.8	7.6	7.6	7.8
	Jul	4	7.8	7.8	8.0	7.5	7.5	8.0
	Aug	6	7.6	7.5	7.8	7.1	6.8	7.9
	Sep	2	7.4	7.4	NA	NA	7.0	7.8
	Oct	4	7.5	7.4	7.7	7.1	7.1	7.7
	Nov	5	7.2	7.4	7.7	7.0	6.8	7.8
	Dec	5	7.4	7.3	7.8	6.8	6.7	8.0
Temperature (^{o}C)	Jan	2	0.8	0.8	NA	NA	0.50	1.0
	Feb	8	2.3	2.5	3.6	1.4	0.20	5.0
	Mar	7	4.0	4.0	4.8	3.1	2.0	5.0
	Apr	7	10.0	9.9	11	8.5	7.5	13
	May	8	15	16	18	14	12	21
	Jun	8	21	20	22	19	18	23
	Jul	9	22	22	24	21	20	25
	Aug	8	21	21	22	19	17	25
	Sep	7	17	17	19	14	12	23
	Oct	7	12	11	12	9.3	8.5	14
	Nov	8	4.0	4.4	5.0	3.7	3.0	6
	Dec	6	2.9	2.9	4.4	1.4	0.40	6.0
Turbidity (NTU)	Jul	1	NA	4.1	NA	NA	NA	NA
	Aug	1	NA	35	NA	NA	NA	NA

Table 3-3
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results By Month Sampled -- 1996-2002

Location/ Constituent	Month	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Above Woods Pond Dam								
Conductance (mS/cm)	Feb	1	NA	0.37	NA	NA	NA	NA
	Mar	1	NA	1.13	NA	NA	NA	NA
	Apr	1	NA	0.33	NA	NA	NA	NA
	May	1	NA	0.19	NA	NA	NA	NA
	Jun	1	NA	0.42	NA	NA	NA	NA
	Jul	1	NA	0.42	NA	NA	NA	NA
	Aug	3	0.48	0.58	0.81	0.35	0.45	0.81
	Sep	2	0.41	0.41	NA	NA	0.37	0.45
	Oct	1	NA	0.32	NA	NA	NA	NA
	Nov	1	NA	0.44	NA	NA	NA	NA
	Dec	1	NA	0.41	NA	NA	NA	NA
Dissolved Oxygen (mg/L)	Feb	1	NA	13	NA	NA	NA	NA
	Apr	1	NA	25	NA	NA	NA	NA
	May	1	NA	8.4	NA	NA	NA	NA
	Jun	1	NA	6.5	NA	NA	NA	NA
	Jul	1	NA	6.8	NA	NA	NA	NA
	Aug	3	7.8	7.4	9.2	5.5	5.6	8.8
	Sep	2	11	11	NA	NA	8.6	12
	Oct	1	NA	10	NA	NA	NA	NA
	Nov	1	NA	13	NA	NA	NA	NA
	Dec	1	NA	24	NA	NA	NA	NA
pH (standard units)	Mar	1	NA	7.8	NA	NA	NA	NA
	Apr	1	NA	8.0	NA	NA	NA	NA
	May	1	NA	7.5	NA	NA	NA	NA
	Jun	1	NA	7.6	NA	NA	NA	NA
	Jul	1	NA	7.9	NA	NA	NA	NA
	Aug	3	7.7	7.6	7.9	7.3	7.3	7.8
	Sep	2	7.3	7.3	NA	NA	6.8	7.7
	Nov	1	NA	7.1	NA	NA	NA	NA
Temperature (°C)	Jan	1	NA	3.0	NA	NA	NA	NA
	Feb	3	2.5	2.6	5.3	< 0	0.40	5.0
	Mar	2	3.7	3.7	NA	NA	3.5	4.0
	Apr	2	9.9	9.9	NA	NA	9.8	10
	May	3	15	15	16	13	13	16
	Jun	3	22	22	23	21	21	23
	Jul	4	22	23	24	21	22	25
	Aug	4	21	21	22	21	21	22
	Sep	4	16	15	17	14	13	17
	Oct	3	11	11	12	11	11	12
	Nov	4	4.0	4.0	4.8	3.2	3.0	5
	Dec	2	2.2	2.2	NA	NA	2.0	2.4
Turbidity (NTU)	Jul	1	NA	5.4	NA	NA	NA	NA
	Aug	1	NA	3.1	NA	NA	NA	NA
	Sep	1	NA	0.70	NA	NA	NA	NA

Table 3-3
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results By Month Sampled -- 1996-2002

Location/ Constituent	Month	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Schweitzer/Lenoxdale Bridge								
Conductance (mS/cm)	Jan	5	0.30	0.28	0.37	0.19	0.16	0.43
	Feb	6	0.27	0.26	0.32	0.20	0.16	0.37
	Mar	5	0.35	0.45	0.81	0.09	0.18	1.2
	Apr	3	0.28	0.28	0.36	0.20	0.21	0.34
	May	4	0.19	0.23	0.32	0.13	0.16	0.37
	Jun	4	0.26	0.29	0.39	0.20	0.21	0.43
	Jul	4	0.31	0.30	0.40	0.21	0.18	0.41
	Aug	6	0.46	0.43	0.51	0.35	0.25	0.55
	Sep	3	0.38	0.35	0.42	0.27	0.27	0.39
	Oct	4	0.23	0.19	0.31	0.07	0.022	0.29
	Nov	5	0.24	0.27	0.33	0.21	0.22	0.38
	Dec	5	0.27	0.29	0.35	0.22	0.22	0.41
Dissolved Oxygen (mg/L)	Jan	1	NA	46	NA	NA	NA	NA
	Feb	1	NA	14	NA	NA	NA	NA
	Apr	1	NA	26	NA	NA	NA	NA
	May	1	NA	9.5	NA	NA	NA	NA
	Jun	1	NA	8.3	NA	NA	NA	NA
	Jul	1	NA	8.2	NA	NA	NA	NA
	Aug	3	8.5	9.3	13	6.0	6.9	13
	Sep	1	NA	9.7	NA	NA	NA	NA
	Oct	1	NA	10	NA	NA	NA	NA
	Nov	1	NA	12	NA	NA	NA	NA
	Dec	1	NA	13	NA	NA	NA	NA
pH (standard units)	Jan	5	7.2	7.4	8.0	6.8	6.8	8.6
	Feb	6	7.7	7.5	8.2	6.8	6.3	8.6
	Mar	5	7.1	7.1	7.8	6.5	6.3	8.1
	Apr	3	7.8	7.6	8.1	7.1	7.1	7.9
	May	4	7.8	7.9	8.5	7.2	7.2	8.7
	Jun	4	7.9	7.9	8.1	7.7	7.7	8.1
	Jul	4	7.9	7.9	8.1	7.6	7.6	8.1
	Aug	6	7.7	7.6	8.0	7.3	7.1	8.2
	Sep	3	7.6	7.7	8.1	7.2	7.3	8.1
	Oct	4	7.7	7.6	8.0	7.2	7.0	7.9
	Nov	5	7.2	7.1	8.2	6.1	5.5	8.2
	Dec	5	7.8	7.4	8.2	6.5	6.2	8.3
Temperature (°C)	Jan	6	0.9	1.4	2.4	0.33	0.20	3.0
	Feb	8	1.8	2.2	3.4	1.0	0.33	5.0
	Mar	7	4.0	3.8	4.4	3.1	2.0	5.0
	Apr	7	9.5	10.0	11	8.6	7.8	13
	May	8	15	16	18	14	13	22
	Jun	8	21	20	22	19	17	22
	Jul	9	22	23	24	21	20	25
	Aug	8	21	21	22	20	18	24
	Sep	8	16	16	18	14	12	22
	Oct	7	11	11	13	9.2	8.0	15
	Nov	7	4.0	4.5	5.2	3.7	3.0	6
	Dec	6	2.0	2.2	3.4	0.9	0.70	5.0
Turbidity (NTU)	Jun	1	NA	2.4	NA	NA	NA	NA
	Jul	1	NA	5.1	NA	NA	NA	NA
	Aug	1	NA	2.2	NA	NA	NA	NA
	Sep	1	NA	2.8	NA	NA	NA	NA

Table 3-3
Summary of Monthly Water Column Monitoring in Housatonic River
Field Measurement Results By Month Sampled -- 1996-2002

Location/ Constituent	Month	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Division Street Bridge								
Conductance (mS/cm)	Jan	3	0.22	0.22	0.30	0.13	0.14	0.29
	Feb	5	0.22	0.23	0.27	0.18	0.15	0.28
	Mar	4	0.28	0.28	0.39	0.16	0.17	0.37
	Apr	2	0.26	0.26	NA	NA	0.22	0.30
	May	3	0.19	0.23	0.35	0.10	0.14	0.35
	Jun	3	0.24	0.24	0.30	0.19	0.20	0.29
	Jul	3	0.30	0.26	0.37	0.15	0.15	0.32
	Aug	3	0.41	0.40	0.58	0.23	0.25	0.55
	Sep	1	NA	0.29	NA	NA	NA	NA
	Oct	3	0.25	0.24	0.30	0.18	0.19	0.29
	Nov	4	0.26	0.26	0.30	0.22	0.22	0.30
	Dec	4	0.27	0.26	0.29	0.23	0.22	0.29
pH (standard units)	Jan	3	7.6	7.5	7.8	7.2	7.3	7.7
	Feb	5	8.5	7.7	8.8	6.6	6.3	8.7
	Mar	4	7.3	7.5	8.5	6.5	6.6	8.9
	Apr	2	7.3	7.3	NA	NA	7.0	7.6
	May	3	8.2	7.9	8.7	7.1	7.1	8.3
	Jun	3	7.6	7.5	7.9	7.2	7.2	7.8
	Jul	3	7.9	7.8	8.1	7.4	7.4	8.0
	Aug	3	7.8	7.9	8.4	7.5	7.6	8.4
	Sep	1	NA	8.3	NA	NA	NA	NA
	Oct	3	7.5	7.6	8.1	7.2	7.3	8.1
	Nov	4	7.4	7.5	8.1	6.9	6.9	8.3
	Dec	4	8.0	7.6	8.9	6.3	5.7	8.6
Temperature (°C)	Jan	4	1.4	1.2	2.1	0.31	0.20	2.0
	Feb	7	2.5	2.5	3.7	1.3	1.0	5.0
	Mar	6	4.0	3.8	4.6	3.0	2.0	5.0
	Apr	6	9.8	9.9	11	8.4	7.7	13
	May	7	15	16	18	14	12	20
	Jun	7	21	20	22	19	17	22
	Jul	8	23	23	24	21	19	25
	Aug	5	21	21	23	19	18	24
	Sep	6	17	17	20	14	13	22
	Oct	6	11	11	13	9.3	8.0	14
	Nov	7	4.0	4.6	5.6	3.5	3.0	7
	Dec	5	2.0	2.8	4.5	1.0	0.80	6.0

Notes:

1. Includes all monthly and bi-weekly monitoring data collected by GE (1996-2002) and EPA (1998-1999) as reported in the GE and EPA databases, respectively. Does not include data from specific stormwater sampling events or other specialized surface water sampling.
2. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).

Table 3-4
Summary of R2 Temperature Probe Water Column Monitoring in Housatonic River (°C) -- 2000-2001

Location	Month	Sample Number	Median	Arithmetic Mean	Standard Deviation	Minimum	Maximum
East Branch	Mar	182	1.7	1.7	0.9	0.1	3.7
	Apr	1200	4.4	5.2	3.0	0.9	12.6
	May	2447	14.7	16.2	4.4	9.3	33.6
	Jun	2399	18.1	17.7	3.0	10.6	24.2
	Jul	2480	18.9	19.2	1.7	15.5	24.9
	Aug	2446	20.0	19.9	2.1	14.0	25.4
	Sep	2254	16.9	16.7	2.3	10.7	22.5
	Oct	430	12.1	12.1	2.2	7.8	16.3
West Branch	Mar	182	2.3	2.3	1.2	0.2	4.5
	Apr	1200	5.7	6.7	3.7	0.4	14.9
	May	1781	14.7	15.0	1.9	11.5	20.8
	Jun	2399	19.2	18.9	2.9	11.6	24.9
	Jul	2480	20.0	20.2	1.8	16.4	26.8
	Aug	2440	20.7	20.8	2.0	15.5	27.9
	Sep	2255	17.8	17.6	2.6	10.7	24.1
	Oct	429	12.1	12.2	2.7	6.7	17.4
Morewood Brook	May	578	15.7	16.2	1.8	13.5	22.2
	Jun	1200	18.7	18.5	2.1	11.8	23.0
	Jul	1240	20.7	20.7	1.0	17.4	24.4
	Aug	1238	20.2	20.6	1.9	16.3	25.9
	Sep	1091	18.6	18.7	2.0	14.4	23.0
Holmes Road	Mar	184	2.0	1.9	1.0	0.1	3.9
	Apr	1200	4.9	5.8	3.2	0.8	13.7
	May	1728	14.3	14.7	1.8	11.5	20.2
	Jun	2400	18.7	18.2	2.8	11.2	23.9
	Jul	2480	19.5	19.6	1.7	13.7	25.6
	Aug	2476	20.2	20.4	1.9	14.9	26.3
	Sep	2289	17.1	17.0	2.4	11.7	23.2
	Oct	428	12.3	12.1	2.2	8.1	15.7
Sackett Brook	May	503	11.0	11.3	1.6	8.6	15.6
	Jun	1200	14.6	14.5	2.3	9.5	19.7
	Jul	1240	16.0	16.1	1.4	12.0	19.4
	Aug	1159	16.2	16.3	1.7	11.5	20.4
	Sep	1052	15.1	15.0	2.4	9.0	20.2
Upstream of New Lenox-Main Channel	May	1214	14.4	14.7	1.7	9.6	18.7
	Jun	1054	18.7	18.2	2.9	12.0	23.0
Upstream of New Lenox-Backwater	May	2001	15.2	15.5	2.0	12.1	22.8
	Jun	2358	17.9	18.1	2.8	11.0	24.4
	Jul	2480	19.4	19.8	1.7	17.1	27.3
	Aug	2438	19.6	20.0	2.5	15.6	26.6
	Sep	2223	16.7	16.7	1.8	12.6	23.2
	Oct	337	13.6	13.0	1.9	6.2	15.5
New Lenox Road	Mar	147	2.3	2.3	0.9	0.7	3.9
	Apr	1200	5.1	6.1	3.0	1.0	12.7
	May	1233	14.4	14.7	1.5	12.0	18.4
	Jun	1199	18.9	18.2	2.7	12.3	22.3
	Jul	1240	19.6	19.7	1.6	16.5	24.2
	Aug	1240	20.7	21.0	1.4	18.7	24.7
	Sep	1200	17.4	17.1	1.8	12.6	21.7
	Oct	339	13.7	13.5	1.8	9.0	16.2

Table 3-4
Summary of R2 Temperature Probe Water Column Monitoring in Housatonic River (^{o}C) -- 2000-2001

Location	Month	Sample Number	Median	Arithmetic Mean	Standard Deviation	Minimum	Maximum
Upstream of Mill Brook	May	1159	14.7	14.9	1.6	12.4	18.5
	Jun	1160	19.3	18.5	2.9	12.7	22.9
	Jul	1240	19.6	19.9	1.6	16.9	24.8
	Aug	1240	21.1	21.5	1.4	19.2	25.5
	Sep	1200	17.5	17.4	1.9	13.0	21.8
	Oct	375	13.7	13.4	1.8	9.7	16.0
Lower Mill Brook	May	626	12.3	12.3	0.9	10.4	14.7
	Jun	1200	15.0	15.0	1.8	10.9	19.2
	Jul	1240	15.5	15.8	1.8	12.1	21.5
	Aug	1196	17.1	16.9	1.9	11.8	20.5
	Sep	1050	15.5	15.6	2.4	9.3	21.3
Upper Mill Brook	May	629	12.4	12.4	0.9	10.5	14.8
	Jun	1200	15.1	15.1	1.9	11.0	19.6
	Jul	1240	15.6	16.0	2.0	11.9	22.1
	Aug	1195	17.2	17.0	2.0	11.9	20.4
	Sep	1051	15.6	15.6	2.4	9.4	21.4
Downstream of Mill Brook	May	1176	14.5	14.8	1.7	10.3	18.7
	Jun	1159	19.3	18.5	3.0	12.5	23.1
	Jul	1240	19.8	20.0	1.6	16.9	25.1
	Aug	1240	21.2	21.5	1.4	19.1	25.5
	Sep	1200	17.5	17.4	1.9	13.0	21.9
	Oct	375	13.7	13.3	2.0	9.3	16.1
Roaring Brook	May	590	9.6	9.6	1.0	7.6	11.5
	Jun	1200	13.0	13.2	1.8	8.8	16.8
	Jul	1240	14.6	14.5	1.1	11.3	17.6
	Aug	1195	15.0	14.8	1.6	10.4	17.9
	Sep	1050	13.3	13.5	2.2	7.8	17.9
Yokun Brook Outlet	May	1137	16.5	17.3	2.9	12.3	24.4
	Jun	1159	20.2	20.2	4.6	13.5	30.9
	Jul	1240	21.5	22.0	3.9	14.8	32.8
	Aug	1240	23.0	23.7	2.8	18.9	32.6
	Sep	1200	17.9	17.9	3.1	10.1	26.1
	Oct	357	13.4	13.3	3.3	6.7	19.2
OM8-Backwater	May	1138	17.5	17.8	3.0	10.6	26.9
	Jun	1162	21.4	20.9	4.5	11.2	30.1
	Jul	1240	22.2	22.8	3.3	16.2	33.4
	Aug	1240	24.1	24.4	2.8	18.4	33.0
	Sep	1200	18.8	18.7	3.2	9.6	26.7
	Oct	423	12.3	12.8	3.1	6.2	19.4
HRDSOM8	May	1166	14.9	15.3	1.8	11.5	20.3
	Jun	1200	19.7	19.0	3.2	12.7	23.7
	Jul	1240	20.3	20.6	1.6	17.7	26.8
	Aug	1240	21.9	22.3	1.4	20.1	26.1
	Sep	1200	18.0	17.9	1.9	13.5	21.6
	Oct	382	14.1	13.8	1.6	10.2	16.4
Felton Brook	May	584	12.1	12.1	1.1	9.9	14.6
	Jun	1200	15.5	15.7	2.3	10.9	21.3
	Jul	1240	16.3	16.5	1.5	12.9	20.2
	Aug	1195	17.3	17.2	1.7	12.4	20.5
	Sep	1092	15.4	15.4	2.8	9.3	22.0
Lower Woods Pond	Mar	149	1.8	1.7	0.5	0.1	2.5
	Apr	1200	5.3	6.3	3.5	1.2	13.6
	May	2012	15.7	15.9	1.9	11.9	22.8
	Jun	2374	19.4	19.3	3.3	12.4	27.3
	Jul	2465	21.5	21.9	2.0	17.8	29.9
	Aug	2470	22.7	22.6	2.9	16.0	31.0
	Sep	2265	18.9	18.8	2.6	11.9	25.4
	Oct	429	13.8	14.0	2.0	10.1	18.2

Note:
1. Includes all data collected by R2 (5/1/2000 - 10/11/2001).

Table 3-5
Summary of R2 Dissolved Oxygen Probe Water Column Monitoring in Housatonic River -- 2001

Location[c]	Month	Sample Number	Median	Arithmetic Mean	Standard Deviation	Minimum	Maximum
Dissolved Oxygen (mg/L)							
OM8-MAINCHANNEL	Jun	781	7.2	7.3	0.7	5.9	9.7
	Jul	1401	7.0	7.0	1.0	3.1	10.2
	Aug	692	4.6	4.9	1.1	2.5	7.8
	Sep	24	7.6	7.7	0.6	7.0	9.1
	Oct	505	6.9	7.1	0.7	6.2	9.0
OM8-MIDDLE	Jun	834	0.0	1.4	2.7	0.0	11.4
	Jul	1397	4.0	3.8	2.7	-0.1	10.1
	Aug	1443	1.0	1.6	1.7	-0.1	7.8
	Sep	1391	3.1	3.2	3.0	-0.2	12.7
	Oct	505	9.3	8.7	2.3	2.2	13.0
OM8-NEARSHORE	Jun	1074	6.0	6.2	3.0	0.0	15.3
	Jul	881	6.5	6.7	3.5	0.6	16.3
	Aug	750	5.5	6.0	4.3	0.1	16.8
	Sep	1391	6.3	6.5	3.7	0.0	13.6
	Oct	505	6.3	6.5	3.7	0.2	13.7
UWP-MAINCHANNEL	Jun	826	6.4	6.3	1.1	0.0	8.4
	Jul	1396	6.9	6.9	1.1	3.1	10.2
	Aug	1443	5.0	5.0	1.6	0.1	8.1
	Sep	1384	6.4	6.0	1.8	0.0	14.9
	Oct	505	7.2	7.4	0.7	5.8	9.6
UWP-MIDDLE	Jun	1013	3.6	5.2	4.8	0.0	17.5
	Jul	1389	0.0	1.5	2.5	-0.2	10.0
	Aug	1443	0.2	1.1	1.9	-0.2	9.1
	Sep	1391	1.8	2.5	2.1	0.1	10.5
	Oct	505	8.8	8.5	1.9	4.2	17.8
UWP-NEARSHORE	Jun	1076	2.7	3.6	3.4	0.0	12.7
	Jul	1433	4.6	4.6	2.9	0.0	11.2
	Aug	1444	0.9	1.7	2.1	-0.1	8.5
	Sep	1390	2.3	2.4	1.9	-0.1	8.6
	Oct	505	7.0	6.6	1.8	1.6	9.5
UWP2-MAINCHANNEL	Jun	1059	7.2	7.3	0.5	5.8	10.9
	Jul	1108	7.4	7.4	0.6	5.6	8.9
	Aug	1444	5.5	5.0	2.4	-0.1	9.2
	Sep	1390	6.0	4.8	2.6	-0.1	9.5
	Oct	504	6.8	6.9	0.6	5.9	8.4
UWP2-MIDDLE	Jun	781	6.7	6.9	2.7	1.8	15.1
	Jul	1433	3.3	3.5	2.7	-0.1	13.8
	Aug	1444	-0.1	0.0	0.6	-0.2	6.6
	Sep	1390	-0.2	0.4	1.3	-0.2	8.9
	Oct	505	-0.3	-0.2	0.7	-0.3	6.3
UWP2-NEARSHORE	Jun	1009	7.2	7.7	2.7	3.3	18.4
	Jul	1391	3.3	3.5	2.5	-0.2	10.5
	Aug	1444	0.5	1.0	1.7	-0.4	11.0
	Sep	1389	2.8	3.0	2.6	-0.4	16.4
	Oct	505	7.7	7.6	2.4	1.8	13.2

Table 3-5
Summary of R2 Dissolved Oxygen Probe Water Column Monitoring in Housatonic River -- 2001

Location[c]	Month	Sample Number	Median	Arithmetic Mean	Standard Deviation	Minimum	Maximum
Temperature (°C)							
OM8-MAINCHANNEL	Jun	781	21.7	21.3	1.5	17.6	23.8
	Jul	1401	20.4	20.6	1.8	13.0	26.1
	Aug	692	22.7	23.1	1.5	20.5	25.8
	Sep	24	14.2	14.1	0.2	13.9	14.3
	Oct	505	13.8	13.6	1.9	9.9	16.5
OM8-MIDDLE	Jun	834	23.4	23.2	1.8	18.7	27.0
	Jul	1397	21.9	21.9	2.1	13.2	27.5
	Aug	1443	23.8	24.1	1.7	20.2	28.4
	Sep	1391	19.5	19.6	2.2	13.7	25.0
	Oct	505	13.5	13.2	2.7	7.5	17.4
OM8-NEARSHORE	Jun	1074	23.0	22.7	3.1	14.5	29.2
	Jul	881	21.0	21.0	2.7	13.9	28.7
	Aug	750	23.9	24.1	2.3	19.3	30.1
	Sep	1391	19.7	19.7	2.9	13.1	27.0
	Oct	505	13.4	13.7	3.3	7.1	20.4
UWP-MAINCHANNEL	Jun	826	21.8	21.6	1.6	17.5	26.1
	Jul	1396	20.5	21.1	2.1	13.7	26.7
	Aug	1443	22.8	23.1	1.5	20.2	27.8
	Sep	1384	18.6	18.7	2.1	13.9	22.6
	Oct	505	14.0	14.0	1.9	9.8	17.8
UWP-MIDDLE	Jun	1013	22.2	21.8	2.0	15.7	26.0
	Jul	1389	20.1	20.3	1.6	13.4	25.4
	Aug	1443	22.6	22.9	1.9	19.6	31.0
	Sep	1391	18.7	18.6	2.2	13.6	23.6
	Oct	505	14.0	14.4	3.1	8.4	20.5
UWP-NEARSHORE	Jun	1076	21.4	21.3	2.2	15.6	28.6
	Jul	1433	21.6	21.5	2.5	13.1	29.3
	Aug	1444	23.7	24.2	2.3	19.5	30.3
	Sep	1390	19.3	19.2	2.4	13.7	24.8
	Oct	505	13.7	14.2	3.2	7.5	20.8
UWP2-MAINCHANNEL	Jun	1059	20.8	20.5	2.2	15.6	23.7
	Jul	1108	20.8	21.0	1.7	18.1	25.6
	Aug	1444	22.2	22.6	1.5	20.2	26.4
	Sep	1390	18.3	18.1	1.9	13.9	22.0
	Oct	504	13.9	13.7	1.8	10.5	16.8
UWP2-MIDDLE	Jun	781	22.9	22.1	2.8	15.3	26.1
	Jul	1433	21.0	21.2	1.9	13.1	25.3
	Aug	1444	21.9	21.9	1.2	19.7	24.6
	Sep	1390	18.6	18.3	1.6	14.0	21.6
	Oct	505	14.3	14.3	2.1	10.5	18.2
UWP2-NEARSHORE	Jun	1009	22.8	22.4	2.8	15.1	27.4
	Jul	1391	21.1	21.4	2.0	12.8	28.7
	Aug	1444	22.8	23.0	1.5	19.8	26.7
	Sep	1389	19.3	19.2	2.1	13.6	24.4
	Oct	505	13.4	13.9	3.1	7.5	19.9

Table 3-5
Summary of R2 Dissolved Oxygen Probe Water Column Monitoring in Housatonic River -- 2001

Location[2]	Month	Sample Number	Median	Arithmetic Mean	Standard Deviation	Minimum	Maximum
			pH				
OM8-MAINCHANNEL	Jun	781	7.7	7.8	0.1	7.5	8.5
	Jul	1401	7.8	7.8	0.2	6.2	8.9
	Aug	692	7.7	7.7	0.1	7.5	8.0
	Sep	24	7.6	7.6	0.0	7.5	7.6
	Oct	505	7.6	7.6	0.1	7.4	7.9
OM8-MIDDLE	Jun	834	7.3	7.4	0.2	7.0	8.4
	Jul	1397	7.5	7.6	0.3	5.4	8.6
	Aug	1443	7.5	7.5	0.3	7.1	8.8
	Sep	1391	7.9	7.9	0.3	7.3	8.9
	Oct	505	7.9	7.9	0.3	7.2	8.6
OM8-NEARSHORE	Jun	1074	7.5	7.6	0.4	7.1	9.3
	Jul	881	7.5	7.6	0.5	5.9	9.4
	Aug	750	8.4	8.4	0.6	7.4	9.9
	Sep	1391	8.2	8.3	0.6	7.2	9.7
	Oct	505	7.7	7.7	0.4	7.1	8.7
UWP-MAINCHANNEL	Jun	826	7.6	7.6	0.1	7.0	8.2
	Jul	1105	7.6	7.7	0.2	6.5	8.9
	Aug	1443	7.7	7.8	0.2	7.2	8.3
	Sep	1384	7.5	7.5	0.2	7.1	8.3
	Oct	505	7.5	7.5	0.2	7.1	8.4
UWP-MIDDLE	Jun	1013	7.2	7.4	0.5	7.0	9.2
	Jul	1389	7.1	7.2	0.2	5.7	8.5
	Aug	1443	7.3	7.4	0.4	6.9	9.2
	Sep	1391	7.4	7.5	0.4	7.0	8.8
	Oct	505	7.9	8.0	0.3	7.3	8.9
UWP-NEARSHORE	Jun	1076	7.1	7.2	0.4	6.9	10.0
	Jul	1433	7.4	7.5	0.4	6.8	8.8
	Aug	1444	7.3	7.3	0.3	6.7	8.5
	Sep	1390	7.4	7.5	0.2	7.2	8.5
	Oct	505	7.8	7.8	0.3	7.3	8.5
UWP2-MAINCHANNEL	Jun	1059	7.7	7.8	0.1	7.4	8.0
	Jul	1108	7.8	7.8	0.1	7.0	8.3
	Aug	1444	7.7	7.7	0.2	7.2	8.2
	Sep	1390	7.5	7.5	0.1	7.2	8.3
	Oct	504	7.7	7.7	0.1	7.5	7.9
UWP2-MIDDLE	Jun	781	7.8	8.0	0.5	7.2	9.2
	Jul	1433	7.6	7.7	0.4	6.5	9.2
	Aug	1444	7.2	7.2	0.2	6.9	8.5
	Sep	1390	7.2	7.2	0.1	7.0	7.9
	Oct	505	7.2	7.2	0.1	7.1	7.5
UWP2-NEARSHORE	Jun	1009	7.8	8.0	0.5	7.1	9.5
	Jul	1391	7.5	7.6	0.4	6.8	9.0
	Aug	1444	7.3	7.3	0.2	6.9	8.0
	Sep	1389	7.3	7.4	0.2	6.8	8.8
	Oct	505	7.7	7.8	0.4	7.2	8.9

Notes:

1. Includes all data collected by R2 (6/6/2001 - 10/11/2001).

2. Refer to Figure 3-2 for locations.

Table 3-6
Summary of Monthly Water Column Monitoring in Housatonic River
Inorganic Constituent Analysis -- 1996-2002

Constituent/ Location	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Alkalinity (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	100	136	125	150	101	25	186
Holmes Road Bridge	15	100	118	118	137	99	39.5	170
Adjacent to Joseph Drive	15	100	120	119	136	101	41	170
Pittsfield WWTP	14	100	105	101	112	89	44	124
New Lenox Road Bridge	15	100	112	108	121	96	55	138
Woods Pond Headwaters	14	100	113	110	122	98	61	140
Above Woods Pond Dam	13	100	104	107	119	96	63	134
Schweitzer/Lenoxdale Bridge	14	100	102	106	119	94	64	161
Ammonia as N (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	100	0.25	0.44	0.66	0.21	0.060	1.6
Holmes Road Bridge	15	100	0.17	0.24	0.33	0.14	0.040	0.78
Adjacent to Joseph Drive	15	100	0.11	0.21	0.30	0.11	0.060	0.75
Pittsfield WWTP	14	100	0.14	0.37	0.78	< 0	0.070	3.0
New Lenox Road Bridge	15	100	0.11	0.16	0.21	0.10	0.050	0.37
Woods Pond Headwaters	14	100	0.12	0.27	0.53	0.015	0.060	1.9
Above Woods Pond Dam	13	92	0.10	0.13	0.18	0.088	ND	0.32
Schweitzer/Lenoxdale Bridge	14	93	0.11	0.13	0.17	0.092	ND	0.30
5-Day Biological Oxygen Demand (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	47	1.5	1.7	2.2	1.3	ND	3.0
Holmes Road Bridge	16	38	1.0	1.6	2.0	1.1	ND	3.5
Adjacent to Joseph Drive	16	38	1.0	1.6	1.9	1.2	ND	2.9
Pittsfield WWTP	15	53	2.1	1.9	2.3	1.4	ND	3.8
New Lenox Road Bridge	16	31	1.0	1.6	2.0	1.2	ND	3.7
Woods Pond Headwaters	15	27	1.0	1.4	1.8	1.1	ND	3.0
Above Woods Pond Dam	14	43	1.3	1.8	2.3	1.3	ND	3.8
Schweitzer/Lenoxdale Bridge	15	47	1.5	2.0	2.7	1.4	ND	4.1

Table 3-6
Summary of Monthly Water Column Monitoring in Housatonic River
Inorganic Constituent Analysis -- 1996-2002

Constituent/ Location	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Cyanide (µg/L)								
Dawes/Pomeroy Avenue Bridge	14	0	NA	ND	NA	NA	ND	NA
Holmes Road Bridge	15	0	NA	ND	NA	NA	ND	NA
Adjacent to Joseph Drive	15	0	NA	ND	NA	NA	ND	NA
Pittsfield WWTP	13	0	NA	ND	NA	NA	ND	NA
New Lenox Road Bridge	15	0	NA	ND	NA	NA	ND	NA
Woods Pond Headwaters	14	0	NA	ND	NA	NA	ND	NA
Above Woods Pond Dam	12	0	NA	ND	NA	NA	ND	NA
Schweitzer/Lenoxdale Bridge	13	0	NA	ND	NA	NA	ND	NA
Hardness (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	100	150	133	158	109	34	186
Holmes Road Bridge	15	100	130	129	148	110	51	176
Adjacent to Joseph Drive	15	100	132	130	149	112	50	182
Pittsfield WWTP	14	100	129	125	140	109	56	166
New Lenox Road Bridge	15	100	132	128	143	114	66	162
Woods Pond Headwaters	14	100	132	127	141	113	71	156
Above Woods Pond Dam	13	100	126	121	133	110	76	150
Schweitzer/Lenoxdale Bridge	14	100	133	134	151	117	94	226
Hardness, Dissolved (mg/L)								
Dawes/Pomeroy Avenue Bridge	1	100	NA	70	NA	NA	NA	NA
Holmes Road Bridge	1	100	NA	90	NA	NA	NA	NA
Nitrate and Nitrite as N (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	100	0.53	0.95	1.6	0.31	0.11	5.0
Holmes Road Bridge	15	100	0.43	0.55	0.76	0.34	0.11	1.7
Adjacent to Joseph Drive	15	100	0.58	0.64	0.85	0.42	0.020	1.7
Pittsfield WWTP	14	100	2.0	2.8	3.8	1.7	0.10	6.4
New Lenox Road Bridge	15	93	2.1	2.3	3.0	1.6	ND	5.1
Woods Pond Headwaters	14	93	1.7	1.9	2.5	1.4	ND	3.6
Above Woods Pond Dam	13	100	1.8	2.1	2.9	1.3	0.36	6.3
Schweitzer/Lenoxdale Bridge	14	100	1.8	2.0	2.6	1.4	0.39	4.6

Table 3-6
Summary of Monthly Water Column Monitoring in Housatonic River
Inorganic Constituent Analysis -- 1996-2002

Constituent/ Location	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Nitrite as N (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	73	0.016	0.034	0.063	0.0060	ND	0.22
Holmes Road Bridge	15	60	0.0080	0.019	0.036	0.0025	ND	0.13
Adjacent to Joseph Drive	15	67	0.0090	0.015	0.027	0.0033	ND	0.089
Pittsfield WWTP	14	79	0.0075	0.012	0.020	0.0035	ND	0.064
New Lenox Road Bridge	15	87	0.010	0.016	0.028	0.0041	ND	0.098
Woods Pond Headwaters	14	71	0.015	0.017	0.025	0.0089	ND	0.057
Above Woods Pond Dam	13	85	0.010	0.024	0.038	0.011	ND	0.081
Schweitzer/Lenoxdale Bridge	14	93	0.013	0.023	0.035	0.011	ND	0.082
Orthophosphate as P (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	13	0.0050	0.0063	0.0084	0.0043	ND	0.020
Holmes Road Bridge	15	27	0.0050	0.020	0.036	0.0038	ND	0.090
Adjacent to Joseph Drive	15	20	0.0050	0.0093	0.015	0.0032	ND	0.050
Pittsfield WWTP	14	100	0.15	0.14	0.19	0.088	0.010	0.32
New Lenox Road Bridge	15	100	0.090	0.091	0.11	0.071	0.020	0.15
Woods Pond Headwaters	14	100	0.070	0.077	0.099	0.055	0.010	0.16
Above Woods Pond Dam	13	100	0.060	0.10	0.17	0.040	0.020	0.44
Schweitzer/Lenoxdale Bridge	14	100	0.085	0.10	0.14	0.058	0.030	0.36
Total Phosphate as P (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	93	0.030	0.034	0.047	0.021	ND	0.10
Holmes Road Bridge	15	93	0.020	0.029	0.041	0.017	ND	0.090
Adjacent to Joseph Drive	15	87	0.020	0.052	0.099	0.0054	ND	0.31
Pittsfield WWTP	14	100	0.19	0.18	0.24	0.12	0.020	0.39
New Lenox Road Bridge	15	100	0.12	0.14	0.16	0.11	0.050	0.27
Woods Pond Headwaters	14	100	0.11	0.11	0.13	0.089	0.050	0.20
Above Woods Pond Dam	13	100	0.080	0.11	0.15	0.074	0.040	0.30
Schweitzer/Lenoxdale Bridge	14	100	0.11	0.12	0.14	0.094	0.050	0.21

Table 3-6
Summary of Monthly Water Column Monitoring in Housatonic River
Inorganic Constituent Analysis -- 1996-2002

Constituent/ Location	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Sulfide (mg/L)								
Dawes/Pomeroy Avenue Bridge	13	38	0.40	0.45	0.53	0.37	ND	0.80
Holmes Road Bridge	13	31	0.40	0.44	0.53	0.35	ND	0.80
Adjacent to Joseph Drive	13	23	0.40	0.41	0.49	0.32	ND	0.80
Pittsfield WWTP	12	17	0.40	0.40	0.49	0.31	ND	0.80
New Lenox Road Bridge	13	31	0.40	0.44	0.53	0.35	ND	0.80
Woods Pond Headwaters	12	17	0.40	0.40	0.46	0.33	ND	0.60
Above Woods Pond Dam	11	9	0.40	0.38	0.43	0.32	ND	0.50
Schweitzer/Lenoxdale Bridge	12	8	0.40	0.38	0.44	0.31	ND	0.60
TKN (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	100	0.99	1.0	1.3	0.82	0.37	2.0
Holmes Road Bridge	15	100	0.72	0.68	0.77	0.58	0.24	1.1
Adjacent to Joseph Drive	15	93	0.67	0.64	0.74	0.53	ND	1.0
Pittsfield WWTP	14	100	0.78	0.83	1.0	0.64	0.24	1.9
New Lenox Road Bridge	15	100	0.76	0.87	1.2	0.58	0.39	2.8
Woods Pond Headwaters	14	86	0.69	0.62	0.75	0.49	ND	0.95
Above Woods Pond Dam	13	92	0.77	0.69	0.86	0.53	ND	1.1
Schweitzer/Lenoxdale Bridge	14	100	0.82	0.74	0.84	0.64	0.44	0.96
Total Dissolved Solids (mg/L)								
Dawes/Pomeroy Avenue Bridge	15	100	262	244	287	200	64	390
Holmes Road Bridge	15	100	207	239	292	186	88	813
Adjacent to Joseph Drive	15	100	197	203	235	171	87	305
Pittsfield WWTP	14	100	207	213	245	181	104	300
New Lenox Road Bridge	15	100	212	214	243	185	102	292
Woods Pond Headwaters	14	100	201	208	240	177	125	307
Above Woods Pond Dam	13	100	198	200	226	175	128	267
Schweitzer/Lenoxdale Bridge	14	100	201	206	227	184	145	260

Table 3-6
Summary of Monthly Water Column Monitoring in Housatonic River
Inorganic Constituent Analysis -- 1996-2002

Constituent/ Location	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Total Suspended Solids (mg/L)								
Dawes/Pomeroy Avenue Bridge	94	98	3.5	7.0	9.3	4.7	ND	74
Holmes Road Bridge	94	98	3.7	8.3	11	5.4	ND	82
Adjacent to Joseph Drive	36	100	4.2	11	18	3.2	1.0	127
Pittsfield WWTP	17	100	4.4	16	35	< 0	1.3	169
New Lenox Road Bridge	94	99	4.0	7.1	9.9	4.4	ND	111
Woods Pond Headwaters	89	100	3.8	5.1	6.1	4.1	1.0	26
Above Woods Pond Dam	34	100	4.0	4.1	4.8	3.4	1.3	13
Schweitzer/Lenoxdale Bridge	93	96	2.9	3.6	4.2	3.0	ND	22
Division Street Bridge	78	96	3.9	4.7	5.5	3.9	ND	24

Notes:
1. Includes all monthly and bi-weekly monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include data from specific stormwater events or other specialized surface water sampling events.
2. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
3. Duplicate samples were averaged.
4. ND = Not Detected.
5. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).

Table 3-7
Summary of Monthly Water Column Monitoring in Housatonic River
Organic Constituent Analysis -- 1996-2002

Constituent/ Location	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Chlorophyll *a* (μg/L)								
Dawes/Pomeroy Avenue Bridge	82	100	1.2	1.7	2.1	1.3	0.30	15
Holmes Road Bridge	82	100	1.6	2.0	2.4	1.6	0.40	13
Adjacent to Joseph Drive	27	100	1.8	1.9	2.2	1.5	0.70	3.9
Pittsfield WWTP	14	100	1.4	1.7	2.1	1.2	0.70	3.8
New Lenox Road Bridge	82	100	1.6	1.7	1.9	1.5	0.50	4.1
Woods Pond Headwaters	78	100	1.5	2.0	2.4	1.7	0.50	9.7
Above Woods Pond Dam	26	100	4.6	6.6	9.4	3.9	0.60	29
Schweitzer/Lenoxdale Bridge	82	100	2.3	4.1	5.2	3.1	0.50	20
Division Street Bridge	66	100	2.4	5.6	8.2	3.1	0.60	66
Particulate Organic Carbon (mg/L)								
Dawes/Pomeroy Avenue Bridge	70	93	0.28	0.59	0.87	0.32	ND	7.7
Holmes Road Bridge	70	96	0.27	0.62	0.90	0.34	ND	6.5
Adjacent to Joseph Drive	12	92	0.34	0.67	1.3	0.036	ND	4.1
New Lenox Road Bridge	70	94	0.29	0.48	0.66	0.31	ND	4.4
Woods Pond Headwaters	67	94	0.28	0.41	0.53	0.28	ND	3.8
Above Woods Pond Dam	12	75	0.38	0.41	0.61	0.21	ND	1.3
Schweitzer/Lenoxdale Bridge	70	91	0.24	0.39	0.60	0.19	ND	7.4
Division Street Bridge	69	93	0.28	0.39	0.48	0.30	ND	2.5

Table 3-7
Summary of Monthly Water Column Monitoring in Housatonic River
Organic Constituent Analysis -- 1996-2002

Constituent/ Location	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Total Organic Carbon (mg/L)								
Dawes/Pomeroy Avenue Bridge	8	100	5.6	5.9	7.1	4.8	4.0	9.2
Holmes Road Bridge	8	100	4.7	4.5	5.3	3.7	2.9	6.9
Adjacent to Joseph Drive	8	100	4.8	4.3	5.2	3.5	2.7	6.2
Pittsfield WWTP	8	100	4.8	4.7	5.5	3.9	2.8	6.0
New Lenox Road Bridge	8	100	4.7	4.9	6.0	3.7	3.0	7.4
Woods Pond Headwaters	8	100	4.3	4.4	5.1	3.7	3.4	6.5
Above Woods Pond Dam	8	100	4.4	4.6	5.5	3.8	3.2	6.5
Schweitzer/Lenoxdale Bridge	8	100	4.0	4.2	4.9	3.6	3.1	6.0
Dissolved Organic Carbon (mg/L)								
Dawes/Pomeroy Avenue Bridge	14	100	6.4	7.0	8.2	5.7	4.8	12
Holmes Road Bridge	15	100	5.6	5.8	6.8	4.7	2.9	9.8
Adjacent to Joseph Drive	15	100	4.9	6.0	7.6	4.4	2.7	13
Pittsfield WWTP	14	100	5.1	6.9	9.6	4.2	2.8	22
New Lenox Road Bridge	15	100	4.9	7.4	9.9	4.9	2.7	20
Woods Pond Headwaters	14	100	5.5	5.9	7.5	4.4	2.9	15
Above Woods Pond Dam	14	100	5.8	7.5	10	4.7	3.7	22
Schweitzer/Lenoxdale Bridge	14	100	4.9	6.2	8.0	4.4	3.1	14

Notes:

1. Includes all monthly and bi-weekly monitoring data collected by GE (1996-2002) and EPA (1998-1999), with the exception of the TOC data, which were collected monthly in 1999. Does not include data from specific stormwater sampling events or other specialized surface water sampling events.
2. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
3. Duplicate samples were averaged.
4. ND = Not Detected.

Table 3-8
Summary of TSS Concentration by Year (mg/L) -- 1996-2002

Sampling Location/ Year	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Dawes/Pomeroy Avenue Bridge								
1996	7	100	4.4	6.3	11	2.1	2.3	18
1997	12	100	4.3	8.2	16	0.8	2.4	48
1998	26	100	3.3	5.9	11	1.2	1.3	74
1999	17	100	4.4	12	19	4.3	1.5	47
2000	12	83	2.1	2.7	3.8	1.5	ND	7.9
2001	12	100	3.2	6.1	12	0.5	1.0	36
2002	8	100	4.3	7.2	12	2.4	1.8	21
Holmes Road Bridge								
1996	7	100	5.7	7.1	11	2.9	1.6	19
1997	12	100	4.4	8.9	16	1.7	2.9	47
1998	26	100	2.9	7.9	14	1.4	0.8	82
1999	17	100	3.9	9.0	15	2.9	1.2	49
2000	12	83	2.7	5.4	11	0.2	ND	34
2001	12	100	3.1	7.8	17	< 0	1.5	56
2002	8	100	4.3	13	26	0.1	1.8	51
New Lenox Road Bridge								
1996	7	100	5.5	6.2	8.4	4.0	3.1	11
1997	12	100	6.4	12	21	2.3	3.6	60
1998	26	100	3.8	5.8	9.1	2.5	1.4	46
1999	17	100	3.8	12	25	< 0	1.5	111
2000	12	92	2.9	4.6	6.9	2.2	ND	14
2001	12	100	3.0	3.5	4.9	2.2	1.0	8.0
2002	8	100	3.5	4.1	5.3	2.8	2.8	8.3

Table 3-8
Summary of TSS Concentration by Year (mg/L) -- 1996-2002

Sampling Location/ Year	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Woods Pond Headwaters								
1996	7	100	6.4	7.2	9.1	5.3	4.5	10
1997	11	100	6.0	7.9	12	3.6	2.3	26
1998	26	100	3.9	3.9	4.6	3.2	1.2	8.9
1999	15	100	3.6	6.1	9.4	2.8	1.0	26
2000	12	100	3.1	5.2	9.0	1.4	1.2	25
2001	10	100	3.5	3.5	4.2	2.8	1.7	5.1
2002	8	100	3.1	3.1	3.8	2.5	1.9	4.3
Schweitzer/Lenoxdale Bridge								
1996	7	100	3.8	4.5	6.1	2.9	2.3	8.2
1997	12	100	4.2	4.1	5.2	3.0	1.9	8.0
1998	25	96	3.5	3.5	4.2	2.9	ND	6.6
1999	17	94	2.8	3.6	4.8	2.4	ND	9.5
2000	12	83	2.4	3.3	5.5	1.1	ND	15
2001	12	100	2.1	3.9	7.2	0.6	1.4	22
2002	8	100	2.8	2.5	3.1	1.9	1.2	3.6
Division Street Bridge								
1996	7	100	5.9	7.4	10	4.5	3.8	14
1997	12	100	5.3	5.4	6.9	4.0	2.3	9.7
1998	20	95	4.2	4.5	5.8	3.3	ND	11
1999	7	100	3.1	3.6	5.3	1.8	1.3	8.2
2000	12	100	2.8	5.3	9.1	1.5	1.2	24
2001	12	92	2.3	3.2	4.6	1.8	ND	8.0
2002	8	88	4.0	3.8	5.2	2.3	ND	6.4

Notes:

1. Includes all monthly and bi-weekly monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include data from specific stormwater sampling events or other specialized surface water sampling events.
2. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
3. Duplicate samples were averaged.
4. ND = Not Detected.

Table 3-9
Summary of PCB Data from the Housatonic River (μg/L) -- 1996-2002

Sampling Location	Years Sampled	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Total PCB									
Dawes/Pomeroy Avenue Bridge	1996-2002	94	53	0.027	0.067	0.089	0.045	ND	0.62
Holmes Road Bridge	1996-2002	94	56	0.026	0.077	0.11	0.048	ND	0.95
Adjacent to Joseph Drive	1996-1999	36	89	0.078	0.12	0.17	0.070	ND	0.72
Pittsfield WWTP	1996-1999	17	82	0.054	0.066	0.09	0.040	ND	0.19
New Lenox Road Bridge	1996-2002	94	80	0.075	0.10	0.13	0.077	ND	0.63
Woods Pond Headwaters	1996-2002	89	89	0.084	0.10	0.12	0.079	ND	0.60
Above Woods Pond Dam	1996-1999	34	88	0.073	0.083	0.11	0.058	ND	0.39
Schweitzer/Lenoxdale Bridge	1996-2002	93	74	0.062	0.066	0.079	0.054	ND	0.35
Division Street Bridge	1996-2002	78	36	0.015	0.033	0.040	0.026	ND	0.18
Dissolved PCB									
Dawes/Pomeroy Avenue Bridge	1996-1999	19	11	0.0070	0.0086	0.010	0.0073	ND	0.016
Holmes Road Bridge	1996-1999	20	15	0.0070	0.023	0.043	0.0033	ND	0.17
Adjacent to Joseph Drive	1996-1999	20	10	0.0070	0.031	0.062	< 0	ND	0.26
Pittsfield WWTP	1996-1999	15	13	0.0070	0.023	0.052	< 0	ND	0.23
New Lenox Road Bridge	1996-1999	20	20	0.0070	0.038	0.073	0.0030	ND	0.32
Woods Pond Headwaters	1996-1999	19	16	0.0070	0.019	0.033	0.0048	ND	0.13
Above Woods Pond Dam	1996-1999	18	17	0.0070	0.019	0.033	0.0036	ND	0.13
Schweitzer/Lenoxdale Bridge	1996-1999	19	16	0.0070	0.010	0.013	0.0073	ND	0.028
Division Street Bridge	1996	5	40	0.011	0.018	0.027	0.0093	ND	0.031

Notes:

1. Includes all monthly and bi-weekly monitoring data collected by GE (1996-2002) and EPA (1998-1999).
   Does not include data from specific stormwater sampling events or other specialized surface water sampling events.
2. Sample BBLID 1543 (Total PCB at Division Street Bridge) excluded due to an anomalously high detection of 21μg/L.
3. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
4. Duplicate samples were averaged.
5. ND = Not Detected.

Table 3-10
Summary of PCB Concentration by Year (μg/L) -- 1996-2002

Sampling Location/ Year	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Total PCB Concentration								
Dawes/Pomeroy Avenue Bridge								
1996	7	57	0.024	0.030	0.046	0.015	ND	0.057
1997	12	50	0.018	0.067	0.13	0.0076	ND	0.35
1998	26	54	0.063	0.047	0.056	0.038	ND	0.14
1999	17	65	0.018	0.089	0.15	0.022	ND	0.55
2000	12	33	0.013	0.026	0.040	0.013	ND	0.077
2001	12	42	0.013	0.099	0.21	< 0	ND	0.62
2002	8	75	0.11	0.13	0.22	0.041	ND	0.40
Holmes Road Bridge								
1996	7	86	0.094	0.11	0.19	0.035	ND	0.28
1997	12	75	0.043	0.13	0.28	< 0	ND	0.95
1998	26	58	0.045	0.072	0.12	0.024	ND	0.61
1999	17	71	0.031	0.061	0.090	0.031	ND	0.20
2000	12	25	0.013	0.040	0.087	< 0	ND	0.30
2001	12	42	0.013	0.067	0.16	< 0	ND	0.60
2002	8	38	0.013	0.089	0.20	< 0	ND	0.49
Adjacent to Joseph Drive								
1996	7	86	0.065	0.079	0.13	0.030	ND	0.39
1997	12	100	0.091	0.19	0.31	0.068	0.027	0.72
1998	8	88	0.043	0.047	0.068	0.025	ND	0.096
1999	9	78	0.091	0.13	0.23	0.025	ND	0.50

Table 3-10
Summary of PCB Concentration by Year (μg/L) -- 1996-2002

Sampling Location/ Year	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Pittsfield WWTP								
1996	3	67	0.049	0.044	0.080	0.0082	ND	0.073
1998	5	80	0.034	0.036	0.053	0.018	ND	0.057
1999	9	89	0.098	0.089	0.13	0.048	ND	0.19
New Lenox Road Bridge								
1996	7	100	0.17	0.28	0.46	0.098	0.025	0.63
1997	12	83	0.079	0.11	0.18	0.049	ND	0.42
1998	26	85	0.066	0.079	0.10	0.057	ND	0.28
1999	17	88	0.089	0.12	0.19	0.055	ND	0.63
2000	12	50	0.019	0.055	0.089	0.021	ND	0.18
2001	12	75	0.043	0.063	0.097	0.029	ND	0.20
2002	8	75	0.083	0.079	0.12	0.038	ND	0.18
Woods Pond Headwaters								
1996	7	100	0.13	0.26	0.44	0.084	0.051	0.60
1997	11	100	0.094	0.10	0.13	0.078	0.025	0.15
1998	26	92	0.093	0.094	0.12	0.073	ND	0.29
1999	15	80	0.068	0.10	0.16	0.040	ND	0.48
2000	12	83	0.050	0.069	0.098	0.039	ND	0.17
2001	10	80	0.082	0.074	0.098	0.050	ND	0.12
2002	8	88	0.054	0.057	0.082	0.032	ND	0.12

Table 3-10
Summary of PCB Concentration by Year (μg/L) -- 1996-2002

Sampling Location/ Year	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Above Woods Pond Dam								
1996	7	100	0.16	0.16	0.25	0.073	0.036	0.39
1997	12	92	0.063	0.064	0.084	0.043	ND	0.14
1998	7	71	0.054	0.052	0.080	0.024	ND	0.11
1999	8	88	0.079	0.071	0.10	0.039	ND	0.14
Schweitzer/Lenoxdale Bridge								
1996	7	100	0.071	0.081	0.12	0.047	0.030	0.15
1997	12	75	0.059	0.049	0.066	0.031	ND	0.088
1998	25	88	0.081	0.091	0.12	0.066	ND	0.35
1999	17	59	0.018	0.069	0.11	0.030	ND	0.25
2000	12	67	0.044	0.053	0.077	0.029	ND	0.14
2001	12	67	0.031	0.055	0.085	0.024	ND	0.19
2002	8	63	0.029	0.035	0.057	0.012	ND	0.11
Division Street Bridge								
1996	7	86	0.048	0.064	0.11	0.022	ND	0.18
1997	12	42	0.011	0.019	0.026	0.013	ND	0.045
1998	20	50	0.063	0.057	0.067	0.047	ND	0.10
1999	7	29	0.013	0.029	0.055	0.0033	ND	0.11
2000	12	25	0.013	0.022	0.032	0.012	ND	0.063
2001	12	8	0.013	0.015	0.019	0.010	ND	0.037
2002	8	13	0.013	0.014	0.017	0.011	ND	0.025

Table 3-10
Summary of PCB Concentration by Year (µg/L) -- 1996-2002

Sampling Location/ Year	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Dissolved PCB Concentration								
Dawes/Pomeroy Avenue Bridge								
1996	5	0	NA	ND	NA	NA	ND	NA
1998	5	40	0.0070	0.0097	0.014	0.0057	ND	0.016
1999	9	0	NA	ND	NA	NA	ND	NA
Holmes Road Bridge								
1996	5	60	0.028	0.071	0.14	0.0037	ND	0.17
1998	6	0	NA	ND	NA	NA	ND	NA
1999	9	0	NA	ND	NA	NA	ND	NA
Adjacent to Joseph Drive								
1996	5	0	NA	ND	NA	NA	ND	NA
1998	6	33	0.0070	0.083	0.18	< 0	ND	0.26
1999	9	0	NA	ND	NA	NA	ND	NA
Pittsfield WWTP								
1996	1	0	NA	ND	NA	NA	NA	NA
1998	5	20	0.0070	0.0085	0.012	0.0052	ND	0.015
1999	9	11	0.0070	0.032	0.081	< 0	ND	0.23
New Lenox Road Bridge								
1996	5	60	0.055	0.068	0.13	0.0082	ND	0.17
1998	6	17	0.0065	0.059	0.16	< 0	ND	0.32
1999	9	0	NA	ND	NA	NA	ND	NA

Table 3-10
Summary of PCB Concentration by Year ($\mu g/L$) -- 1996-2002

Sampling Location/ Year	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Woods Pond Headwaters								
1996	5	60	0.050	0.053	0.095	0.0099	ND	0.13
1998	6	0	NA	ND	NA	NA	ND	NA
1999	8	0	NA	ND	NA	NA	ND	NA
Above Woods Pond Dam								
1996	5	60	0.029	0.049	0.095	0.0029	ND	0.13
1998	6	0	NA	ND	NA	NA	ND	NA
1999	7	0	NA	ND	NA	NA	ND	NA
Schweitzer/Lenoxdale Bridge								
1996	5	40	0.011	0.017	0.024	0.0095	ND	0.028
1998	5	20	0.0070	0.0089	0.013	0.0048	ND	0.017
1999	9	0	NA	ND	NA	NA	ND	NA
Division Street Bridge								
1996	5	40	0.011	0.018	0.027	0.0093	ND	0.031

Notes:

1. Includes all monthly and bi-weekly monitoring data collected by GE (1996-2002) and EPA (1998-1999).
   Does not include data from specific stormwater sampling events or other specialized surface water sampling events.
2. Sample BBLID 1543 (Total PCB at Division Street Bridge) excluded due to an anomalously high detection of 21 ng/L.
3. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
4. Duplicate samples were averaged.
5. ND = Not Detected.
6. NA = Analysis not conducted due to sample size ($n<3$) and/or frequency of detection (0%).
7. Data results from sampling collected prior to 1989 and LMS sampling in 1991-1993 are not included due to inconsistent sampling methods.

Table 3-11
Summary of Surface Water Total PCB Data (µg/L) -- 1989-1991 and 1996-2002

Sampling Location	Year	Sample Number	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Dawes/Pomeroy Avenue Bridge	1989-1991	17	35	0.033	0.064	0.11	0.022	ND	0.39
	1996-2002	94	53	0.027	0.067	0.089	0.045	ND	0.62
New Lenox Road Bridge	1989-1991	19	89	0.12	0.20	0.31	0.084	ND	1.1
	1996-2002	94	80	0.075	0.10	0.13	0.077	ND	0.63
Woods Pond Headwaters	1989-1991	17	94	0.14	0.16	0.20	0.12	ND	0.29
	1996-2002	89	89	0.084	0.10	0.12	0.079	ND	0.60
Above Woods Pond Dam	1989-1992	20	95	0.13	0.22	0.31	0.13	ND	0.89
	1996-1999	34	88	0.073	0.083	0.11	0.058	ND	0.39
Schweitzer/Lenoxdale Bridge	1989-1991	20	75	0.14	0.17	0.23	0.11	ND	0.50
	1996-2002	93	74	0.062	0.066	0.079	0.054	ND	0.35
Division Street Bridge	1989-1991	19	63	0.080	0.11	0.16	0.052	ND	0.45
	1996-2002	78	36	0.015	0.033	0.040	0.026	ND	0.18

Notes:

1. Includes all monthly and bi-weekly water column monitoring data collected by GE (1989-2002) and EPA (1998-1999). Does not include data from specific stormwater sampling events or other specialized surface water sampling events.
2. Sample BBLID 1543 (Total PCB at Division Street Bridge) excluded due to an anomalously high detectiion of 21 ng/L.
3. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
4. Duplicate samples were averaged.
5. ND = Not Detected.

Section 3 Figures

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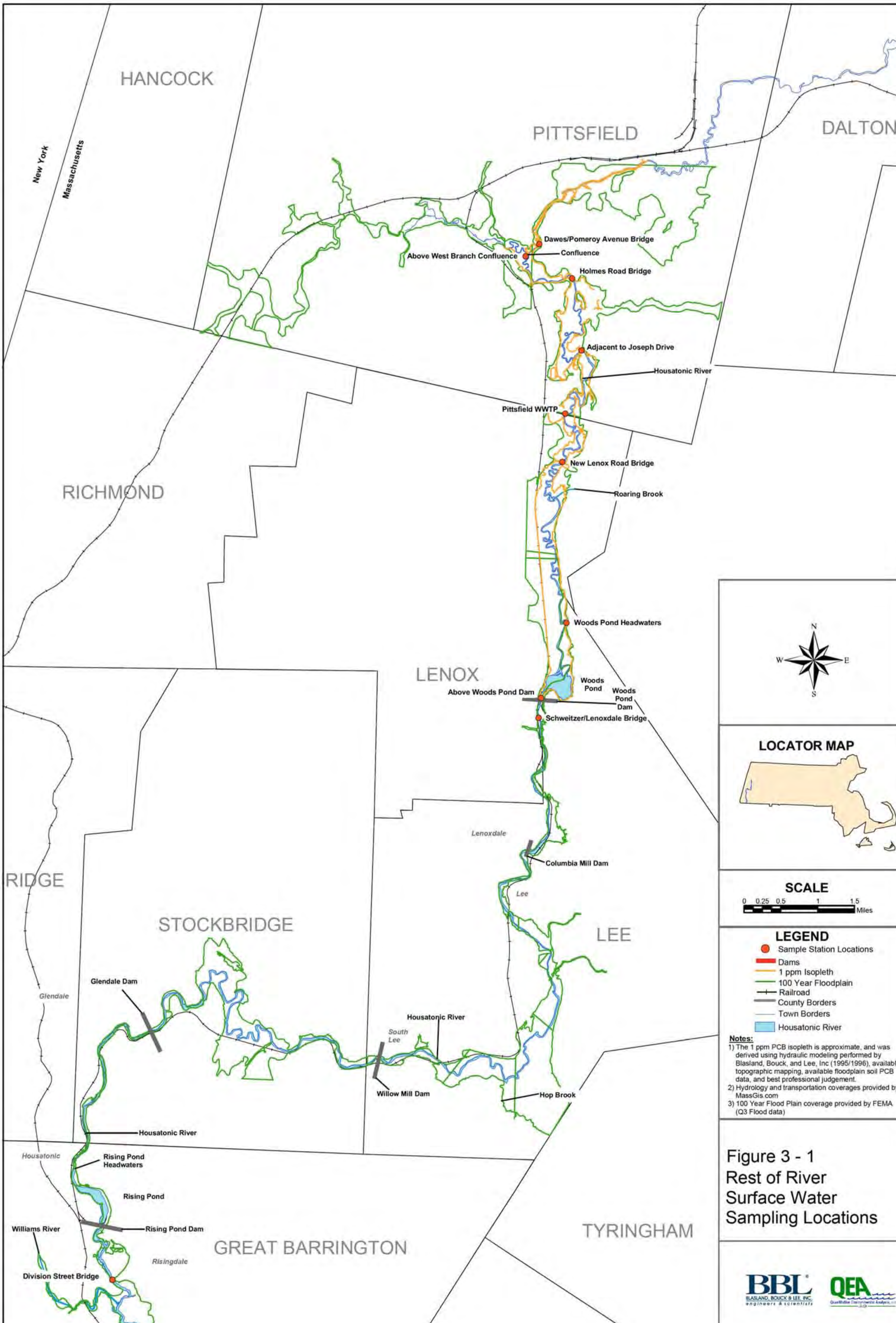

Figure 3 - 1
Rest of River
Surface Water
Sampling Locations

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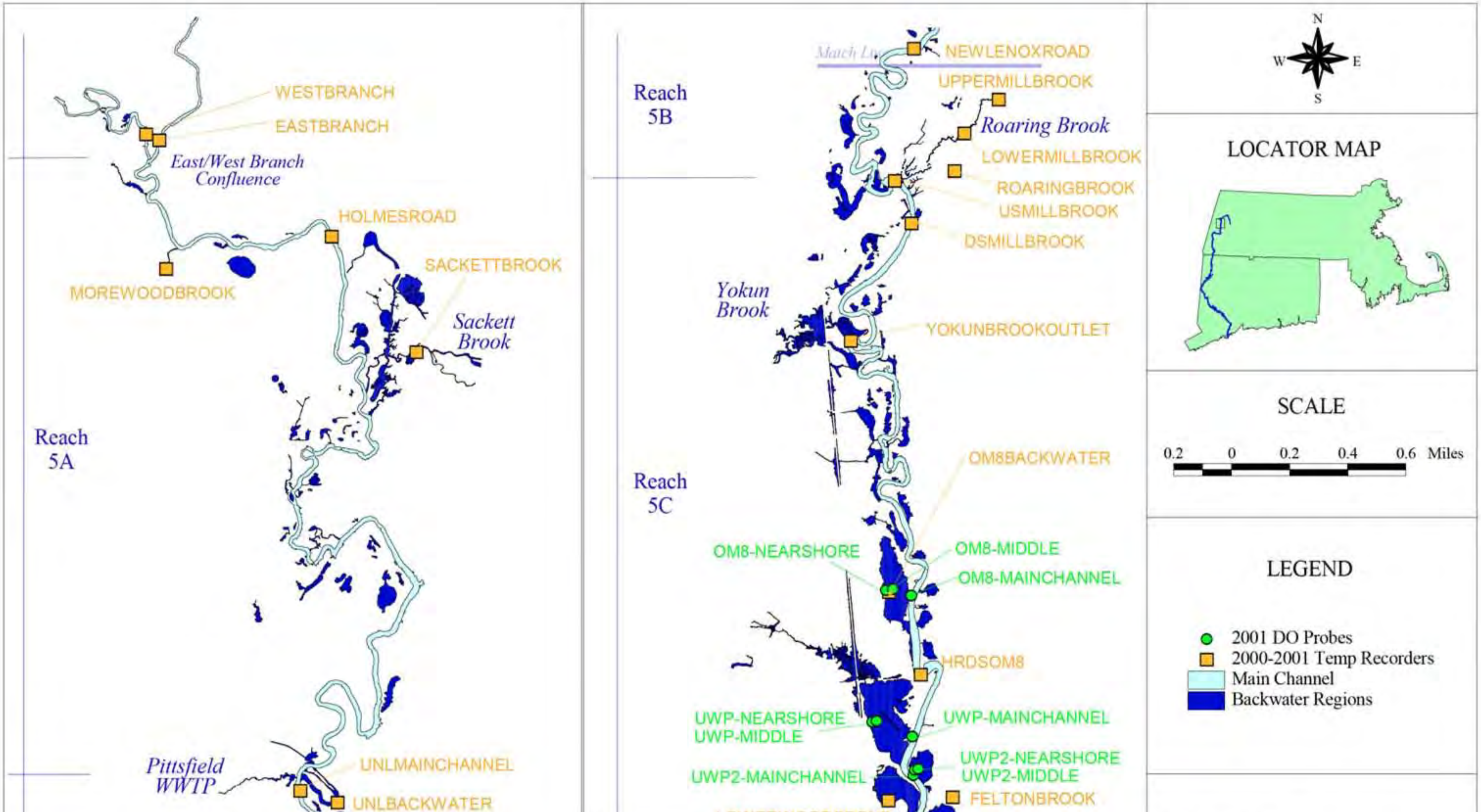

Figure 3-2.
Location of probes during 2001-2002 R2 study.

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GENhou 135

January 2003

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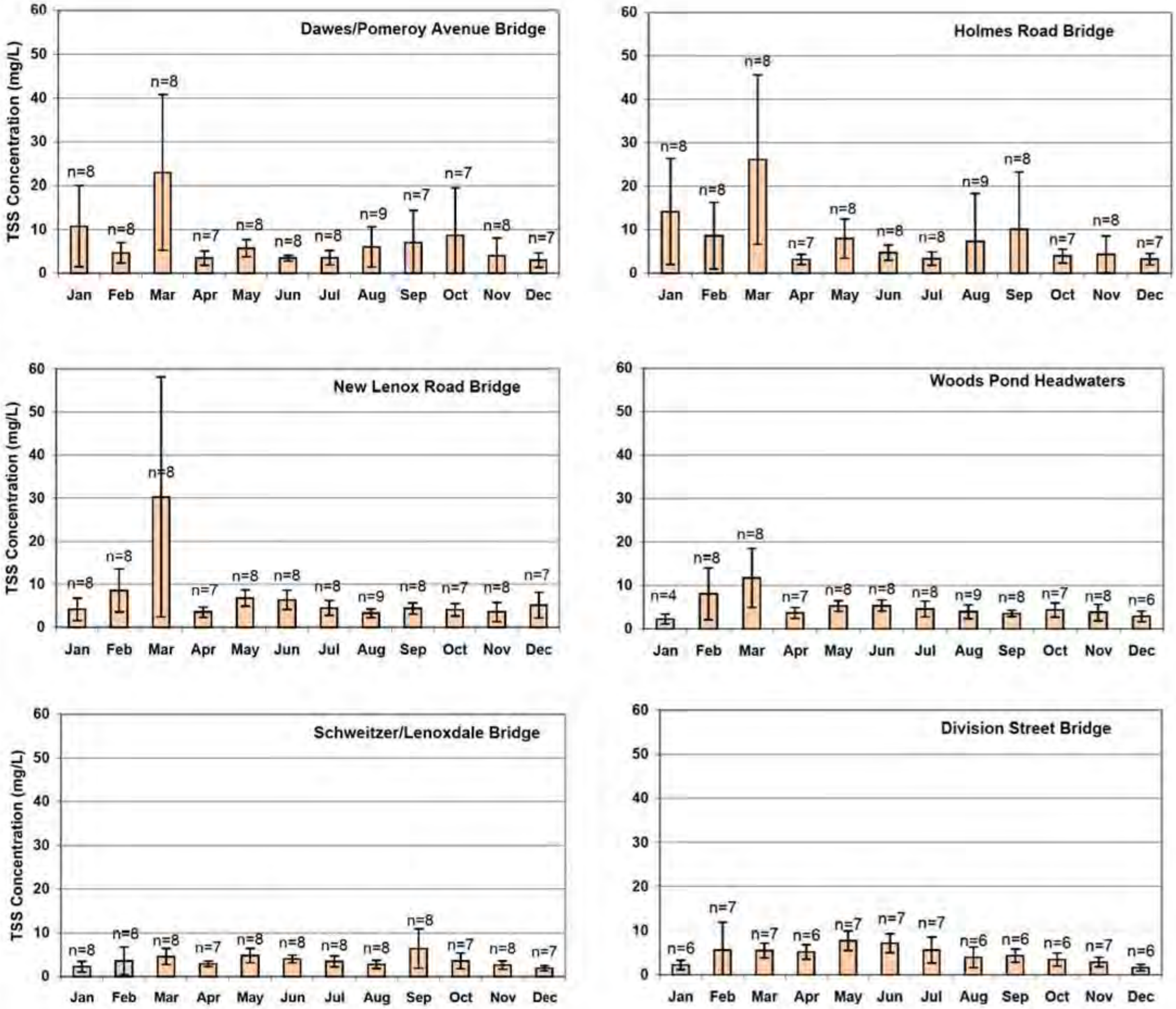

Notes:
1. TSS = total suspended solids.
2. mg/L = milligrams per liter.
3. Presents the arithmetic mean TSS concentration and 2 standard errors by month for GE and EPA monthly and bi-weekly sampling conducted between 1996-2002.
Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.

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TOTAL SUSPENDED SOLIDS CONCENTRATION BY MONTH

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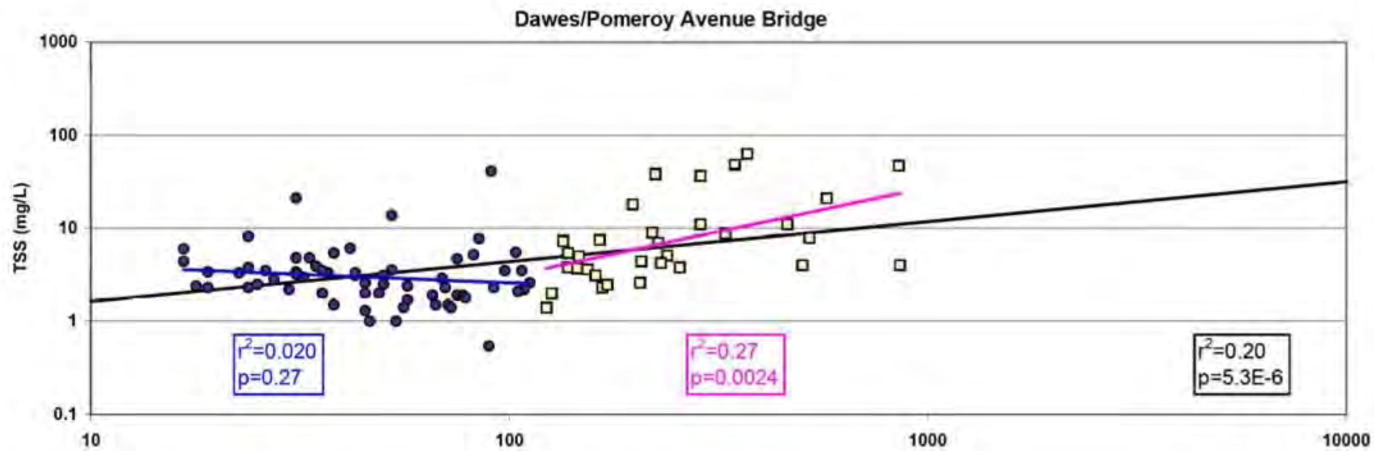
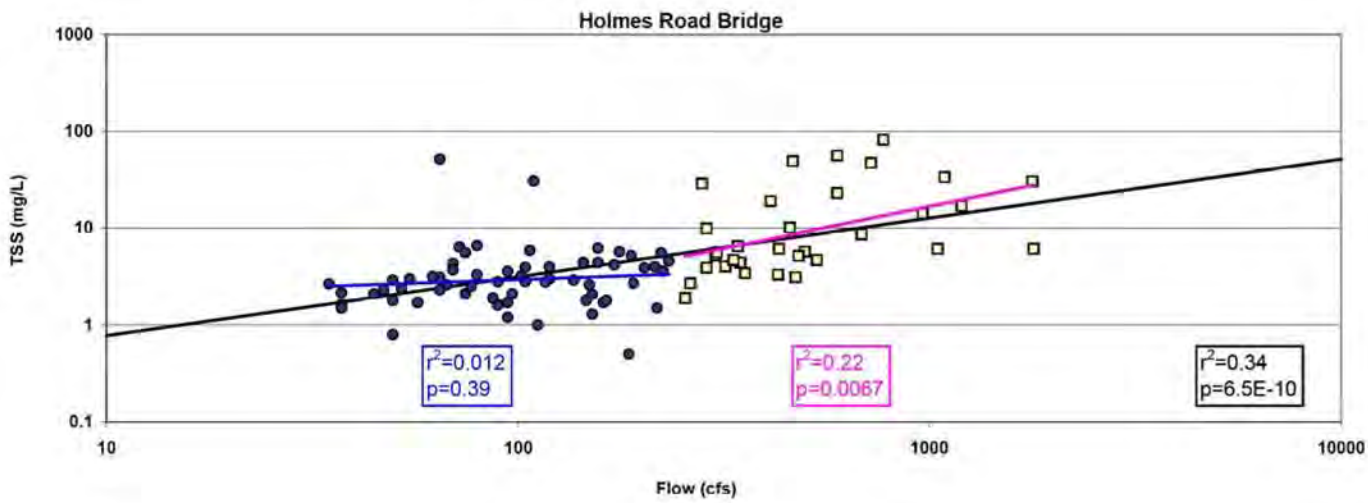
FIGURE
3-4





Notes:
1. TSS = total suspended solids.
2. mg/L = milligrams per liter.
3. cfs = cubic feet per second.
4. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.
5. Flow at each location based on location specific drainage basin proation of flows measured at Coltsville.

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RELATIONSHIP OF TSS CONCENTRATION AND FLOW IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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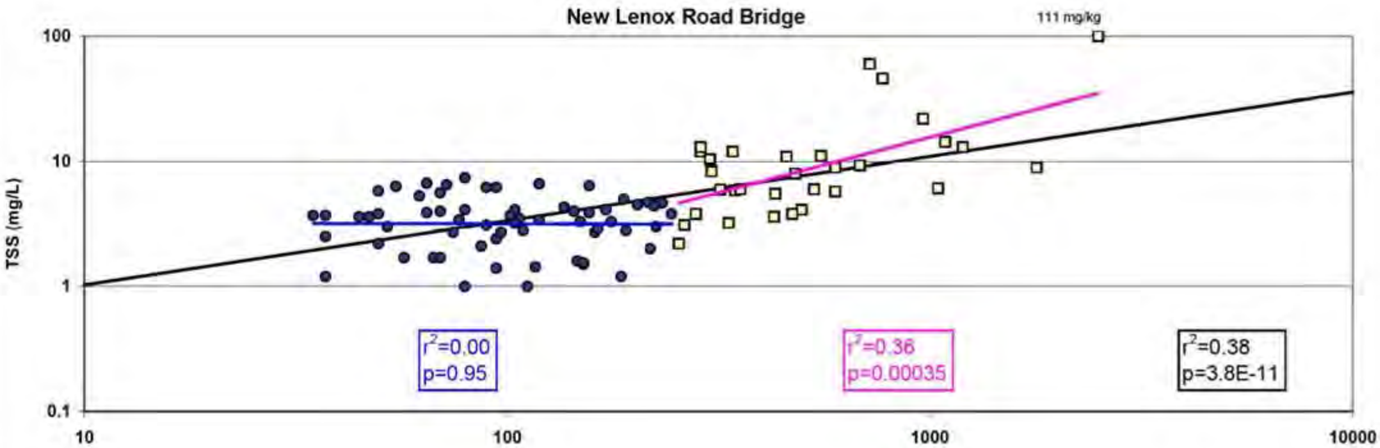
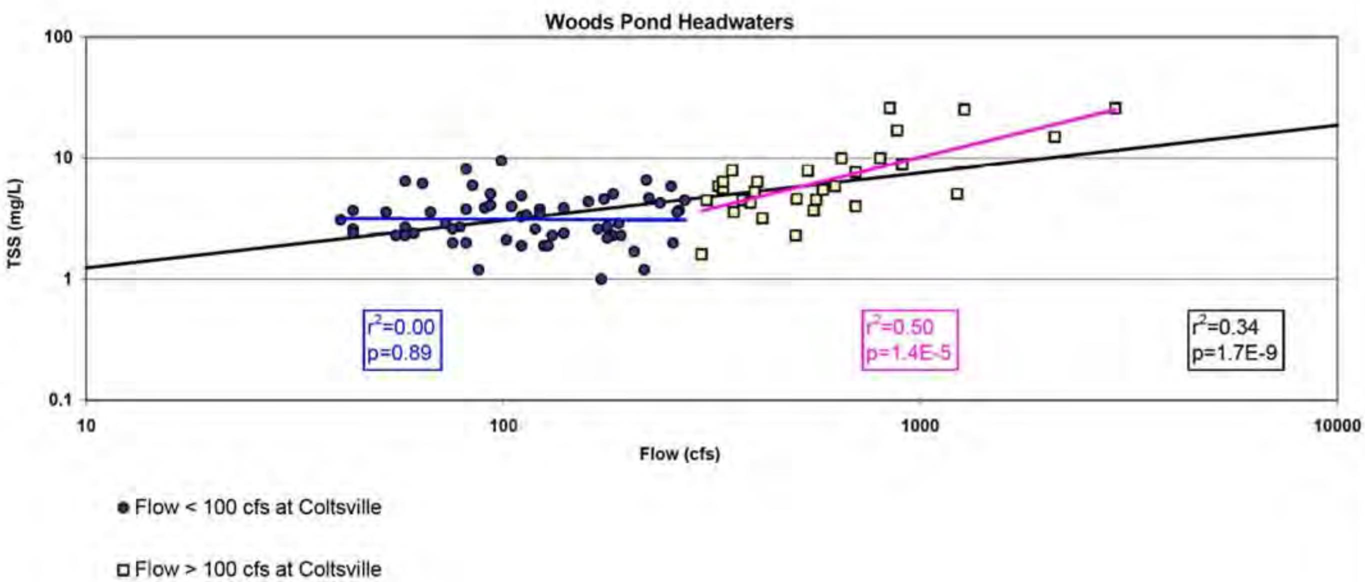
FIGURE
3-6a

Figure 3-6.xls
8/5/2003





Notes:

1. TSS = total suspended solids.
2. mg/L = milligrams per liter.
3. cfs = cubic feet per second.
4. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.
5. Flow at each location based on location specific drainage basin proation of flows measured at Coltsville.

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RELATIONSHIP OF TSS CONCENTRATION AND FLOW IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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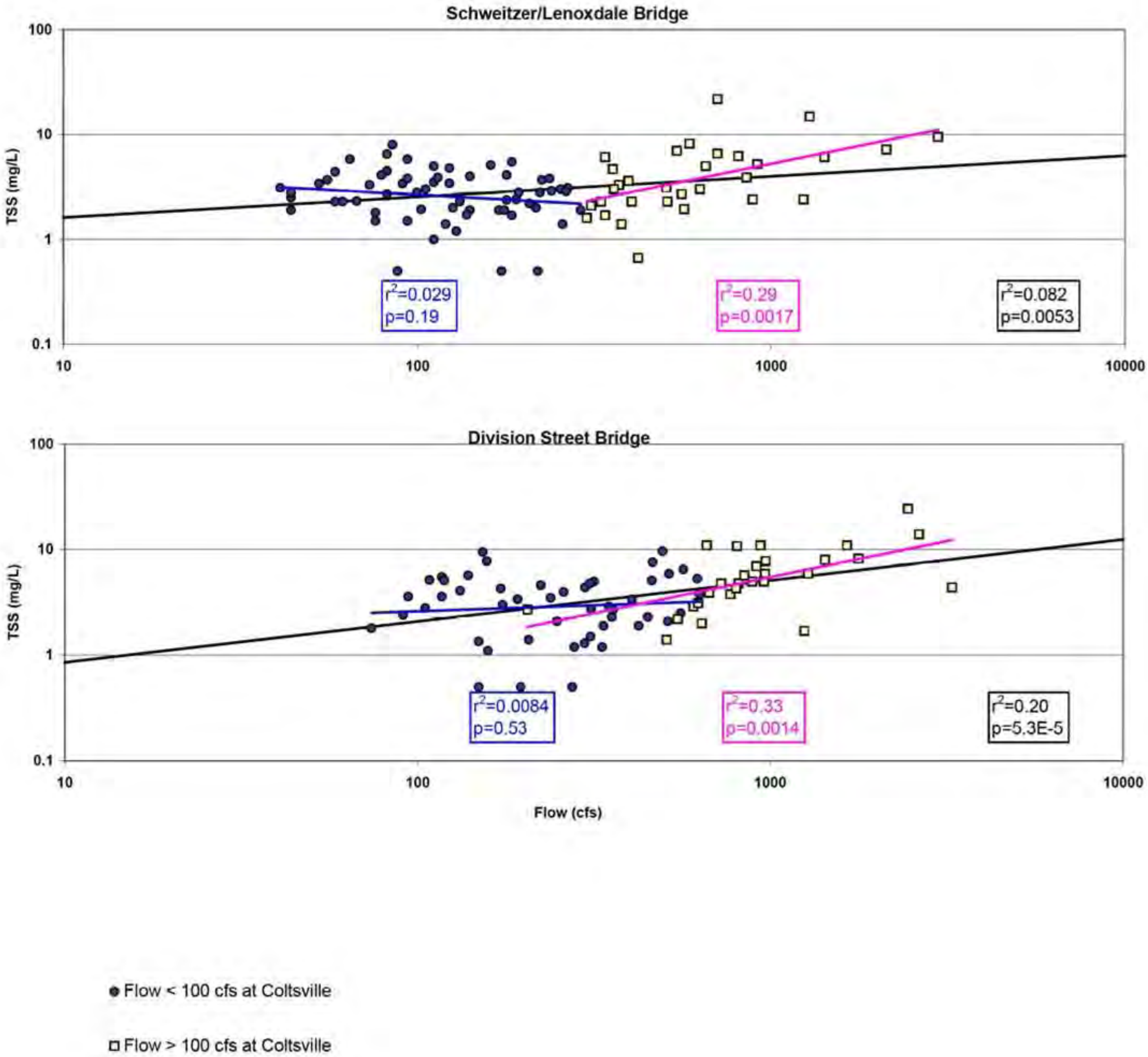
FIGURE
3-6b



Notes:
1. TSS = total suspended solids.
2. mg/L = milligrams per liter.
3. cfs = cubic feet per second.
4. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.
5. Flow at each location based on location specific drainage basin proation of flows measured at Coltsville.

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RELATIONSHIP OF TSS CONCENTRATION AND FLOW IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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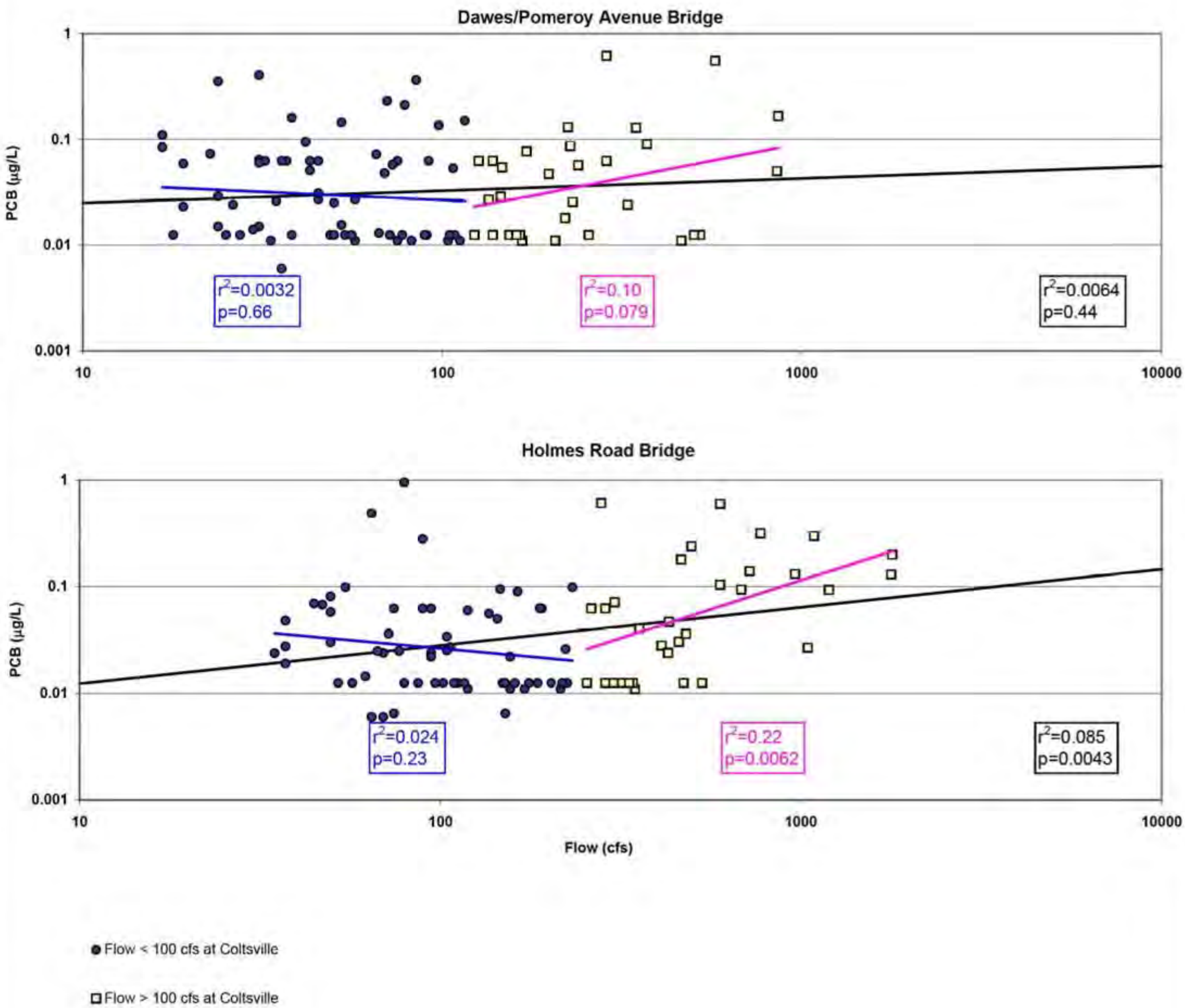
FIGURE 3-6c



Notes:

1. PCB = polychlorinated biphenyls.
2. μg/L = micrograms per liter.
3. cfs = cubic feet per second.
4. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data or data from stormwater sampling events or other specialized surface water sampling events.
5. Flow at each location based on location specific drainage basin proation of flows measured at Coltsville.

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RELATIONSHIP OF PCB CONCENTRATION AND FLOW IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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FIGURE 3-9a

Figure 3-9.xls
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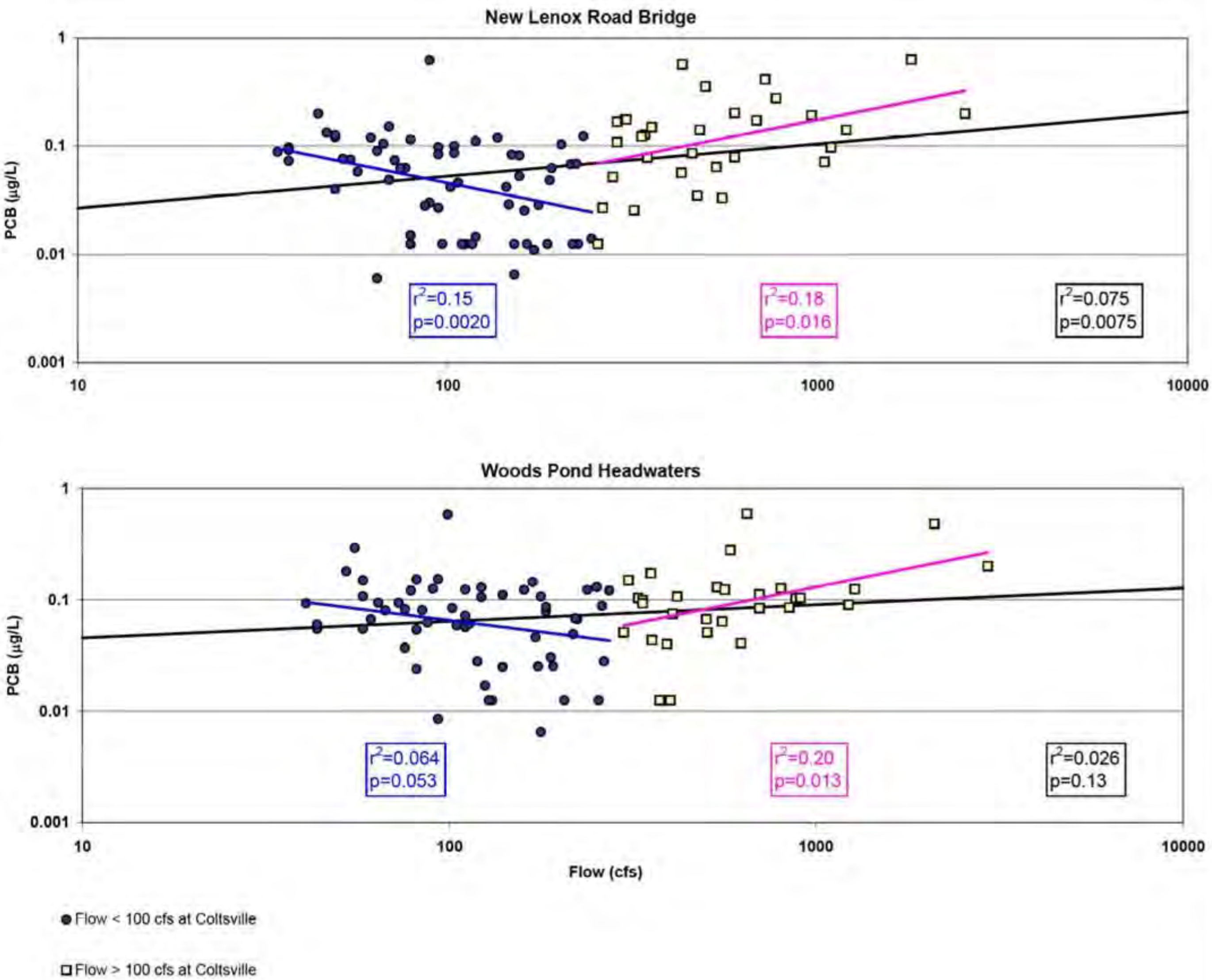

Notes:
1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. cfs = cubic feet per second.
4. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.
5. Flow at each location based on location specific drainage basin proation of flows measured at Coltsville.

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RELATIONSHIP OF PCB CONCENTRATION TO FLOW FOR HOUSATONIC RIVER SURFACE WATER SAMPLES

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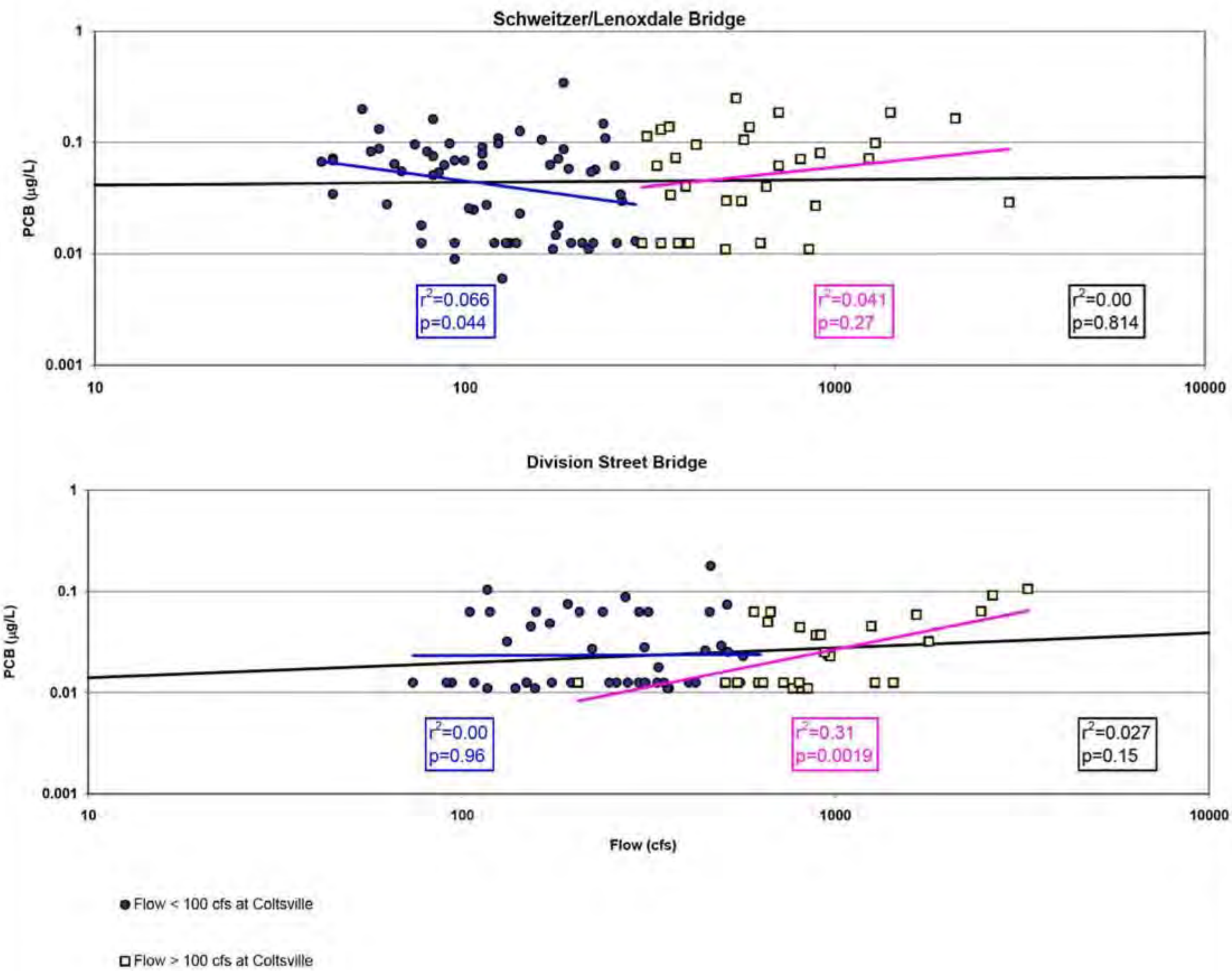
FIGURE 3-9b



Notes:
1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. cfs = cubic feet per second.
4. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.
5. Flow at each location based on location specific drainage basin proation of flows measured at Coltsville.
6. sample BBLID 1543, collected at Division Street Bridge, excluded due to an anomalously high total PCB detection of 21 ng/L

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RELATIONSHIP OF PCB CONCENTRATION AND FLOW IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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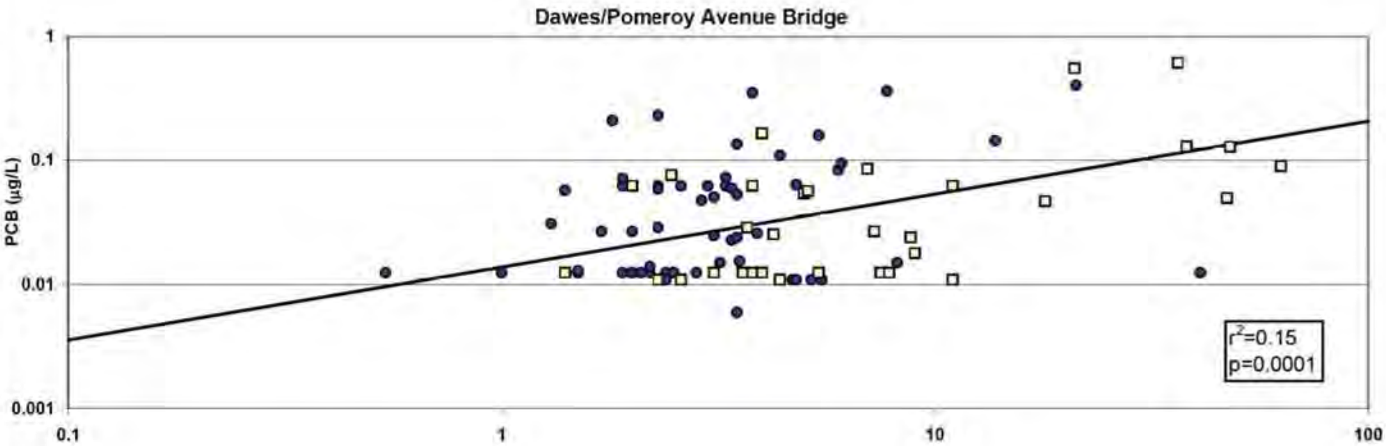
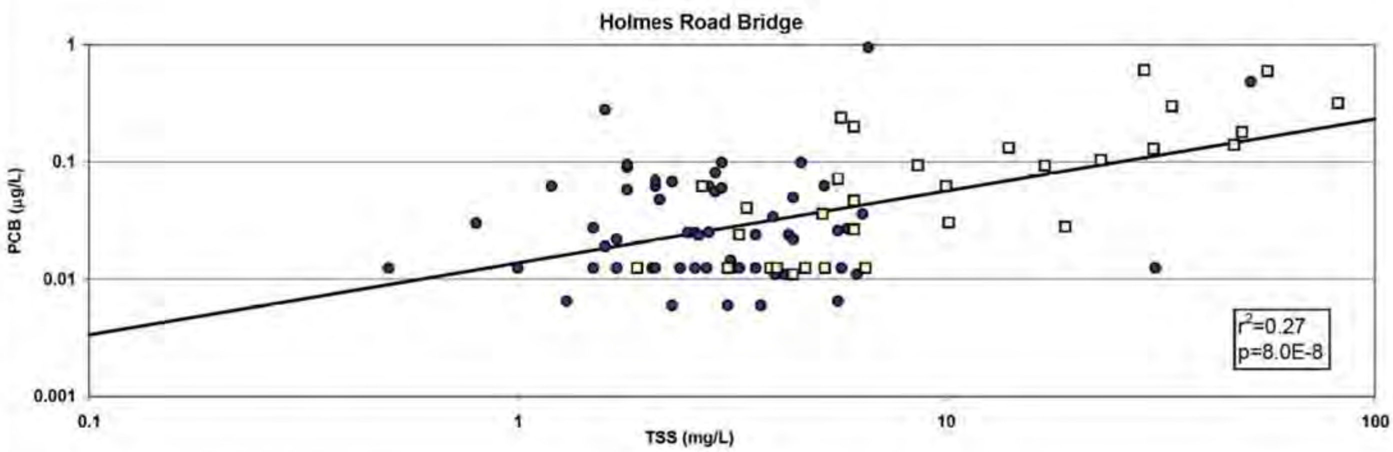
FIGURE 3-9c





● Flow < 100 cfs at Coltsville

□ Flow > 100 cfs at Coltsville

Notes:
1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. TSS = total suspended solids
4. mg/L = milligrams per liter.
5. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.

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RELATIONSHIP OF PCB AND TSS CONCENTRATION IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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FIGURE 3-11a

Figure 3-11.xls
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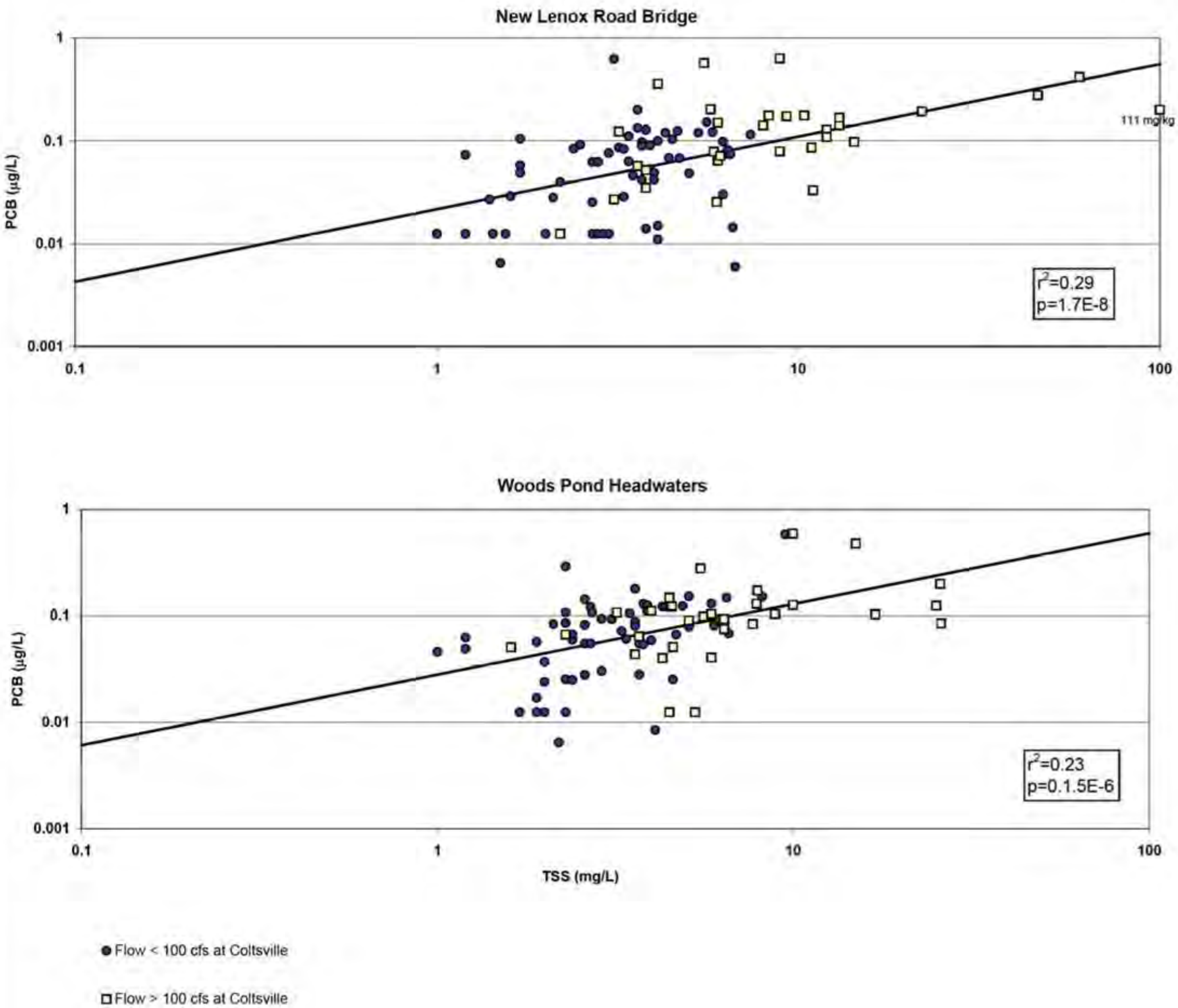

Notes:
1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. TSS = total suspended solids
4. mg/L = milligrams per liter.
5. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.

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RELATIONSHIP OF PCB AND TSS CONCENTRATION IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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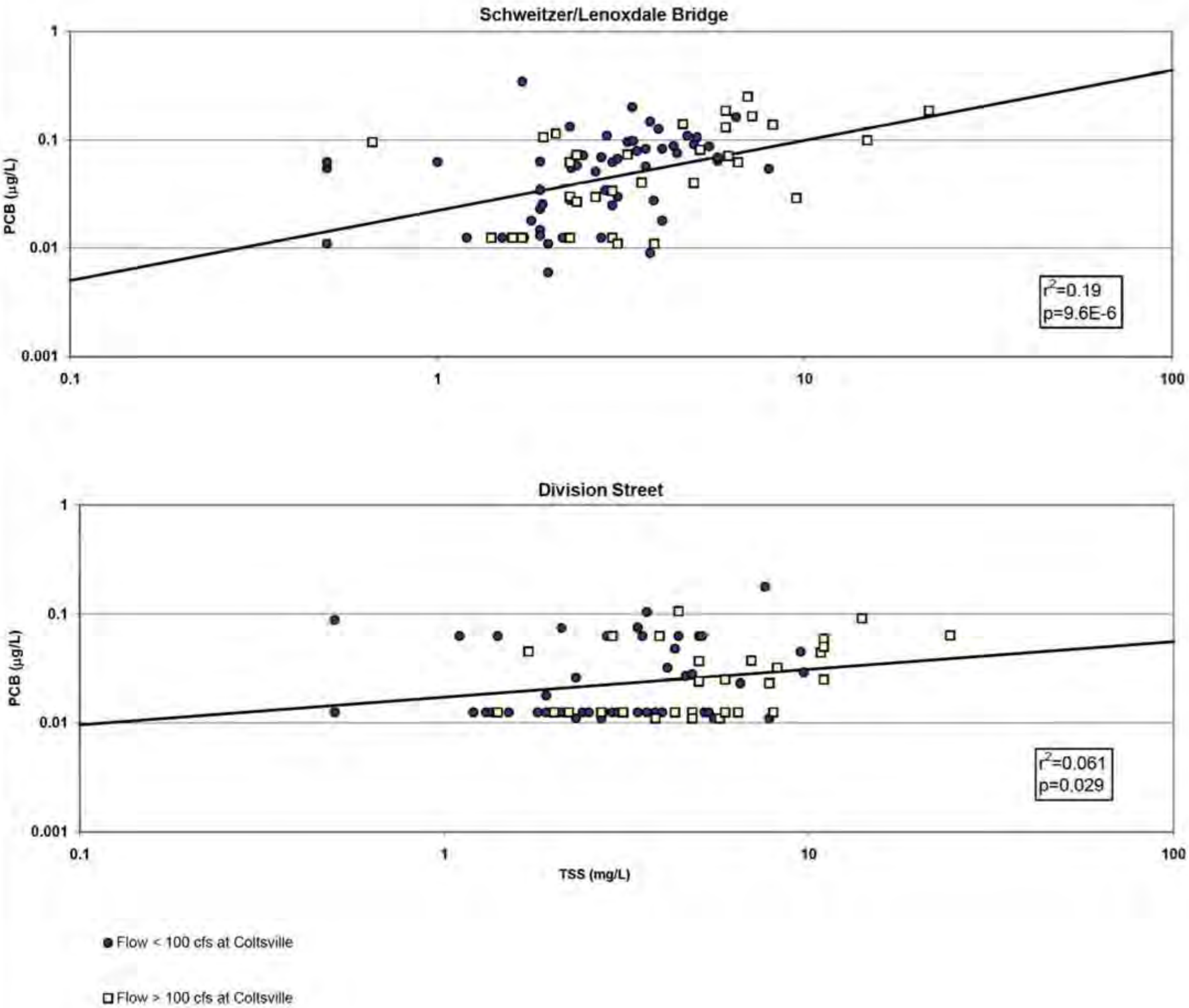
FIGURE 3-11b



Notes:
1. PCB = polychlorinated biphenyls .
2. µg/L = micrograms per liter.
3. TSS = total suspended solids
4. mg/L = milligrams per liter.
5. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.
6 Sample BBLID 1543, collected at Division Street Bridge, excluded due to an anomalously high total PCB detection of 21 ng/L

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RELATIONSHIP OF PCB AND TSS CONCENTRATION IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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FIGURE 3-11c

Figure 3-11.xls
6/5/2003

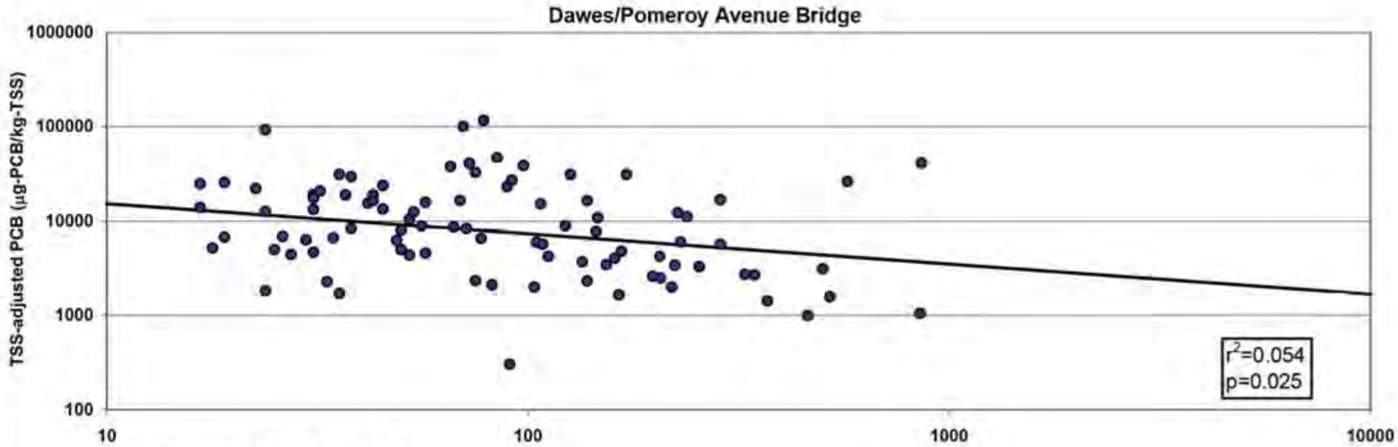
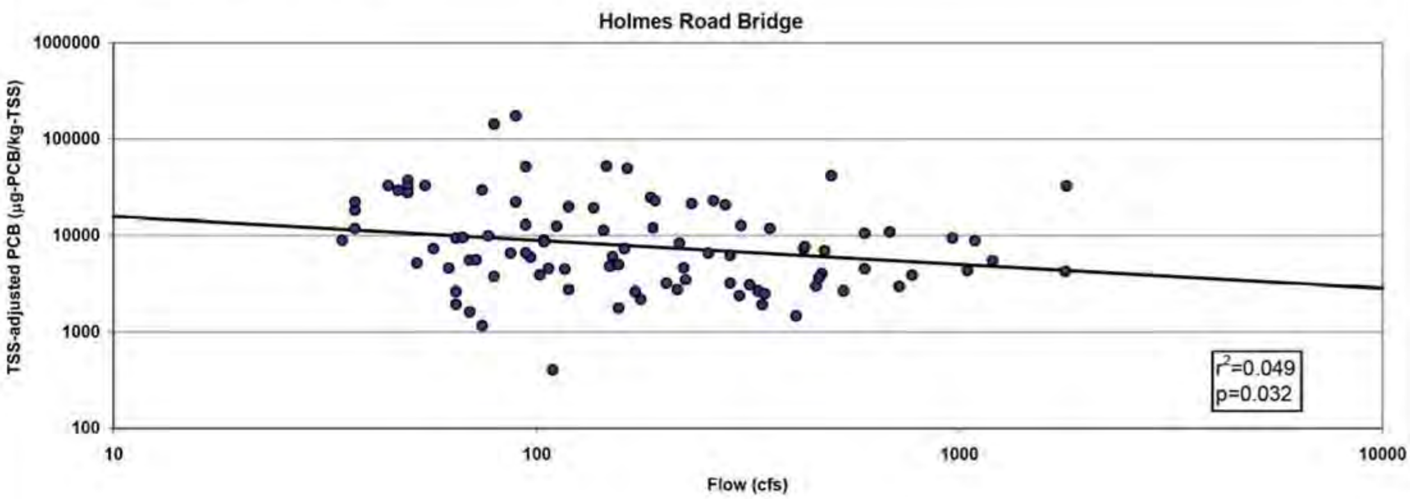


Figure does not show sample 10694 (Flow 46 cfs; TSS-adjusted PCB = 10 µg-PCB/kg-TSS)



Notes:

1. TSS = total suspended solids.
2. PCB = polychlorinated biphenyls.
3. µg = micrograms.
4. g = grams.
5. cfs = cubic feet per second.
6. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.
7. Flow at each location based on location specific drainage basin proration of flows measured at Coltsville.

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RELATIONSHIP OF TSS-ADJUSTED PCB CONCENTRATION AND FLOW IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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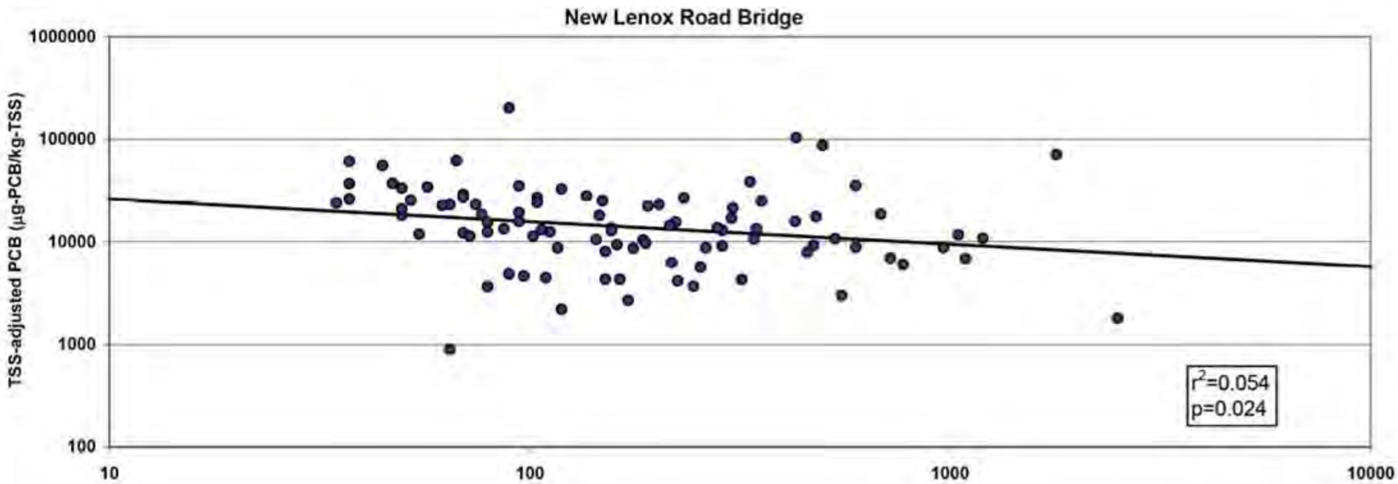
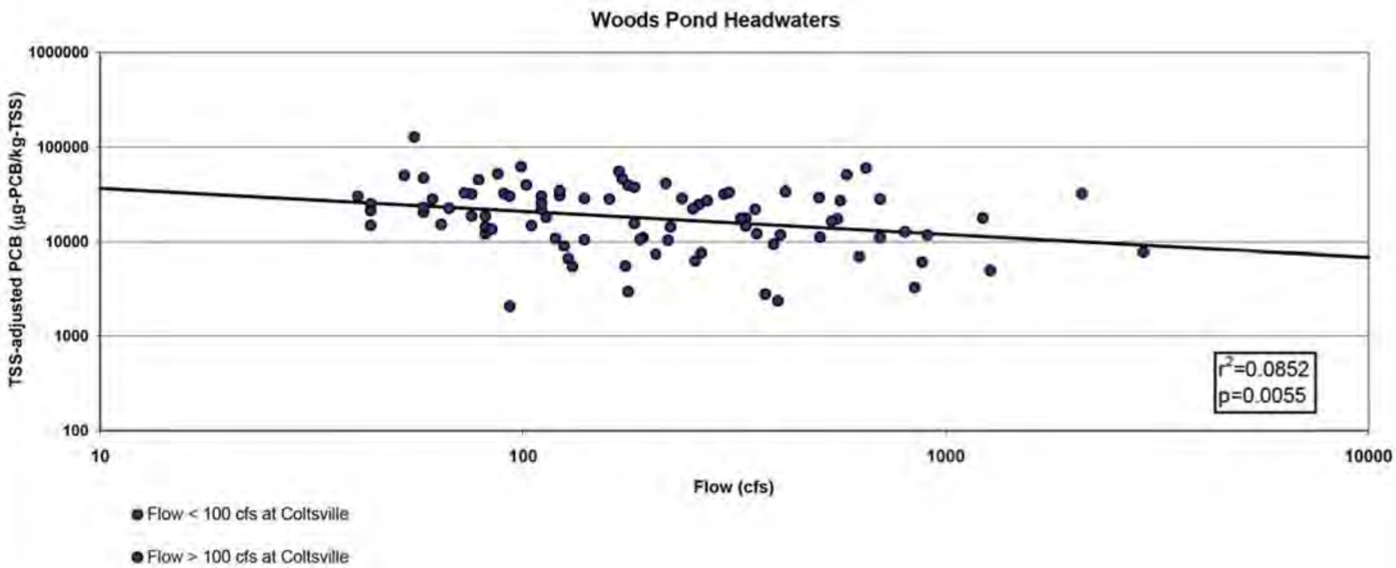
FIGURE 3-12a





Notes:
1. TSS = total suspended solids.
2. PCB = polychlorinated biphenyls.
3. µg = micrograms.
4. g = grams.
5. cfs = cubic feet per second.
6. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.
7. Flow at each location based on location specific drainage basin proration of flows measured at Coltsville.

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RELATIONSHIP OF TSS-ADJUSTED PCB CONCENTRATION AND FLOW IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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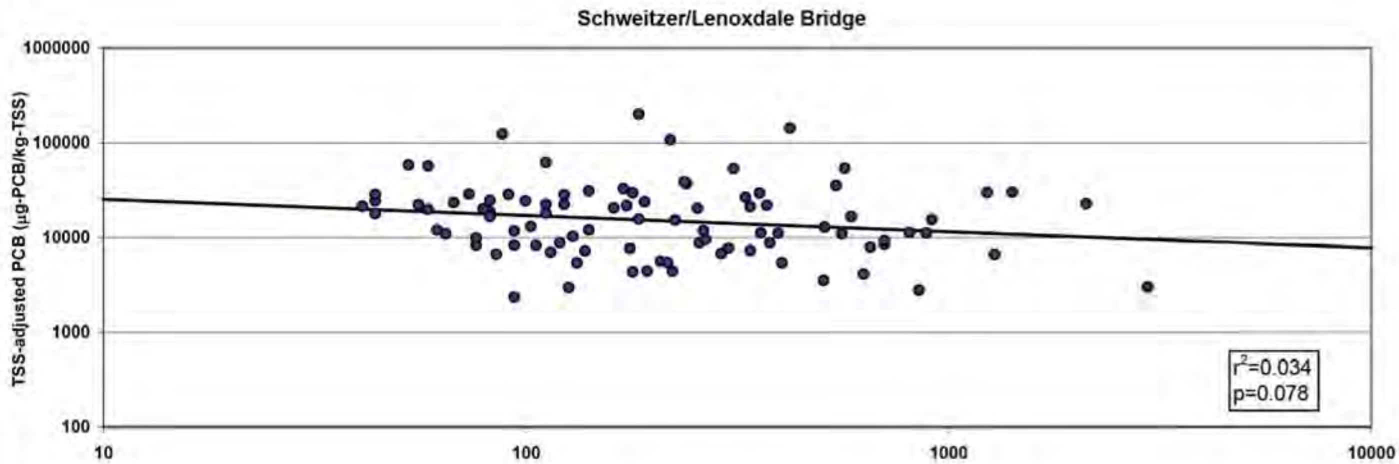
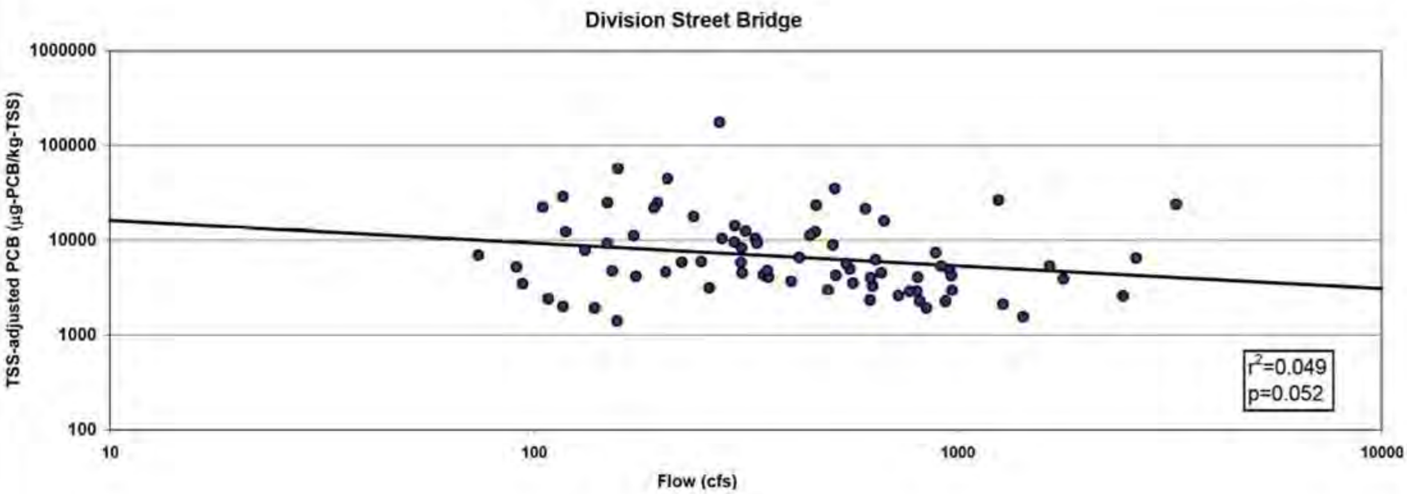
FIGURE
3-12b





Notes:
1. TSS = total suspended solids.
2. PCB = polychlorinated biphenyls.
3. µg = micrograms.
4. g = grams.
5. cfs = cubic feet per second.
6. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.
7. Flow at each location based on location specific drainage basin proration of flows measured at Coltsville.

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RELATIONSHIP OF TSS-ADJUSTED PCB CONCENTRATION TO FLOW IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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FIGURE
3-12c

Figure 3-12.xls
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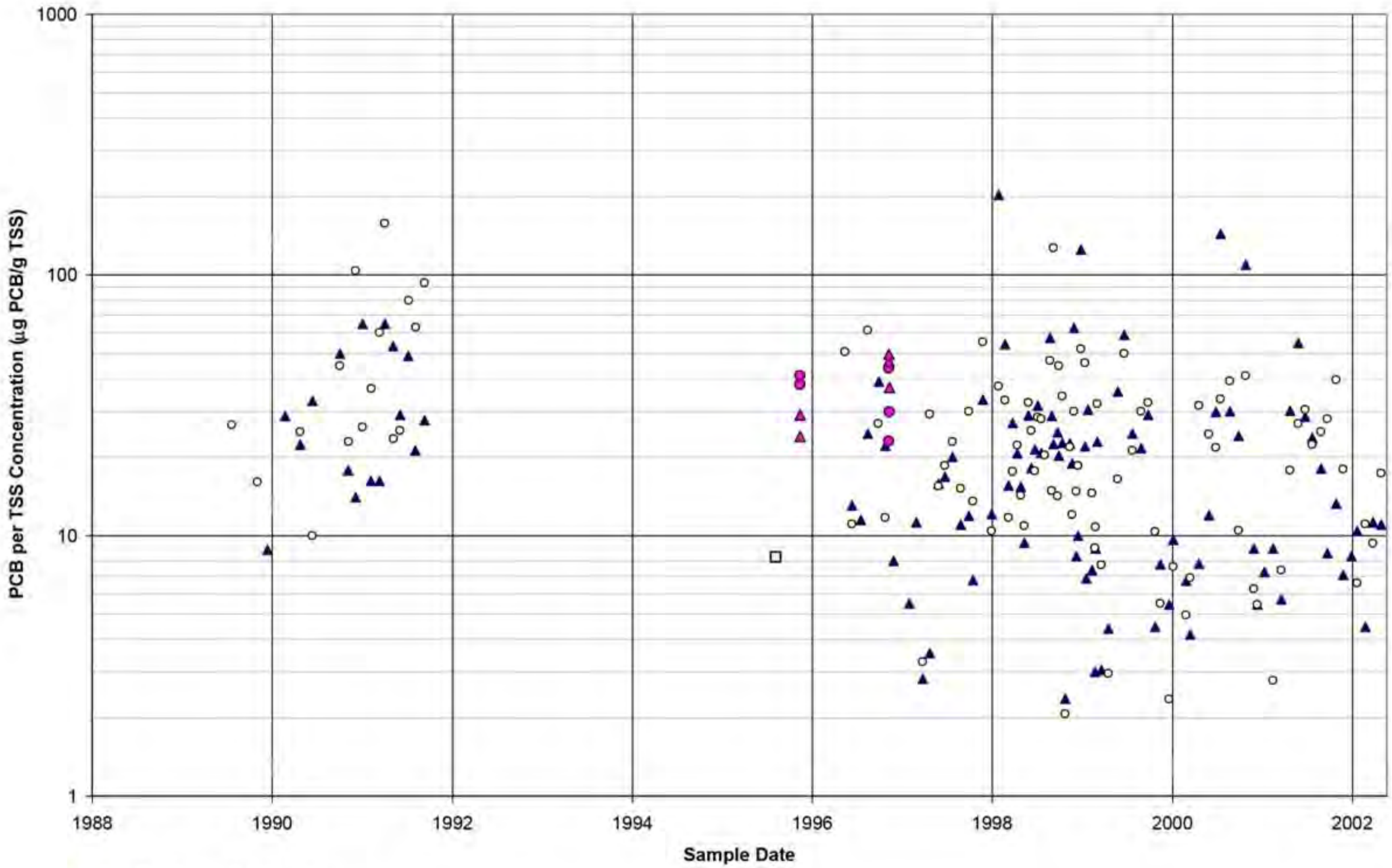

▲ Schweitzer/Lenoxdale Bridge
○ Woods Pond Headwaters
● GE Suspended Sediment Sampling at Woods Pond Headwaters
□ Woods Pond Sediment Trap
▲ GE Suspended Sediment Sampling at Schweitzer/Lenoxdale Bridge

Notes:
1. The PCB per TSS concentration for the monthly and bi-weekly monitoring data is represented by the TSS-adjusted PCB concentrauion.
2. PCB = polychlorinated biphenyls.
3. TSS = total suspended solids.
4. µg = micrograms.
5. g = grams.

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PCB PER TSS CONCENTRATION IN THE VICINITY OF WOODS POND

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FIGURE
3-13

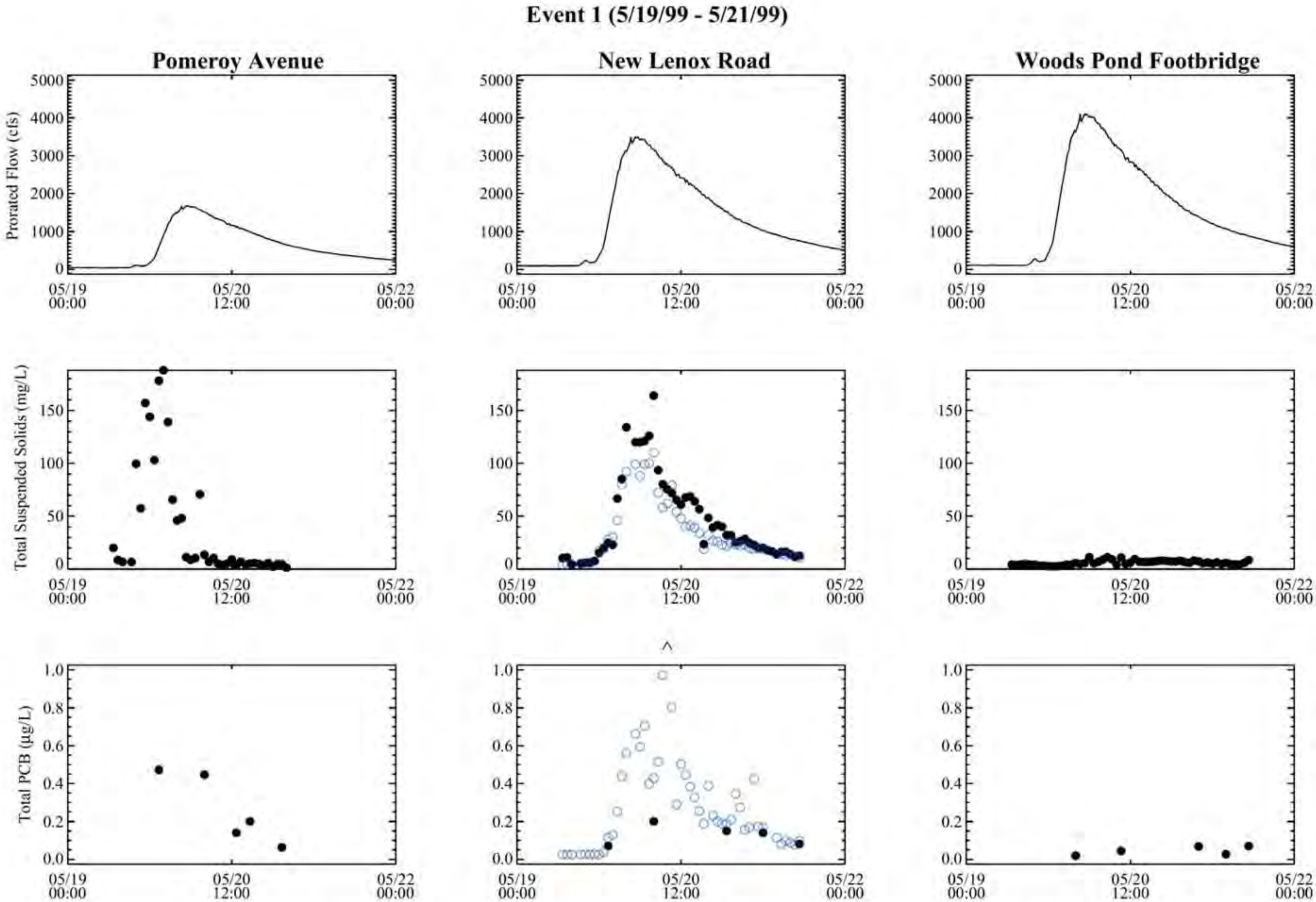

Figure 3-14a. PCB and TSS concentrations measured during 1999 USEPA storm event sampling

Notes: Flow at each location estimated based on drainage area proration; USEPA TSS data shown were collected using ISCO sampler.

● EPA Data
○ GE splits

WK - J:\GENhou\documents\reports\RFI_report\Section3\figures\storm_EPA_GE_combined.pro
Thu Jan 02 10:06:55 2003

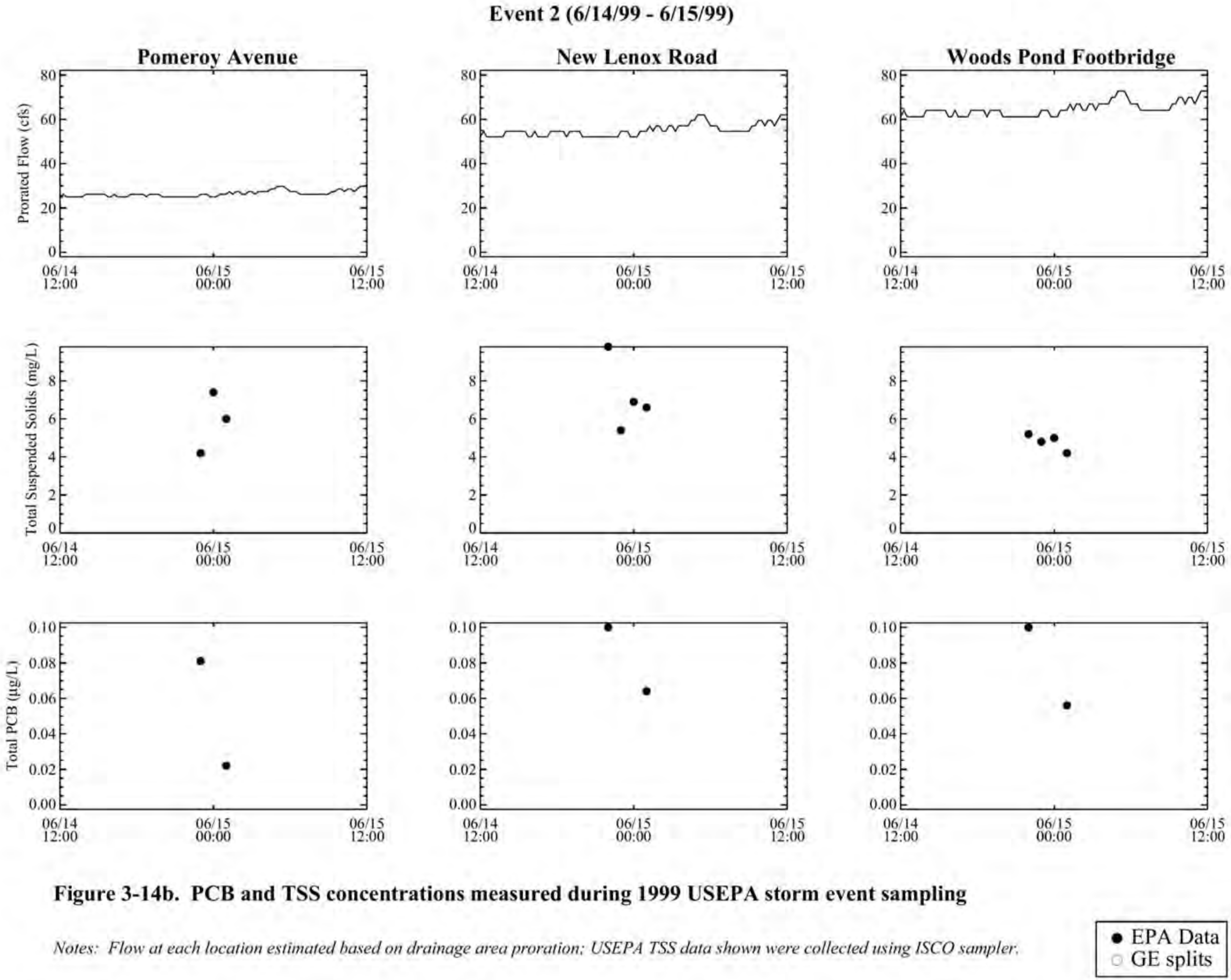

Figure 3-14b. PCB and TSS concentrations measured during 1999 USEPA storm event sampling

Notes: Flow at each location estimated based on drainage area proration; USEPA TSS data shown were collected using ISCO sampler.

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Thu Jan 02 10:06:55 2003

Event 3 (6/17/99 - 6/18/99)

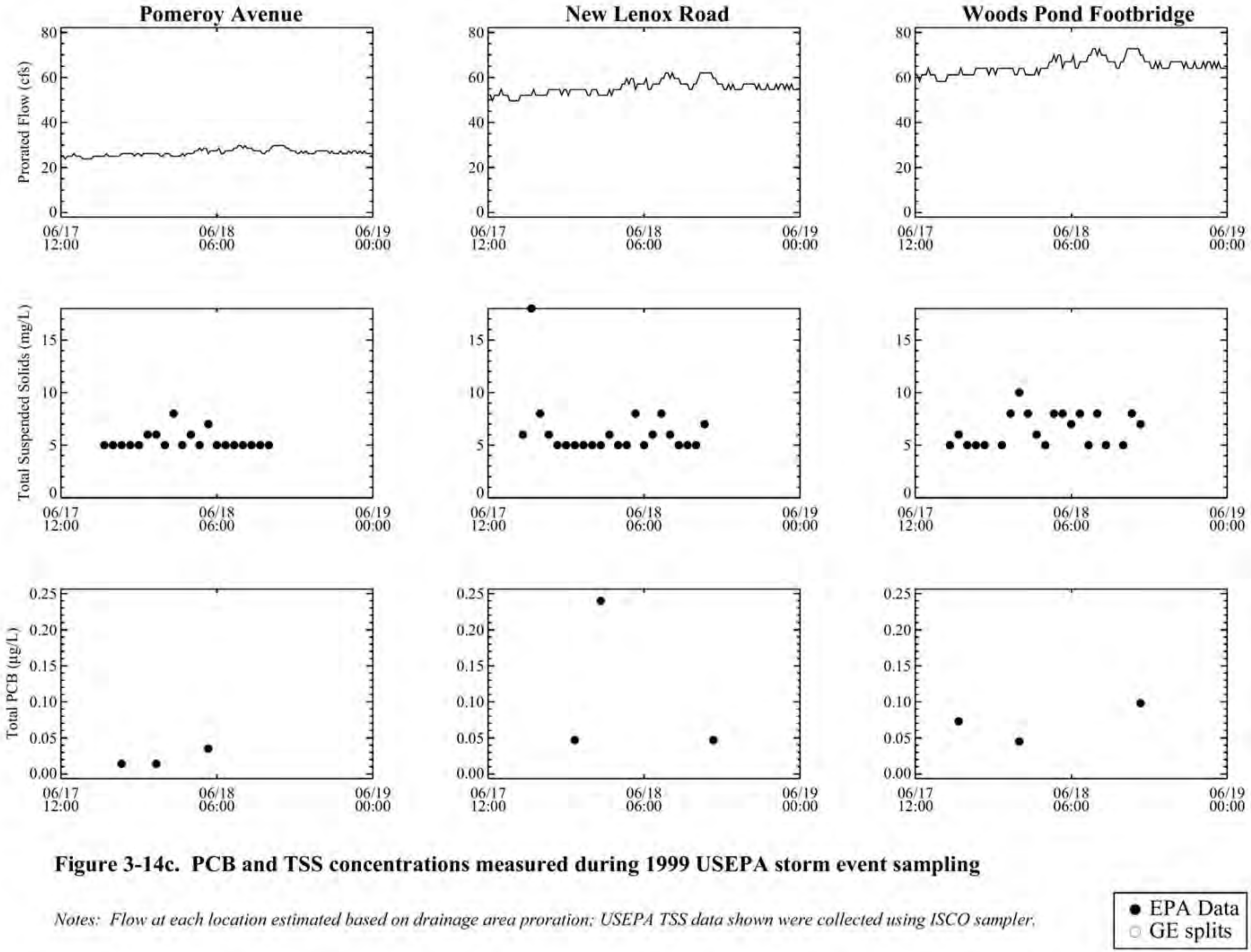

Figure 3-14c. PCB and TSS concentrations measured during 1999 USEPA storm event sampling

Notes: Flow at each location estimated based on drainage area proration; USEPA TSS data shown were collected using ISCO sampler.

WK - J:\GENhou\documents\reports\RFI_report\Section3\figures\storm_EPA_GE_combined.pro
Thu Jan 02 10:06:55 2003

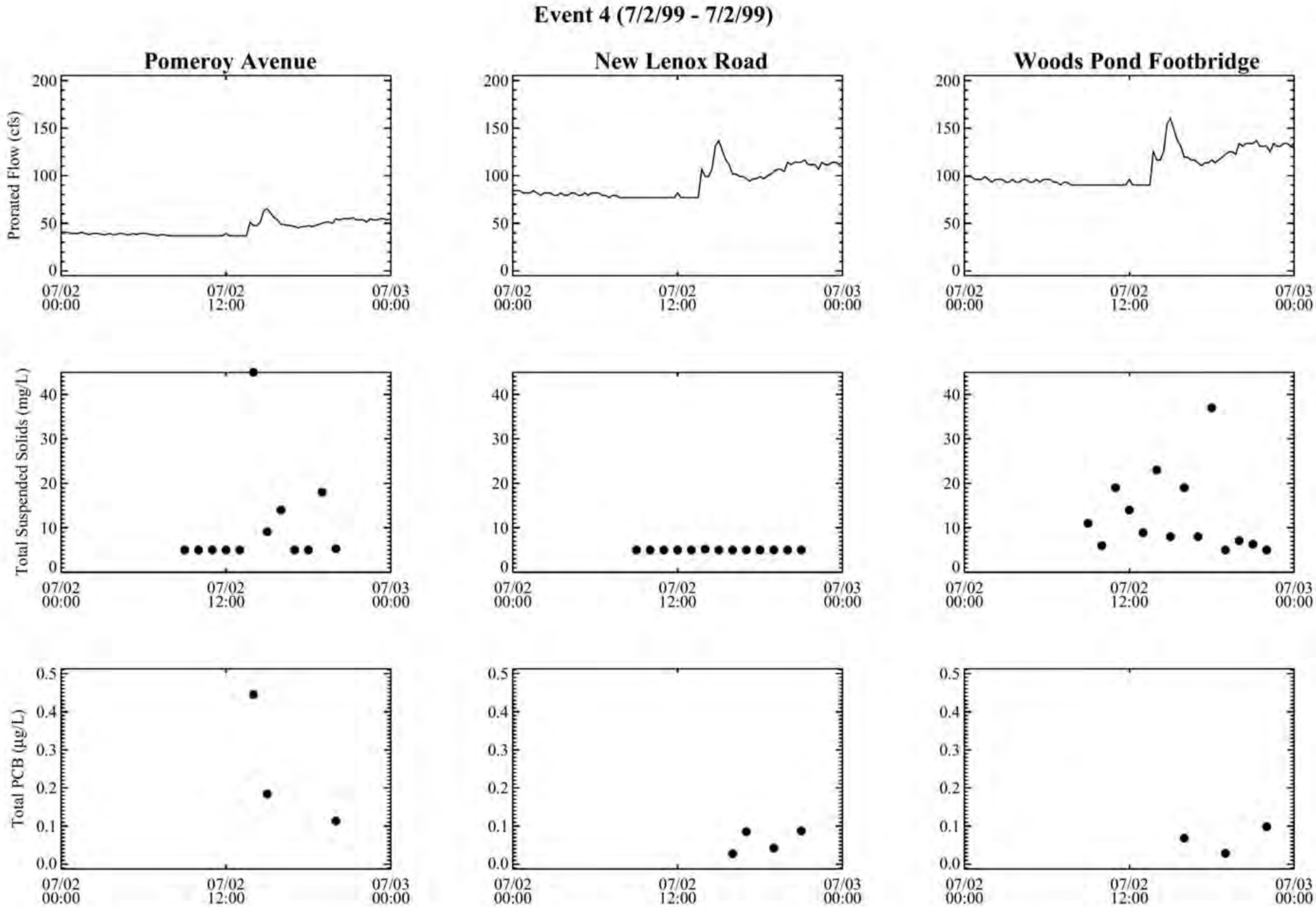

Figure 3-14d. PCB and TSS concentrations measured during 1999 USEPA storm event sampling

Notes: Flow at each location estimated based on drainage area proration; USEPA TSS data shown were collected using ISCO sampler.

● EPA Data
○ GE splits

WK - J:\GENhou\documents\reports\RFI_report\Section3\figures\storm_EPA_GE_combined.pro
Thu Jan 02 10:06:55 2003

Event 5 (8/14/99 - 8/16/99)

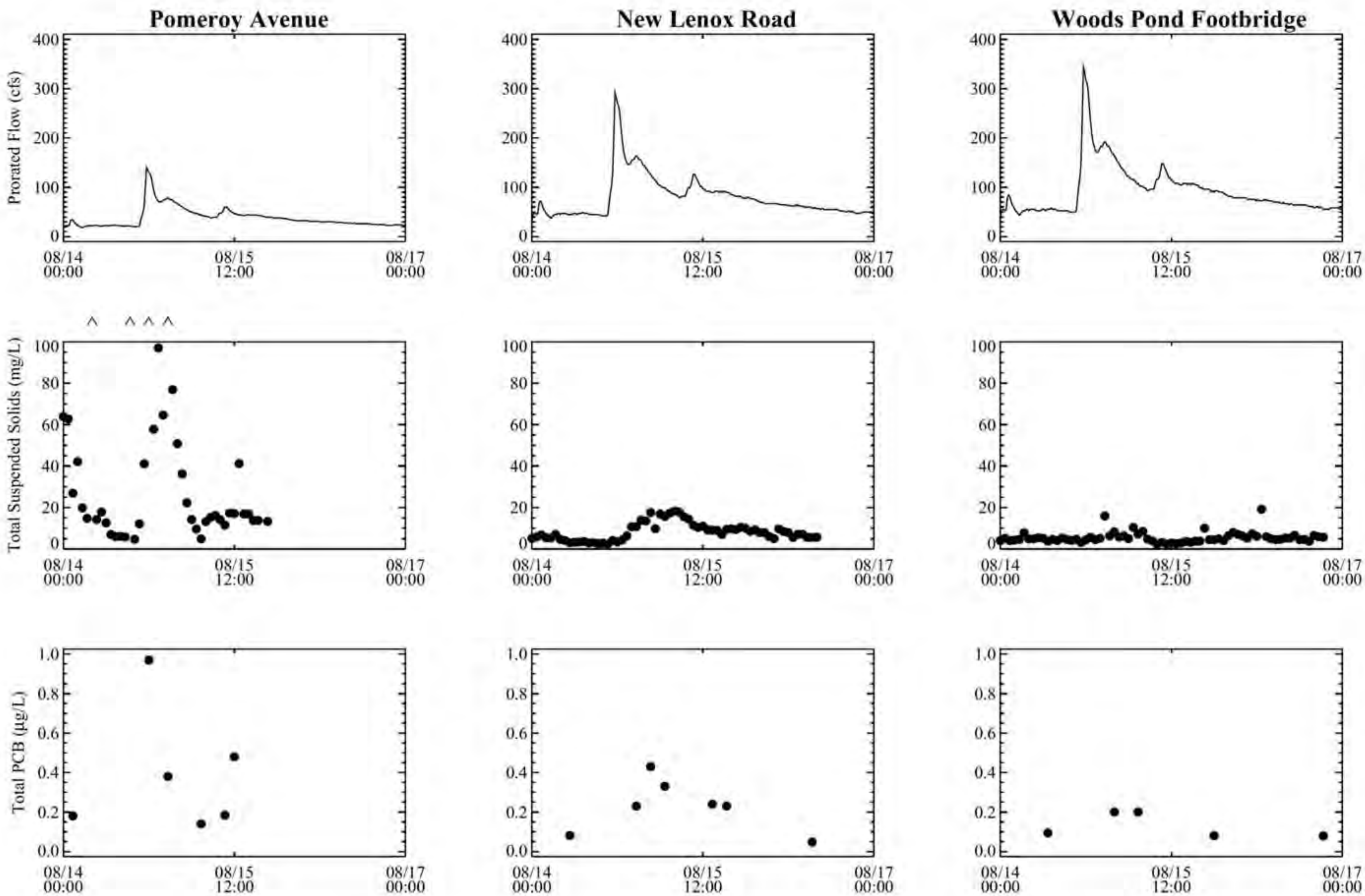

Figure 3-14e. PCB and TSS concentrations measured during 1999 USEPA storm event sampling

Notes: Flow at each location estimated based on drainage area proration; USEPA TSS data shown were collected using ISCO sampler.

● EPA Data
○ GE splits

WK - J:\GENhou\documents\reports\RFI_report\Section3\figures\storm_EPA_GE_combined.pro
Thu Jan 02 10:06:55 2003

Event 6 (9/16/99 - 9/19/99)

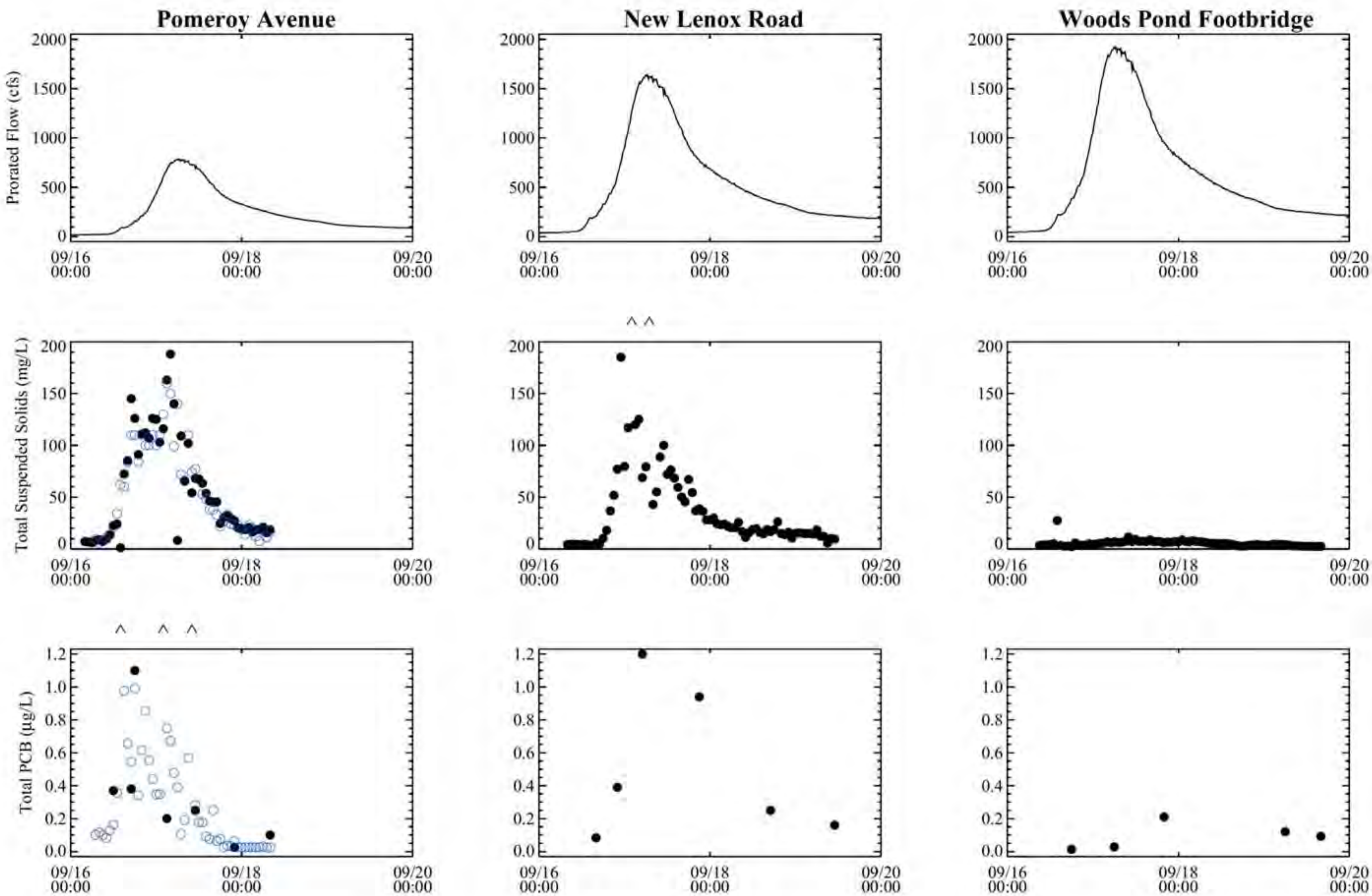

Figure 3-14f. PCB and TSS concentrations measured during 1999 USEPA storm event sampling

Notes: Flow at each location estimated based on drainage area proration; USEPA TSS data shown were collected using ISCO sampler.

WK - J:\GENhou\documents\reports\RFI_report\Section3\figures\storm_EPA_GE_combined.pro
Thu Jan 02 10:06:55 2003

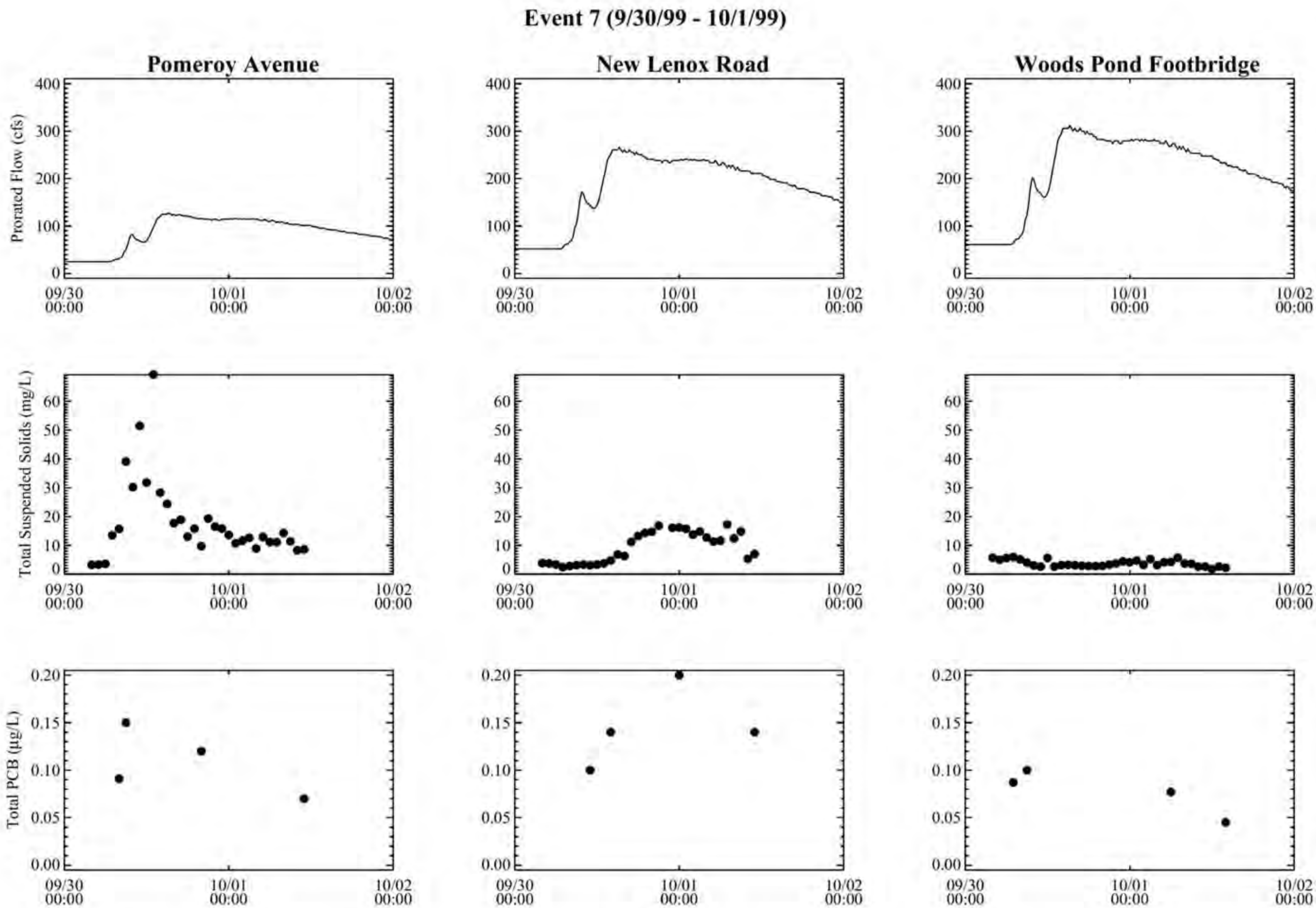

Figure 3-14g. PCB and TSS concentrations measured during 1999 USEPA storm event sampling

Notes: Flow at each location estimated based on drainage area proration; USEPA TSS data shown were collected using ISCO sampler.

WK - J:\GENhou\documents\reports\RFI_report\Section3\figures\storm_EPA_GE_combined.pro
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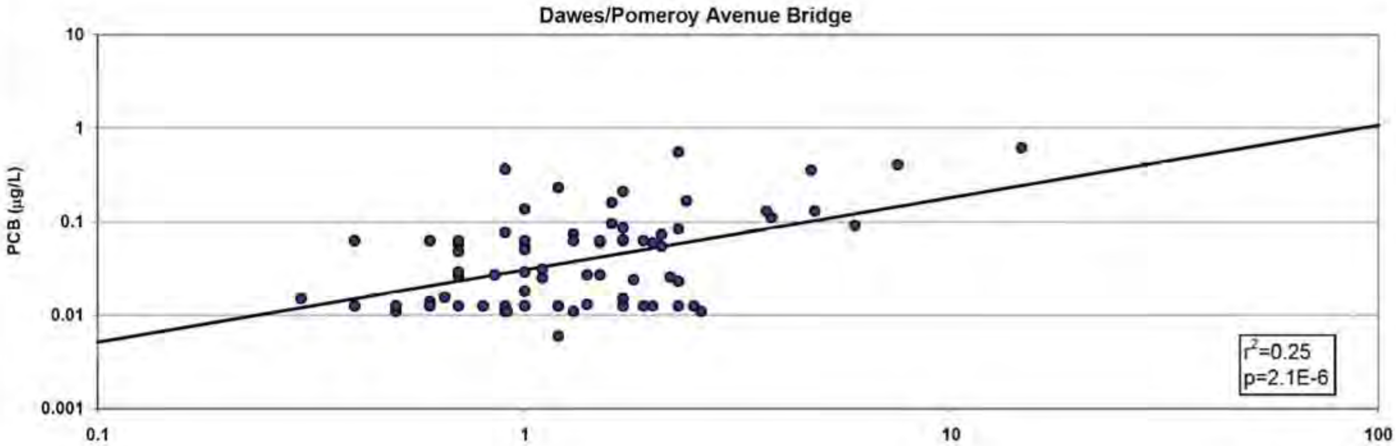

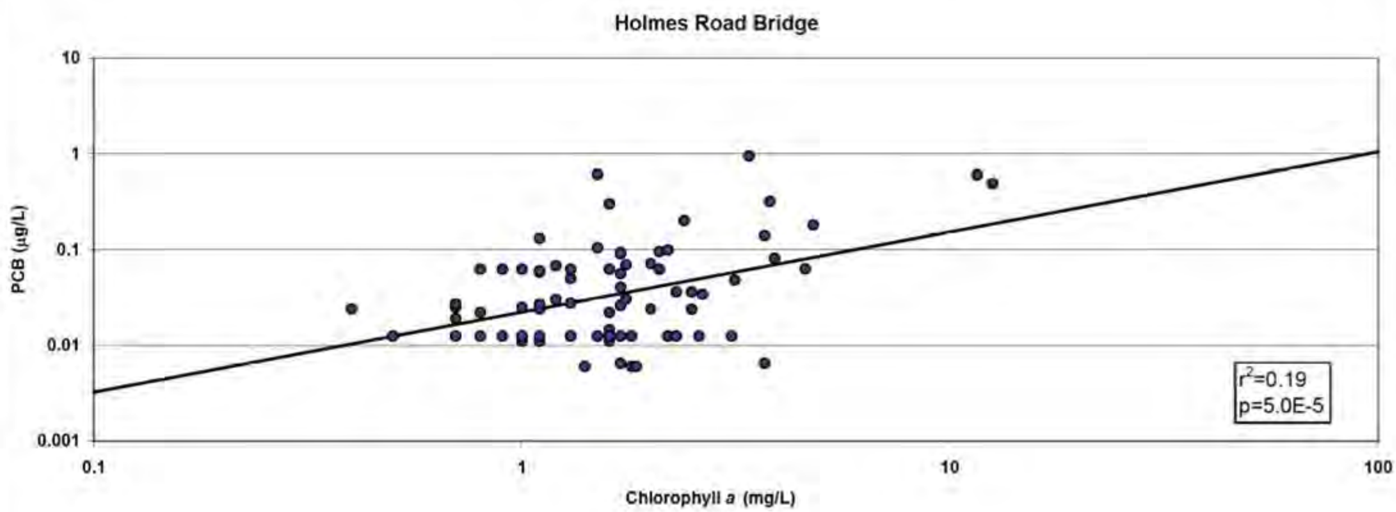

Notes:
1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. mg/L = milligrams per liter.
4. cfs = cubic feet per second.
5. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data or data from stormwater sampling events or other specialized surface water sampling events.

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RELATIONSHIP OF PCB CONCENTRATION AND CHLOROPHYLL *A* IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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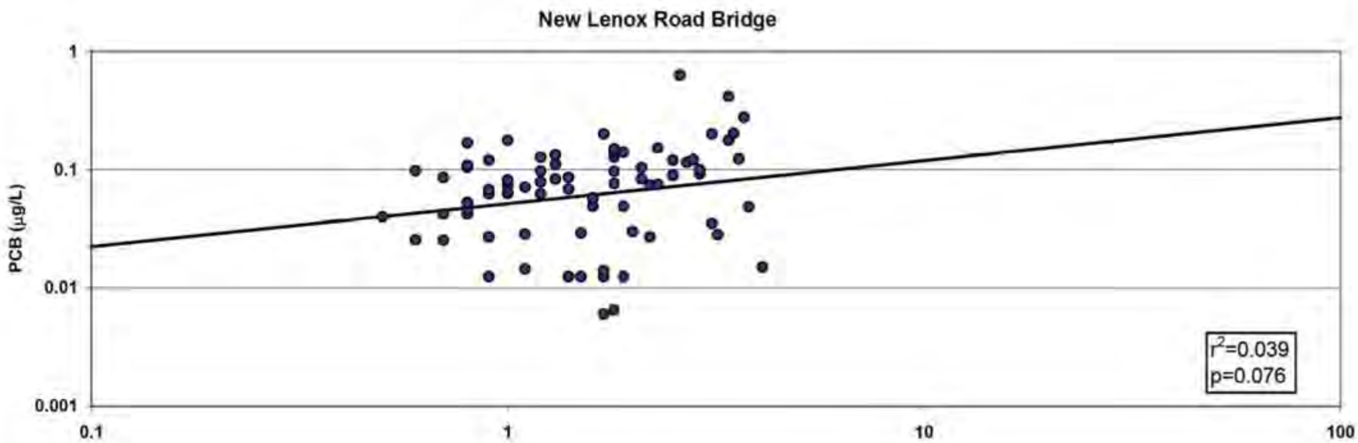
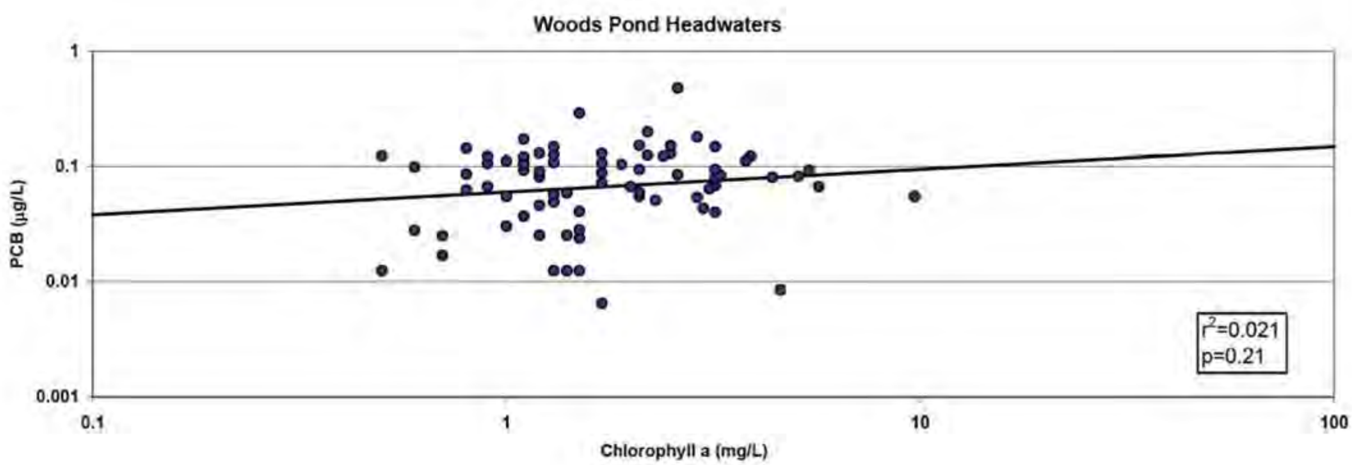
FIGURE 3-17a

Figure 3-17.xls
8/5/2003





Notes:
1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. mg/L = milligrams per liter.
4. cfs = cubic feet per second.
5. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.

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RELATIONSHIP OF PCB CONCENTRATION AND CHLOROPHYLL A IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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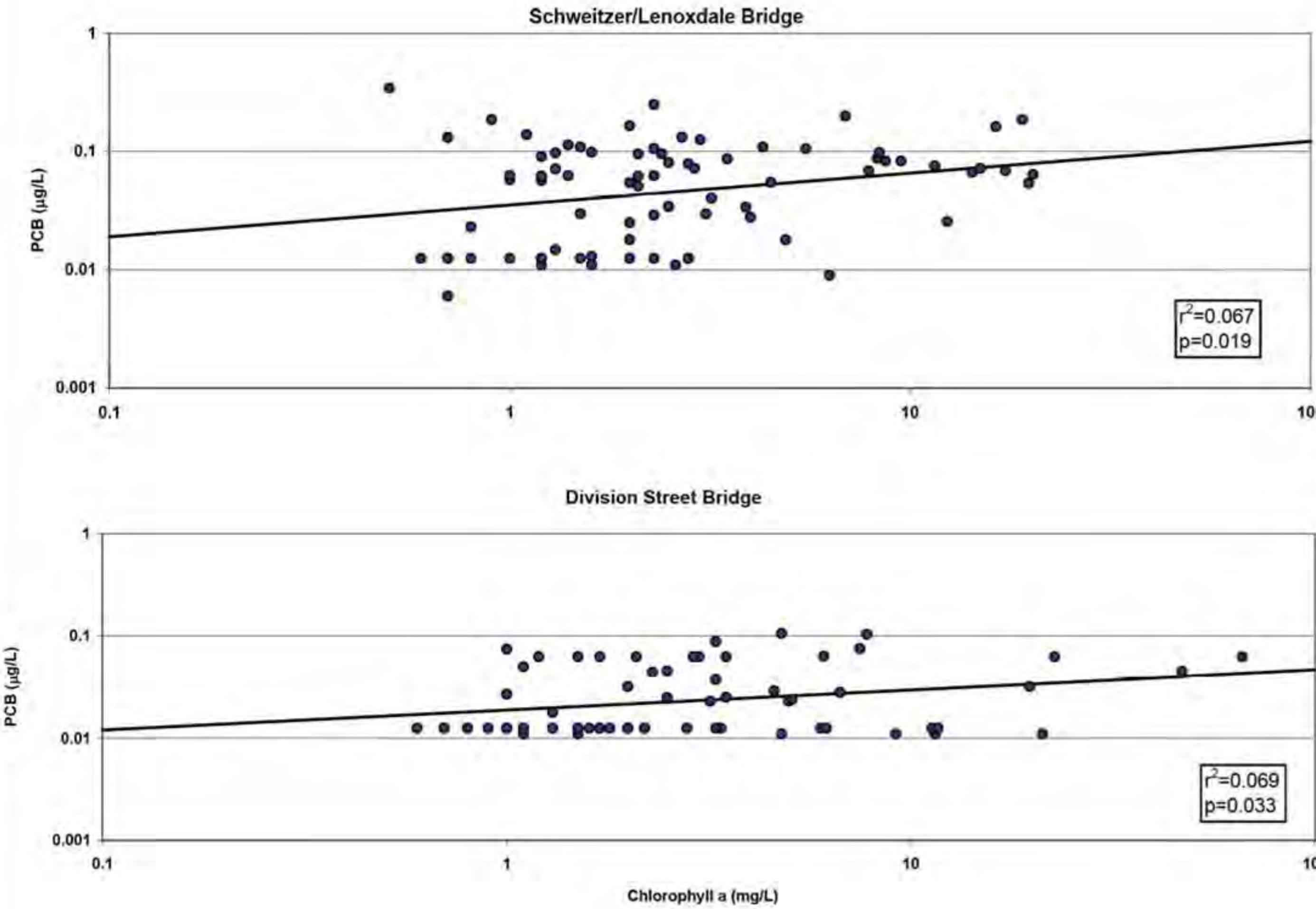
FIGURE 3-17b

Figure 3-17.xls
6/5/2003



Notes:
1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. mg/L = milligrams per liter.
4. cfs = cubic feet per second.
5. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.

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RELATIONSHIP OF PCB CONCENTRATION AND CHLOROPHYLL A IN HOUSATONIC RIVER SURFACE WATER SAMPLES

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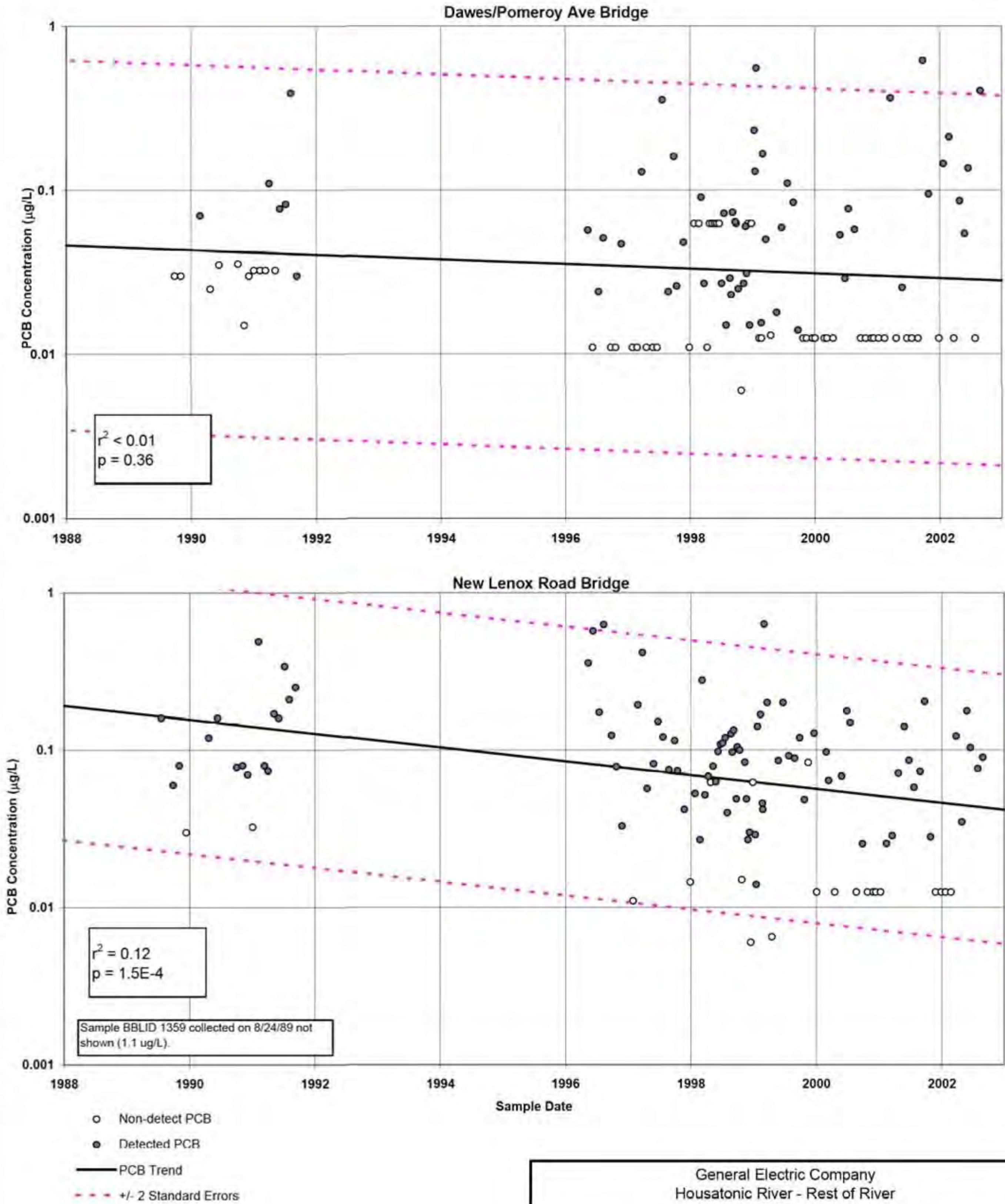
FIGURE
3-17c



Notes:

1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data or data from stormwater sampling events or other specialized surface water sampling events.

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PCB TRENDS IN HOUSATONIC RIVER SURFACE WATER

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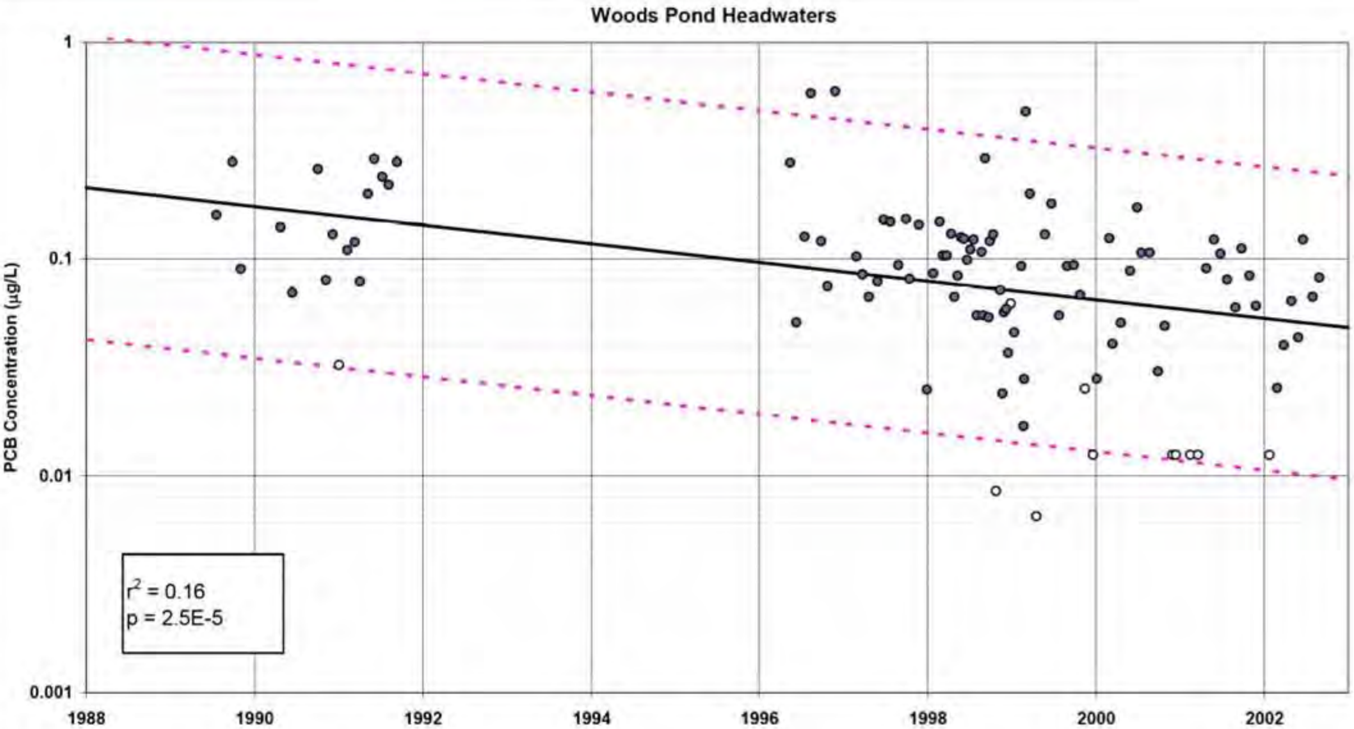
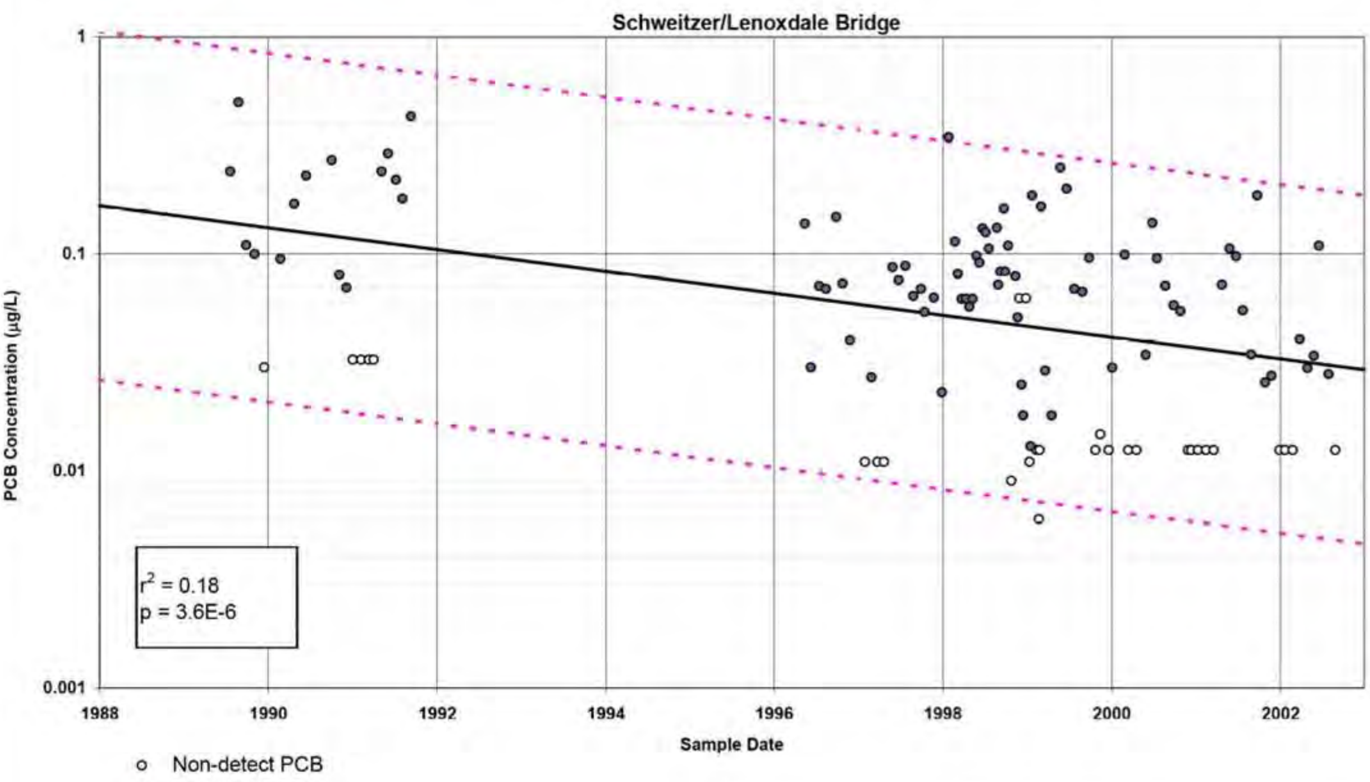
FIGURE 3-18a





Notes:
1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.

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RFI Report

PCB TRENDS IN HOUSATONIC RIVER SURFACE WATER

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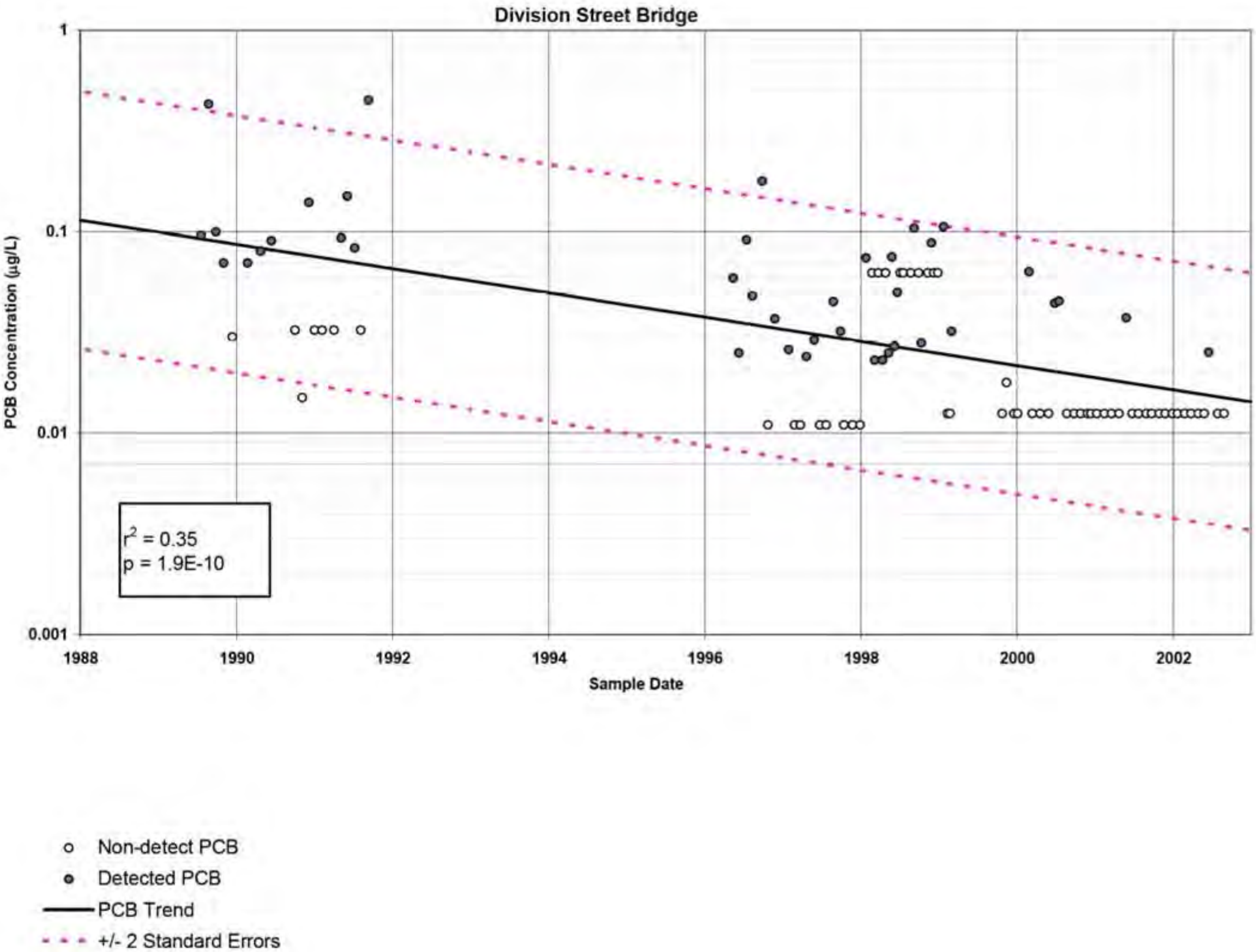
FIGURE 3-18b



Notes:
1. PCB = polychlorinated biphenyls.
2. µg/L = micrograms per liter.
3. Presents monthly and bi-weekly water column monitoring data collected by GE (1996-2002) and EPA (1998-1999). Does not include pre-1996 data,or data from stormwater sampling events or other specialized surface water sampling events.

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PCB TRENDS IN HOUSATONIC RIVER SURFACE WATER

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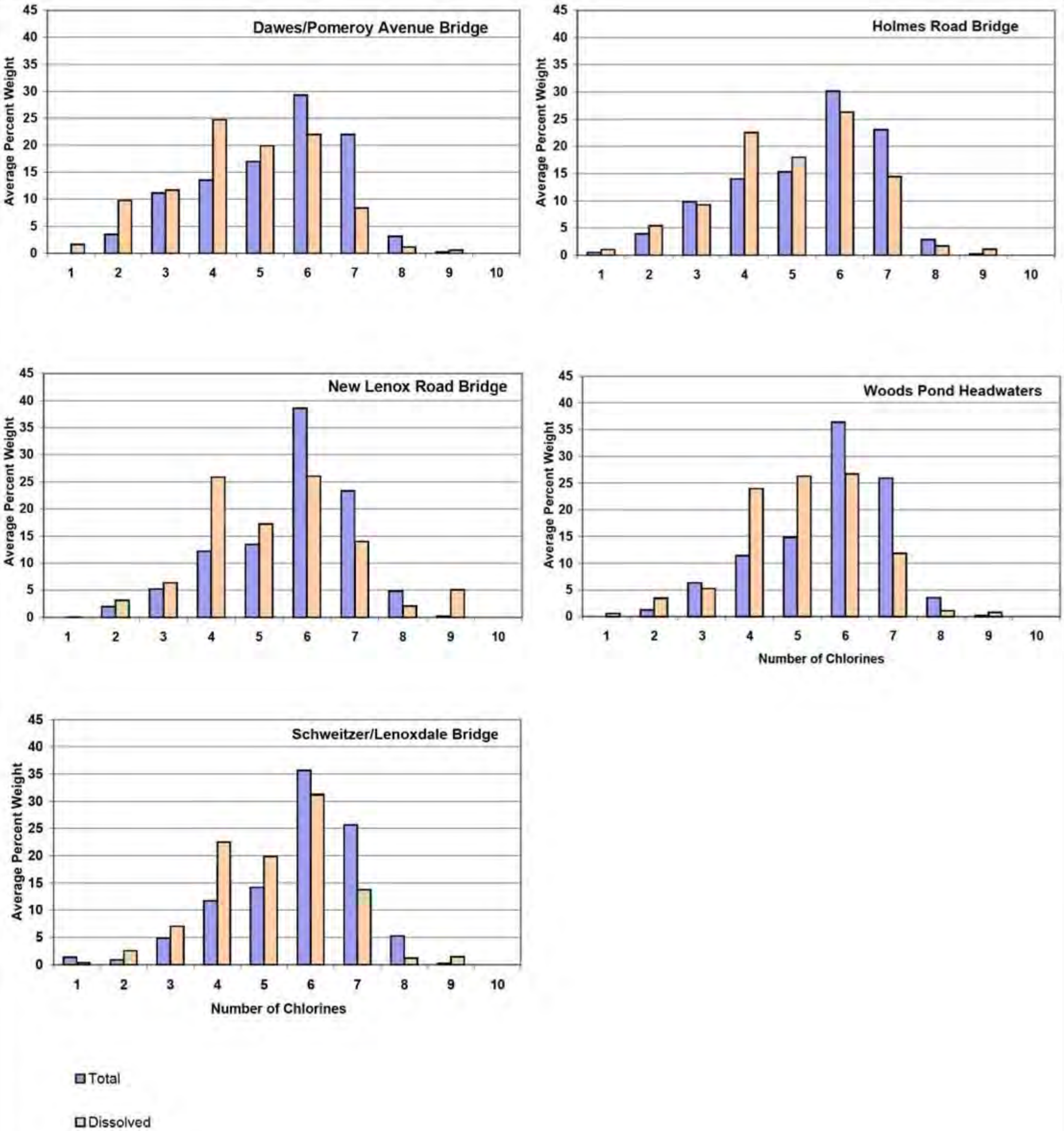
FIGURE
3-18c



Note:
1. Presents the arithmetic average PCB homolog percent weight for PCB congener data collected by EPA.

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PCB HOMOLOG DISTRIBUTION IN TOTAL AND DISSOLVED WATER COLUMN SAMPLES

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FIGURE
3-20

Section 4

4. Sediment Investigations

4.1 General

This section presents the results of a wide variety of sediment investigations designed to assess the physical characteristics of Housatonic River sediment, the nature and extent of PCBs and other constituents in sediment, and the factors that affect the fate and transport of PCBs in the sediment. After providing an overview of all sediment sampling and PCB data collected from the major investigations conducted in the Rest of River area, subsets of the sediment data are evaluated as appropriate to assess spatial and temporal trends in PCB concentrations. Data are typically divided into the River reaches defined by EPA and described in Section 2 (e.g., 5A, 5B, etc.). The primary subject of analysis is the River channel sediment, including sediments in impounded areas of the River. The results of sediment sampling performed in backwater areas are also presented and analyzed in this section.

Section 4.2 provides a review of the sampling and analysis activities conducted in the Rest of River area since the mid-1970s. Section 4.3 presents an assessment of the major datasets for the purposes of identifying the appropriate data for evaluation of trends and relationships. Section 4.4 presents an analysis of physical characteristics of the sediments, while Section 4.5 presents an evaluation of the nature, extent, and spatial distribution of PCBs in sediments in the Rest of River area, and includes an evaluation of sedimentation. Information relevant to temporal trends in PCB concentrations in surface sediments is provided in Section 4.6, estimates of PCB mass in the sediments are presented in Section 4.7, and sediment PCB composition is discussed in Section 4.8. Finally, a discussion of other constituents in sediments is presented in Section 4.9, and a summary of conclusions drawn from sediment investigation is provided in Section 4.10.

4.2 Description of Sediment Sampling and Analysis Activities

Numerous sediment investigations have been conducted since the mid-1970s to study the presence and extent of PCBs and other chemical constituents in the sediments of the Housatonic River. These investigations have been conducted with varying objectives, locations, and potentially different analytical methods and data QA/QC procedures. Thus, the following subsections present a brief overview of the activities and results, and provide the rationale for the identification of the most appropriate dataset to analyze the nature and extent of PCBs in the Rest of River. A summary listing of sediment investigation/sampling activities conducted since 1977 is contained in Table 4-1, and these programs are described in detail in Appendix A.

4.2.1 1970s to 1990

Between 1979 and 1982, CAES, in cooperation with CDEP and USGS, performed a detailed study of the sediments in portions of the Housatonic River in Connecticut and, to a lesser extent, Massachusetts after the initial identification of PCBs in the River sediments. The CAES study was designed to assess the extent of PCB contamination in the River system and "to determine the mass of PCBs in the bottom sediments of the Housatonic River and determine the rate of transport of suspended sediment and PCBs down the river" (Frink et al., 1982). A total of 174 sediment core samples (of various depth increments) were analyzed for PCBs. TOC was also measured in a number of samples.

In 1980-82, on GE's behalf, Stewart conducted an extensive study of the presence and distribution of PCBs within the sediments of the Housatonic River system. As part of the Stewart study, 36 major sediment sampling stations between Center Pond in Dalton, Massachusetts, and the Connecticut state border were identified. A total of 892 sediment samples were collected for PCB and grain size analyses.

In October 1986, on behalf of GE, LMS collected one sediment core from each of six locations in or near Connecticut, including Falls Village Impoundment, Bulls Bridge Impoundment, Route 133 Bridge, Shepaug Dam, and Route 84 Bridge (all in Connecticut), as well as immediately upstream of the dam at Stevenson, Massachusetts. Sediment cores, ranging in depth from 7 to 31 inches, were sectioned into 1-inch increments, resulting in 100 samples submitted for PCB and TOC analyses. The results of these samples were used to assess transport and distribution of PCBs within these impounded areas.

4.2.2 1990 to 1994

In 1990, under the ACO issued by MDEP in that year, Blasland & Bouck, on GE's behalf, undertook an MCP Phase II Investigation to further investigate the nature and extent of PCBs within the Housatonic

River. As part of that investigation, a sediment survey was conducted to supplement the extensive existing database generated during the Stewart studies and to attempt to confirm the distribution of PCBs in the portion of the Housatonic River between Pittsfield and Rising Pond. Thirty-two sampling transects were established from just upstream of the GE facility to Woods Pond. Sediment probing and core sampling were performed at up to nine equidistant locations across the River width. In addition, 39 core locations were established near locations sampled during the 1980-1982 Stewart study. The core locations were selected from those found in the Stewart study to have yielded core samples with PCB concentrations in excess of 50 mg/kg. Sediment cores were sectioned into 6-inch increments to a depth below the level of the areas previously identified as having elevated levels of PCBs, and then into 1-foot increments to the end of the core, resulting in 213 samples for chemical analysis. Sediment samples were analyzed for PCBs and TOC.

In addition to PCB analysis, another objective of the MCP Phase II Investigation was to determine the presence of other chemical constituents in River sediments and to identify which of these might be considered "target" constituents potentially related to releases from the GE facility. Nine core samples were collected in 1990 and 1991 from two locations in Rising Pond and nine locations in the River between the Hubbard Avenue Bridge and the Elm Street Bridge. Samples were analyzed for Appendix IX+3 constituents. In 1992, additional upstream sampling was conducted to further define upstream and/or background levels of inorganic compounds for comparison with downstream sediment concentrations and to aid in the identification of "target" inorganic constituents.

In 1991, a sediment sampling program was conducted by GZA GeoEnvironmental, Inc. (GZA) and GE to assess the nature and extent of contamination of sediments in Rising Pond as a result of releases from the GE facility, and the potential impact of that contamination on management options for the Rising Pond Dam. Sediment core samples were collected from 33 locations in Rising Pond to depths of 3 feet to 4.5 feet below the sediment/water interface. A total of 78 sediment core sections were collected from the 33 locations in Rising Pond and were analyzed for a number of constituents including PCBs, VOCs, total petroleum hydrocarbons, and RCRA-regulated metals.

4.2.3 1995 to 1998

The data obtained as part of the MCP Phase II Investigation and prior Housatonic River investigative efforts addressed many of the MCP Phase II requirements and 1994 EPA RCRA Permit goals as they related to PCBs. However, additional investigations were necessary either to address specific MDEP/EPA concerns or to satisfy data needs identified in GE's *Proposal for the Preliminary Investigation of Corrective Measures for Housatonic River and Silver Lake Sediment* (PICM Proposal) (Canonie Environmental, 1995). To address these data needs, a number of activities were conducted in 1994 and 1995 as part of the Supplemental MCP Phase II/RFI investigation implemented by BBL on behalf of GE. These included:

- Field reconnaissance, sediment probing, and visual characterization of sediments;
- Sediment sampling to further delineate the horizontal and vertical extent of PCB contamination;
- Assessment of correlations among grain size, PCB concentration, and oil and grease content;
- Evaluation of historical sedimentation rates;
- Sediment sampling in the Connecticut portion of the Housatonic River for PCBs and TOC; and
- Assessment of concentrations of other chemical constituents.

Each of these field efforts is discussed in detail in Appendix A.

GE sponsored a number of subsequent sediment sampling programs in part to address MCP Phase II data needs. Between May and June 1996, BBL, on behalf of GE, collected 380 discrete sediment samples in the Housatonic River. Within the Rest of River between the Confluence and the Woods Pond Dam, 289 sediment samples were collected; all 289 were analyzed for PCB, and 99 of the 289 were also analyzed for TOC.

Subsequently, between December 1997 and March 1998, on behalf of GE, BBL conducted sediment core sampling and analysis in the Housatonic River to provide additional information on PCBs in sediments between Woods Pond and Connecticut. The sampling program consisted of surface sediment coring, sampling and analysis of Cesium-137 (Cs-137 or ^{137}Cs) in finely segmented deep cores, and bulk sediment sampling. The surface sediment survey provided surface sediment PCB information for comparison with historical data. The Cs-137 coring program provided information on the depositional history of PCBs within several Housatonic River impoundments, including Rising Pond, Falls Village Dam impoundment, and Bulls Bridge Dam impoundment. Bulk sediment cores provided data on bulk sediment qualities (e.g., bulk density and grain size) at various locations on the River. Tests were also performed on sediment cores to evaluate the erosion properties of cohesive sediments in these areas (discussed in Section 8).

4.2.4 1998 to Present

In 1998 and 1999, on behalf of EPA, Weston conducted systematic and discrete sediment sampling programs along the five designated Rest of River reaches as part of EPA's SI to further delineate the nature and extent of PCBs and other constituents in sediment. These data were also collected to facilitate EPA's human health and ecological risk assessments, as well as its modeling study. Systematic sampling consisted of the collection of samples at regular intervals over the study area. The interval distance for systematic sampling in each reach was determined based on several factors, including expected contaminant concentrations, distance from sources, and length of River reach (Weston, 2000). Weston conducted a comprehensive survey of sediment depth to aid in defining the sediment profile within each reach. Core collection locations were placed at approximately three equidistant points along each transect, unless the review of the probing information warranted otherwise. Within the Rest of River, sediment cores were generally sectioned into the 0- to 6-inch, 6- to 12-inch, 12- to 18-inch, and 18- to 24-inch depth intervals prior to laboratory analysis. Approximately 980 systematic sediment samples were analyzed for PCBs (total and Aroclors), 1,070 samples were analyzed for grain size, 870 samples were analyzed for percent solids, and 1,050 samples were analyzed for TOC. A total of 42 samples were analyzed for Appendix IX SVOCs, organochlorine pesticides, PCDDs/PCDFs, and inorganics, and eight additional samples were analyzed for Appendix IX organophosphate pesticides and herbicides.

In addition to the systematic sampling program, EPA also conducted a discrete sampling program between 1998 and 2002. Discrete sampling consisted of "random, judgmental, or focused samples collected at distinct locations" (Weston, 2000) for the purposes of supporting EPA's human health and ecological risk assessments and modeling study. Under this program, sediment samples were collected from specific locations (e.g., aggrading bars), specific habitats (e.g., vernal pools), or areas determined by EPA to be associated with recreational use (e.g., canoe-launch areas). Paired sediment and pore water samples were also collected to evaluate PCB partitioning characteristics. Further, EPA performed periodic cross-section surveys to evaluate changes in the sediment bed morphology (presented in Section 8). As discussed below, EPA's systematic and discrete sampling programs comprise a large proportion of the total available PCB data, and provide the most recent data for the Rest of River area.

Table 4-2 (below) summarizes the number of samples that EPA collected for PCB analysis by sampling protocol (e.g., systematic) and location (i.e., reach). Sample counts for the CAES and GE sampling efforts from 1980 through 1998 are included for comparison.

Table 4-2. Number of Discrete and Systematic Samples Collected for Total PCB Analysis

Sampling Description	Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7	Reach 8	Reach 9	Connecticut	Total
EPA Systematic Sampling	190	129	305	14	100	286	--	--	--	**1024**
EPA Discrete Sampling	1034	420	634	76	618	93	279	63	44	**3261**
CAES/GE Sediment Sampling	282	159	297	134	506	176	121	133	364	**2172**
Total	**1506**	**708**	**1236**	**224**	**1224**	**555**	**400**	**196**	**408**	**6457**

Notes:

1. All samples compiled from GE and EPA November 2002 databases, respectively.
2. EPA systematic sampling includes all EPA program codes 1 and 2 data results collected between 1998 and 1999.
3. EPA discrete sampling includes all EPA program codes 3 through 99 data results collected between 1998 and 2002.
4. CAES/GE sampling includes all sampling conducted between 1980 and 1998.

All data on sediment PCB concentrations and other relevant physical parameters (e.g., TOC, percent solids) corresponding to these PCB results are presented in tables in Appendix B, while figures in Appendix B that were developed by EPA show sediment sample locations and associated PCB results. Summary statistics on all detected non-PCB constituents in sediments are included in tables in Appendix C.

4.3 Identification of Appropriate Data for Spatial Trend Analysis

Based on the descriptions provided above, data exist from several sampling programs designed to study PCBs in Housatonic River sediments. These programs were conducted at different times and each had its own objectives and employed program-specific sample collection and analytical methods, as well as QA/QC protocols. Data are available from four major sampling programs (or sets of programs):

1. 1978-82 CAES/USGS and Stewart studies;
2. 1990-94 GE/Blasland & Bouck sampling;
3. 1995-98 GE/BBL sampling; and
4. 1998-2002 EPA sampling.

The data from these programs through 1996 were presented and discussed in the 1996 RFI Report (BBL, 1996) and other prior reports, as listed in Table 4-1, and all data are included in Appendix F. The sediment PCB data from each of the above programs are shown on Figure 4-1, which depicts, by depth increment, all such data and the data average by RM, with the data from each of the above programs shown in different colors.

The PCB results from the 1978-1982, 1990-1994, and 1995-1998 datasets may be briefly summarized as follows:

- The 1978 and 1982 sediment PCB data were collected in both the Massachusetts and Connecticut portions of the Housatonic River. Within the Rest of River, PCB concentrations generally decreased with distance downstream, with the highest levels observed between the Confluence and Woods Pond Dam. Total PCBs ranged in concentration from non-detect to 270 mg/kg, and were detected in nearly 96% of the samples.
- Between 1990 and 1994, sediment samples were also collected in both the Massachusetts and Connecticut portions of the River. PCB concentrations ranged from non-detect to 610 mg/kg, and were detected in approximately 78% of samples.
- Sediment samples collected between 1995 and 1998 from locations between the Confluence and Bulls Bridge Dam in Connecticut contained total PCB concentrations that ranged from non-detect to 430 mg/kg, plus one sample with a higher concentration (2,270 mg/kg) observed near the Confluence in 1996. PCBs were detected in 82% of samples.

As shown on Figure 4-1, these earlier datasets exhibit a generally similar range in concentrations and spatial trend as the more recent 1998-2002 EPA data, characterized by large local variability and a decline in the one-mile averages over the reaches downstream of the Confluence. Some differences are evident between the earlier and recent datasets. While some of these observed differences may be related to changes in surface sediment concentrations over time, some of these differences may be attributed to changes in analytical methods, detection limits, and data QA/QC procedures over time. For example, analysis of split sediment samples collected by GE during the 1998-99 EPA sampling program indicated the presence of inter-laboratory variability and may explain some of the observed differences between datasets (see Appendix D). These factors are taken into consideration when the datasets are used together for assessment of temporal trends in PCB concentrations in Section 4.9.

The 1998-2002 EPA dataset (combining EPA's systematic and discrete sampling results) provides the most recent measurements and has by far the greatest number of samples. Furthermore, the EPA dataset provides the most comprehensive spatial coverage (Figure 4-1). Moreover, this dataset also contains the most consistent segmentation scheme, and the most extensive and consistent measurements of TOC and grain size from which to establish relationships with measured PCB concentrations. In contrast, for example, the 1980-1982 Stewart dataset lacks TOC measurements, while a large fraction of the 1995-1998 GE/BBL cores were sectioned into different intervals from the 6-inch intervals used in the EPA sampling program, and grain size analysis was not performed for all samples in that GE/BBL program. For these reasons, and given the generally similar concentration ranges and spatial distributions shown by the PCB data from all programs (Figure 4-1), the 1998-2002 EPA dataset provides the most appropriate basis for evaluating the current nature and extent of PCBs and related physical characteristics of the sediments in the Rest of River. Accordingly, in the remainder of this section, the evaluations of sediment physical characteristics, spatial PCB trends, and relationships among sediment physical properties were generally carried out with the EPA 1998-2002 dataset. However, one addition was made to that dataset for purposes of these evaluations. Specifically, the GE/BBL data collected in December 1997 through 1998 were included in the spatial analyses for reaches downstream of Woods Pond Dam because those data represent a significant fraction of the available PCB data downstream of Rising Pond (see Figure 4-1).

In assessing the available data, sediment samples were generally categorized as either surface (i.e., 0 to 6 inches) or subsurface (i.e., 6-inch increments down to the end of the core). In the event that a sediment core was not sectioned in 6-inch increments, but a true 6-inch measurement could be constructed, the core was depth-weighted into 6-inch increments to provide representative concentrations for the analyses (e.g., results from 0- to 2-inch and 2- to 6-inch core sections were weighted by factors of 1/3 and 2/3, respectively, to calculate the 0- to 6-inch value). A subset of samples was not incorporated in the general

6-inch layer sediment data processing because of differences in depth sectioning and/or sampling techniques (e.g., sediment fractionation); however the data from these samples are included in Appendix B. In addition, results from duplicate samples were averaged with their respective parent samples prior to analysis of the data presented in this section. Also, split sample results were not included in the analysis.

4.4 Physical Characteristics of Sediments

A number of sediment samples have been collected from the River channel and backwater areas and analyzed for various physical characteristics, including solids content, grain size distribution, specific gravity, bulk density, and TOC content. To evaluate the spatial distribution of these parameters in Housatonic River sediment, results were grouped by EPA-defined River reach as described in Section 2 and evaluated collectively. Unless specifically noted otherwise, the following evaluations were performed using the dataset discussed in Section 4.3.

The remainder of this section presents the reach-specific results for the physical parameters. Results for individual samples are included in Appendix B, where available, in conjunction with the associated sediment PCB data.

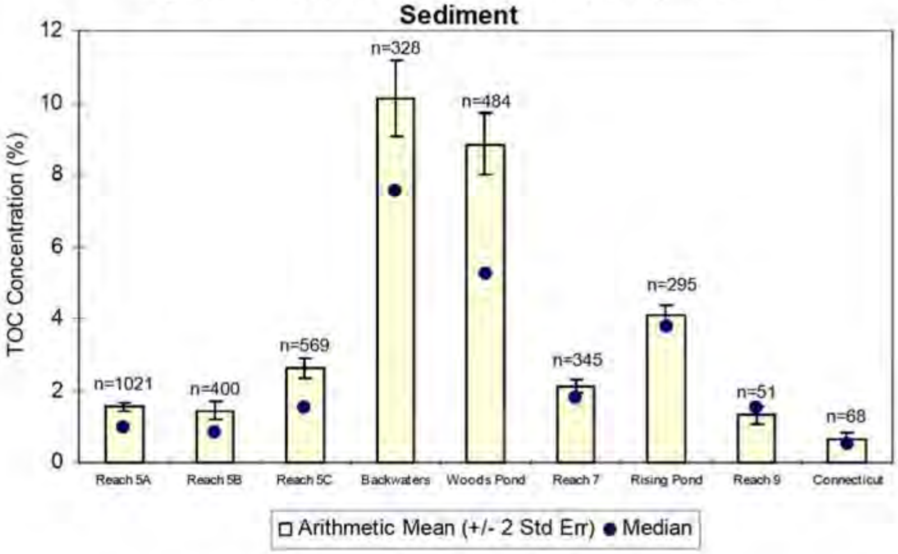
4.4.1 TOC

Sediment TOC is an important determinant of the distribution of PCBs and other hydrophobic organic chemicals within natural water bodies. This is due to the chemicals' affinity for organic carbon. Consequently, TOC plays an important role in the fate and transport of these chemicals.

To evaluate the spatial distribution of TOC in sediments present in the main channel and backwater areas of the Housatonic River, the data discussed in Section 4.3 were first compiled by reach and depth, as shown in Table 4-3. In summary, approximately 3,500 samples were analyzed for TOC at depths up to 14.5 feet (Woods Pond), with TOC concentrations ranging from non-detect to 57.8% by weight (0- to 6-inch backwater sample). As noted in Table 4-3, approximately 60% of the TOC dataset corresponds to samples collected between the Confluence and Woods Pond. Within each reach, the surficial (0- to 6-inch) segment was the depth interval most frequently analyzed, with a general decrease in available TOC data with depth. While sufficient TOC data are not available to assess vertical trends much below 2 feet to 3 feet in most of the reported River reaches and no discernible trend is noted in the upper few feet, a review of the mean TOC concentrations by reach for the upper few feet of sediment suggests that TOC may increase with depth in Rising Pond and decrease with depth in the backwater areas.

To help assess whether notable changes in sediment TOC concentrations exist among the various reaches, a scatter plot of all surficial and subsurface (samples collected at depths below 6 inches) TOC data (Figure 4-2) and a bar chart depicting overall reach mean and median sediment TOC concentrations (Figure 4-3) were prepared. As noted on Figure 4-2, the distribution of surface and subsurface sediment TOC concentrations are generally similar, except in Rising Pond (Reach 8), where there is a slight increase in the number of higher subsurface TOC samples. For both surface and subsurface samples, there is a general increase in sediment TOC concentration in the impoundments associated with Woods Pond and Rising Pond, and to a lesser extent in the impounded areas of Reach 7 (i.e., Columbia Mill Dam, Willow Mill Dam, and Glendale Dam). The increased TOC concentrations in sediments in the more quiescent, finer-grained sediment accumulation areas are further depicted on Figure 4-3 (below).

Figure 4-3. TOC Concentration in Housatonic River Sediment



Note:
Includes all TOC data from all depths collected by EPA (1998-2002) and GE (Dec. 1997-1998).
n = sample size.

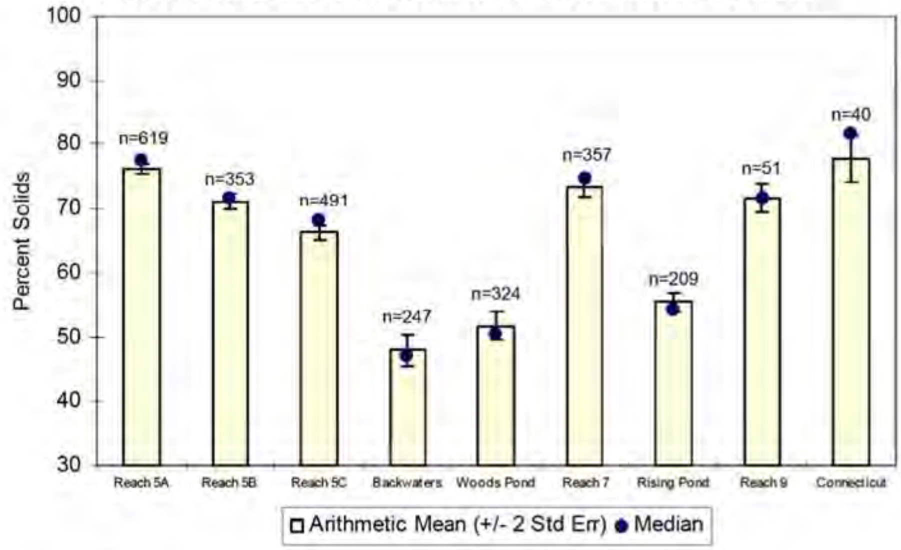
Between the Confluence and Woods Pond Headwaters, the average sediment TOC concentrations increase from approximately 1.5% in Reaches 5A and 5B to 2.6% in Reach 5C, and increase substantially to approximately 9% to 10% in the backwaters and Woods Pond (see Figure 4-3, above). From Woods Pond Dam to the Connecticut border, the sediment TOC averages decrease to less than 2%, except in Rising Pond, where the average TOC concentration is approximately 4%. The median sediment TOC concentrations are generally lower than the averages, but follow similar trends.

4.4.2 Percent Solids

The percent of solid material in a sediment sample is descriptive of its composition, density, and depositional environment. Similar to TOC, collection and analysis of solids data can provide further insight on the observed distribution of PCBs and other organic constituents in sediment, since TOC and percent solids are generally inversely related. All available percent solids data for the Housatonic River sediment were collected by EPA (1998-2002), and are summarized by reach/subreach and by depth increment in Table 4-4. In summary, approximately 2,800 sediment samples were collected from the Massachusetts and Connecticut portions of the Housatonic River for percent solids analysis. Approximately 40% of the results were obtained for surficial (0- to 6-inch depth increment) sediment samples, with the remainder being for samples collected at depths of up to 14 feet. The percent solids reported for the sediments samples ranged from 1.1% to 100%, with an overall average of 70%. Percent solids appear to be generally similar among depth intervals. A slightly increasing trend was noted with increasing depth at some locations (e.g., Woods Pond); however, this could be related to the relatively fewer number of samples collected at depth.

To help assess whether notable changes in percent solids exist among the various reaches, a bar chart depicting average and median percent solids by reach (Figure 4-4, below) was prepared. As expected, the trend in percent solids data is opposite from that observed in TOC concentrations. Since the deposition of fine sediments and organic debris results in typically lower solids content (and higher TOC), lower reported solids are found in the impounded and backwater areas. In the higher-energy, more riverine portions of the River (Reaches 5, 7, and 9), the coarser, more sandy material is reflected by average percent solids typically of 70% or more. The lowest percent solids were in the backwater areas, indicative of the fine organic sediment in those quiescent areas. The median percent solids were generally similar to the reach averages.

Figure 4-4. Solids Content in Housatonic River Sediment



Note:
Includes all solids data collected by EPA (1998-2002). No solids data were collected during GE sampling (Dec. 1997-1998).
n = sample size.

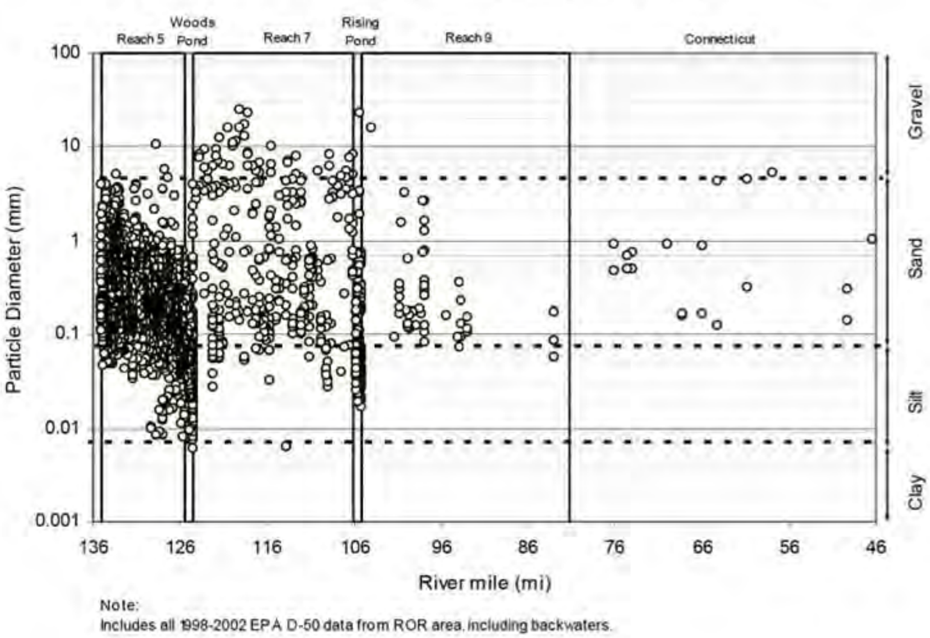
Within these reaches, the percent solids data show the effect of dams on the sediment characteristics. All percent solids data are shown by distance on Figure 4-5. A decline in percent solids is evident in surface sediment behind Woods Pond Dam, Rising Pond Dam, and the three smaller dams between them in Reach 7. For example, solids content in both surface and subsurface sediments declines through the subreaches of Reach 5, decreasing almost 20%, on average, in the top 6 inches from Reach 5A to Reach 5C (Table 4-4). Within Woods Pond, Rising Pond and the backwater areas, solids content in the surface sediments was much lower than observed in the riverine reaches.

4.4.3 Grain Size Distribution

Grain size analyses were conducted on approximately 3,400 sediment samples collected from the Housatonic River to further characterize areas of finer and coarser sediment. Grain size analysis is determined by measuring the various percentages of the sediment mass that pass specific sized sieves. Therefore, a high weight percent of smaller particle size material is indicative of fine-grained material such as silt, clay, or loam. The presence of fine-grained material, in turn, indicates a low-energy, net depositional environment, where lower percent solids and higher TOC concentrations would be expected.

A useful measure of grain size is the D-50 value, or the median diameter of the sediment particles from a sample. The use of the D-50 value allows for a general categorization of the sediment type: clay (particle diameter = < 0.007 millimeter [mm]), silt (diameter = 0.007 to 0.075 mm), sand (diameter = 0.075 to 4.75 mm), and gravel (diameter = > 4.75 mm). These particle diameter ranges associated with each sediment type are consistent with the data in the EPA Housatonic River database and represent a modification of the Unified Soil Classification System (USCS). A summary of the D-50 data by reach and by depth is presented in Table 4-5, while Figure 4-6 (below) shows the D-50 for each sample plotted by distance. In summary, D-50 values range from 0.0060 mm to 25 mm, with an overall average of 0.49 mm. Figure 4-6 indicates a general decline in D-50 values through the subreaches of Reach 5 and into Woods Pond. As expected, the sediment D-50 values are generally smaller in the slower-flowing, depositional Woods Pond, Rising Pond, and backwater environments than in the more riverine sections. Based on a review of the data presented in Table 4-5, no distinct vertical trends in grain size are apparent.

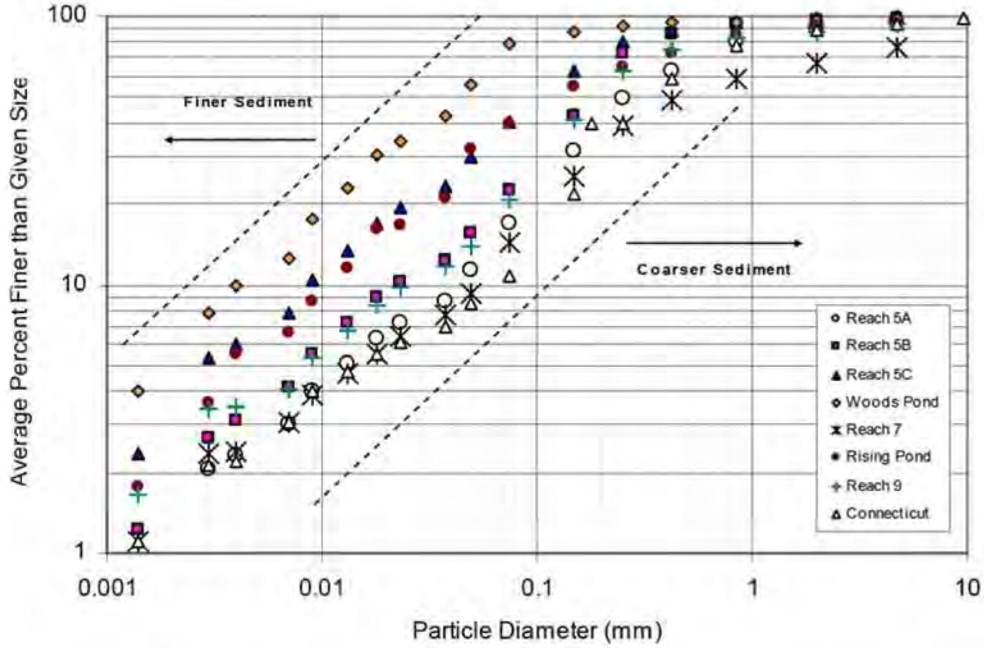
Figure 4-6. D-50 Results for Housatonic River Sediment



Note:
Includes all 1998-2002 EPA D-50 data from ROR area, including backwaters.

To further assess grain size distribution in surficial sediments, the mean particle size distribution in Housatonic River surface sediment was plotted by reach (Figure 4-7, below). A summary of the analysis of the grain size data in surface sediment, by reach, is presented in Table 4-6.

Figure 4-7. Mean Particle Size in Housatonic River Surface Sediment



Note:
Includes all surface (0-6 in) sediment data collected by EPA (1998-2002) from ROR area, including backwaters.

Consistent with the TOC and percent solids data, these grain size data provide further evidence as to the depositional nature of Woods Pond, Rising Pond, and Reach 5C. The sediment particles are finer in the slower-flowing Woods Pond and Rising Pond environments and backwater areas than in the faster-flowing channel sections. For example, in the surface sediment of Woods Pond, almost 90% of sediment by weight is smaller than 0.1 mm, while in Reach 5, less than 30% of sediment by weight is smaller than 0.1 mm (see Figure 4-7). Within Reach 5, results of particle size analysis showed that, as expected, surface sediment in the low-energy, depositional area near Woods Pond Headwaters is composed of the finest material. Between Woods Pond Dam and Rising Pond, over 90% of sediment is larger than 0.1 mm, indicating a substantially coarser sediment bed. The surface sediments of Rising Pond are slightly coarser than those of Woods Pond, but still indicative of deposition of finer material, with approximately

50% of the surface sediment by weight smaller than 1 mm. Downstream of Rising Pond, surface sediment particle size is similar to the results seen in Reach 5.

4.4.4 Bulk Density

To provide further insight on the physical characteristics of Housatonic River sediment, bulk density was measured. Bulk density represents the dry mass of solids per in-situ unit volume, including sediment and pore space (i.e., grams dry / cm^3 wet). Therefore, sediments that are more finely textured (i.e., silt, clay) and less consolidated have lower bulk densities. It should be noted that most of the bulk density measurements discussed in this section were made on surface sediment samples. Bulk density in deeper samples is generally higher than in the surface sediments as a result of consolidation.

To provide for the most robust bulk density dataset, data collected during GE's bulk sediment sampling program (1997-1998) and results from EPA's discrete sampling program (conducted from 1999–2001) were combined to provide site-specific bulk density data for the Rest of River reaches and backwater areas. A total of 112 sediment samples were collected by GE and EPA from the Massachusetts and Connecticut portions of the River for bulk density analysis. A summary of the samples analyzed by reach/subreach is presented in Table 4-7. Bulk densities ranged from 0.1 g/cm^3 to 1.8 g/cm^3. In general, sediment bulk density in the more free-flowing reaches of the Housatonic River are relatively consistent, with average bulk densities ranging between 0.89 gram per cubic centimeter (g/cm^3) (Reach 7) and 1.3 g/cm^3 (Reach 5A). Reflective of the depositional nature of the area upstream of Woods Pond, Woods Pond, and Rising Pond (Reaches 5C, 6, and 8, respectively), bulk densities are lower in those reaches, with averages of 0.74 g/cm^3, 0.37 g/cm^3, and 0.64 g/cm^3, respectively. These values are consistent with the less consolidated, finer-grained sediment found in the impoundments, which have higher water content and TOC concentrations than those in the higher-energy riverine areas. The reported sediment bulk densities in backwater areas are similar to those observed in the impoundments, with a mean of 0.52 g/cm^3.

4.4.5 Other Physical Parameters

Other parameters that are sometimes used to characterize sediments include pH, ion exchange capacity, settleability characteristics, and shear stress data. The Housatonic River sediment sampling programs did not include measurements of pH, ion exchange capacity, and settleability characteristics. Shear stress data, in the form of cohesive sediment erosion tests, were collected in 1998. Results from these studies are discussed in Section 8.

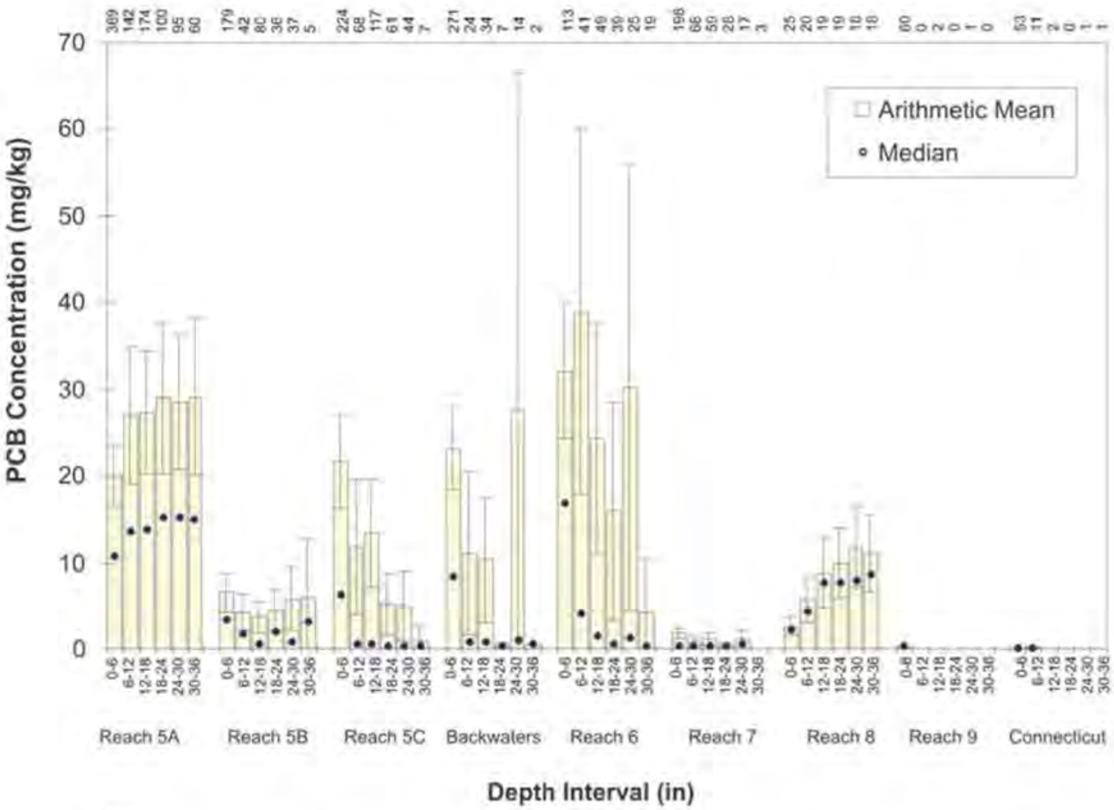
4.5 Nature and Extent of PCBs in Sediments

4.5.1 Overview of PCB Spatial Distribution

Summary statistics for PCB concentrations from the 1998-2002 EPA dataset, supplemented by the GE/BBL 1997-1998 data for reaches downstream of Woods Pond, are provided in Table 4-8 and are plotted for the upper 36 inches of sediment on Figure 4-8 (below). The table and figure show differences in PCB concentrations both among the various reaches and by depth. In general, the differences among reaches (i.e., longitudinal differences) are greater than vertical differences within a given reach. For example, based on the upper 36-inch data plotted on Figure 4-8, average concentrations in Reach 5B are less than those from the corresponding depth intervals in Reach 5A by a factor of 3 to 9. In contrast, the greatest vertical difference among the six-inch depth intervals within Reach 5A or 5B is only a factor of 1.5 (the difference between the 0- to 6-inch and 6- to 12-inch intervals from Reach 5B). Further, the within-reach vertical patterns are not consistent among all reaches (e.g., average PCB concentrations decrease with depth in Reach 5C, but the opposite is true in Reach 8).

In general, as shown on Figure 4-8, the data show the highest average concentrations of PCBs in Reaches 5A and 6 (Woods Pond), with somewhat lower average concentrations in Reaches 5B and 5C. Downstream of Woods Pond Dam, PCB concentrations generally decrease to lower average levels, except in Rising Pond. In that impoundment, average 0-6" sediment PCB concentrations are lower than those in Reaches 5 and 6, and unlike Reaches 5 and 6, the higher average concentrations are present in the deeper increments. The median concentrations are lower, but generally indicate spatial trends similar to the means among reaches. In some reaches (e.g., 5C, backwaters, and 6), the median concentrations are considerably higher in the upper 6 inches than in other depth intervals.

Figure 4-8. PCB Concentrations in Housatonic River Sediment.



Notes:
Includes EPA (1998-2002) and GE (Dec. 1997-1998) sampling data.
Presents arithmetic mean PCB concentration and median in the top 36 inches of sediment (see Table 4-8 for results from all depths). Error bars represent 2 standard errors about the mean. Numbers posted on top of panel represent sample size.

The vertical distribution of PCBs within each reach is discussed in more detail in Section 4.5.2. This is followed by a more detailed discussion of the areal distribution of surface sediment PCBs in Section 4.5.3. The evaluation of areal patterns focuses on surface sediments because the spatial patterns in other depth horizons are generally similar to those in the surface (e.g., average PCB concentrations are lower in Reach 5B than in 5A for all depth intervals plotted on Figure 4-8), thereby simplifying the discussion. The analysis of areal patterns includes both: 1) a discussion of longitudinal patterns, which considers changes in PCB concentrations averaged over one-mile segments to evaluate a scale finer than that of the individual reaches; and 2) a discussion of the PCB distribution in specific regions, such as aggrading bars and terraces, backwaters, and the shallow and deep portions of Woods Pond. Finally, Section 4.5.4 presents a discussion of the geochronological analyses and corresponding estimated sedimentation rates, while Section 4.5.5 provides a brief discussion of PCB concentrations in sediment pore water.

The following discussions of vertical and areal patterns include an evaluation of relationships among PCBs and TOC and grain size (as represented by D-50) to evaluate the extent to which the spatial patterns observed in the PCB data relate to patterns in these physical parameters. For example, a useful way to evaluate the relationship between PCBs and TOC is to evaluate the organic carbon-normalized PCB concentration (i.e., mg PCB/kg organic carbon). In some cases, higher PCBs are associated with higher TOC; organic carbon normalization serves to account for this phenomenon. Furthermore, both diffusive flux to surface water and food web exposure are directly proportional to organic carbon-normalized PCB concentrations.

4.5.2 Vertical Distribution of PCBs

To evaluate the vertical distribution of PCBs within the Rest of River area, probability distributions of sediment PCB concentrations were plotted by depth for each Reach on Figure 4-9. (The discussion in this section of the vertical distribution of PCBs is based on an evaluation of the concentrations from 6-inch core segments. In a limited number of cores, PCBs were measured at a finer vertical resolution to support an evaluation of depositional history; these are discussed in Section 4.5.4.) Since some of the observed vertical differences in PCB concentration may be explained by differences in organic carbon and grain size within each depth interval, average depth profiles of PCB, TOC, organic carbon-normalized PCB concentration and D-50 were plotted for each reach on Figure 4-10. These plots only include data to a depth of approximately 3 feet. For most reaches, a substantial decrease in PCB concentrations and the frequency of detection was observed at depths below 3 feet to 4 feet, although significantly fewer samples were collected at these depths. However, PCBs were found at greater depths within Woods Pond and Rising Pond and therefore data below 3 feet are considered in the discussion of these reaches. PCB data collected at all depths are summarized in Table 4-8. Vertical distribution of PCBs by reach is discussed in the following subsections.

4.5.2.1 Reach 5 – Confluence to the Headwaters of Woods Pond

Between the Confluence and Woods Pond, PCB concentrations ranged from non-detect to 614 mg/kg (Table 4-8). PCBs were detected in approximately 83% of the sediment samples collected within the top 3 feet of sediment. The average surface sediment PCB concentration ranged from 6.5 mg/kg in Reach 5B to 22 mg/kg in Reach 5C. Sediment samples collected at depth intervals below 6 inches generally encompass the same range of concentrations. Within Reach 5A, there is little gradient in the vertical distribution of PCBs within the top 36 inches of sediment. Average PCB concentrations to a depth of 3 feet within Reach 5A are somewhat higher (generally between 5 and 10 mg/kg higher) than surface sediment concentrations. Median PCB concentrations are lower, while generally exhibiting the same vertical trend. Below 36 inches, average PCB concentrations in Reach 5A increase slightly at a depth of approximately 4 feet, and then decrease to non-detect levels below 6.5 feet (Table 4-8). In general, average PCB concentrations are similar in the upper three feet of subreach 5B, while PCBs tend to decrease with depth in subreach 5C (Figure 4-9; Table 4-8). Median concentrations are lower, but exhibit the same vertical pattern as the averages for these subreaches. Vertical variation in sediment TOC was evaluated as a potential explanation for these observations. However, sediment TOC values in Reach 5, on average, do not vary appreciably with depth (Figure 4-10a). On the other hand, in Reach 5C, surface sediment D-50 is nearly a factor of 2 lower than the D-50 of sediments at depth (Figure 4-10a).

During 2001-2002, EPA collected 26 deep "Vertical Definition Cores" within Reach 5. These cores were collected at 13 locations (one core on each side of the channel) to further define the vertical distribution of PCBs within sediments. A profile of PCB concentrations measured in the EPA vertical definition sediment cores is plotted on Figure 4-11. At the majority of locations sampled, the highest PCB concentrations are observed near the surface (i.e., 0 to 6 inches), with samples from deeper sections having generally lower concentrations. However, PCB concentrations at depths below four feet are greater than 1 mg/kg in three of the twelve vertical definition cores from Reach 5A (RM 130 – 135) and one of the fourteen cores from Reaches 5B and 5C..

In addition to channel sediments, PCBs were also measured in sediments located in backwater areas within Reach 5. PCBs were below the detection limit in approximately 20% of the sediment samples collected within the top 3 feet of backwater sediments. Within the top 6 inches of sediment, PCB concentrations ranged from non-detect to 290 mg/kg. In many cases, concentrations in these areas differed from one backwater to another (e.g., high concentrations were observed in one backwater while relatively lower concentrations were observed in another; see Section 4.5.3.2). Similar to the PCB data from the main channel of Reach 5C (where most backwaters are located), the average PCB concentration in backwaters is generally highest in the top 6 inches of sediment (23 mg/kg), and decreases with depth (Table 4-8). One exception is the higher average PCB concentration observed within the 24-30 inch depth interval (28 mg/kg). While the average PCB concentration in this depth interval is similar to the average observed in surface sediments, the large errors bars indicate that there is significant variability in the data collected within this interval (Figure 4-8). The higher surface sediment PCB concentrations observed in backwaters are likely due to the highly depositional nature of these areas and the high organic carbon content of backwater surface sediments (i.e., average of 12%); TOC is relatively lower in sediments at depth within the backwaters (average of approximately 7%) (Table 4-3; Figure 4-10b).

4.5.2.2 Reach 6 – Woods Pond

In Woods Pond, PCB concentrations ranged from non-detect to 668 mg/kg (Table 4-8). PCBs were below the detection limit in approximately 25% of the sediment samples collected within the top 3 feet of sediment in this impoundment. Despite a large amount of variability in the data, PCB concentrations in samples from Woods Pond are generally highest in the top 6 inches, and decrease with depth. This can be illustrated by the probability distribution for Reach 6 in Figure 4-9, which shows that in the 10^{th} to 60^{th} percentile of the data, the concentrations in the top 6 inches are a factor of two or more greater than the concentrations in the deeper intervals. Average concentrations for the individual 6-inch intervals within the top 3 feet of sediment in Woods Pond range from 4.3 mg/kg within the 30-36 inch depth interval to 39 mg/kg within the 6-12 inch depth interval (Table 4-8). At depths of 3 to 7 feet, PCB concentrations were detected but at lower average concentrations ranging from 0.3 mg/kg (72-78") to 18 mg/kg (42-48") (Table 4-8). No distinct vertical pattern is present in the TOC averages (Figure 4-10b).

For the samples segmented into 6 inch sections, the highest average PCB concentration in Woods Pond is 39 mg/kg at a depth of 6 to 12 inches. The average PCB concentration in the surficial 0 to 6 inches of sediment is 32 mg/kg (Table 4-8), which is similar to the 6-12 inch average. Because rates of sediment accumulation may occur relatively slowly, interpretation of vertical patterns in PCBs is difficult at a resolution of 6 inches. Analysis of finely sectioned sediment cores collected within Woods Pond typically show that the PCB peak within the top 6 inches of sediment is generally below the surface, as discussed further in Section 4.5.4.

4.5.2.3 Reach 7 – Woods Pond Dam to Rising Pond

Reach 7 is the first reach within the Rest of River downstream of an impounded portion of the River. Average sediment PCB concentrations in Reach 7 are lower than those in Reaches 5 and 6. PCB concentrations ranged from non-detect to 38 mg/kg, and were below the detection limit in nearly 50% of the sediment samples collected within the top 3 feet of sediment (Figure 4-9). The maximum average PCB concentration (1.8 mg/kg) occurs within the 0- to 6-inch sediment depth interval. Average PCB concentrations at depth are variable, but slightly lower than that for the 0- to 6-inch interval, ranging between non-detect and 1.2 mg/kg (Table 4-8). For comparison, no distinct vertical pattern is present in the TOC averages, while the average D-50 appears to be higher in the top foot than in the deeper intervals (Figure 4-10b).

4.5.2.4 Reach 8 – Rising Pond

Similar to Woods Pond, Rising Pond is an impoundment in which significant deposition of sediment has been documented. PCBs were detected in nearly 90% of samples collected within the top 3 feet of sediment in Rising Pond, and ranged from non-detect to 34 mg/kg. Below 3 feet, average PCB concentrations range from 6 mg/kg to 15 mg/kg at depths between 3 feet and 7 feet, and decrease to less than 1 mg/kg at depths below 8 feet (Table 4-8). Unlike Woods Pond, average PCB concentrations in the top 3 feet of sediment in Rising Pond generally increase with depth; averages increase from 3 mg/kg at the surface to 12 mg/kg at a depth of 24 to 30 inches (Figure 4-10c). The lower PCB concentrations observed in the surface sediments of Rising Pond may be due, in part, to the presence of lower organic carbon, as evidenced by the higher TOC values in the deeper sediments (Figure 4-10c). Furthermore, deposition of "cleaner" sediments over time would also result in the observed trend in the average PCB concentrations in Rising Pond. Vertical patterns in PCBs from finely segmented sediment cores collected from Rising Pond are discussed further in Section 4.5.2.

4.5.2.5 Reach 9 – Downstream of Rising Pond to Connecticut Border

Within Reach 9, PCB concentrations ranged from non-detect to 1.2 mg/kg in surface sediments, and were below the detection limit in 68% of the samples (Table 4-8). The average surface sediment PCB concentration in this reach is 0.27 mg/kg (using a concentration of one half the method detection limit [MDL] for non-detect samples). Only three samples were collected in the subsurface intervals; PCB concentrations in these samples were below the detection limit.

4.5.2.6 Connecticut Reach

Similar to the results reported in Reach 9, PCB concentrations in the Connecticut portion of the Housatonic River are low relative to concentrations measured in upstream reaches. Surface sediment PCB concentrations ranged from non-detect (in 84% of samples) to 0.47 mg/kg, with an average concentration below 0.1 mg/kg (Table 4-8). The majority of samples (12 of 15) collected in the subsurface were below the detection limit, with a maximum concentration of 1.2 mg/kg in the 6- to 12-inch depth interval. Further, vertical patterns in PCBs from finely segmented sediment cores collected from the Bulls Bridge impoundment exhibit concentrations in the 1- to 2-mg/kg range at depths below 8 inches; these are discussed further in Section 4.5.4.

4.5.3 Areal Distribution of PCBs

Differences in average PCB concentrations among Reaches (in surface sediments and at depth) were noted in the discussion of vertical distributions in Section 4.5.2. This section explores the areal distribution of PCBs in Housatonic River sediments, focusing primarily on surface sediment (0- to 6-inch) PCB data. As discussed in Section 4.5.1, longitudinal variability is generally similar among the various depth intervals; therefore trends in only surface sediment are presented to simplify the discussion.

Similar to the differences observed in average PCB concentrations with depth, areal differences in average surface sediment PCB concentrations may be explained, in part, by the distribution of sediment organic carbon and differences in grain size. For this reason, spatial trends in TOC, organic carbon-normalized PCB concentrations, and D-50 are also examined.

4.5.3.1 Longitudinal Patterns in PCB Concentrations

Spatial profiles of surface sediment (0 to 6 inches) PCB concentrations, TOC concentrations, organic carbon-normalized PCB concentrations, and D-50 from the Confluence to Bulls Bridge Dam are plotted on Figure 4-12. To facilitate an assessment of longitudinal patterns, the data in this figure are presented as one-mile averages; this simplifies the assessment by reducing the variability shown in plotted data, which often spans more than four orders of magnitude over a relatively short distance. In general, average dry-weight PCB concentrations decline with distance downstream, ranging from averages of 20 to 40 mg/kg in Reach 5 to near non-detect levels in Connecticut. It should be noted that nearly all surface sediments samples in Connecticut are below the detection limit; the increase in concentration indicated between Falls Village Dam (FVD) and Bulls Bridge Dam (BBD) simply represents a difference in the detection limits between the EPA and GE datasets included in the one-mile averages.

In addition to the general decline in dry-weight PCB concentration with distance downstream, a distinct increase in the average PCB and TOC concentrations is observed immediately upstream of each major impoundment from Woods Pond to Connecticut, followed by a notable decrease in average PCB concentration downstream of the impoundment (Figure 4-12). This observation is consistent with the low-energy, high-deposition environment observed within the impoundments, resulting in increased deposition of PCBs that are sorbed to particulate matter.

On average, TOC between the Confluence and Bulls Bridge decreases with distance downstream, while D-50 shows the opposite trend (Figure 4-12). The observed longitudinal decline in PCB concentration may be explained in part by these spatial trends in organic carbon and sediment grain size. This statement is further supported by examining more closely the average spatial trends in surface sediments of Reaches 5 and 6, as shown on Figure 4-13. The one-mile average surface sediment PCB concentrations are approximately 18 to 25 mg/kg in Reach 5A, decline to 5 to 10 mg/kg in Reach 5B, and increase to approximately 10 to 35 mg/kg and then to 32 mg/kg across Reach 5C and Woods Pond, respectively. The observed increase in average PCB concentration in Reach 5C may be due to the higher organic carbon, fine-grained sediments observed within in this reach. When PCB concentrations are normalized to sediment organic carbon, the one-mile average PCB concentrations in Reaches 5C and 6 are substantially lower and less variable than in Reach 5A (Figure 4-13). Some of the variability in the Reach 5A organic carbon-normalized concentrations is an artifact of a small number of samples with TOC concentrations at a reported detection limit near 0.01% (see Figure 4-2). When the PCB concentration is divided by these low TOC values, the normalized concentration is a factor of 10 or more higher than that of other samples in which TOC was not detected at a detection limit of 0.1% (Figure 4-2).

The relationship between the longitudinal pattern in PCBs and sediment type is further demonstrated by examining the subset of samples collected by EPA in Reaches 5 and 6 in which the sediment was first separated (fractionated) into three different size classes: 1) <62 μm; 2) 62-250 μm; and 3) >250 μm, and then analyzed separately for PCBs and TOC. Data for each size class were averaged by river mile and plotted spatially on Figure 4-14. The spatial trend in sediment PCBs and TOC measured in the fractionation samples is similar to the trend observed in the remainder of the sediment dataset discussed above. As expected, this figure demonstrates that the highest PCB concentrations are generally associated with the smallest size class (<62 μm). On a mass basis, the largest PCB mass is associated with the >250 μm size class in Reach 5A because this sediment fraction contains the largest fraction of total solids mass in this reach (Figure 4-14). The distribution of PCB mass among grain sizes shifts moving downstream, with the finest sediment (<62 μm size class) accounting for the majority of PCB mass within Woods Pond, which is consistent with other observations in that reach. It should be noted that some uncharacteristically high TOC concentrations (greater than 20%) were observed in the coarse (>250 μm) sediment fraction, resulting in the higher and more variable average TOC concentrations shown at RMs 133, 126, and 125 (Figure 4-14). When PCB concentrations are normalized to organic carbon in the sediments, the highest PCB concentrations are again observed in Reach 5A for all three size classes. However, the highest organic carbon-normalized concentrations in Reach 5A are associated with the largest size class. This difference is related to a number of samples with low TOC concentrations, including a few that were reported at a detection limit of approximately 0.01%. As discussed above, normalizing PCB concentrations by these low TOC values adds considerable variability to the averages. In Reaches 5B, 5C, and 6, average organic carbon-normalized PCB concentrations are similar among the three size classes, which is expected if organic carbon is the primary sorbent for PCBs in these areas.

To evaluate the relationships between PCBs and TOC/grain size at a scale of less than one mile, scatter plots of PCB versus TOC and D-50 were developed for all data within a given RM on Figures 4-15 and 4-16, respectively. Within Reach 5A (i.e., RM 135-130), little correlation between PCB and TOC or PCB and D-50 can be seen, as evidenced by the low r^2 and high p-values associated with the log-log regression lines. Within Reaches 5B and 5C, (i.e., RM 130-125), there is relatively less variability and some evidence of a positive relationship between PCB and TOC can be observed (e.g., r^2 values for the regression lines are generally higher). Within Woods Pond, there is relatively less variability in the PCB and TOC concentrations (e.g., PCB, TOC, and D-50 values generally cluster within one order of magnitude in Woods Pond; these values generally span at least two orders of magnitude elsewhere), making an assessment of these relationships difficult. Similarly, PCBs tend to be inversely related to D-50 in Reaches 5B and 5C (Figure 4-16). Based on these plots, however, the variability in PCB concentration at scales of less than one mile cannot be entirely explained by TOC and grain size, suggesting that other sources contribute to the local variability in the distribution of PCBs in the sediments (e.g., analytical variability, see Appendix D.1).

4.5.3.2 PCB Distribution in Deposits and Backwaters

As discussed in Section 4.2, EPA collected sediment samples from transects at regular intervals perpendicular to the River channel as part of its systematic sediment sampling program. At each transect, three sediment samples were collected across the channel (right side, mid-channel, and left side). Because of the large local variability in PCB concentrations, no lateral (i.e., cross-channel) patterns can be discerned from these transect data, making it difficult to draw conclusions regarding lateral differences in PCB concentrations. However, as part of its discrete sediment sampling program, EPA collected sediment from aggrading bars and terraces located within Reach 5. Aggrading bars are defined as deposits, or small islands or mounds within the River channel that often occur along the inner sides of a channel curve (Weston, 2000). Terrace deposits are areas of the river bed that are typically inundated during high-flow conditions, and exposed during low-flow conditions. These localized areas of higher sediment deposition within the River channel may provide some insight regarding lateral variation in PCB concentrations within depositional areas.

A spatial comparison of average PCB and TOC concentrations in aggrading bar and terrace samples with the average PCB concentration in the remainder of the sediment dataset is plotted on Figure 4-17. One-mile averages of the data from the surface (0-6" interval), the top 36 inches (from which the majority of the PCB data were collected), and for completeness, data from all depths, are shown. Despite the large amount of variability in the dataset, average PCB concentrations are generally higher in the aggrading bar and terrace samples than in the remainder of the sediment dataset. The higher concentrations in some aggrading bars and terraces can be explained by differences in organic carbon (i.e., aggrading bars with higher average PCBs also have higher average TOC; Figure 4-17). As a result, average organic carbon-normalized PCB concentrations from the aggrading bar and terrace samples are generally similar to or lower than those from the remaining areas.

The potential for significant lateral variations in sediment PCB concentrations exists within impounded portions of the River such as Woods Pond. An illustration of surface sediment PCB concentrations in Woods Pond is shown on Figure 4-18. Similar to sediment PCB data observed in other portions of the River, surface sediment PCB concentrations vary throughout the Pond. Based on Figure 4-18, there does not appear to be any particular areas of Woods Pond that exhibit consistently higher or lower concentrations than others. Further, organic carbon normalization of the PCB data does not account for the observed variability in PCB concentration. This uneven distribution of PCBs may reflect differences in hydrologic and other environmental conditions within Woods Pond. Figure 4-18 shows the channelization that exists in Woods Pond, which reflects variable hydrologic conditions.

As discussed in Section 2.2.3, backwaters are defined as quiescent areas adjacent and hydraulically connected to the main channel of the Housatonic River (see Figure 2-3 for locations of backwaters). Because of the low-energy environment present in the backwaters, some lateral differences are observed between backwater sediment data and sediments collected within the main channel adjacent to the backwaters. Figure 4-19 is a spatial profile of main channel and backwater surface sediment PCB concentrations. In general, dry-weight surface sediment PCB concentrations in backwaters are within the range of concentrations observed in the main channel, and the one-mile averages are typically higher (Figure 4-19). Sediment organic carbon concentrations are much higher on average in backwaters, resulting in lower organic carbon-normalized PCB concentrations in these areas (Figure 4-19). Therefore, both the depositional nature and high organic carbon content of sediments deposited in these areas have resulted in elevated PCB concentrations in some of the backwaters.

Figure 4-20 is an illustration of surface sediment PCB concentrations in the individual backwater regions located within Reaches 5 and 6. This figure shows that these backwaters range in size, from relatively small in Reaches 5A and 5B to somewhat larger in Reaches 5C and 6 (near Woods Pond). PCB concentrations in backwaters are variable and appear to be somewhat independent of size (i.e., high concentrations are observed in both large and small backwaters). Generally, the largest proportion of high concentration samples is observed in some of the larger backwaters in the vicinity of Woods Pond Headwaters.

4.5.4 Geochronologic Analysis and Sedimentation

Several cores collected throughout the system were segmented into much finer increments than the 6-inch intervals discussed thus far, and were analyzed for radioisotopes to facilitate the estimation of depositional rates. Since 1995, GE and EPA have collected a total of 32 sediment cores for radioisotope analysis (i.e., Cs-137) in addition to the typical suite of PCB, TOC, and solids analyses. Analysis of Cs-137 allows for the dating of sediment layers and estimation of deposition rates since the 1950s, due to fallout activity from open-air nuclear testing that was initiated in 1955 and peaked around 1963 (Pennington, 1973). Atmospheric Cs-137 fallout was a byproduct of these nuclear tests, and Cs-137 data from finely-sectioned sediment cores reflects the historical fallout chronology and allows for the identification of two distinct chronological markers. The 1954 horizon is indicated by the first (deepest) transition from non-detect to detectable Cs-137 activity and the 1963 horizon is represented by the peak Cs-137 concentration. Identifying the depth of these horizons then allows for the estimation of the average rate of net sediment deposition that has occurred since that time.

In addition to Cs-137, the finely-sectioned sediment cores collected by EPA in 1998 and 1999 were analyzed for two other naturally occurring radioisotopes: Lead-210 (Pb-210) and Beryllium-7 (Be-7). Analysis of Pb-210 (half-life 22.3 years) allows for a reasonably reliable dating of sediment deposited over the last 100-150 years (Krishnaswami et al., 1971). Moreover, if sediment mixing is minor, the Pb-210 dating can provide information on the rate of sedimentation. Be-7 (half-life of 53 days) is generally found only in the top few centimeters of sediment due to its short half-life. Analysis of Be-7 provides information on sediment mixing (i.e., Be-7 in the subsurface would likely indicate mixing) and the integrity of the core collection.

To date, a total of 32 cores have been collected for geochronologic analysis from sediment deposits in Reach 5, the backwater areas, Woods Pond, and three impoundments downstream of Woods Pond. The results of geochronologic analysis of 17 of these sediment cores collected from Reach 5, backwater areas, and Woods Pond in 1995 were reported in the prior RFI Report (BBL, 1996). Due to some minor changes in reported concentrations as a result of data validation in 2002, the results and concentration profiles are included again in the following section. However, the overall conclusions presented in the 1996 RFI Report did not change, and in fact are further supported by subsequent data. These conclusions are:

- Estimated deposition rates are relatively variable depending on whether the cores were taken from a predominantly depositional area or from an area subject to erosion or little deposition. Cores collected from predominantly depositional areas were more suitable for estimating sediment deposition rates (as opposed to those collected from the channel).

- Overall, in cores with interpretable Cs-137 profiles, the observed peak PCB concentration was generally associated with the peak Cs-137 concentration, indicating a general decline in PCB transport and deposition over time.

The simplest method to interpret sediment core Cs-137 data is to identify the depth of the peak activity and divide that depth by the number of years since that 1963 peak has occurred, to yield an annual average net sedimentation rate. Alternatively, sedimentation rates may also be calculated by dividing the depth of the first detectable Cs-137 concentration by the number of years since the first detect occurred in 1954. While both methods are an adequate approximation of deposition, they do not account for variations in sediment mixing, compaction of deeper sediments, sediment disturbance or anomalous processes caused by hydrologic events (e.g., short-term extreme erosion or deposition), bioturbation, or other factors. Thus, qualitatively, cores collected in areas of consistent deposition will produce the best estimates of sediment chronology; those cores will exhibit a smooth, uninterrupted peak of Cs-137 activity and gradual decline toward the sediment surface. For the Housatonic River geochronologic cores, a majority of the cores collected from Woods Pond and the backwater areas fit this description, while those collected from the channels and terraces (in Reach 5) produced results that are more variable and difficult to interpret. Given the variability in the data, deposition rates for interpretable cores were calculated using both methods discussed above and are summarized in Table 4-9.

Table 4-9. Calculated Deposition Rates for Finely-Sectioned Cores

Source	Location	Core ID	Depth (cm)		Deposition Rate (cm/yr)	
			First Detectable Cs-137	Peak Cs-137	First Detectable Cs-137	Peak Cs-137
1995 GE	Reach 5A	4-7F	1	1	NI	NI
	Reach 5A	5-3A	65	44	1.6	1.4
	Reach 5B	6-1B	70	39	1.7	1.2
	Reach 5B-BW	6-2E	32	6	0.8	0.2
	Reach 5C	6-2G	6	6	0.1	0.2
	Reach 5C-BW	6-2N	37	6	0.9	0.2
	Reach 5C-BW	7-1F	22	17	0.5	0.5
	Reach 5C-BW	7-1J	6	4	0.1	0.1
	Reach 5C-BW	7-1Q	6	4	0.1	0.1
	Reach 5C-BW	7-1U	6	1	NI	NI
	Reach 5C-BW	7-1X	22	6	0.5	0.2
	Reach 6	WP-1	22	14	0.5	0.4
	Reach 6	WP-2	22	14	0.5	0.4
	Reach 6	WP-3	6	6	0.1	0.2
	Reach 6	WP-5	44	29	1.1	0.9
	Reach 6	WP-6	29	14	0.7	0.4
	Reach 6	WP-7	>70	>70	NI	NI
1998-99 EPA	Reach 6	H4-SE001004	>50	3	NI	NI
	Reach 6	H4-SE001007	32	11	0.7	0.3
	Reach 6	H4-SE001008	60	1	NI	NI
	Reach 6	H4-SE001011	24	5	0.5	0.1
	Reach 6	H4-SE001012	90	20	2.0	0.6
	Reach 6	H4-SE001013	44	16	1.0	0.4
	Reach 6	H4-SE001014	50	5	1.1	0.1
	Reach 6	H4-SE001015	24	9	0.5	0.3
	Reach 6	H4-SE001016	24	1	NI	NI
1998 GE	Rising Pond	RPD-CS-01	76	36	1.7	1.0
	Rising Pond	RPD-CS-02	60	28	1.4	0.8
	Falls Village	FVD-CS-01	16	1	NI	NI
	Falls Village	FVD-CS-03	>109	20	NI	NI
	Bulls Bridge	BBD-CS-01	16	16	NI	NI
	Bulls Bridge	BBD-CS-02	64	46	1.5	1.3

NI = Deposition rate not calculated because Cs-137 profile difficult to interpret (results are shaded gray in the table)

(>) = indicates that first detectable or peak concentration was somewhere below last core segment collected

It is important to note that the deposition rates listed in Table 4-9 are not necessarily representative of entire reaches because these cores were intentionally collected from depositional areas. This results in an estimated average deposition rate that is likely somewhat higher than the true reach average deposition rate. It should also be noted that for nearly all cores, the deposition rate calculated based on the first detectable concentration in 1954 is higher than that based on the 1963 peak. To simplify the discussion in the remainder of this section, deposition rates calculated based on the 1963 peak method are the only values presented unless otherwise indicated.

Cs-137 and PCB results for the geochronologic cores are shown on Figures 4-21 through 4-23. Of the four geochronologic cores collected from the River channel (all in 1995), three produced interpretable results: one from a terrace deposit in Reach 5A (core 5-3A; Figure 4-21a), and one each from sediment deposits in Reaches 5B and 5C (cores 6-1B and 6-2G, respectively; Figure 4-21a). The Reach 5A terrace deposit core produced an average sedimentation rate of 1.4 centimeters per year (cm/yr), and the Reach 5B and 5C sediment deposits exhibited deposition rates of 1.2 cm/yr and 0.20 cm/yr, respectively. In all three cases, the PCB concentration was highest at depths of 15 cm or more, and was substantially lower at the sediment surface than the maximum within the core.

The most thorough geochronologic sampling in the Housatonic River was performed in Woods Pond, from which 15 cores were collected (six by GE in 1995 and nine by EPA in 1999). Of the 15 cores, 11 produced largely undisturbed interpretable Cs-137 profiles (Figures 4-21c and 4-22). One core from 1995 (WP-7) was not interpreted because the highest Cs-137 activity was in the deepest sampling increment, at 70 cm, suggesting that the core did not extend deep enough to capture the whole profile. In the 11 cores with interpretable Cs-137 profiles, the identified 1963 horizon was identified at depths ranging from 5 cm to 29 cm, and resulted in annual net deposition rates of 0.14 to 0.91 cm/yr, with an average of 0.39 cm/yr (Figures 4-21c and 4-22). However, a qualitative assessment of the Cs-137 data reveals that, in general, the profiles from cores collected in 1999 contain much more variability than those collected in 1995 (see Figure 4-22), and hence their interpretation is more questionable. The Cs-137 peaks in the 1999 cores are often near the surface, even though Cs-137 extends well beneath that depth in the core; thus, using the peak Cs-137 only to produce a chronology in those cores may underestimate the true sedimentation rate. The average deposition rate for the 1995 Woods Pond cores based on the peak Cs-137 is 0.49 cm/yr. The average Woods Pond deposition rate calculated based on the 1954 first detection is somewhat higher at a value of 0.60 cm/yr. The average deposition rate from the 1995 cores may be a more accurate estimate of overall net deposition in Woods Pond than the average deposition rate calculated from the 1999 cores because the results are much more consistent between cores in 1995. Of the five interpretable cores collected from Woods Pond in 1995, four exhibit sharp gradients in PCB concentration within the top 15 cm, increasing to a distinct peak between 10 and 50 cm. PCB peak depth is variable in the nine cores collected by EPA in 1999, and is not distinct in three of these cores. Three of the EPA cores have a PCB peak at or near the surface, while the remaining three cores have a peak between 10 and 35 cm.

The nine geochronologic cores collected by EPA from Woods Pond in 1998 and 1999 were also analyzed for Pb-210 and Be-7. These isotope data were generally inconclusive due to the highly variable and sometimes conflicting results. Only three of the Woods Pond cores had Be-7 in the surface samples, suggesting both that these three locations had experienced recent deposition, and that the other cores were either disturbed during collection or were from areas where recent deposition had not occurred. Three cores, including one of the above, contained Be-7 in subsurface samples, which suggests that the integrity of the samples were compromised during collection or handling. The Pb-210 results, on the other hand, were interpretable in 7 of 9 cores. These data results and profiles are presented in the SI Data Report (Weston, 2002). The dating of these cores based on Pb-210 varied greatly among locations, and generally showed faster rates of deposition (between 0.4 cm/yr and 4 cm/yr) than indicated by the Cs-137 results for those cores.

Cores collected from backwater areas consistently show a very low net rate of sediment deposition. Six of the seven cores collected (all collected in 1995) produced interpretable Cs-137 profiles, one from Reach 5B (core 6-2E; Figure 4-21a) and five of six cores collected in Reach 5C (Figures 4-21a and 4-21b). The Cs-137 peak associated with the 1963 horizon was observed between 4 and 17 cm depth in all cases, resulting in average deposition rates ranging between 0.13 and 0.53 cm, with an average of 0.21 cm/yr (or 0.51 cm/yr based on 1954 first detect). Although two of the six cores contain somewhat questionable profiles, the average rate among the four cores with clearly defined Cs-137 profiles is 0.24 cm/yr, about half the rate observed in Woods Pond. PCB peak depths in the backwater cores generally range between 5 and 40 cm and are similar in depth to the Cs-137 peak. Two of the seven cores have PCB peaks near the surface, consistent with the Cs-137 concentrations in these cores. The presence of a PCB and Cs-137 peak near the surface further suggests that these backwater locations have lower deposition rates than those observed in Woods Pond.

Downstream of Woods Pond Dam, GE collected 6 cores for geochronologic analysis, of which two from Rising Pond and one from Bulls Bridge impoundment were interpretable (Figure 4-23). In Rising Pond, the Cs-137 peaks were detected at depths of 28 cm and 36 cm, resulting in approximate sedimentation rates of 0.8 cm/yr and 1.0 cm/yr. The deposition rate for the Bulls Bridge impoundment core was estimated to be 1.3 cm/yr. Overall, the estimated deposition rates for these impoundments are generally higher than, but not inconsistent with, the estimates for Woods Pond, and reflect the depositional nature of impoundments. For the two cores collected from Rising Pond, PCB concentrations in the top 15 cm are typically less than 10 mg/kg and distinct peaks within the range of 25-30 mg/kg are observed at depths of 35 and 50 cm. PCB concentrations in the Bulls Bridge impoundment core are considerably lower and more variable, with PCB concentrations less than 1 mg/kg within the top 15 cm, and a peak concentration of approximately 2.5 mg/kg at a depth of 45 cm.

4.5.5 PCBs in Sediment Pore Water

In fall 2001, EPA and GE conducted a joint sampling program to evaluate PCB partitioning characteristics (described in Appendix A). This program included PCB analysis of pore water extracted from surface sediment (0- to 6-inch) core samples. PCB concentrations in sediment pore water ranged from 0.4 μg/L to 8.1 μg/L, with an overall average of 2.2 μg/L (Figure 4-24). On average, pore water PCB concentrations were lower in Reach 5A than in Reaches 5B and 5C. Lower concentrations were also observed in the samples from Woods Pond. These differences are related to differences in the concentrations of DOC in the pore water as well as PCB and TOC in the local sediments, and are discussed further, in the context of PCB partitioning, in Section 8.

4.6 Temporal Trends in Sediment PCB Concentrations

Comparison of the historical and recent surface sediment PCB data can provide an indication of temporal trends in PCB transport and deposition in the Housatonic River. Sediment samples have been collected from the Housatonic River at many different locations and for many different reasons since the late 1970s. As noted above, the locations of the samples collected can have a significant impact on the expected or observed sediment PCB concentrations (e.g., sediment collected from an area of fine sediment deposition may be more likely to have higher concentrations of PCB). Therefore, to properly assess changes in PCBs in sediment over time, it is important to maximize the comparability of sample locations. Based on a qualitative comparison of historical and more recent sample locations, Woods Pond and Rising Pond provide the most robust datasets. For this reason, these impoundments were selected for an evaluation of temporal trends in surface sediment PCB concentration. Due to the depositional nature of these impounded areas, changes in surface sediment PCB concentrations over time can provide insight into the changes in deposition and transport within the respective upstream reaches.

The assessment of temporal trends in these impoundments was based on data from all available sampling programs that included PCB data from these impoundments – i.e., the 1980-1982 CAES and Stewart studies, the 1990 GE/Blasland & Bouck Study, the GE/BBL 1995-1996 and 1997-1998 sampling, and the 1998-2002 EPA data. It is important to recognize in the analysis of temporal trends that there is uncertainty associated with combining datasets that span nearly 20 years. These uncertainties stem from changes in analytical methods, detection limits, and data QA/QC procedures over time. Further, analysis of split sediment samples collected by GE during the 1998-2002 EPA sampling program suggests that PCB concentrations generated by one EPA laboratory (ONSITE) are not directly comparable with PCB measurements made by GE's laboratory, and may in fact be systematically lower (see Appendix D.2). Sediment split sample results from two other EPA laboratories (ITS and Quanterra) were not significantly different from the GE analyses (Appendix D.2). While this observation does not in itself preclude the direct comparison of EPA 1998-2002 sediment data with historical data collected by GE (e.g., the 1980 data), it suggests that a potential low bias in the latter EPA data would complicate such a comparison.

Figure 4-25 presents the temporal trend in surface sediment (0 to 6 inches) PCB concentrations in Woods Pond and Rising Pond. To evaluate the effect of the potential low bias in the EPA/ONSITE dataset on the overall temporal trend, the plots in Figure 4-25 have been prepared both with and without this dataset. This approach represents a simple way to assess whether the trend is significantly affected by the EPA/ONSITE data. Due to the limited data within the range of sampled years and the large spread of the data, a clear visual trend is not apparent in surface sediment (0-6") PCB concentrations in Woods Pond and Rising Pond. Using a first-order decay curve to represent concentration changes over time, a least squares regression analysis was used to fit the data. The data plotted in Figure 4-25 were binned by a single date for each individual collection program rather than considering individual sampling dates. The purpose of binning the data was to recognize that changes in concentration over the course of an individual sampling effort are likely not associated with a true change over time. Binning the data in this manner increases the uncertainty (e.g., the 95% confidence interval) in the resulting regression line.

The best fits calculated with this approach result in downward sloping regression lines for both Woods Pond and Rising Pond (Figure 4-25). When the EPA/ONSITE data are excluded, the slopes of the regression line are still downward, but the results are less significant (p-values increase from 0.09 to 0.42 and 0.06 to 0.12 for Woods Pond and Rising Pond, respectively), suggesting that the apparent low bias in these data may impact the temporal trend analysis. Although slight downward slopes are computed in the regression analyses plotted in Figure 4-25, the relatively high p-values (all greater than a 95% significance level of 0.05) indicate that the downward slopes are not statistically significant. The results of this trend analysis should be interpreted with caution due to the limited data and high variability within the range of sampled years. Indeed, the low r^2 values (all less than or equal to 0.1) shown on Figure 4-25 illustrate the importance of caution in interpreting these results, as the simple model of an exponential decline over time explains less than 10% of the variability in surface PCB concentrations in these impoundments.

Another method to assess temporal trends in sediment PCBs is to use the geochronologic analyses discussed in Section 4.5.4 to estimate dates for the PCB concentrations measured in the finely-sectioned cores. This approach provides an assessment of the PCB depositional history in the areas sampled. The calculated deposition rates listed in Table 4-9 (using the Cs-137 peak = 1963 method) were used to estimate dates for each section of the cores from Woods Pond and Rising Pond, excluding the cores with uninterpretable Cs-137 profiles. The depth sections corresponding to the peak in Cs-137 were assigned a date of 1963, while the dates for the other sections were based on the difference between the year of sampling and the depth of the section midpoint divided by the average deposition rate (Table 4-9). The PCB concentrations are plotted against these estimated dates for all post-1960 sections in Figure 4-26. The GE and EPA cores from Woods Pond were plotted separately to eliminate any data comparability issues. Regression analyses similar to those discussed above (i.e., first order decay) were performed for the post-1963 PCB concentrations from all dated cores within a given impoundment. PCB concentrations from samples dated as pre-1963 were excluded from the regressions for two reasons: 1) the Cs-137 peak method cannot be extrapolated to sediment deposited prior to 1963, and 2) the PCB concentrations do not appear to begin decreasing until the 1960s (Figures 4-21 through 4-23). The regression lines resulting from this analysis contain downward slopes, consistent with those from the surface sediment comparison discussed above. The r^2 values are higher for this analysis, however, ranging from 0.18 for the more variable EPA cores in Woods Pond to 0.42 and 0.52 for the GE cores from Woods Pond and Rising Pond, respectively. Further, in this case, the p-values calculated for the regression slopes are below the 95% significance level of 0.05, indicating that the results are statistically significant. Therefore, this analysis indicates that the PCB concentration of particles that settled in depositional areas of Woods Pond and Rising Pond have significantly decreased since the 1960s. The results for these cores, however, cannot be used to conclude that reach-wide concentrations in these impoundments have significantly decreased during this period.

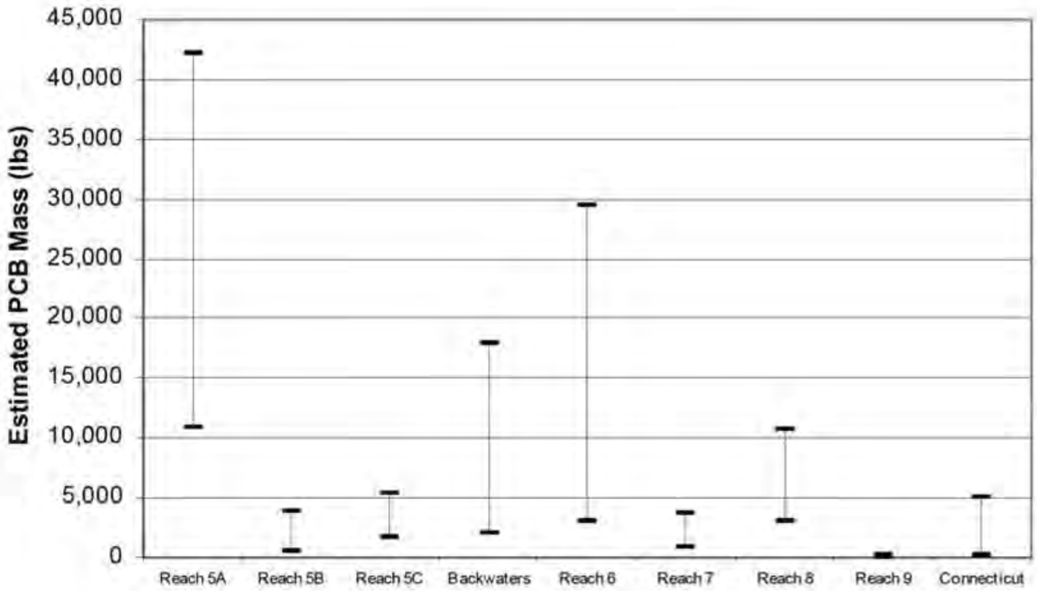
4.7 Sediment PCB Mass Estimates

The PCB mass within several reaches of the Rest of River area was estimated using the physical data (sediment area, sediment depth, and sediment bulk density) and analytical data (dry-weight PCB concentrations) collected during the 1998-2002 sediment sampling activities. In general, PCB mass estimates tend to be highly uncertain due to different methods of calculating mass, the spatial variability of both the physical and chemical characteristics of sediment, the density and distribution of available data, the inherent need to extrapolate the representativeness of available data over large volumes of sediment, and the compounding effect of combining all these uncertainties in the resulting mass estimates. In consideration of these factors, a range of mass estimates, rather than a single value, is presented for each River reach. In deriving such ranges, the variations in the bulk density and PCB concentrations have been estimated by two standard errors of the means, and mass was calculated using the upper and lower limits of both factors. Mass estimates for this RFI Report were generated for Reaches 5 through 9, the River in Connecticut, and the backwater areas.

To estimate the PCB mass in these reaches and capture some of the observed differences in PCB concentrations with depth, PCB mass was calculated for 6-inch depths, by reach, for all depths in which PCBs were detected. The first step in the calculation of the reach-specific PCB mass was to estimate the area over which PCBs were distributed. To facilitate this calculation, the percentage of PCBs detected within each depth interval was assumed to be representative of the fraction of the sediment that contains PCBs. For example, if PCBs were detected in 97% of samples collected from the top 6 inches of sediment in Reach 5A, then 97% of the 41-acre surface area of that reach was assumed to contain PCB mass in that depth interval, resulting in an area of 40 acres (i.e., 41 acres x 0.97 = 40 acres). This calculation was conducted for each 6-inch depth interval at which PCBs were detected. After calculating these areas, the volume of PCB-containing sediment was determined as the product of the depth (i.e., 6 inches) and the estimated area over which PCBs were detected. Corresponding with the calculated PCB-containing sediment volume for each sediment depth interval, upper and lower PCB concentrations within each 6-inch depth increment were estimated as the reach-wide arithmetic mean of detected PCB concentration results plus and minus two standard errors of the mean. In addition, a similar range was calculated for reach-wide bulk density (i.e., +/- 2 standard errors). For the mass calculations, bulk density was estimated from percent solids data because percent solids was measured for nearly all samples, while the bulk density measurements were mainly made on surface sediment samples. As discussed in Section 4.4.4, surface sediments tend to be less dense than deeper, more consolidated sediments.

The PCB mass in each reach-specific depth interval was then estimated as the product of the PCB-containing sediment volume, the upper and lower PCB concentrations, and the upper and lower sediment bulk density values within the specific reach and depth interval (see Table 4-10). The total PCB mass within the reach was calculated as the sum of those calculated for the individual depth intervals. Based on the calculation methods described above, the calculated ranges of PCB mass (in pounds [lbs] of PCBs) are shown, per reach, in Table 4-10 and on Figure 4-27 (below).

Figure 4-27. Estimated PCB Mass in Housatonic River Sediment



The ranges of PCB mass shown above are the upper and lower bounds based on uncertainty in both the PCB concentration and bulk density, and when summed for the entire River from the Confluence to Long Island Sound (including backwaters), produce a range of approximately 22,000 lbs to 118,000 lbs of PCBs.

For comparison, Stewart (1982) estimated that 37,500 lbs of PCB were present in sediment between the Confluence and the Connecticut border. A more detailed comparison is provided in Table 4-11 (below) in lbs of PCBs.

Table 4-11. Comparison of Estimated PCB Mass

	PCB Mass (lbs)	
	Stewart, 1982 Estimate	**Current Estimate**
Confluence to Woods Pond	13,200	13,000 – 51,000
Backwaters	13,000	2,000 – 18,000
Woods Pond	7,400	3,000 – 29,000
Woods Pond Dam to Rising Pond Dam	3,300	3,900 – 14,000
Rising Pond Dam to Connecticut Border	600	60 - 110
Connecticut Border to Long Island Sound	----	120 - 5,000
Rounded Total	**37,500**	**22,000 - 118,000**

The large range in the current PCB mass estimates highlights the uncertainty inherent in the calculations. If the upper and lower bounds on the uncertainty in PCB and bulk density are assessed separately, different estimates of PCB mass are calculated. If the arithmetic mean of detected PCB is used and only the bulk density is varied, the overall range of PCB mass is between 50,000 lbs and 68,000 lbs. On the other hand, if the arithmetic mean bulk-density value is used for each reach and depth and the PCB concentrations are varied, the overall range of PCB mass is estimated to be 25,000 lbs to 101,000 lbs. The observed differences in the PCB mass estimated by varying these reach-specific values further demonstrate the uncertainties associated with the estimation of PCB mass.

4.8 Sediment PCB Composition

PCBs were used at the GE facility in Pittsfield from 1932 to 1977 as part of a flame-resistant, insulating liquid for select transformer applications (Blasland & Bouck, 1991). As noted in Section 3.8, PCB Aroclors were composed of various combinations of chlorobiphenyls; Aroclors 1254 and 1260 generally contain higher-chlorinated chlorobiphenyls (e.g., penta-, hexa-, hepta-, octa-, and nona-chlorobiphenyls) and were the Aroclors used in GE's manufacturing operations in Pittsfield. The presence of higher-chlorinated PCB Aroclors (i.e., Aroclor 1254 and Aroclor 1260) is evident in the Housatonic River sediment data, as discussed below.

Due to the lack of PCB congener data for EPA's systematic sediment samples, the results of the PCB congener analyses from EPA's discrete sediment sampling in Reaches 5, 6, and 8 and the GE/EPA partitioning study were used to calculate PCB homolog distributions for sediments in those reaches. Those distributions are shown on Figure 4-28. These PCB homolog distributions are indicative of the higher chlorinated Aroclors. However, there are slight differences in the distributions between Reach 5 and Woods Pond. Approximately 70% of the sediment PCBs in Reaches 5A, B, and C possesses six (hexa) or seven (hepta) chlorine atoms per biphenyl (CL/BP). The percentage of hexa- and hepta-CL/BP is somewhat lower in Woods Pond (approximately 60%), while the percentage of lower chlorinated congeners increases slightly (primarily the tetra and penta congeners). The slight decrease in CL/BP at Woods Pond compared to samples collected upstream may reflect the impact of modest levels of dechlorination that have been observed in Woods Pond (see Bedard and May, 1996, and Section 8.8.1.11 below). The limited congener-specific data collected in Rising Pond indicate a PCB homolog composition that is generally similar to that in Woods Pond.

The average PCB homolog distribution for the 2001 pore water data from Reaches 5 and 6 is shown on Figure 4-29. The pore water composition is lighter than that from the sediments; this difference is expected because lighter congeners tend to more readily desorb from sediments.

The presence of the higher-chlorinated Aroclors as the predominant PCB mixtures in the Rest of River is also shown by the reported Aroclor results for surface sediment samples in which PCBs were detected above 1 mg/kg, as presented in Table 4-12 (below). Only Aroclors 1248, 1254, and 1260 were quantified in the sediments within the Rest of River area. As shown in Table 4-12, Aroclor 1260 was by far the predominant Aroclor quantified in the subreaches of Reach 5. In Reach 6 (Woods Pond), a somewhat greater (but still small) proportion of the reported total PCBs was quantified as Aroclors 1254 and 1248, which, as noted above, may reflect naturally occurring dechlorination processes in Woods Pond. Downstream of Woods Pond Dam, a greater proportion of Aroclor 1254 was quantified in the samples from Reach 7 and Rising Pond.

Table 4-12. Summary of Aroclor Quantification Frequency

Reach	N	Average Quantitation at Each Location (%)		
		Aroclor 1248	Aroclor 1254	Aroclor 1260
Reach 5A	326	< 0.1	2.2	98
Reach 5B	115	0.1	1.7	98
Reach 5C	161	0.6	4.3	95
Woods Pond	88	1.8	5.3	93
Reach 7	46	0	13	87
Rising Pond	19	0	6.8	93

Note:

Includes all surface sediment (0-6 in) data with PCB concentrations > 1 mg/kg.

No data collected downstream of Rising Pond had PCB concentrations > 1 mg/kg.

4.9 Other Constituents

In addition to the PCB analyses discussed in the previous subsections, analyses for non-PCB constituents were also performed on some sediment samples collected by EPA from Reaches 5 and 6 of the Housatonic River during 1998 and 1999. Compounds analyzed for included SVOCs, pesticides, herbicides, PCDDs/PCDFs, cyanide, sulfide, and metals. Information on frequency of detection of these constituents in sediments, as well as summary statistics on concentrations, are included in Appendix C.

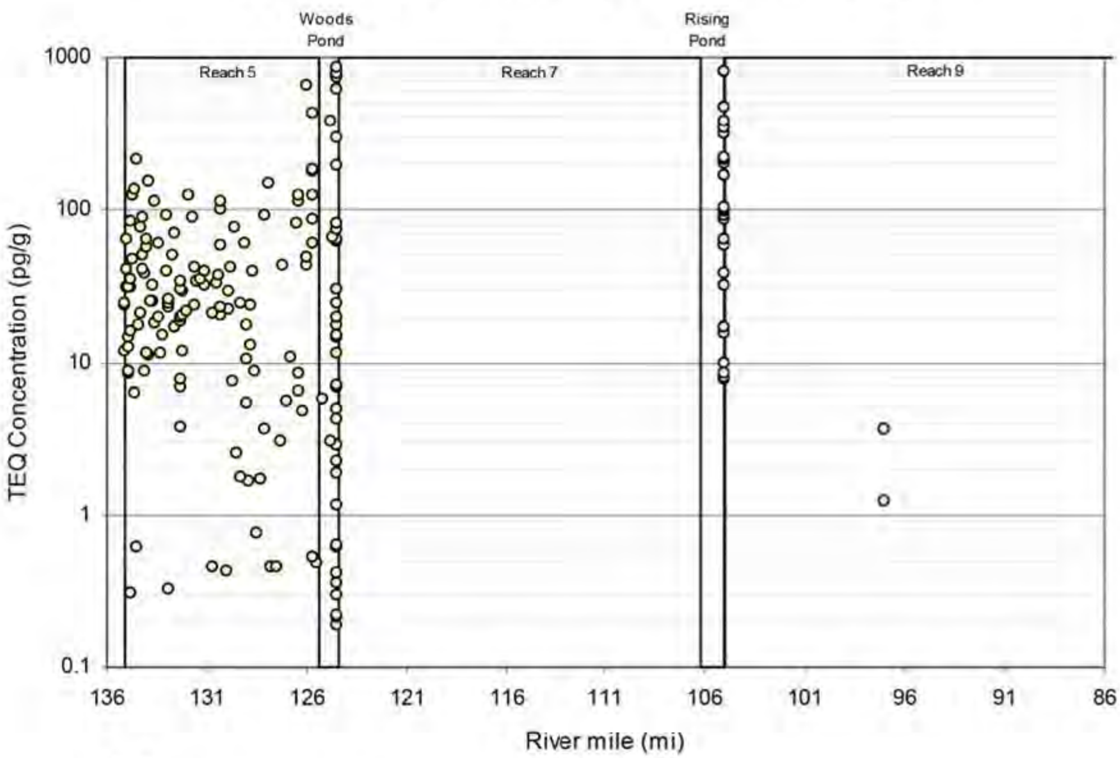
As discussed in Section 2.6, EPA has advised GE that, based on EPA's human health and ecological screening evaluations, the non-PCB constituents, other than potentially PCDDs/PCDFs, are not key constituents of concern in the Rest of River. As a result, the extent of these constituents in the Rest of River sediments will not be evaluated further, except for a brief discussion of PCDD/PCDF compounds.

For PCDDs/PCDFs, review of the data indicates detection of a number of PCDD/PCDF compounds in sediments. To evaluate these data further, a TEQ concentration was calculated for each sample using the mammalian TEFs published by the WHO (van den Berg et al., 1998) and representing non-detected compounds as one-half the analytical detection limit. TEQ values calculated for samples collected by EPA during 1998 and 1999 as part of its systematic sampling in Reaches 5 and 6 range from 0.33 pg/g to 123 pg/g (both within Reach 5A), with arithmetic means ranging from 4.1 pg/g (within Reach 5B) to 31 pg/g (within Reach 5C). TEQ values calculated for samples collected by EPA in 1998 and 1999 from the backwater areas in Reach 5 range from 2.0 pg/g (within Reach 5D) to 513 pg/g (within Reach 5C), with arithmetic means ranging from 14 pg/g (within Reach 5B) to 134 pg/g (within Reach 5C).

In addition, EPA collected discrete samples in 1999 associated primarily with its risk assessment work. TEQs for the discrete samples ranged from 0.19 pg/g to 1,133 pg/g (reported for a subsurface sediment sample collected within the eastern half of Woods Pond), and the arithmetic TEQ means by program range from 1.0 pg/g to 299 pg/g.

Sediment TEQs are plotted by RM on Figure 4-30 (below), which shows a great deal of variability in the data regardless of location, but overall indicates maximum TEQ values in the Woods Pond Headwaters and within Woods Pond and Rising Pond.

Figure 4-30. TEQ Concentration in the Housatonic River



Note:
Presents TEQ results from all depths. Results from Woods Pond locations SE001020 (TEQ=1023 pg/g), SE001008 (TEQ=1032 pg/g), and SE001015 (TEQ=1132 pg/g) are not shown.

4.10 Summary

PCB data from Rest of River sediments indicate that considerable spatial variability occurs in PCB concentrations, not only among River reaches but within each reach and subreach as well. The widest range and highest average concentrations occur in Reach 5 (especially Reach 5A) and Reach 6 (Woods Pond). PCB concentrations in both surface and subsurface sediments in backwater regions are similar to concentrations reported from Reach 5A and Woods Pond. Downstream of Woods Pond in Reaches 7, 8, and 9 and in Connecticut, PCB concentrations are substantially lower than those upstream.

Although PCB concentrations in Rising Pond show an increase in concentrations relative to the other reaches downstream of Woods Pond, the surface sediment PCB concentrations in Rising Pond remain well below those in Reaches 5 and 6. This decrease in PCB concentrations downstream of Woods Pond Dam indicates a reduction of downstream transport of PCBs.

As expected, sediment PCB concentrations appear to relate to a number of variables, including percent solids, grain size, and TOC. In general, higher PCB concentrations were found in areas with finer-grained sediments containing lower percent solids and higher TOC, such as areas behind dams and in backwaters.

The highest concentrations of PCBs in Reaches 5 and 6 (Woods Pond) were found in the top three to four feet in Reaches 5A and 5B and in the top one foot of sediments in Reach 5C and Woods Pond, with generally lower concentrations occurring with depth. Overall, geochronological data collected from thin sediment layers from Woods Pond show that while much of the PCBs are contained within the top 6 inches, PCB concentrations within this layer increase with depth, indicating that declines in the PCB content of sediments deposited in Woods Pond are occurring. However, results of a time trend analysis of the mean surface sediment PCB concentration in Woods Pond show no statistically significant trend using both historical and recent data. Data from Rising Pond show that PCB concentrations are lower in the top 6 inches than at greater depths. The geochronological data from Rising Pond also indicate a decline in Rising Pond surface sediment PCB concentrations over time.

Estimates of PCB mass for the Rest of River sediments consist of wide ranges, reflecting the uncertainties inherent in the methods and data used and thus in the calculations. These estimates of PCB mass have resulted in a range of 22,000 lbs to 118,000 lbs of PCBs in the Rest of River sediments.

Other chemical constituents were also detected in sediment samples. However, these constituents are not the focus of this RFI Report, except for a brief discussion of PCDDs/PCDFs. For PCDDs/PCDFs, TEQ values range up to 1,133 pg/g (approximately 1 μg/kg) and show no clear spatial trends, except for higher maximum levels in the Woods Pond Headwaters and within Woods Pond and Rising Pond.

Section 4 Tables

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Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
USGS, CT DEP, CAES - Cooperative PCB Investigation				
1979-82	Connecticut Agricultural Experiment Station (CAES) Study - During a joint effort by the CAES, USGS, and CDEP, sediment samples were collected from locations in the Massachusetts and Connecticut portions of the Housatonic River. The study was designed to determine the mass of PCBs in the bottom sediments of the Housatonic River and determine presence and distribution of PCBs.	Reach 1,2	TOC (2), Total PCB (2)	Frink et al., Dec. 1982; BBEPC, Dec. 1991 (Sec. 4.3.1)
		Reach 4	TOC (3), Total PCB (3)	
		Reach 5A	TOC (2), Total PCB (2)	
		Reach 5B	TOC (14), Total PCB (14)	
		Reach 5C	TOC (14), Total PCB (14)	
		Reach 6	TOC (38), Total PCB (36)	
		Reach 7	TOC (20), Total PCB (26)	
		Reach 8	TOC (5), Total PCB (14)	
		Reach 9	TOC (30), Total PCB (37)	
		Connecticut	TOC (133), Total PCB (170)	
		West Branch	TOC (3), Total PCB (3)	
		Silver Lake	TOC (4), Total PCB (4)	

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
Stewart Investigation				
1980	Stewart Laboratories, Inc. Study - Stewart conducted a baseline survey of the occurrence, distribution, and transport of PCBs. One or more sediment cores were collected from sediment sampling substations which were deemed representative of distinct sediment accumulation areas in the river.	Reach 1,2	Total PCB (30)	Stewart, 1982; BBEPC, Dec. 1991 (Sec. 4.2 & 4.3.2)
		Reach 3	Total PCB (3)	
		Reach 4	Total PCB (11)	
		Reach 5A	Total PCB (11)	
		Reach 5B	Total PCB (52)	
		Reach 5C	Total PCB (154)	
		Reach 6	Total PCB (270)	
		Reach 7	Total PCB (132)	
		Reach 8	Total PCB (89)	
		Reach 9	Total PCB (43)	
		Connecticut	Total PCB (1)	
		West Branch	Total PCB (3)	

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
1982	Stewart Laboratories, Inc. Study - Stewart conducted a baseline survey of the occurrence, distribution, and transport of PCBs. One or more sediment cores were collected from sediment sampling substations which were deemed representative of distinct sediment accumulation areas in the river.	Reach 3	Total PCB (8)	Stewart, 1982; BBEPC, Dec. 1991 (Sec. 4.2 & 4.3.2)
		Reach 4	Total PCB (1)	
		Reach 5A	Total PCB (2)	
		Reach 5B	Total PCB (5)	
		Reach 5C	Total PCB (16)	
		Reach 6	Total PCB (41)	
		Reach 7	Total PCB (4)	
		Reach 9	Total PCB (10)	
LMS Fate and Transport Model				
1986	LMS collected one sediment core (six cores total) from Falls Village, Bulls Bridge, Route 133 Bridge, Shepaug Dam, Route 84 Bridge, and Stevenson Dam, respectively. Cores were sectioned into 1-inch increments.	Connecticut	PCBs, TOC (100)	LMS, Apr. 1988; BBEPC, Dec. 1991 (Sec. 4.3.3)
1992	LMS collected sediment samples at 49 stations in the Massachusetts and Connecticut portions of the Housatonic River. Surficial sediment samples were collected from the 0- to 3-inch depth interval.	Reach 9	PCB (37), TOC (37), Bulk Density (5), Particle Size (5)	LMS, Nov. 1994
		Connecticut	PCB (23), TOC (23), Bulk Density (5), Particle Size (5)	
	LMS collected sediment samples at six "deep" sediment core locations. Cores were collected and sectioned into 1-inch intervals.	Connecticut	PCB (105), TOC (105), Cs-137 (40)	LMS, Nov. 1994

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
MCP Phase II Investigation				
1990	Prior to the performance of MCP Phase II field sampling activities, BBEPC conducted thorough site reconnaissance activities to assess (then) present-day sediment depositional areas in comparison to those found in prior investigations. Along 32 sampling transects (76 locations), sediment was probed and cores were collected at equi-distant locations across the river width. Water depth, sediment depth penetrated, sediment length recovered, and field core description were recorded.	Reach 1,2	Probing Locations (11)	BBEPC, Dec. 1991 (Sec.4.3.4.1)
		Reach 3	Probing Locations (5)	
		Reach 4	Probing Locations (16)	
		Reach 5A	Probing Locations (18)	
		Reach 5B	Probing Locations (4)	
		Reach 5C	Probing Locations (22)	
1990-91	As part of the MCP Phase II Investigation, sediment samples were collected from 39 core locations where Stewart investigation (1980 and 1982) had indicated PCB concentrations > 50 ppm. In addition, water depth, sediment depth penetrated, sediment length recovered, and field core description were recorded.	Reach 3	TOC (1), Total PCB (6)	BBEPC, Dec. 1991 (Sec. 4.3.4)
		Reach 4	TOC (4), Total PCB (11)	
		Reach 5A	TOC (8), Total PCB (14)	
		Reach 5B	TOC (2), Total PCB (12)	
		Reach 5C	TOC (17), Total PCB (29)	
		Reach 6	TOC (44), Total PCB (75)	
		Reach 7	TOC (4), Total PCB (8)	
		Reach 8	TOC (14), Total PCB (29)	

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
1990-91	Another objective of the MCP Phase II Investigation was to determine the presence (if any) of other hazardous constituents in river sediments and to identify which of these constituents could be considered "target" constituents. Samples were collected by BBEPC from nine sampling locations along the river (collected in 1990) and two in Rising Pond (collected in 1991).	Reach 1,2	TOC (5), Total PCB (5), Appendix IX+3 Organics (5), PCDDs/PCDFs (5), Inorganics (5)	BBEPC, Dec. 1991 (Sec. 4.4)
		Reach 3	TOC (1), Total PCB (1), Appendix IX+3 Organics (1), PCDDs/PCDFs (1), Inorganics (1)	
		Reach 4	TOC (4), Total PCB (4), Appendix IX+3 Organics (4), PCDDs/PCDFs (4), Inorganics (4)	
		Reach 8	TOC (2), Total PCB (2), Appendix IX+3 Organics (2), PCDDs/PCDFs (2), Inorganics (2)	
1991	GZA GeoEnvironmental, Inc. (GZA) Study - GZA and GE (with BBEPC oversight) initiated a sediment sampling program to identify chemicals which may be present in Rising Pond.	Reach 8	PCBs (63), VOCs (7), TPH (18), RCRA-Regulated Metals (17)	GZA, May 1991; BBEPC, Dec. 1991 (Sec. 4.3.5 & 4.4.2)
1992	BBEPC collected sediment samples at six locations to supplement/support existing data and analysis of other hazardous constituents.	Reach 1,2	Appendix IX+3 Inorganics (4)	BBL, Jan. 1996 (Sec. 3.2.8)
		Reach 4	PCBs (7), Appendix IX+3 SVOC (2), PCDDs/PCDFs (2), Inorganics (2)	
1994	Sediment reconnaissance/probing activities were conducted in October 1994 to provide additional information related to sediment accumulation/deposition areas between the GE facility and Woods Pond. As part of these activities, water depth, sediment probing depth, field core description, and classification (backwater, channel, terrace, or aggrading bar) of deposits was noted.	Reach 1,2	Probing Locations (46)	BBL, Jan. 1996 (Sec. 3.2.2)
		Reach 3	Probing Locations (24)	
		Reach 4	Probing Locations (20)	
		Reach 5A	Probing Locations (64)	
		Reach 5B	Probing Locations (15)	
		Reach 5C	Probing Locations (53)	

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
MCP Supplemental Phase II Investigation				
1994	Based on the results of the 1994 reconnaissance/probing activities, additional sampling locations were selected to further define the presence of PCBs in sediments. Sediment samples were collected until refusal and generally sectioned into 6-inch depth increments.	Reach 1,2	Oil and Grease (1), Total PCB (13)	BBL, Jan. 1996 (Sec. 3.2.4 - Sec. 3.2.6)
		Reach 3	Bulk Density (1), Moisture Content (3), Oil and Grease (3), Percent Solids (1), TOC (3), Total PCB (5)	
		Reach 4	Bulk Density (1), Moisture Content (9), Oil and Grease (11), Percent Solids (1), TOC (9), Total PCB (65)	
		Reach 5A	Bulk Density (5), Moisture Content (9), Oil and Grease (12), Percent Solids (5), TOC (9), Total PCB (88)	
		Reach 5B	Bulk Density (1), Moisture Content (7), Oil and Grease (8), Percent Solids (1), TOC (12), Total PCB (25)	
		Reach 5C	Bulk Density (4), Moisture Content (15), Oil and Grease (16), Percent Solids (4), TOC (16)	
		Reach 6	Bulk Density (3), Moisture Content (6), Oil and Grease (8), Percent Solids (3), TOC (7), Total PCB (4)	
		Reach 9	TOC (3), Total PCB (3)	
1995	Based on the results of the 1994 reconnaissance/probing activities, additional sampling locations were selected to further define the presence of PCBs in sediments. Sediment samples were collected until refusal and generally sectioned into 6-inch depth increments.	Reach 4	Berylium-7 (3), Cesium-137 (3), TOC (19), Total PCB (29)	BBL, Jan. 1996 (Sec. 3.2.4 - Sec. 3.2.6)
		Reach 5A	Berylium-7 (18), Cesium-137 (18), TOC (34), Total PCB (34)	
		Reach 5B	Berylium-7 (18), Cesium-137 (18), TOC (18), Total PCB (20)	
		Reach 5C	Berylium-7 (60), Cesium-137 (60), Oil and Grease (2), TOC (75), Total PCB (67)	
		Reach 6	Berylium-7 (65), Cesium-137 (64), Oil and Grease (2), TOC (63), Total PCB (64)	
	Sediment samples were co-located with samples previously collected upstream of the GE facility (between the Hubbard Avenue Bridge and Center Pond) in 1992, and analyzed for PCDDs/PCDFs. In addition, two Unkamet Brook sediment samples were collected and submitted for PCDDs/PCDFs analysis.	Reach 5A	Dioxins/Furans (4)	BBL, Jan. 1996 (Sec. 3.2.8)
		Unkamet Brook	Dioxins/Furans (2)	

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
1996	Sediment samples were collected	Reach 3	TOC (20), Total PCB (191)	GE database (November 2002 release)
		Reach 4	TOC (53), Total PCB (71)	
		Reach 5A	TOC (84), Total PCB (148)	
		Reach 5B	TOC (13), Total PCB (39)	
		Reach 5C	Total PCB (58)	
		Reach 6	Total PCB (42)	
MCP Supplemental Phase II/RFI - Sediment Coring Program				
1997-98	The objective of the Sediment Coring Program was to provide sediment data required for calibration of the Sediment Fate and Transport Models that were being developed for the river. Therefore, bulk sediment cores were collected to provide bulk sediment qualities for calibration of the Sediment Transport Model.	Reach 4	Bulk Density (1), Moisture Content (1), TOC (1)	GE database (November 2002 release)
		Reach 5A	Bulk Density (3), Moisture Content (3), TOC (3)	
		Reach 5B	Bulk Density (2), Moisture Content (2), TOC (2)	
		Reach 5C	Bulk Density (4), Moisture Content (4), TOC (4)	
		Reach 7	Bulk Density (15), Moisture Content (15), TOC (15)	
		Reach 8	Bulk Density (6), Moisture Content (6), TOC (6)	
		Reach 9	Bulk Density (7), Moisture Content (7), TOC (7)	
		Connecticut	Bulk Density (15), Moisture Content (15), TOC (15)	
	The Cs-137 coring program provided information on the depositional history of PCBs within several impoundments including Rising Pond, Falls Village Dam Impoundment, and Bulls Bridge Dam Impoundment.	Reach 8	Bulk Density (33), Cesium-137 (34), Moisture Content (33), TOC (33), Total PCB (33)	
		Connecticut	Bulk Density (16), Cesium-137 (66), Moisture Content (16), TOC (16), Total PCB (15)	
	The surface sediment survey provided surface sediment PCB information for comparison with historical data.	Reach 7	TOC (31), Total PCB (31)	
		Reach 8	TOC (20), Total PCB (20)	
		Reach 9	TOC (16), Total PCB (16)	
		Connecticut	TOC (58), Total PCB (58)	

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
1998-99	Sediment sampling was conducted along nine designated river reaches to provide data for a modeling study. Sediment samples and cores were collected by way of systematic/transect sampling methods.	Reach 1,2	Appendix IX Pesticides (83), Appendix IX SVOCs (83), Dioxins/Furans (83), Grain Size (680), Grain Size Class (680), Herbicides (18), Inorganics (207), Metals (83), OP Pesticides (18), Organics (644), PCBs (668)	EPA database (November 2002 release)
		Reach 3	Appendix IX Pesticides (55), Appendix IX SVOCs (55), Dioxins/Furans (55), Grain Size (487), Grain Size Class (487), Herbicides (15), Inorganics (55), Metals (55), OP Pesticides (15), Organics (500), PCBs (506)	
		Reach 4	Appendix IX Pesticides (60), Appendix IX SVOCs (59), Dioxins/Furans (60), Grain Size (587), Grain Size Class (587), Herbicides (10), Inorganics (190), Metals (60), OP Pesticides (14), Organics (629), PCBs (726)	
		Reach 5A	Appendix IX Pesticides (17), Appendix IX SVOCs (17), Dioxins/Furans (17), Grain Size (197), Grain Size Class (197), Herbicides (3), Inorganics (185), Metals (17), MINERAL (1), OP Pesticides (3), Organics (205), PCB Congeners (1), PCBs (186)	
		Reach 5B	Appendix IX Pesticides (9), Appendix IX SVOCs (9), Dioxins/Furans (9), Grain Size (132), Grain Size Class (132), Herbicides (3), Inorganics (115), Metals (9), OP Pesticides (3), Organics (129), PCBs (115)	
		Reach 5C	Appendix IX Pesticides (12), Appendix IX SVOCs (12), Dioxins/Furans (12), Grain Size (362), Grain Size Class (362), Herbicides (2), Inorganics (265), Metals (12), OP Pesticides (2), Organics (286), PCBs (265)	
		Reach 6	Appendix IX Pesticides (3), Appendix IX SVOCs (3), Dioxins/Furans (3), Grain Size (91), Grain Size Class (91), Inorganics (42), Metals (3), Organics (97), PCBs (94)	
		Reach 7	Grain Size (285), Grain Size Class (285), Inorganics (286), Organics (277), PCBs (286)	
		West Branch	Appendix IX Pesticides (7), Appendix IX SVOCs (7), Dioxins/Furans (7), Grain Size (71), Grain Size Class (71), Inorganics (40), Metals (7), Organics (74), PCBs (69)	

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
1998-2002	Sediment sampling was conducted along 12 designated river reaches and 1 reference reach to provide data for the human health and ecological risk assessments. Sediment samples and cores were collected by way of discrete sampling methods to support various objectives and individual studies. See USACE, 2000 for a detailed description of the Discrete Programs.	Reach 1,2	Appendix IX Pesticides (8), Appendix IX SVOCs (8), Dioxins/Furans (8), Grain Size (56), Grain Size Class (56), Herbicides (5), Inorganics (43), Metals (8), OP Pesticides (5), Organics (59), PCB Congeners (14), PCBs (60)	EPA database (November 2002 release)
		Reach 3	Appendix IX SVOCs (4), Appendix IX VOCs (2), Dioxins/Furans (1), Inorganics (32), PCBs (33), TPH (2)	
		Reach 4	Appendix IX Pesticides (13), Appendix IX SVOCs (13), Atterberg Limits (28), Bulk Density (33), Dioxins/Furans (13), Grain Size (147), Grain Size Class (142), Herbicides (3), Inorganics (194), Metals (13), OP Pesticides (3), Organics (166), PCB Congeners (6), PCBs (182), Specific Gravity (28), TCLP Herbicides (28), TCLP Metals (28), TCLP Pesticides (28), TCLP SVOCs (28)	
		Reach 5A	Appendix IX Pesticides (62), Appendix IX SVOCs (66), Bulk Density (12), Dioxins/Furans (67), Grain Size (803), Grain Size Class (791), Herbicides (13), Inorganics (612), Metals (66), MINERAL (9), OP Pesticides (13), Organics (951), PCB Congeners (112), PCBs (967)	
		Reach 5B	Appendix IX Pesticides (12), Appendix IX SVOCs (12), Bulk Density (7), Dioxins/Furans (12), Grain Size (263), Grain Size Class (256), Herbicides (2), Inorganics (302), Metals (12), OP Pesticides (2), Organics (359), PCB Congeners (41), PCBs (360)	
		Reach 5C	Appendix IX Pesticides (12), Appendix IX SVOCs (16), Bulk Density (11), Dioxins/Furans (17), Grain Size (291), Grain Size Class (280), Herbicides (5), Inorganics (349), Metals (16), OP Pesticides (5), Organics (387), PCB Congeners (56), PCBs (368)	
		Reach 6	Appendix IX Pesticides (38), Appendix IX SVOCs (38), Bulk Density (25), Dioxins/Furans (38), Grain Size (419), Grain Size Class (410), Herbicides (4), Inorganics (503), Metals (38), OP Pesticides (4), Organics (587), PCB Congeners (86), PCBs (576)	
		Reach 7	Grain Size (66), Grain Size Class (66), Inorganics (90), Organics (68), PCBs (91)	

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
1998-2002	Sediment sampling was conducted along 12 designated river reaches and 1 reference reach to provide data for the human health and ecological risk assessments. Sediment samples and cores were collected by way of discrete sampling methods to support various objectives and individual studies. See USACE, 2000 for a detailed description of the Discrete Programs.	Reach 8	Appendix IX Pesticides (32), Appendix IX SVOCs (32), Dioxins/Furans (32), Grain Size (306), Grain Size Class (306), Herbicides (4), Inorganics (242), Metals (32), OP Pesticides (4), Organics (305), PCB Congeners (33), PCBs (279)	
		Reach 9	Appendix IX Pesticides (2), Appendix IX SVOCs (2), Dioxins/Furans (2), Grain Size (54), Grain Size Class (54), Inorganics (62), Metals (2), Organics (50), PCB Congeners (2), PCBs (63)	
		Connecticut	Appendix IX Pesticides (4), Appendix IX SVOCs (4), Dioxins/Furans (4), Grain Size (20), Grain Size Class (20), Herbicides (2), Inorganics (55), Metals (4), OP Pesticides (2), Organics (55), PCB Congeners (3), PCBs (55)	
		West Branch	Appendix IX Pesticides (4), Appendix IX SVOCs (6), Dioxins/Furans (6), Grain Size (68), Grain Size Class (68), Herbicides (1), Inorganics (63), Metals (6), OP Pesticides (1), Organics (88), PCB Congeners (34), PCBs (103)	
		Reference	Appendix IX Pesticides (12), Appendix IX SVOCs (9), Dioxins/Furans (11), Grain Size (41), Grain Size Class (41), Herbicides (6), Inorganics (38), Metals (12), OP Pesticides (6), Organics (44), PAHS (3), PCB Congeners (16), PCBs (40)	
1998-2002	As part of the EPA Discrete Sampling Program, backwater areas were specifically targeted for sediment sampling and analysis.	Reach 5A	Appendix IX Pesticides (3), Appendix IX SVOCs (3), Bulk Density (2), Dioxins/Furans (3), Grain Size (49), Grain Size Class (47), Inorganics (36), Metals (3), Organics (49), PCB Congeners (5), PCBs (54)	EPA database (November 2002 release)
		Reach 5B	Appendix IX Pesticides (3), Appendix IX SVOCs (2), Bulk Density (2), Dioxins/Furans (3), Grain Size (46), Grain Size Class (44), Inorganics (57), Metals (2), Organics (52), PCB Congeners (4), PCBs (66)	
		Reach 5C	Appendix IX Pesticides (15), Appendix IX SVOCs (15), Bulk Density (1), Dioxins/Furans (15), Grain Size (191), Grain Size Class (190), Herbicides (7), Inorganics (201), Metals (15), OP Pesticides (7), Organics (235), PCB Congeners (25), PCBs (286)	
		Reach 5D	Appendix IX Pesticides (3), Appendix IX SVOCs (3), Bulk Density (4), Dioxins/Furans (3), Grain Size (86), Grain Size Class (84), Herbicides (1), Inorganics (79), Metals (3), OP Pesticides (1), Organics (99), PCB Congeners (9), PCBs (87)	

Table 4-1
Summary of Sediment Sampling Activities/Investigations

Year	Description	Location	Total Samples Analyzed	Reported In
1998-2002	As part of the EPA Discrete Sampling Program, backwater areas were specifically targeted for sediment sampling and analysis.	Reach 6	Appendix IX Pesticides (1), Appendix IX SVOCs (1), Bulk Density (1), Dioxins/Furans (1), Grain Size (28), Grain Size Class (27), Inorganics (29), Metals (1), Organics (37), PCB Congeners (7), PCBs (36)	EPA database (November 2002 release)
		Reach 7	Grain Size (2), Grain Size Class (2), Inorganics (2), Organics (2), PCBs (2)	

Note:
1. Sample/analyses counts based on data as reported in the GE database (November release and EPA database (November release).

Table 4-3
Summary of TOC Concentration in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (%)	Arithmetic Mean (%)	Arithmetic +2 Std Error (%)	Arithmetic -2 Std Error (%)	Maximum (%)	Minimum (%)
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP								
0-6	351	81	0.77	1.4	1.6	1.2	21	ND
6-12	144	82	1.2	1.7	1.9	1.4	9.2	ND
12-18	178	80	0.91	1.5	1.8	1.2	13	ND
18-24	104	88	0.95	1.4	1.7	1.2	5.8	ND
24-30	95	91	1.1	1.6	1.9	1.3	7.0	ND
30-36	58	91	1.2	1.8	2.3	1.3	11	ND
36-42	43	95	1.1	1.9	2.6	1.1	13	ND
42-48	22	95	0.88	2.8	4.4	1.2	13	ND
48-54	11	91	0.96	1.2	1.7	0.63	2.6	ND
54-60	5	100	1.6	1.9	2.7	1.2	3.3	1.1
60-66	4	100	0.58	1.0	2.2	< 0	2.7	0.22
66-72	1	0	NA	ND	NA	NA	NA	NA
72-78	3	100	3.0	2.4	3.9	0.83	3.3	0.84
78-84	1	100	NA	1.1	NA	NA	NA	NA
102-108	1	100	NA	2.0	NA	NA	NA	NA
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence								
0-6	177	91	1.0	1.4	1.6	1.2	13	ND
6-12	44	75	0.59	1.4	2.0	0.81	11	ND
12-18	81	85	0.71	1.4	1.7	1.0	8.4	ND
18-24	37	81	0.65	2.1	4.3	< 0	40	ND
24-30	37	89	0.78	0.98	1.3	0.63	5.1	ND
30-36	5	100	0.87	0.91	1.5	0.34	1.9	0.11
36-42	4	50	0.35	2.9	8.2	< 0	11	ND
42-48	4	75	0.27	2.7	7.6	< 0	10	ND
48-54	4	50	0.26	0.50	1.2	< 0	1.5	ND
60-66	2	50	0.99	0.99	NA	NA	2.0	ND
66-72	2	100	0.75	0.75	NA	NA	0.90	0.59
72-78	1	100	NA	1.3	NA	NA	NA	NA
84-90	1	100	NA	0.34	NA	NA	NA	NA
96-102	1	100	NA	0.59	NA	NA	NA	NA
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond								
0-6	236	95	2.3	3.2	3.6	2.8	25	ND
6-12	68	88	0.94	2.1	2.8	1.3	19	ND
12-18	117	89	1.5	2.7	3.3	2.0	29	ND
18-24	66	85	0.90	1.8	2.3	1.2	12	ND
24-30	44	82	0.96	2.6	3.9	1.3	22	ND
30-36	7	86	1.0	3.2	6.4	< 0	9.8	ND
36-42	7	100	0.27	0.85	1.8	< 0	3.5	0.14
42-48	3	100	0.75	1.4	2.9	< 0	2.9	0.56
48-54	2	100	1.7	1.7	NA	NA	2.7	0.62
54-60	4	100	0.92	1.2	2.3	0.14	2.7	0.31
60-66	4	100	0.72	1.1	2.2	< 0	2.7	0.13
66-72	5	80	0.25	0.31	0.56	0.055	0.67	ND
72-78	2	100	0.28	0.28	NA	NA	0.34	0.22
78-84	1	100	NA	1.9	NA	NA	NA	NA
84-90	1	100	NA	0.53	NA	NA	NA	NA
90-96	1	100	NA	1.7	NA	NA	NA	NA
114-120	1	100	NA	0.13	NA	NA	NA	NA

Table 4-3
Summary of TOC Concentration in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (%)	Arithmetic Mean (%)	+2 Std Error (%)	-2 Std Error (%)	Maximum (%)	Minimum (%)
Backwaters								
0-6	233	100	8.7	12	13	11	58	0.52
6-12	15	100	5.8	7.1	9.7	4.5	17	0.23
12-18	36	97	5.4	6.7	8.6	4.7	21	ND
18-24	12	92	4.3	6.7	11	2.7	22	ND
24-30	13	85	5.6	5.8	9.0	2.6	17	ND
30-36	2	100	1.6	1.6	NA	NA	2.6	0.58
36-42	2	100	4.4	4.4	NA	NA	6.9	1.8
42-48	2	100	2.1	2.1	NA	NA	2.6	1.6
48-54	2	100	2.0	2.0	NA	NA	3.2	0.79
54-60	2	100	2.9	2.9	NA	NA	4.8	1.0
60-66	2	50	2.3	2.3	NA	NA	4.3	ND
66-72	2	100	2.2	2.2	NA	NA	3.8	0.57
72-78	2	50	2.0	2.0	NA	NA	3.8	ND
78-84	2	50	1.3	1.3	NA	NA	2.3	ND
84-90	1	0	NA	ND	NA	NA	NA	NA
Reach 6 - Woods Pond								
0-6	121	100	6.2	7.8	9.0	6.6	36	0.058
6-12	43	100	7.4	9.2	12	6.9	36	0.53
12-18	50	94	7.7	9.7	12	7.1	44	ND
18-24	41	93	5.6	11.1	15	7.5	42	ND
24-30	23	100	5.7	9.5	14	5.4	40	0.71
30-36	18	100	4.2	9.1	14	4.3	36	0.69
36-42	18	100	3.9	8.5	13	4.3	33	1.3
42-48	17	94	2.7	7.1	11	3.2	31	ND
48-54	18	94	3.4	10	16	4.1	45	ND
54-60	17	100	5.3	10	17	3.8	52	0.83
60-66	15	100	3.6	11	18	4.1	50	1.6
66-72	15	100	2.4	9.9	17	2.8	50	1.3
72-78	14	100	2.0	8.2	15	1.6	45	0.90
78-84	12	100	2.4	9.6	17	2.0	43	0.85
84-90	9	100	2.2	9.2	17	1.1	36	1.3
90-96	8	100	6.4	9.9	17	2.5	30	1.2
96-102	7	100	3.0	8.6	17	0.53	28	1.3
102-108	7	100	2.2	7.5	15	0.12	24	1.1
108-114	3	100	3.5	9.8	24	< 0	24	1.6
114-120	4	100	2.2	5.8	13	< 0	17	1.9
120-126	4	100	1.8	6.3	16	< 0	20	1.2
126-132	4	100	2.0	5.7	13	< 0	17	1.5
132-138	3	100	7.0	8.4	17	0.0026	16	1.9
138-144	3	100	1.4	5.5	14	< 0	14	0.64
144-150	3	100	1.4	5.3	14	< 0	14	0.56
150-156	3	100	1.6	4.6	12	< 0	12	0.11
156-162	2	50	0.70	0.70	NA	NA	1.4	ND
162-168	1	0	NA	ND	NA	NA	NA	NA
168-174	1	100	NA	0.62	NA	NA	NA	NA

Table 4-3
Summary of TOC Concentration in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (%)	Arithmetic Mean (%)	Arithmetic +2 Std Error (%)	Arithmetic -2 Std Error (%)	Maximum (%)	Minimum (%)
Reach 7 - Housatonic River - Woods Pond to Rising Pond								
0-6	173	97	1.8	2.1	2.4	1.8	19	ND
6-12	67	99	1.8	2.0	2.4	1.7	6.1	ND
12-18	57	100	1.7	2.2	2.6	1.7	7.7	0.18
18-24	26	96	1.8	1.9	2.5	1.4	5.9	ND
24-30	17	100	1.4	2.1	3.3	0.93	9.2	0.15
30-36	3	100	0.99	1.7	3.3	0.024	3.3	0.70
36-42	2	100	6.5	6.5	NA	NA	9.3	3.6
Reach 8 - Rising Pond								
0-6	27	85	2.4	2.4	3.1	1.8	5.3	ND
6-12	20	85	2.5	2.8	3.6	2.0	6.8	ND
12-18	20	90	2.8	2.7	3.4	2.1	6.1	ND
18-24	20	85	2.8	2.9	3.6	2.2	6.5	ND
24-30	19	100	3.3	4.0	4.8	3.2	7.6	1.7
30-36	19	100	3.4	4.2	5.2	3.3	10	2.0
36-42	18	100	4.4	4.5	5.3	3.6	7.6	0.37
42-48	18	94	5.4	5.5	6.9	4.1	14	ND
48-54	18	100	5.3	5.2	6.3	4.0	11	0.64
54-60	18	100	5.0	5.3	6.5	4.0	11	1.3
60-66	18	94	3.8	4.3	5.3	3.3	7.7	ND
66-72	18	100	4.9	4.9	5.9	4.0	8.4	1.6
72-78	16	94	4.4	5.0	6.6	3.4	12	ND
78-84	13	100	3.8	4.4	5.6	3.1	9.4	2.1
84-90	13	92	4.2	4.2	5.1	3.3	6.1	ND
90-96	12	100	4.1	4.6	5.7	3.5	8.5	2.2
96-102	6	100	4.2	4.4	5.5	3.3	6.6	2.7
102-108	2	100	3.7	3.7	NA	NA	4.1	3.3
Reach 9 - Downstream of Rising Pond Dam to the Connecticut Border								
0-6	48	85	1.5	1.3	1.6	1.04	3.0	ND
12-18	2	100	1.1	1.1	NA	NA	1.9	0.34
24-30	1	100	NA	1.2	NA	NA	NA	NA
Connecticut								
0-6	53	98	0.50	0.60	0.75	0.45	3.5	ND
6-12	11	91	0.88	1.1	1.9	0.40	3.5	ND
12-18	2	100	0.25	0.25	NA	NA	0.37	0.13
24-30	1	100	NA	0.43	NA	NA	NA	NA
30-36	1	100	NA	0.21	NA	NA	NA	NA

Notes:

1. All GE (Dec. 1997-1998) and EPA (1998-2002) data are included.
2. Non-detect values assigned a value of one-half the detection limit prior to calculation of statistics.
3. Duplicate samples were averaged prior to calculation of statistics.
4. Data were depth-weighted (as necessary) to provide representative and comparable values for 6-inch increments (e.g., 0-6, 6-12, etc.)
5. Backwater areas determined via probing description and/or GIS methods.
6. ND = Not Detected.
7. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).

Table 4-4
Summary of Percent Solids in Housatonic River Sediment Sampling Results -- 1998-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (%)	Arithmetic Mean (%)	Arithmetic +2 Std Error (%)	Arithmetic -2 Std Error (%)	Maximum (%)	Minimum (%)
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP								
0-6	250	100	76	76	77	74	99	31
6-12	81	100	77	77	79	75	96	53
12-18	116	100	79	77	79	74	96	33
18-24	53	100	77	76	79	74	91	55
24-30	49	100	77	74	77	70	89	41
30-36	21	100	77	77	80	73	90	57
36-42	16	100	80	81	84	78	89	70
42-48	12	100	75	72	81	64	91	41
48-54	8	100	81	82	84	80	88	77
54-60	4	100	82	82	90	74	92	73
60-66	3	100	81	77	91	62	86	63
66-72	1	100	NA	82	NA	NA	NA	NA
72-78	3	100	81	81	83	79	83	80
78-84	1	100	NA	81	NA	NA	NA	NA
102-108	1	100	NA	84	NA	NA	NA	NA
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence								
0-6	142	100	72	71	73	69	94	48
6-12	35	100	71	72	76	69	97	52
12-18	80	100	71	71	74	69	100	44
18-24	35	100	72	72	76	68	90	20
24-30	37	100	70	69	73	66	88	35
30-36	5	100	74	72	76	67	77	64
36-42	4	100	70	63	80	47	74	39
42-48	4	100	74	66	86	47	80	37
48-54	4	100	80	77	86	68	85	64
60-66	2	100	80	80	NA	NA	84	76
66-72	2	100	76	76	NA	NA	78	74
72-78	1	100	NA	79	NA	NA	NA	NA
84-90	1	100	NA	72	NA	NA	NA	NA
96-102	1	100	NA	74	NA	NA	NA	NA
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond								
0-6	174	100	64	62	64	60	98	31
6-12	61	100	68	68	71	65	97	42
12-18	113	100	70	68	70	65	99	12
18-24	61	100	71	69	71	66	87	38
24-30	44	100	73	68	73	64	90	16
30-36	7	100	72	75	83	66	94	58
36-42	7	100	75	73	79	68	84	60
42-48	3	100	71	66	82	50	76	50
48-54	2	100	65	65	NA	NA	69	61
54-60	4	100	73	70	78	61	76	57
60-66	4	100	73	72	80	64	80	61
66-72	5	100	76	80	87	74	91	75
72-78	2	100	79	79	NA	NA	83	75
78-84	1	100	NA	79	NA	NA	NA	NA
84-90	1	100	NA	75	NA	NA	NA	NA
90-96	1	100	NA	71	NA	NA	NA	NA
114-120	1	100	NA	73	NA	NA	NA	NA

Table 4-4
Summary of Percent Solids in Housatonic River Sediment Sampling Results -- 1998-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (%)	Arithmetic Mean (%)	Arithmetic +2 Std Error (%)	Arithmetic -2 Std Error (%)	Maximum (%)	Minimum (%)
Backwaters								
0-6	166	100	42	44	47	41	95	6.3
6-12	13	100	49	49	57	41	70	29
12-18	30	100	58	55	62	48	95	19
18-24	6	100	68	63	77	49	75	29
24-30	14	100	70	59	71	48	92	28
30-36	2	100	62	62	NA	NA	71	53
36-42	2	100	51	51	NA	NA	60	42
42-48	2	100	53	53	NA	NA	55	52
48-54	2	100	72	72	NA	NA	77	67
54-60	2	100	56	56	NA	NA	70	43
60-66	2	100	57	57	NA	NA	69	46
66-72	2	100	59	59	NA	NA	63	56
72-78	1	100	NA	71	NA	NA	NA	NA
78-84	2	100	67	67	NA	NA	80	55
84-90	1	100	NA	68	NA	NA	NA	NA
Reach 6 - Woods Pond								
0-6	58	100	37	43	48	38	85	9.0
6-12	19	100	52	50	59	40	79	13
12-18	31	100	40	47	55	39	86	9.1
18-24	20	100	44	46	55	37	75	16
24-30	17	100	44	50	59	41	88	18
30-36	17	100	58	53	66	41	97	13
36-42	15	100	61	55	65	44	80	15
42-48	14	100	55	53	64	43	80	21
48-54	13	100	47	47	58	36	77	12
54-60	14	100	54	51	61	42	74	14
60-66	12	100	53	57	67	47	86	33
66-72	14	100	50	52	59	44	76	31
72-78	12	100	51	54	63	46	87	37
78-84	12	100	53	57	67	47	84	30
84-90	8	100	47	47	58	37	65	19
90-96	9	100	66	59	73	45	92	30
96-102	4	100	68	67	86	48	90	43
102-108	8	100	67	63	74	52	92	41
108-114	3	100	82	83	99	66	97	68
114-120	4	100	68	69	90	49	96	46
120-126	4	100	59	63	81	45	86	48
126-132	4	100	59	64	87	41	93	45
132-138	2	100	81	81	NA	NA	94	69
138-144	3	100	65	66	81	51	79	53
144-150	3	100	74	65	83	47	74	47
150-156	2	100	68	68	NA	NA	74	63
156-162	1	100	NA	69	NA	NA	NA	NA
162-168	1	100	NA	78	NA	NA	NA	NA

Table 4-4
Summary of Percent Solids in Housatonic River Sediment Sampling Results -- 1998-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (%)	Arithmetic Mean (%)	Arithmetic +2 Std Error (%)	Arithmetic -2 Std Error (%)	Maximum (%)	Minimum (%)
Reach 7 - Housatonic River - Woods Pond to Rising Pond								
0-6	181	100	75	73	75	71	100	24
6-12	68	100	76	75	79	71	99	40
12-18	58	100	75	74	78	70	100	40
18-24	28	100	73	74	79	68	99	45
24-30	17	100	73	74	81	67	95	40
30-36	3	100	80	60	105	14	85	14
36-42	2	100	52	52	NA	NA	65	39
Reach 8 - Rising Pond								
0-6	16	100	56	59	68	50	88	34
6-12	11	100	54	58	68	49	89	37
12-18	14	100	59	60	67	52	84	41
18-24	17	100	56	60	66	53	84	44
24-30	14	100	54	55	59	51	69	45
30-36	14	100	53	54	59	48	73	40
36-42	13	100	50	50	53	47	59	37
42-48	14	100	50	53	59	48	79	40
48-54	13	100	48	51	56	47	67	39
54-60	11	100	52	52	56	48	63	42
60-66	11	100	54	56	59	54	64	53
66-72	13	100	55	55	58	51	67	46
72-78	8	100	54	55	58	52	61	50
78-84	10	100	57	57	60	54	66	52
84-90	12	100	55	56	59	53	65	49
90-96	11	100	54	56	60	53	70	50
96-102	5	100	55	55	58	51	60	51
102-108	2	100	54	54	NA	NA	55	54
Reach 9 - Downstream of Rising Pond Dam to the Connecticut Border								
0-6	48	100	71	71	74	69	90	53
12-18	2	100	78	78	NA	NA	80	76
24-30	1	100	NA	77	NA	NA	NA	NA
Connecticut								
0-6	25	100	81	79	84	74	95	40
6-12	11	100	83	74	82	66	87	47
12-18	2	100	86	86	NA	NA	87	85
24-30	1	100	NA	75	NA	NA	NA	NA
30-36	1	100	NA	73	NA	NA	NA	NA

Notes:

1. All GE (Dec. 1997-1998) and EPA (1998-2002) data are included.
2. Duplicate samples were averaged prior to calculation of statistics.
3. Data were depth-weighted (as necessary) to provide representative and comparable values for 6-inch increments (e.g., 0-6, 6-12, etc.)
4. Backwater areas determined via probing description and/or GIS methods.
5. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).

Table 4-5
Summary of D-50 Results in Housatonic River Sediment -- 1998-2002

Depth Interval (inch)	Number of Samples	Median (mm)	Arithmetic Mean (mm)	+2 Std Error (mm)	-2 Std Error (mm)	Maximum (mm)	Minimum (mm)
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP							
0-6	293	0.28	0.50	0.57	0.43	5.2	0.043
6-12	142	0.21	0.46	0.55	0.36	3.7	0.050
12-18	162	0.29	0.62	0.74	0.49	4.0	0.043
18-24	102	0.24	0.51	0.64	0.38	3.6	0.051
24-30	91	0.27	0.57	0.72	0.42	3.8	0.055
30-36	58	0.29	0.52	0.69	0.36	2.7	0.048
36-42	44	0.24	0.63	0.83	0.42	2.5	0.043
42-48	22	0.28	0.47	0.68	0.26	1.9	0.046
48-54	11	0.30	0.44	0.76	0.12	1.9	0.037
54-60	5	0.13	0.65	1.5	< 0	2.3	0.075
60-66	4	0.54	0.57	1.0	0.093	1.2	0.047
66-72	1	0.52	0.52	NA	NA	NA	NA
72-78	3	0.056	0.073	0.11	0.033	0.11	0.051
78-84	1	0.070	0.070	NA	NA	NA	NA
102-108	1	0.034	0.034	NA	NA	NA	NA
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence							
0-6	159	0.17	0.23	0.26	0.19	1.2	0.020
6-12	44	0.21	0.55	1.0	0.079	10	0.012
12-18	72	0.19	0.32	0.41	0.22	3.1	0.012
18-24	37	0.24	0.32	0.39	0.25	1.0	0.0080
24-30	36	0.21	0.28	0.33	0.22	0.82	0.037

Table 4-5
Summary of D-50 Results in Housatonic River Sediment -- 1998-2002

Depth Interval (inch)	Number of Samples	Median (mm)	Arithmetic Mean (mm)	Arithmetic +2 Std Error (mm)	Arithmetic -2 Std Error (mm)	Maximum (mm)	Minimum (mm)
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence - (continued)							
30-36	4	0.19	0.21	0.31	0.10	0.35	0.10
36-42	3	0.20	0.19	0.35	0.036	0.33	0.054
42-48	4	0.50	0.47	0.81	0.14	0.85	0.051
48-54	4	0.45	0.80	1.8	< 0	2.2	0.09
60-66	2	0.34	0.34	NA	NA	0.60	0.070
66-72	2	0.012	0.012	NA	NA	0.016	0.0090
72-78	1	0.055	0.055	NA	NA	NA	NA
84-90	1	0.010	0.010	NA	NA	NA	NA
96-102	1	0.010	0.010	NA	NA	NA	NA
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond							
0-6	232	0.11	0.19	0.22	0.16	1.5	0.0080
6-12	87	0.17	0.26	0.31	0.20	1.5	0.039
12-18	130	0.13	0.25	0.31	0.19	3.0	0.018
18-24	82	0.22	0.28	0.34	0.23	1.5	0.015
24-30	44	0.14	0.30	0.51	0.092	4.6	0.039
30-36	7	0.30	0.35	0.57	0.13	0.79	0.034
36-42	7	0.15	0.67	1.6	< 0	3.5	0.013
42-48	3	0.098	0.093	0.18	0.011	0.16	0.020
48-54	2	0.21	0.21	NA	NA	0.41	0.012
54-60	4	0.071	0.071	0.14	0.0040	0.14	0.0080
60-66	4	0.18	0.34	0.78	< 0	0.96	0.013

Table 4-5
Summary of D-50 Results in Housatonic River Sediment -- 1998-2002

Depth Interval (inch)	Number of Samples	Median (mm)	Arithmetic Mean (mm)	Arithmetic +2 Std Error (mm)	Arithmetic -2 Std Error (mm)	Maximum (mm)	Minimum (mm)
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond - (continued)							
66-72	5	0.64	1.5	3.7	< 0	5.8	0.013
72-78	2	0.018	0.018	NA	NA	0.021	0.015
78-84	1	0.084	0.084	NA	NA	NA	NA
84-90	1	0.020	0.020	NA	NA	NA	NA
90-96	1	0.075	0.075	NA	NA	NA	NA
114-120	1	0.013	0.013	NA	NA	NA	NA
Backwaters							
0-6	215	0.026	0.043	0.051	0.035	0.61	0.0080
6-12	12	0.037	0.039	0.053	0.026	0.091	0.012
12-18	28	0.050	0.083	0.12	0.045	0.38	0.012
18-24	8	0.053	0.051	0.072	0.029	0.094	0.013
24-30	13	0.061	0.091	0.14	0.040	0.34	0.017
30-36	2	0.049	0.049	NA	NA	0.068	0.030
36-42	2	0.056	0.056	NA	NA	0.058	0.055
42-48	2	0.061	0.060	NA	NA	0.075	0.046
48-54	2	0.087	0.087	NA	NA	0.12	0.051
54-60	2	0.087	0.087	NA	NA	0.12	0.052
60-66	2	0.084	0.084	NA	NA	0.12	0.053
66-72	2	0.088	0.088	NA	NA	0.12	0.053
72-78	2	0.097	0.097	NA	NA	0.14	0.050
78-84	2	0.11	0.11	NA	NA	0.17	0.051
84-90	1	0.23	0.23	NA	NA	NA	NA

Table 4-5
Summary of D-50 Results in Housatonic River Sediment -- 1998-2002

Depth Interval (inch)	Number of Samples	Median (mm)	Arithmetic Mean (mm)	Arithmetic +2 Std Error (mm)	Arithmetic -2 Std Error (mm)	Maximum (mm)	Minimum (mm)
Reach 6 - Woods Pond							
0-6	113	0.037	0.13	0.22	0.042	4.0	0.0080
6-12	45	0.040	0.056	0.078	0.033	0.52	0.010
12-18	45	0.032	0.058	0.086	0.030	0.62	0.010
18-24	41	0.042	0.092	0.16	0.029	1.2	0.012
24-30	25	0.039	0.045	0.059	0.032	0.17	0.010
30-36	20	0.028	0.037	0.049	0.025	0.11	0.0090
36-42	20	0.029	0.041	0.057	0.025	0.15	0.0080
42-48	19	0.040	0.041	0.054	0.028	0.12	0.0070
48-54	19	0.045	0.044	0.056	0.032	0.11	0.012
54-60	18	0.027	0.038	0.055	0.022	0.16	0.0080
60-66	16	0.033	0.038	0.048	0.028	0.088	0.011
66-72	15	0.037	0.042	0.053	0.030	0.080	0.011
72-78	14	0.040	0.044	0.060	0.029	0.10	0.0060
78-84	13	0.045	0.052	0.072	0.032	0.12	0.015
84-90	10	0.022	0.036	0.050	0.022	0.070	0.017
90-96	9	0.018	0.034	0.052	0.017	0.071	0.0090
96-102	8	0.026	0.033	0.047	0.019	0.066	0.013
102-108	8	0.023	0.036	0.054	0.018	0.081	0.014
108-114	4	0.038	0.045	0.073	0.016	0.081	0.022
114-120	4	0.029	0.036	0.059	0.012	0.068	0.018
120-126	4	0.037	0.047	0.078	0.016	0.091	0.022
126-132	4	0.035	0.049	0.086	0.012	0.10	0.021
132-138	3	0.044	0.043	0.076	0.0090	0.071	0.013

Table 4-5
Summary of D-50 Results in Housatonic River Sediment -- 1998-2002

Depth Interval (inch)	Number of Samples	Median (mm)	Arithmetic Mean (mm)	Arithmetic +2 Std Error (mm)	Arithmetic -2 Std Error (mm)	Maximum (mm)	Minimum (mm)
Reach 6 - Woods Pond - (continued)							
138-144	3	0.041	0.042	0.068	0.017	0.065	0.021
144-150	3	0.034	0.059	0.11	0.0060	0.11	0.031
150-156	3	0.038	0.069	0.15	< 0	0.15	0.022
156-162	2	0.14	0.14	NA	NA	0.27	0.020
162-168	1	0.38	0.38	NA	NA	NA	NA
168-174	1	0.25	0.25	NA	NA	NA	NA
Reach 7 - Housatonic River - Woods Pond to Rising Pond							
0-6	160	0.62	2.6	3.1	2.0	17	0.027
6-12	68	0.37	2.4	3.5	1.3	25	0.0060
12-18	58	0.24	1.1	1.6	0.63	8.2	0.0060
18-24	28	0.23	0.59	0.91	0.28	3.1	0.057
24-30	17	0.30	0.68	1.1	0.25	3.2	0.032
30-36	3	0.31	0.76	1.7	< 0	1.7	0.30
36-42	2	0.24	0.24	NA	NA	0.46	0.028
Reach 8 - Rising Pond							
0-6	20	0.12	1.4	3.6	< 0	23	0.020
6-12	20	0.082	0.36	0.69	0.023	3.4	0.022
12-18	20	0.059	0.25	0.45	0.053	1.9	0.032
18-24	20	0.057	0.29	0.61	< 0	3.3	0.030
24-30	19	0.050	0.072	0.099	0.046	0.24	0.023
30-36	19	0.043	0.069	0.098	0.040	0.27	0.021
36-42	18	0.042	0.071	0.11	0.036	0.29	0.022
42-48	18	0.043	0.055	0.082	0.027	0.28	0.020
48-54	18	0.041	0.052	0.069	0.036	0.18	0.021

Table 4-5
Summary of D-50 Results in Housatonic River Sediment -- 1998-2002

Depth Interval (inch)	Number of Samples	Median (mm)	Arithmetic Mean (mm)	Arithmetic +2 Std Error (mm)	Arithmetic -2 Std Error (mm)	Maximum (mm)	Minimum (mm)
Reach 8 - Rising Pond - (continued)							
54-60	18	0.043	0.048	0.056	0.039	0.091	0.017
60-66	18	0.050	0.053	0.063	0.043	0.12	0.025
66-72	18	0.047	0.049	0.056	0.043	0.087	0.030
72-78	16	0.047	0.058	0.079	0.037	0.21	0.035
78-84	13	0.040	0.049	0.058	0.039	0.096	0.034
84-90	13	0.047	0.047	0.055	0.039	0.078	0.027
90-96	12	0.044	0.047	0.056	0.038	0.075	0.021
96-102	6	0.034	0.033	0.041	0.025	0.047	0.019
102-108	2	0.029	0.029	NA	NA	0.030	0.029
Reach 9 - Downstream of Rising Pond Dam to the Connecticut Border							
0-6	45	0.18	0.82	1.5	0.11	16	0.056
12-18	2	0.25	0.25	NA	NA	0.34	0.16
24-30	1	0.20	0.20	NA	NA	NA	NA
Connecticut							
0-6	25	0.48	2.0	3.5	0.41	15	0.026
6-12	11	0.17	1.7	3.4	< 0	9.3	0.020
12-18	2	0.78	0.78	NA	NA	0.82	0.74
24-30	1	0.14	0.14	NA	NA	NA	NA
30-36	1	0.17	0.17	NA	NA	NA	NA

Notes:

1. All EPA (1998-2002) data are included.
2. Duplicate samples were averaged prior to calculation of statistics.
3. Data were depth-weighted (as necessary) to provide representative and comparable values for 6-inch increments (e.g., 0-6, 6-12, etc.)
4. Backwater areas determined via probing description and/or GIS methods.
5. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).

Table 4-6
Summary of Grain Size Distribution in Housatonic River Surface Sediment (0 to 6 Inches) -- 1998-2002

Particle Size (mm)	Sample Number	Median	Average Percent Finer	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP							
0.0014	264	0.5	0.9	1.0	0.8	5.5	0.0
0.003	264	1.4	2.0	2.3	1.8	11.0	0.0
0.004	248	1.6	2.3	2.6	2.0	11.0	0.0
0.007	264	2.2	3.0	3.4	2.7	16.0	0.0
0.009	264	2.8	4.0	4.4	3.5	19.0	0.0
0.013	264	3.7	5.1	5.6	4.5	28.0	0.0
0.018	248	4.9	6.3	7.0	5.6	33.0	0.0
0.023	264	5.0	7.2	8.0	6.4	38.0	0.0
0.037	264	6.1	8.6	9.6	7.7	45.0	0.0
0.049	248	7.2	11.0	13.0	9.9	55.0	0.0
0.075	277	9.7	17.0	19.0	15.0	71.0	0.4
0.106	13	10.0	19.0	27.0	11.0	46.0	7.0
0.15	277	23.0	31.0	35.0	28.0	89.0	0.7
0.18	31	25.0	36.0	47.0	25.0	97.0	3.6
0.25	277	47.0	49.0	54.0	45.0	99.0	1.4
0.3	13	24.0	47.0	67.0	28.0	95.0	11.0
0.425	277	68.0	63.0	67.0	59.0	100.0	1.9
0.6	13	57.0	64.0	80.0	48.0	100.0	25.0
0.635	13	98.0	95.0	101.0	90.0	100.0	61.0
0.85	264	92.0	81.0	83.0	78.0	100.0	5.3
2	277	98.0	91.0	92.0	89.0	100.0	33.0
2.36	13	90.0	88.0	97.0	78.0	100.0	39.0
4.75	277	99.0	96.0	97.0	95.0	100.0	47.0
9.5	44	100.0	98.0	100.0	96.0	100.0	71.0
12.7	261	100.0	99.0	99.0	98.0	100.0	70.0
19	277	100.0	100.0	100.0	99.0	100.0	76.0
25	264	100.0	100.0	100.0	100.0	100.0	83.0
37.5	264	100.0	100.0	100.0	100.0	100.0	100.0
50	264	100.0	100.0	100.0	100.0	100.0	100.0
75	263	100.0	100.0	100.0	100.0	100.0	100.0
D-50 (mm)	277	0.28	0.50	0.57	0.43	5.2	0.043
Percent Clay	260	2.2	3.0	3.3	2.6	16.0	0.0
Percent Gravel	260	0.9	4.4	5.4	3.4	53.0	0.0
Percent Sand	260	84.0	79.0	81.0	77.0	99.0	25.0
Percent Silt	260	7.8	14.0	16.0	12.0	59.0	0.0

Table 4-6
Summary of Grain Size Distribution in Housatonic River Surface Sediment (0 to 6 Inches) -- 1998-2002

Particle Size (mm)	Sample Number	Median	Average Percent Finer	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence							
0.0014	143	0.8	1.2	1.5	1.0	6.8	0.0
0.003	143	2.0	2.7	3.1	2.3	9.6	0.0
0.004	137	2.4	3.1	3.6	2.7	11.0	0.0
0.006	1	NA	11.0	NA	NA	NA	NA
0.007	143	3.4	4.1	4.7	3.6	14.0	0.0
0.009	143	4.3	5.5	6.3	4.8	21.0	0.0
0.013	143	5.7	7.2	8.1	6.3	26.0	0.0
0.018	137	6.9	9.0	10.0	7.8	46.0	0.8
0.023	143	8.1	10.0	12.0	8.9	45.0	0.8
0.03	1	NA	29.0	NA	NA	NA	NA
0.037	143	9.8	12.0	14.0	11.0	50.0	0.8
0.049	137	12.0	16.0	18.0	14.0	66.0	0.8
0.06	1	NA	48.0	NA	NA	NA	NA
0.07	1	NA	48.0	NA	NA	NA	NA
0.075	149	18.0	23.0	25.0	20.0	72.0	1.6
0.106	6	48.0	47.0	55.0	38.0	60.0	29.0
0.15	149	40.0	43.0	47.0	39.0	94.0	3.0
0.18	16	52.0	55.0	71.0	39.0	98.0	12.0
0.25	149	83.0	72.0	77.0	68.0	99.0	7.4
0.3	6	97.0	92.0	99.0	85.0	98.0	79.0
0.425	149	97.0	86.0	90.0	83.0	100.0	13.0
0.6	6	100.0	100.0	100.0	99.0	100.0	99.0
0.635	6	100.0	100.0	100.0	100.0	100.0	100.0
0.85	143	100.0	94.0	96.0	91.0	100.0	38.0
2	149	100.0	97.0	98.0	96.0	100.0	60.0
2.36	6	100.0	100.0	100.0	100.0	100.0	100.0
4.75	149	100.0	99.0	99.0	98.0	100.0	66.0
9.5	22	100.0	100.0	100.0	100.0	100.0	100.0
12.7	143	100.0	100.0	100.0	99.0	100.0	80.0
19	149	100.0	100.0	100.0	100.0	100.0	83.0
25	143	100.0	100.0	100.0	100.0	100.0	100.0
37.5	143	100.0	100.0	100.0	100.0	100.0	100.0
50	143	100.0	100.0	100.0	100.0	100.0	100.0
75	143	100.0	100.0	100.0	100.0	100.0	100.0
D-50 (mm)	149	0.17	0.23	0.26	0.19	1.2	0.037
Percent Clay	143	3.4	4.1	4.7	3.6	14.0	0.0
Percent Gravel	143	0.0	1.4	2.2	0.7	34.0	0.0
Percent Sand	143	82.0	76.0	79.0	74.0	96.0	27.0
Percent Silt	143	14.0	18.0	20.0	16.0	67.0	0.6

Table 4-6
Summary of Grain Size Distribution in Housatonic River Surface Sediment (0 to 6 Inches) -- 1998-2002

Particle Size (mm)	Sample Number	Median	Average Percent Finer	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond							
0.0014	188	1.8	2.3	2.7	2.0	9.4	0.0
0.003	188	4.3	5.4	6.0	4.7	18.0	0.0
0.004	166	4.9	6.0	6.7	5.3	18.0	0.0
0.006	1	NA	13.0	NA	NA	NA	NA
0.007	188	6.3	7.8	8.7	6.9	27.0	0.0
0.009	188	8.8	10.0	12.0	9.4	33.0	0.0
0.013	188	11.0	13.0	15.0	12.0	41.0	0.0
0.018	166	14.0	17.0	19.0	15.0	50.0	0.8
0.023	188	16.0	19.0	21.0	17.0	59.0	1.2
0.03	1	NA	35.0	NA	NA	NA	NA
0.037	188	20.0	23.0	26.0	21.0	68.0	1.2
0.049	166	27.0	30.0	34.0	27.0	97.0	1.2
0.06	1	NA	41.0	NA	NA	NA	NA
0.065	3	14.0	13.0	23.0	2.6	21.0	3.5
0.07	1	NA	41.0	NA	NA	NA	NA
0.075	198	39.0	41.0	44.0	37.0	97.0	1.6
0.106	10	54.0	52.0	65.0	38.0	82.0	20.0
0.15	198	71.0	62.0	66.0	58.0	99.0	3.0
0.18	41	82.0	65.0	76.0	55.0	99.0	9.0
0.25	198	96.0	81.0	85.0	77.0	100.0	7.3
0.3	10	94.0	84.0	97.0	70.0	99.0	47.0
0.425	198	99.0	89.0	92.0	87.0	100.0	17.0
0.6	10	99.0	96.0	100.0	91.0	100.0	82.0
0.635	10	100.0	100.0	100.0	100.0	100.0	100.0
0.85	188	100.0	96.0	97.0	94.0	100.0	29.0
2	198	100.0	98.0	99.0	98.0	100.0	56.0
2.36	10	100.0	100.0	100.0	100.0	100.0	100.0
4.75	198	100.0	99.0	100.0	99.0	100.0	71.0
9.5	51	100.0	100.0	100.0	100.0	100.0	100.0
12.7	176	100.0	100.0	100.0	100.0	100.0	88.0
19	198	100.0	100.0	100.0	100.0	100.0	94.0
25	188	100.0	100.0	100.0	100.0	100.0	100.0
37.5	188	100.0	100.0	100.0	100.0	100.0	100.0
50	188	100.0	100.0	100.0	100.0	100.0	100.0
75	188	100.0	100.0	100.0	100.0	100.0	100.0
D-50 (mm)	198	0.10	0.17	0.20	0.14	1.5	0.0079
Percent Clay	184	6.2	7.6	8.5	6.8	27.0	0.0
Percent Gravel	184	0.0	0.9	1.4	0.4	29.0	0.0
Percent Sand	184	61.0	59.0	63.0	55.0	98.0	1.5
Percent Silt	184	30.0	32.0	36.0	29.0	83.0	0.2

Table 4-6
Summary of Grain Size Distribution in Housatonic River Surface Sediment (0 to 6 Inches) -- 1998-2002

Particle Size (mm)	Sample Number	Median	Average Percent Finer	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Backwaters							
0.0014	206	5.1	5.6	6.2	5.0	25.0	0.0
0.003	206	11.0	13.0	14.0	12.0	40.0	0.1
0.004	178	14.0	15.0	16.0	13.0	40.0	0.1
0.007	206	18.0	18.0	19.0	17.0	41.0	0.1
0.009	206	24.0	24.0	26.0	23.0	58.0	4.6
0.013	206	32.0	31.0	33.0	30.0	69.0	6.0
0.018	178	41.0	40.0	42.0	38.0	75.0	7.1
0.023	206	46.0	45.0	47.0	43.0	87.0	8.1
0.037	206	55.0	54.0	56.0	52.0	92.0	10.0
0.049	178	69.0	66.0	69.0	63.0	98.0	12.0
0.065	21	74.0	74.0	80.0	69.0	93.0	53.0
0.075	212	89.0	82.0	85.0	80.0	100.0	15.0
0.106	6	85.0	75.0	98.0	51.0	92.0	17.0
0.15	212	96.0	90.0	92.0	88.0	100.0	20.0
0.18	29	87.0	82.0	88.0	76.0	99.0	39.0
0.25	212	99.0	95.0	96.0	93.0	100.0	39.0
0.3	6	96.0	90.0	103.0	77.0	99.0	58.0
0.425	212	100.0	97.0	98.0	96.0	100.0	48.0
0.6	6	99.0	99.0	100.0	98.0	100.0	97.0
0.635	6	100.0	100.0	100.0	100.0	100.0	100.0
0.85	206	100.0	98.0	99.0	98.0	100.0	53.0
2	212	100.0	99.0	100.0	99.0	100.0	57.0
2.36	6	100.0	100.0	100.0	100.0	100.0	100.0
4.75	212	100.0	99.0	100.0	99.0	100.0	65.0
9.5	40	100.0	100.0	100.0	99.0	100.0	86.0
12.7	184	100.0	100.0	100.0	100.0	100.0	94.0
19	212	100.0	100.0	100.0	100.0	100.0	98.0
25	206	100.0	100.0	100.0	100.0	100.0	100.0
37.5	206	100.0	100.0	100.0	100.0	100.0	100.0
50	206	100.0	100.0	100.0	100.0	100.0	100.0
75	206	100.0	100.0	100.0	100.0	100.0	100.0
D-50 (mm)	212	0.028	0.043	0.051	0.035	0.61	0.0081
Percent Clay	205	18.0	18.0	19.0	17.0	41.0	0.1
Percent Gravel	205	0.0	0.7	1.1	0.4	35.0	0.0
Percent Sand	205	11.0	17.0	19.0	14.0	78.0	0.0
Percent Silt	205	68.0	65.0	67.0	62.0	100.0	13.0

Table 4-6
Summary of Grain Size Distribution in Housatonic River Surface Sediment (0 to 6 Inches) -- 1998-2002

Particle Size (mm)	Sample Number	Median	Average Percent Finer	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Reach 6 - Woods Pond							
0.0014	96	3.2	4.0	4.6	3.3	19.0	0.0
0.003	96	7.1	7.8	8.9	6.8	33.0	0.0
0.004	80	9.7	10.0	11.0	8.6	33.0	0.0
0.007	96	11.0	13.0	14.0	11.0	45.0	0.0
0.009	96	16.0	18.0	20.0	16.0	61.0	0.0
0.013	96	22.0	23.0	25.0	21.0	61.0	0.7
0.018	80	33.0	31.0	34.0	27.0	70.0	1.1
0.023	96	34.0	34.0	37.0	31.0	78.0	1.1
0.037	96	43.0	42.0	46.0	38.0	89.0	1.1
0.049	80	58.0	56.0	61.0	50.0	100.0	1.1
0.065	4	55.0	52.0	61.0	43.0	58.0	40.0
0.075	105	89.0	79.0	84.0	74.0	100.0	2.3
0.106	9	94.0	93.0	96.0	89.0	98.0	84.0
0.15	105	97.0	88.0	92.0	84.0	100.0	6.2
0.18	18	96.0	90.0	97.0	84.0	100.0	39.0
0.25	105	99.0	92.0	96.0	89.0	100.0	11.0
0.3	9	99.0	98.0	99.0	96.0	99.0	94.0
0.425	105	100.0	94.0	97.0	91.0	100.0	25.0
0.6	9	100.0	99.0	100.0	98.0	100.0	97.0
0.635	9	100.0	100.0	100.0	100.0	100.0	100.0
0.85	96	100.0	96.0	98.0	93.0	100.0	36.0
2	105	100.0	97.0	99.0	95.0	100.0	46.0
2.36	9	100.0	100.0	100.0	100.0	100.0	100.0
4.75	105	100.0	98.0	99.0	96.0	100.0	51.0
9.5	27	100.0	100.0	100.0	99.0	100.0	92.0
12.7	89	100.0	99.0	100.0	98.0	100.0	73.0
19	105	100.0	99.0	100.0	99.0	100.0	90.0
25	96	100.0	100.0	100.0	100.0	100.0	92.0
37.5	96	100.0	100.0	100.0	100.0	100.0	100.0
50	96	100.0	100.0	100.0	100.0	100.0	100.0
75	96	100.0	100.0	100.0	100.0	100.0	100.0
D-50 (mm)	105	0.039	0.14	0.24	0.045	4.0	0.0077
Percent Clay	94	11.0	12.0	14.0	11.0	45.0	0.0
Percent Gravel	94	0.0	2.4	4.1	0.7	49.0	0.0
Percent Sand	94	10.0	19.0	24.0	15.0	96.0	0.0
Percent Silt	94	72.0	66.0	71.0	61.0	100.0	1.7

Table 4-6
Summary of Grain Size Distribution in Housatonic River Surface Sediment (0 to 6 Inches) -- 1998-2002

Particle Size (mm)	Sample Number	Median	Average Percent Finer	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Reach 7 - Housatonic River - Woods Pond to Rising Pond							
0.0014	160	0.6	1.1	1.3	0.9	5.6	0.0
0.003	160	1.1	2.4	2.8	1.9	16.0	0.0
0.004	155	1.2	2.4	2.9	1.9	16.0	0.1
0.007	160	1.4	3.1	3.7	2.4	22.0	0.1
0.009	160	1.8	3.9	4.7	3.1	29.0	0.1
0.013	160	2.1	4.7	5.7	3.7	35.0	0.1
0.018	155	2.4	5.6	6.8	4.3	42.0	0.1
0.023	160	2.6	6.5	7.9	5.0	47.0	0.1
0.037	160	2.9	7.8	9.6	6.0	57.0	0.1
0.049	155	3.3	9.3	12.0	7.1	71.0	0.1
0.075	160	3.9	14.0	18.0	11.0	83.0	0.1
0.15	160	10.0	26.0	30.0	21.0	96.0	0.2
0.18	5	10.0	41.0	84.0	< 0	97.0	3.4
0.25	160	24.0	39.0	45.0	33.0	99.0	0.2
0.425	160	41.0	49.0	55.0	43.0	100.0	0.4
0.85	160	60.0	59.0	65.0	53.0	100.0	0.7
2	160	78.0	67.0	72.0	62.0	100.0	2.7
4.75	160	84.0	77.0	80.0	73.0	100.0	16.0
9.5	5	87.0	85.0	101.0	70.0	100.0	58.0
12.7	155	97.0	90.0	92.0	87.0	100.0	36.0
19	160	100.0	95.0	96.0	93.0	100.0	54.0
25	160	100.0	97.0	99.0	96.0	100.0	61.0
37.5	160	100.0	100.0	100.0	100.0	100.0	100.0
50	160	100.0	100.0	100.0	100.0	100.0	100.0
75	160	100.0	100.0	100.0	100.0	100.0	100.0
D-50 (mm)	160	0.62	2.6	3.1	2.0	17.0	0.027
Percent Clay	160	1.4	3.1	3.7	2.4	22.0	0.1
Percent Gravel	160	16.0	23.0	27.0	20.0	84.0	0.0
Percent Sand	160	62.0	62.0	66.0	59.0	99.0	16.0
Percent Silt	160	2.5	11.0	14.0	8.6	67.0	0.0

Table 4-6
Summary of Grain Size Distribution in Housatonic River Surface Sediment (0 to 6 Inches) -- 1998-2002

Particle Size (mm)	Sample Number	Median	Average Percent Finer	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Reach 8 - Rising Pond							
0.0014	20	0.8	1.8	2.7	0.8	6.5	0.0
0.003	20	2.5	3.6	5.2	2.0	12.0	0.0
0.004	17	3.8	5.6	7.9	3.2	14.0	0.0
0.007	20	4.4	6.6	9.7	3.6	21.0	0.0
0.009	20	5.7	8.6	12.0	4.9	26.0	0.0
0.013	20	7.4	12.0	17.0	6.4	36.0	0.0
0.018	17	9.8	16.0	23.0	9.3	46.0	0.4
0.023	20	11.0	17.0	24.0	9.1	55.0	0.8
0.037	20	14.0	21.0	31.0	11.0	75.0	0.8
0.049	17	21.0	32.0	45.0	19.0	85.0	1.3
0.075	20	34.0	40.0	55.0	25.0	100.0	2.2
0.15	20	60.0	54.0	71.0	38.0	100.0	3.3
0.18	3	9.4	15.0	32.0	< 0	32.0	5.1
0.25	20	82.0	64.0	81.0	47.0	100.0	4.3
0.425	20	90.0	73.0	88.0	58.0	100.0	5.4
0.85	20	97.0	86.0	96.0	75.0	100.0	7.4
2	20	98.0	92.0	101.0	83.0	100.0	11.0
4.75	20	100.0	94.0	103.0	85.0	100.0	14.0
9.5	3	100.0	100.0	100.0	100.0	100.0	100.0
12.7	17	100.0	95.0	104.0	85.0	100.0	19.0
19	20	100.0	96.0	104.0	89.0	100.0	25.0
25	20	100.0	98.0	102.0	95.0	100.0	66.0
37.5	20	100.0	100.0	100.0	100.0	100.0	100.0
50	20	100.0	100.0	100.0	100.0	100.0	100.0
75	20	100.0	100.0	100.0	100.0	100.0	100.0
D-50 (mm)	20	0.12	1.4	3.6	< 0	23.0	0.020
Percent Clay	20	4.4	6.6	9.7	3.6	21.0	0.0
Percent Gravel	20	0.1	6.1	15.0	< 0	86.0	0.0
Percent Sand	20	53.0	54.0	69.0	39.0	97.0	0.0
Percent Silt	20	29.0	33.0	46.0	21.0	82.0	1.9

Table 4-6
Summary of Grain Size Distribution in Housatonic River Surface Sediment (0 to 6 Inches) -- 1998-2002

Particle Size (mm)	Sample Number	Median	Average Percent Finer	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Reach 9 - Downstream of Rising Pond Dam to the Connecticut Border							
0.0014	45	1.6	1.6	2.0	1.3	4.2	0.0
0.003	45	2.6	3.5	4.3	2.7	9.6	0.0
0.004	43	2.6	3.5	4.3	2.7	9.6	0.0
0.007	45	3.2	4.1	4.9	3.2	11.0	0.0
0.009	45	4.2	5.3	6.5	4.2	15.0	0.4
0.013	45	5.6	6.7	8.2	5.3	19.0	0.5
0.018	43	7.0	8.4	10.0	6.7	24.0	0.5
0.023	45	7.5	9.8	12.0	7.7	28.0	0.5
0.037	45	8.8	12.0	14.0	9.1	34.0	0.5
0.049	43	11.0	14.0	17.0	11.0	44.0	0.5
0.075	45	17.0	21.0	26.0	16.0	67.0	0.5
0.15	45	41.0	41.0	49.0	32.0	92.0	1.0
0.18	2	49.0	49.0	NA	NA	94.0	4.5
0.25	45	79.0	63.0	73.0	53.0	99.0	1.4
0.425	45	92.0	75.0	84.0	66.0	100.0	2.7
0.85	45	97.0	83.0	91.0	75.0	100.0	9.1
2	45	98.0	88.0	94.0	82.0	100.0	25.0
4.75	45	99.0	93.0	97.0	89.0	100.0	31.0
9.5	2	96.0	96.0	NA	NA	100.0	93.0
12.7	43	100.0	97.0	100.0	95.0	100.0	43.0
19	45	100.0	99.0	101.0	97.0	100.0	58.0
25	45	100.0	100.0	100.0	99.0	100.0	84.0
37.5	45	100.0	100.0	100.0	100.0	100.0	100.0
50	45	100.0	100.0	100.0	100.0	100.0	100.0
75	45	100.0	100.0	100.0	100.0	100.0	100.0
D-50 (mm)	45	0.17	0.81	1.5	0.11	16	0.056
Percent Clay	45	3.2	4.1	4.9	3.2	11.0	0.0
Percent Gravel	45	1.2	6.7	11.0	2.9	70.0	0.0
Percent Sand	45	74.0	72.0	78.0	67.0	97.0	29.0
Percent Silt	45	15.0	17.0	21.0	12.0	56.0	0.4

Table 4-6
Summary of Grain Size Distribution in Housatonic River Surface Sediment (0 to 6 Inches) -- 1998-2002

Particle Size (mm)	Sample Number	Median	Average Percent Finer	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Connecticut							
0.0014	20	0.7	1.1	1.9	0.3	8.3	0.0
0.003	20	1.4	2.1	3.5	0.7	15.0	0.4
0.004	20	1.4	2.2	3.6	0.8	15.0	0.4
0.007	20	1.6	3.1	5.1	1.0	22.0	0.6
0.009	20	1.8	4.0	6.7	1.2	28.0	0.6
0.013	20	2.0	4.7	8.1	1.3	35.0	0.6
0.018	20	2.0	5.5	9.7	1.3	43.0	0.6
0.023	20	2.0	6.1	11.0	1.3	48.0	0.6
0.037	20	2.0	6.9	12.0	1.4	56.0	0.6
0.049	20	2.0	8.6	15.0	1.8	68.0	0.8
0.065	5	6.6	7.5	14.0	0.7	21.0	0.8
0.075	20	2.0	11.0	19.0	2.5	81.0	0.8
0.15	20	5.2	22.0	34.0	10.0	96.0	1.5
0.18	20	24.0	39.0	54.0	25.0	99.0	3.1
0.25	20	24.0	39.0	54.0	25.0	99.0	3.1
0.425	20	52.0	59.0	74.0	44.0	99.0	7.6
0.85	20	87.0	77.0	89.0	66.0	100.0	22.0
2	20	98.0	89.0	97.0	81.0	100.0	34.0
4.75	20	99.0	93.0	99.0	86.0	100.0	46.0
9.5	20	100.0	98.0	100.0	95.0	100.0	75.0
12.7	20	100.0	98.0	100.0	95.0	100.0	75.0
19	20	100.0	99.0	100.0	98.0	100.0	93.0
25	20	100.0	100.0	100.0	99.0	100.0	97.0
37.5	20	100.0	100.0	100.0	100.0	100.0	100.0
50	20	100.0	100.0	100.0	100.0	100.0	100.0
75	20	100.0	100.0	100.0	100.0	100.0	100.0
D-50 (mm)	20	0.42	0.76	1.3	0.22	5.4	0.026
Percent Clay	5	1.8	1.9	2.8	1.0	3.4	0.6
Percent Gravel	5	3.4	15.0	35.0	< 0	54.0	0.6
Percent Sand	5	86.0	78.0	95.0	61.0	93.0	45.0
Percent Silt	5	4.8	5.6	12.0	< 0	17.0	0.1

Notes:
1. All EPA (1998-2002) data are included.
2. Duplicate samples were averaged prior to calculation of statistics.
3. Data were depth-weighted (as necessary) to provide representative and comparable values for 6-inch increments (e.g., 0-6, 6-12, etc.)
4. Backwater areas determined via probing description and/or GIS methods.
5. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).

Table 4-7

Summary of Bulk Density Data from Housatonic River Sediment (g/cm^3) -- 1997-2001

Sampling Location	Sample Number	Mean	+2 Standard Error	-2 Standard Error	Maximum	Minimum
Reach 5A	16	1.3	1.4	1.1	1.6	0.9
Reach 5B	7	0.96	1.1	0.78	1.2	0.5
Reach 5C	13	0.74	0.89	0.59	1.3	0.4
Backwaters	11	0.52	0.73	0.32	1.2	0.2
Reach 6	25	0.37	0.46	0.27	1.1	0.1
Reach 7	16	0.89	1.2	0.60	1.8	0.1
Reach 8	4	0.64	1.1	0.20	1.3	0.3
Reach 9	8	1.3	1.5	1.0	1.6	0.7
Connecticut	12	1.1	1.3	0.87	1.6	0.6

Notes:

1. Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP.
2. Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence.
3. Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond.
4. Backwater areas determined via probing description and/or GIS methods.
5. Reach 6 - Woods Pond.
6. Reach 7 - Woods Pond Dam to Rising Pond.
7. Reach 8 - Rising Pond.
8. Reach 9 - Downstream of Rising Pond Dam.
9. All GE (Dec. 1997-1998) and EPA (1999-2001) data are included.
10. Duplicate samples were averaged prior to calculation of statistics.

Table 4-8
Summary of PCB Concentrations in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (mg/kg)	Arithmetic			Maximum (mg/kg)	Minimum (mg/kg)
				Mean (mg/kg)	+2 Std Error (mg/kg)	-2 Std Error (mg/kg)		
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP								
0-6	369	97	11	20	23	16	290	ND
6-12	142	96	14	27	35	19	346	ND
12-18	174	93	14	27	34	20	387	ND
18-24	100	97	15	29	38	20	274	ND
24-30	95	92	15	29	36	21	253	ND
30-36	60	97	15	29	38	20	150	ND
36-42	44	86	12	41	65	18	374	ND
42-48	22	91	16	44	84	3.4	450	ND
48-54	11	64	0.29	15	37	< 0	126	ND
54-60	5	60	0.033	2.9	8.7	< 0	14	ND
60-66	4	75	1.6	12	33	< 0	44	ND
66-72	1	0	NA	ND	NA	NA	NA	NA
72-78	3	33	0.010	0.025	0.054	< 0	0.054	ND
78-84	1	0	NA	ND	NA	NA	NA	NA
102-108	1	0	NA	ND	NA	NA	NA	NA
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence								
0-6	179	82	3.3	6.5	8.7	4.3	165	ND
6-12	42	67	1.6	4.3	6.5	2.2	32	ND
12-18	80	60	0.53	3.7	5.5	2.0	62	ND
18-24	36	75	1.9	4.6	6.9	2.2	31	ND
24-30	37	65	0.65	5.7	9.4	2.0	62	ND
30-36	5	60	3.2	5.8	13	< 0	19	ND
36-42	4	100	4.4	4.4	7.2	1.6	7.8	1.1

Table 4-8
Summary of PCB Concentrations in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (mg/kg)	Arithmetic Mean (mg/kg)	Arithmetic +2 Std Error (mg/kg)	Arithmetic -2 Std Error (mg/kg)	Maximum (mg/kg)	Minimum (mg/kg)
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence - (continued)								
42-48	4	50	0.085	5.9	17	< 0	23	ND
48-54	4	75	0.14	0.41	1.0	< 0	1.3	ND
60-66	2	50	0.016	0.016	NA	NA	0.021	ND
66-72	2	50	0.026	0.026	NA	NA	0.041	ND
72-78	1	0	NA	ND	NA	NA	NA	NA
84-90	1	0	NA	ND	NA	NA	NA	NA
96-102	1	0	NA	ND	NA	NA	NA	NA
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond								
0-6	224	91	6.1	22	27	16	294	ND
6-12	68	62	0.48	12	19	4.1	196	ND
12-18	117	54	0.51	13	20	7.1	205	ND
18-24	61	36	0.25	5.2	8.7	1.7	65	ND
24-30	44	36	0.25	5.0	8.9	1.0	72	ND
30-36	7	29	0.25	1.0	2.6	< 0	5.9	ND
36-42	7	14	0.014	0.085	0.17	< 0	0.25	ND
42-48	3	0	NA	ND	NA	NA	NA	ND
48-54	2	0	NA	ND	NA	NA	NA	ND
54-60	4	0	NA	ND	NA	NA	NA	ND
60-66	4	0	NA	ND	NA	NA	NA	ND
66-72	5	0	NA	ND	NA	NA	NA	ND
72-78	2	0	NA	ND	NA	NA	NA	ND
78-84	1	0	NA	ND	NA	NA	NA	NA
84-90	1	0	NA	ND	NA	NA	NA	NA

Table 4-8
Summary of PCB Concentrations in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (mg/kg)	Arithmetic Mean (mg/kg)	Arithmetic +2 Std Error (mg/kg)	Arithmetic -2 Std Error (mg/kg)	Maximum (mg/kg)	Minimum (mg/kg)
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond - (continued)								
90-96	1	0	NA	ND	NA	NA	NA	NA
114-120	1	0	NA	ND	NA	NA	NA	NA
Backwaters								
0-6	271	88	8.4	23	28	18	290	ND
6-12	24	50	0.79	11	21	1.6	100	ND
12-18	34	53	0.68	10	18	3.1	88	ND
18-24	7	14	0.25	0.43	0.67	0.19	1.0	ND
24-30	14	50	1.0	28	66	< 0	273	ND
30-36	2	50	0.39	0.39	NA	NA	0.54	ND
36-42	2	50	0.48	0.48	NA	NA	0.71	ND
42-48	2	0	NA	ND	NA	NA	NA	ND
48-54	2	0	NA	ND	NA	NA	NA	ND
54-60	2	50	0.49	0.49	NA	NA	0.72	ND
60-66	2	50	0.67	0.67	NA	NA	1.1	ND
66-72	2	0	NA	ND	NA	NA	NA	ND
72-78	2	50	0.14	0.14	NA	NA	0.25	ND
78-84	2	0	NA	ND	NA	NA	NA	ND
84-90	1	0	NA	ND	NA	NA	NA	NA
Reach 6 - Woods Pond								
0-6	113	93	17	32	40	24	210	ND
6-12	41	71	4.1	39	60	18	244	ND
12-18	49	67	1.5	24	38	11	224	ND
18-24	39	56	0.50	16	29	3.4	167	ND

Table 4-8
Summary of PCB Concentrations in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (mg/kg)	Arithmetic Mean (mg/kg)	+2 Std Error (mg/kg)	-2 Std Error (mg/kg)	Maximum (mg/kg)	Minimum (mg/kg)
Reach 6 - Woods Pond - (continued)								
24-30	25	68	1.2	30	56	4.4	229	ND
30-36	19	42	0.32	4.3	10	< 0	56	ND
36-42	19	42	0.35	3.8	9.7	< 0	57	ND
42-48	17	41	0.35	18	52	< 0	290	ND
48-54	17	41	0.40	10	30	< 0	165	ND
54-60	17	35	0.36	0.50	0.70	0.31	1.8	ND
60-66	15	33	0.37	4.5	13	< 0	61	ND
66-72	15	20	0.31	10	29	< 0	146	ND
72-78	13	15	0.25	0.32	0.46	0.19	1.1	ND
78-84	13	23	0.25	0.35	0.46	0.24	0.78	ND
84-90	10	0	NA	ND	NA	NA	NA	ND
90-96	9	0	NA	ND	NA	NA	NA	ND
96-102	8	25	0.22	0.22	0.37	0.077	0.57	ND
102-108	8	0	NA	ND	NA	NA	NA	ND
108-114	3	0	NA	ND	NA	NA	NA	ND
114-120	4	0	NA	ND	NA	NA	NA	ND
120-126	4	0	NA	ND	NA	NA	NA	ND
126-132	4	0	NA	ND	NA	NA	NA	ND
132-138	3	0	NA	ND	NA	NA	NA	ND
138-144	3	0	NA	ND	NA	NA	NA	ND
144-150	3	0	NA	ND	NA	NA	NA	ND
150-156	2	0	NA	ND	NA	NA	NA	ND
156-162	2	0	NA	ND	NA	NA	NA	ND

Table 4-8
Summary of PCB Concentrations in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (mg/kg)	Arithmetic Mean (mg/kg)	Arithmetic +2 Std Error (mg/kg)	Arithmetic -2 Std Error (mg/kg)	Maximum (mg/kg)	Minimum (mg/kg)
Reach 6 - Woods Pond - (continued)								
162-168	1	0	NA	ND	NA	NA	NA	NA
Reach 7 - Housatonic River - Woods Pond to Rising Pond								
0-6	198	55	0.28	1.8	2.4	1.2	38	ND
6-12	68	46	0.25	0.96	1.3	0.58	6.7	ND
12-18	59	34	0.25	1.2	1.9	0.49	17	ND
18-24	28	32	0.25	0.49	0.73	0.24	3.5	ND
24-30	17	53	0.40	1.1	2.1	0.081	8.3	ND
30-36	3	0	NA	ND	NA	NA	NA	ND
36-42	2	50	0.71	0.71	NA	NA	1.2	ND
Reach 8 - Rising Pond								
0-6	25	84	2.2	2.7	3.7	1.6	11	ND
6-12	20	90	4.4	5.7	8.3	3.1	22	ND
12-18	19	84	7.5	8.8	13	4.8	34	ND
18-24	19	84	7.5	10	14	6.0	27	ND
24-30	18	94	7.7	12	16	7.1	31	ND
30-36	18	89	8.5	11	16	6.7	30	ND
36-42	17	94	5.9	11	16	5.5	34	ND
42-48	17	88	9.8	13	17	7.8	39	ND
48-54	17	94	7.4	13	19	6.5	48	ND
54-60	17	94	7.9	9.4	12	6.4	22	ND
60-66	17	82	6.3	7.7	11	3.9	28	ND
66-72	18	78	11	15	21	7.8	50	ND
72-78	15	93	6.5	12	20	4.8	51	ND

Table 4-8
Summary of PCB Concentrations in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (mg/kg)	Arithmetic Mean (mg/kg)	Arithmetic +2 Std Error (mg/kg)	Arithmetic -2 Std Error (mg/kg)	Maximum (mg/kg)	Minimum (mg/kg)
Reach 8 - Rising Pond - (continued)								
78-84	12	67	1.5	6.4	13	0.088	39	ND
84-90	13	31	0.35	2.9	5.9	0.017	15	ND
90-96	12	33	0.36	2.1	5.1	< 0	19	ND
96-102	6	17	0.35	0.34	0.45	0.24	0.55	ND
102-108	2	50	0.22	0.22	NA	NA	0.36	ND
Reach 9 - Downstream of Rising Pond Dam to the Connecticut Border								
0-6	60	32	0.25	0.27	0.31	0.23	0.73	ND
12-18	2	0	NA	ND	NA	NA	NA	ND
24-30	1	0	NA	ND	NA	NA	NA	NA
Connecticut								
0-6	53	11	0.067	0.062	0.083	0.041	0.47	ND
6-12	11	27	0.012	0.12	0.34	< 0	1.2	ND
12-18	2	0	NA	ND	NA	NA	NA	ND
24-30	1	0	NA	ND	NA	NA	NA	NA
30-36	1	0	NA	ND	NA	NA	NA	NA

Notes:
1. All GE (Dec. 1997-1998) and EPA (1998-2002) data are included.
2. Non-detect values assigned a value of one-half the detection limit prior to calculation of statistics.
3. Duplicate samples were averaged prior to calculation of statistics.
4. Data were depth-weighted (as necessary) to provide representative and comparable values for 6-inch increments (e.g., 0-6, 6-12, etc.) During depth weighting, core sections less than 3 inches and greater than 6 inches thick were excluded from the calculated statistics.
5. Samples without river miles in the database, finely-segmented cores, and congener data excluded from statistics.
6. Backwater areas determined via probing description and/or GIS methods.
7. ND = Not Detected.
8. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).

Table 4-8
Summary of PCB Concentrations in Housatonic River Sediment Sampling Results -- 1997-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median (mg/kg)	Arithmetic Mean (mg/kg)	Arithmetic +2 Std Error (mg/kg)	Arithmetic -2 Std Error (mg/kg)	Maximum (mg/kg)	Minimum (mg/kg)

9. Maximum values reported above occasionally differ from the true data maxima due to data processing steps discussed in notes 2, 3, 4, and 5. These include the following:

Reach	Depth Interval	Max. PCB (mg/kg) Considering all Samples Prior to Data Processing
Reach 5A	0-6	614
	30-36	241
	36-42	605
Reach 5C	0-6	522
Reach 6	0-6	668
	30-36	152
Reach 7	6-12	8.7
Reach 9	0-6	1.2

Table 4-10
Summary of Housatonic River Sediment PCB Mass Estimate

Reach	Total Area (acre)	Depth (inch)	Bulk Density (g/cm³)		Depth Weighted PCB[1] (mg/kg)		Percent Detected	Area[2] (acre)	PCB Mass[3] (lbs)	
			+2 Std Error	-2 Std Error	+2 Std Error	-2 Std Error			+2 Std Error	-2 Std Error
Reach 5A	41	0-6	1.5	1.4	27	17	97	40	2,190	1,314
		6-12	1.6	1.4	44	21	97	39	3,760	1,590
		12-18	1.5	1.4	37	22	93	38	2,996	1,593
		18-24	1.5	1.4	39	21	97	40	3,302	1,596
		24-30	1.5	1.2	40	23	91	37	3,054	1,467
		30-36	1.6	1.3	40	21	98	40	3,501	1,538
		36-42	1.7	1.5	78	22	86	35	6,518	1,573
		42-48	1.6	1.1	96	4.6	95	39	8,375	257
		48-54	1.8	1.6	58	0.0	64	26	3,619	0
		54-60	2.1	1.4	14	0.0	60	25	998	0
		60-66	2.1	1.0	44	0.0	75	31	3,848	0
		72-78	1.7	1.6	0.054	0.054	33	14	2	2
		Total							**42,164**	**10,929**
Reach 5B	25	0-6	1.3	1.2	10	5.2	82	21	390	179
		6-12	1.4	1.2	9.3	3.4	67	17	307	92
		12-18	1.4	1.2	8.9	3.3	60	15	249	81
		18-24	1.4	1.2	8.9	3.1	75	19	331	93
		24-30	1.3	1.1	14	3.3	65	16	418	83
		30-36	1.5	1.1	19	0.14	60	15	571	3
		36-42	1.6	0.66	7.2	1.6	100	25	397	37
		42-48	1.9	0.66	35	0.0	50	13	1,115	0
		48-54	1.9	1.2	1.3	0.0	75	19	65	0
		60-66	2.0	1.3	0.021	0.021	50	13	1	0
		66-72	1.6	1.3	0.041	0.041	50	13	1	1
		Total							**3,844**	**570**

Table 4-10
Summary of Housatonic River Sediment PCB Mass Estimate

Reach	Total Area (acre)	Depth (inch)	Bulk Density (g/cm^3) +2 Std Error	Bulk Density (g/cm^3) -2 Std Error	Depth Weighted PCB[1] (mg/kg) +2 Std Error	Depth Weighted PCB[1] (mg/kg) -2 Std Error	Percent Detected	Area[2] (acre)	PCB Mass[3] (lbs) +2 Std Error	PCB Mass[3] (lbs) -2 Std Error
Reach 5C	38	0-6	1.1	0.96	27	17	91	35	1,395	776
		6-12	1.3	1.1	34	7.3	60	23	1,331	244
		12-18	1.3	1.1	36	14	54	21	1,281	431
		18-24	1.3	1.1	23	5.4	36	14	545	113
		24-30	1.3	1.1	23	3.5	36	14	580	71
		30-36	1.7	1.1	8.7	0.0	29	11	225	0
		36-42	1.6	1.2	0.047	0.047	14	5	1	0
		Total							**5,357**	**1,635**
Backwaters	92	0-6	0.66	0.54	33	22	88	81	2,426	1,322
		6-12	0.86	0.53	45	8.0	52	48	2,548	282
		12-18	1.0	0.68	31	6.8	53	49	2,148	308
		18-24	1.5	0.71	1.0	1.0	14	13	27	13
		24-30	1.3	0.68	129	0.0	50	46	10,400	0
		30-36	1.6	0.60	0.54	0.54	50	46	54	20
		36-42	1.2	0.43	0.71	0.71	50	46	54	19
		54-60	1.8	0.35	0.72	0.72	50	46	80	16
		60-66	1.6	0.44	1.1	1.1	50	46	110	31
		72-78	1.3	1.3	0.033	0.033	50	46	3	3
		Total							**17,850**	**2,014**

Table 4-10
Summary of Housatonic River Sediment PCB Mass Estimate

Reach	Total Area (acre)	Depth (inch)	Bulk Density (g/cm³)		Depth Weighted PCB[1] (mg/kg)		Percent Detected	Area[2] (acre)	PCB Mass[3] (lbs)	
			+2 Std Error	-2 Std Error	+2 Std Error	-2 Std Error			+2 Std Error	-2 Std Error
Reach 6	65	0-6	0.66	0.48	49	28	93	60	2,717	1,140
		6-12	0.91	0.51	83	27	71	46	4,720	870
		12-18	0.82	0.51	55	17	67	44	2,701	522
		18-24	0.83	0.49	51	7.5	55	36	2,102	181
		24-30	0.93	0.55	80	8.1	68	44	4,515	267
		30-36	1.1	0.55	23	0.0	42	27	971	0
		36-42	1.1	0.59	22	0.0	42	27	881	0
		42-48	1.0	0.58	125	0.0	41	27	4,669	0
		48-54	0.91	0.47	71	0.0	41	27	2,375	0
		54-60	0.98	0.56	1.2	0.3	35	23	36	6
		60-66	1.1	0.65	37	0.0	33	22	1,245	0
		66-72	0.94	0.60	146	0.0	20	13	2,446	0
		72-78	1.0	0.64	1.5	0.0	15	10	22	0
		78-84	1.1	0.66	0.79	0.40	23	15	19	5
		96-102	1.9	0.68	0.27	0.0	25	16	11	0
		Total							29,430	2,991
Reach 7	212	0-6	1.4	1.3	4.2	2.0	55	116	938	405
		6-12	1.5	1.3	2.5	1.1	46	97	515	184
		12-18	1.5	1.2	4.9	1.2	34	72	741	149
		18-24	1.5	1.2	1.7	0.32	32	68	238	36
		24-30	1.6	1.1	3.7	0.029	53	112	937	5
		36-42	1.5	0.32	1.2	1.2	50	106	260	54
		Total							3,630	832

Table 4-10
Summary of Housatonic River Sediment PCB Mass Estimate

Reach	Total Area (acre)	Depth (inch)	Bulk Density (g/cm³)		Depth Weighted PCB[1] (mg/kg)		Percent Detected	Area[2] (acre)	PCB Mass[3] (lbs)	
			+2 Std Error	-2 Std Error	+2 Std Error	-2 Std Error			+2 Std Error	-2 Std Error
Reach 8	40	0-6	1.2	0.73	4.0	1.8	85	34	219	63
		6-12	1.2	0.70	9.0	3.6	90	36	528	124
		12-18	1.2	0.77	15	6.1	84	34	795	218
		18-24	1.1	0.79	16	7.6	84	34	833	278
		24-30	0.94	0.74	17	7.7	94	38	843	295
		30-36	0.93	0.69	17	7.9	89	36	773	265
		36-42	0.79	0.66	16	6.0	94	38	664	205
		42-48	0.93	0.68	19	9.4	88	35	852	308
		48-54	0.87	0.66	20	7.1	94	38	895	239
		54-60	0.85	0.68	13	7.0	94	38	572	247
		60-66	0.92	0.81	13	5.1	82	33	559	187
		66-72	0.92	0.75	26	11	78	31	1,019	363
		72-78	0.91	0.78	21	5.3	93	37	968	211
		78-84	0.95	0.82	18	0.69	67	27	638	21
		84-90	0.93	0.79	16	1.9	31	12	244	26
		90-96	0.96	0.78	14	0.0	33	13	254	0
		96-102	0.92	0.75	0.14	0.14	17	7	1	1
		102-108	0.85	0.79	0.083	0.083	50	20	2	2
		Total							**10,659**	**3,051**

Table 4-10
Summary of Housatonic River Sediment PCB Mass Estimate

Reach	Total Area (acre)	Depth (inch)	Bulk Density (g/cm³)		Depth Weighted PCB[1] (mg/kg)		Percent Detected	Area[2] (acre)	PCB Mass[3] (lbs)	
			+2 Std Error	-2 Std Error	+2 Std Error	-2 Std Error			+2 Std Error	-2 Std Error
Reach 9	392	0-6	1.4	1.2	0.48	0.31	32	126	112	65
		Total							**112**	**65**
Connecticut	5860	0-6	1.7	1.4	0.27	0.071	16	919	601	124
		6-12	1.7	1.1	1.2	0.0	27	1,598	4,452	0
		Total							**5,053**	**124**
	River Total								**118,100**	**22,211**

Notes:

1. Two standard errors of the arithmetic mean of detected PCB concentrations.
2. Area prorated by percentage of detections (i.e., Total Area*% detected).
3. The upper bound PCB mass estimate is determined as the product of the arithmetic mean of detected PCB plus 2 standard errors, the reach-wide arithmetic mean bulk density plus 2 standard errors, and the "PCB-containing volume." Conversely, the lower bound PCB mass estimate is determined as the product of the arithmetic mean of detected PCB minus 2 standard errors, the reach-wide arithmetic mean bulk density minus 2 standard errors, and the "PCB-containing volume."
4. All GE (Dec. 1997-1998) and EPA (1998-2002) data are included.
5. Duplicate samples were averaged prior to calculation of statistics.
6. Data were depth-weighted (as necessary) to provide representative and comparable values for 6-inch increments (e.g., 0-6, 6-12, etc.)
7. Backwater areas determined via probing description and/or GIS methods.

Section 4 Figures

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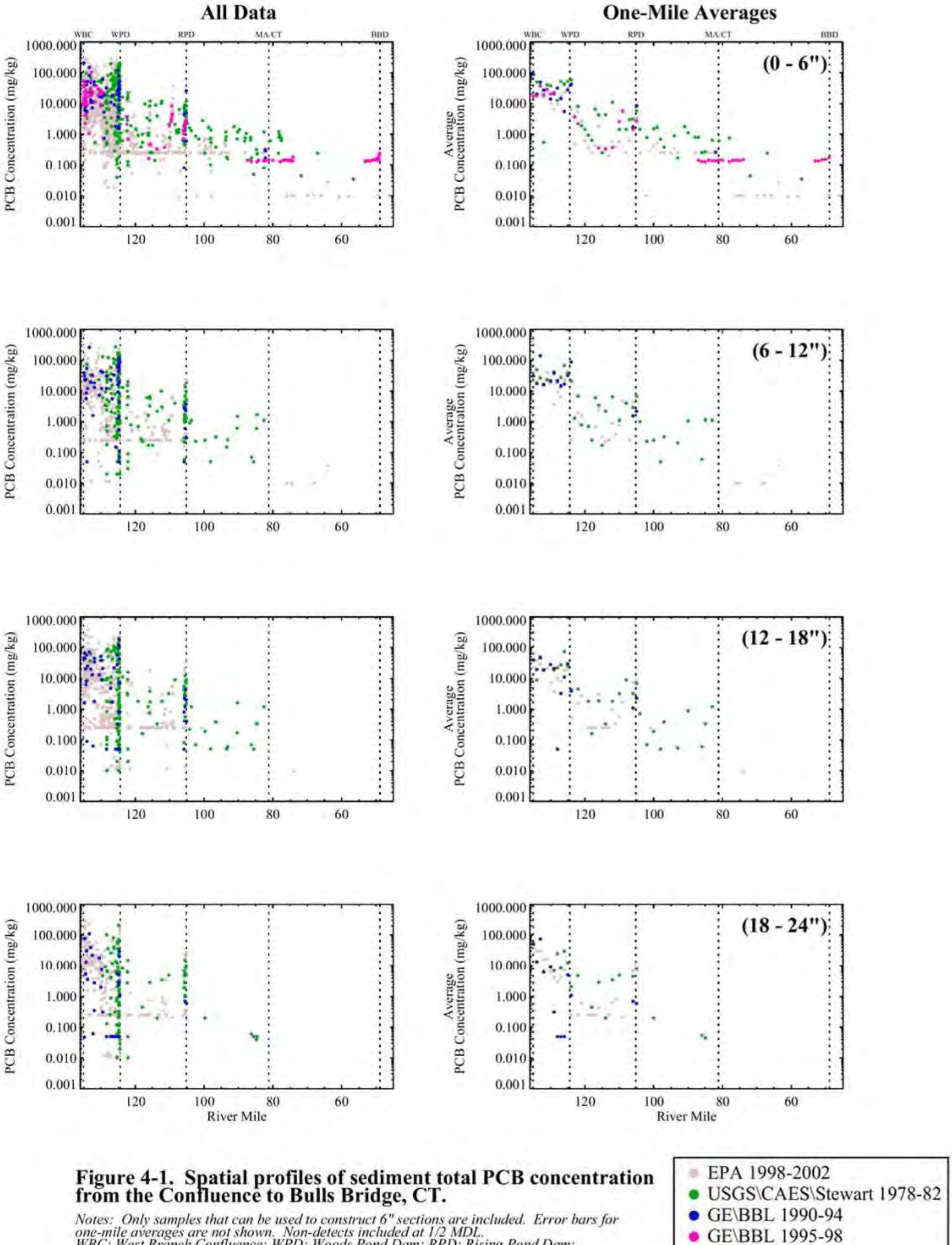

Figure 4-1. Spatial profiles of sediment total PCB concentration from the Confluence to Bulls Bridge, CT.

Notes: Only samples that can be used to construct 6" sections are included. Error bars for one-mile averages are not shown. Non-detects included at 1/2 MDL.
WBC: West Branch Confluence; WPD: Woods Pond Dam; RPD: Rising Pond Dam; MA/CT; Massachusetts/Connecticut Border; BBD: Bulls Bridge Dam.

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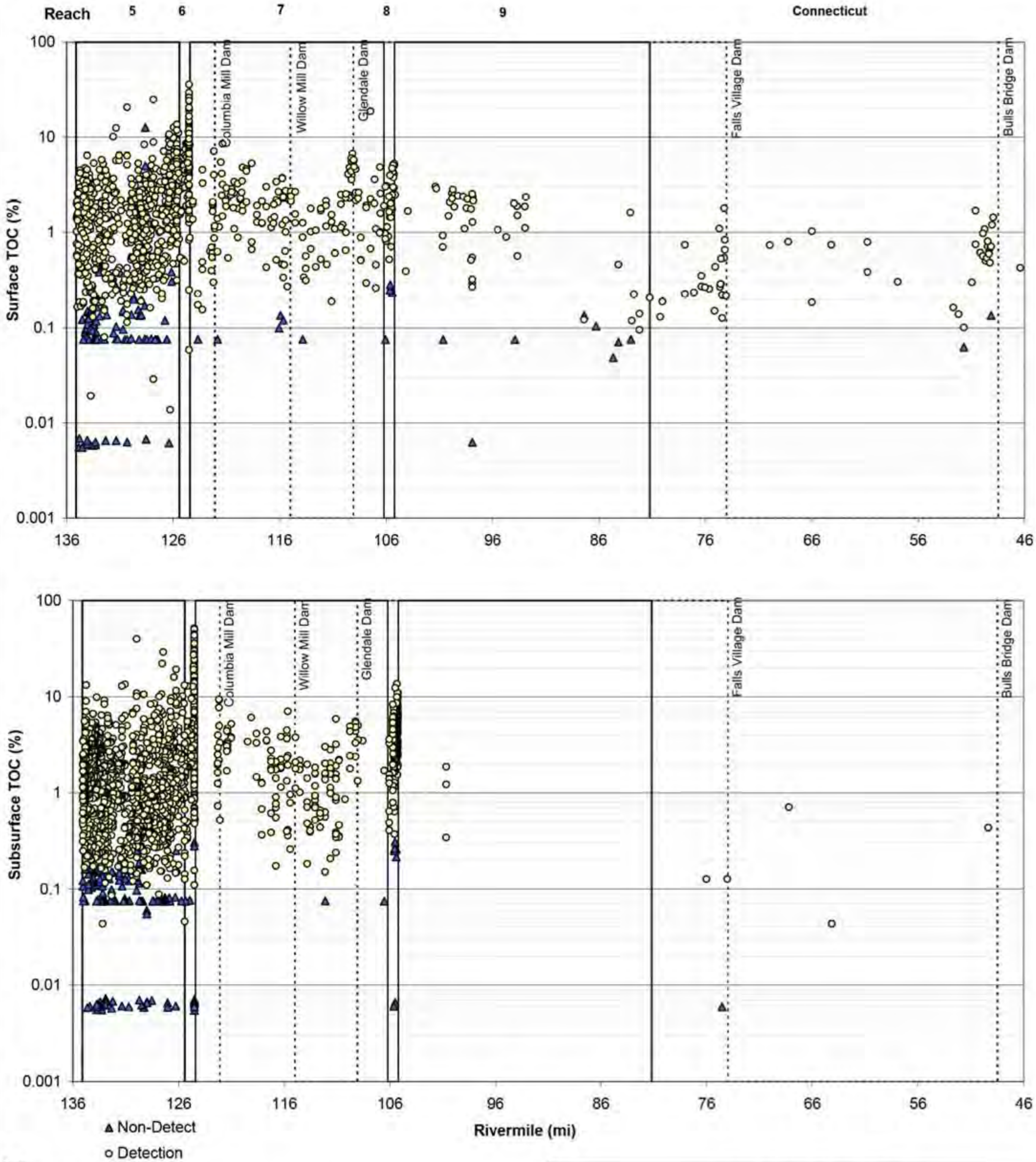

Notes:
1. TOC = total organic carbon.
2. Surface sediment samples represent 0- to 6-inch depth interval.
3. Subsurface sediment sample results are comprised of all depth weighted results below 6-inches.
4. Data shown are 1998-2002 EPA and 1997-1998 GE data sets.

Reach
5 A - Confluence to Pittsfield WWTP
5B - Pittsfield WWTP to Roaring Brook Confluence
5C - Roaring Brook Confluence to Woods Pond Headwaters
6 - Woods Pond
7 - Woods Pond Dam to Rising Pond
8 - Rising Pond
9 - Downstream of Rising Pond

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RFI Report

TOC CONCENTRATIONS FOR HOUSATONIC RIVER SURFACE AND SUBSURFACE SEDIMENT SAMPLES

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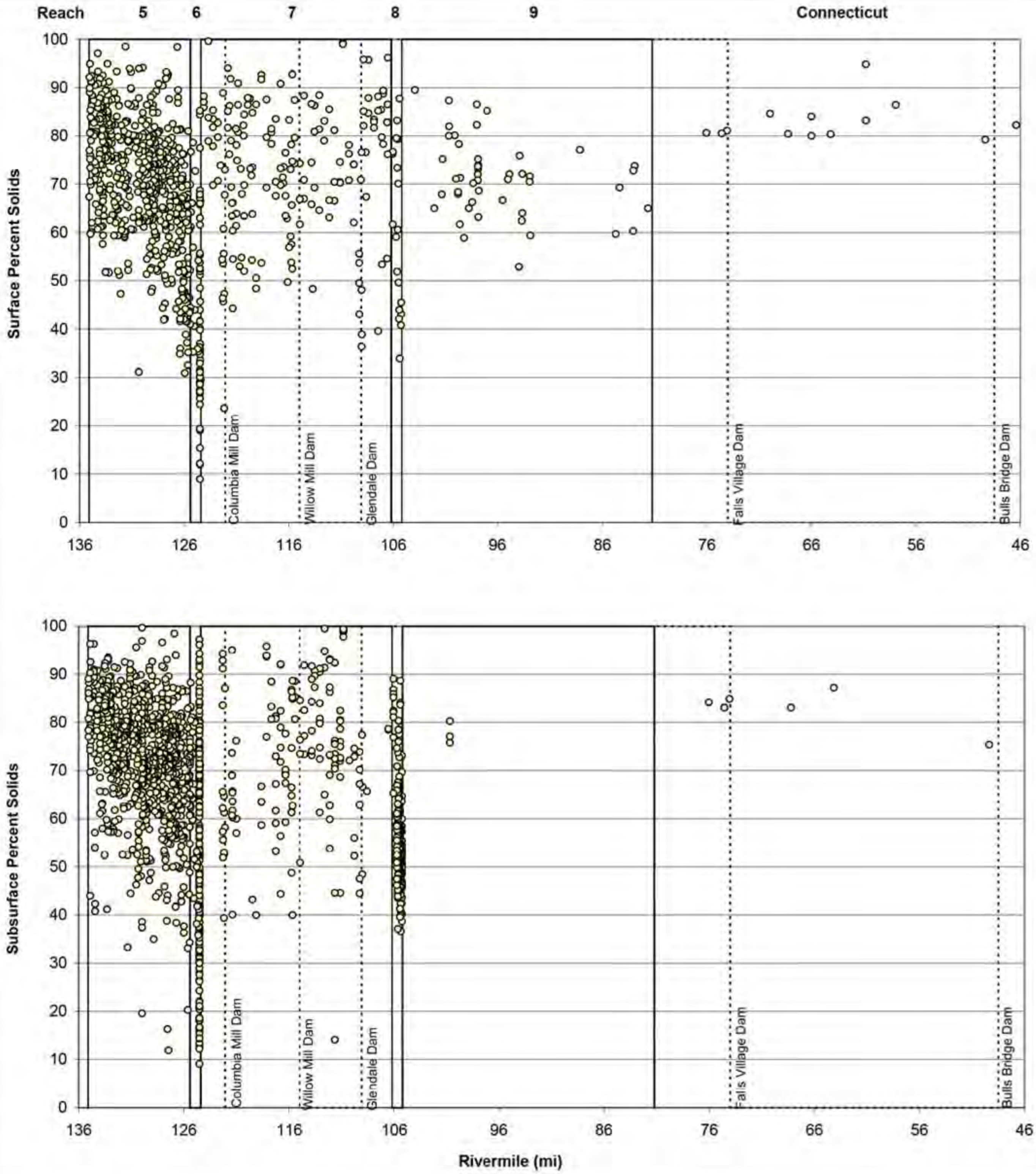
FIGURE
4-2



Notes:
1. Surface sediment samples represent 0- to 6-inch depth interval.
2. Subsurface sediment sample results are comprised of all depth weighted results below 6-inches.
3. Data shown are 1998-2002 EPA data set.

Reach
5 A - Confluence to Pittsfield WWTP
5B - Pittsfield WWTP to Roaring Brook Confluence
5C - Roaring Brook Confluence to Woods Pond Headwaters
6 - Woods Pond
7 - Woods Pond Dam to Rising Pond
8 - Rising Pond
9 - Downstream of Rising Pond

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RFI Report

PERCENT SOLIDS IN HOUSATONIC RIVER SURFACE AND SUBSURFACE SEDIMENT SAMPLES

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FIGURE 4-5

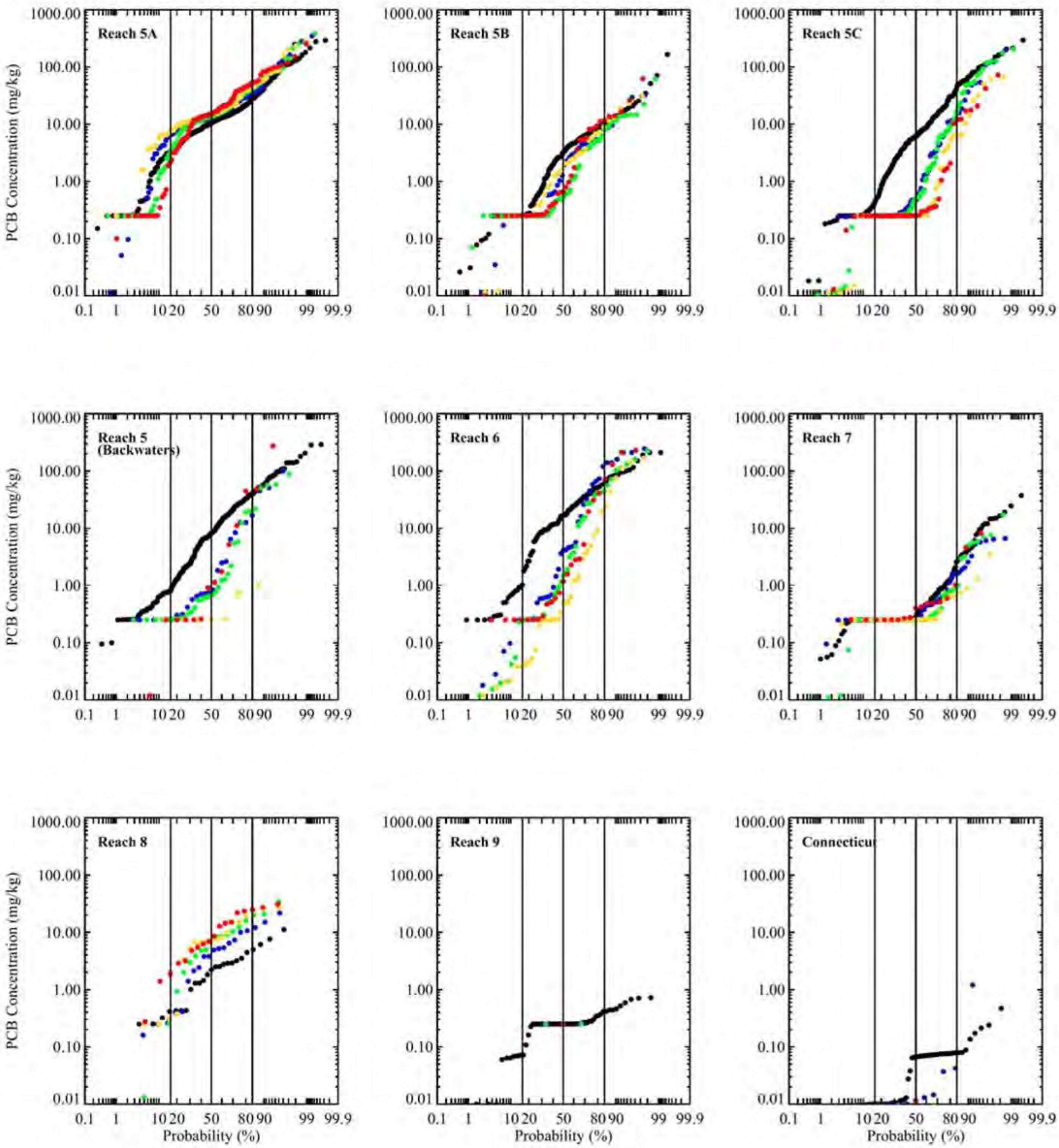

Figure 4-9. Probability distributions of sediment total PCB concentrations by depth and reach.

• 0 - 6"
• 6 - 12"
• 12 - 18"
• 18 - 24"
• 24 - 30"

Note: Data shown are 1998-2002 EPA and 1997-1998 GE data sets.

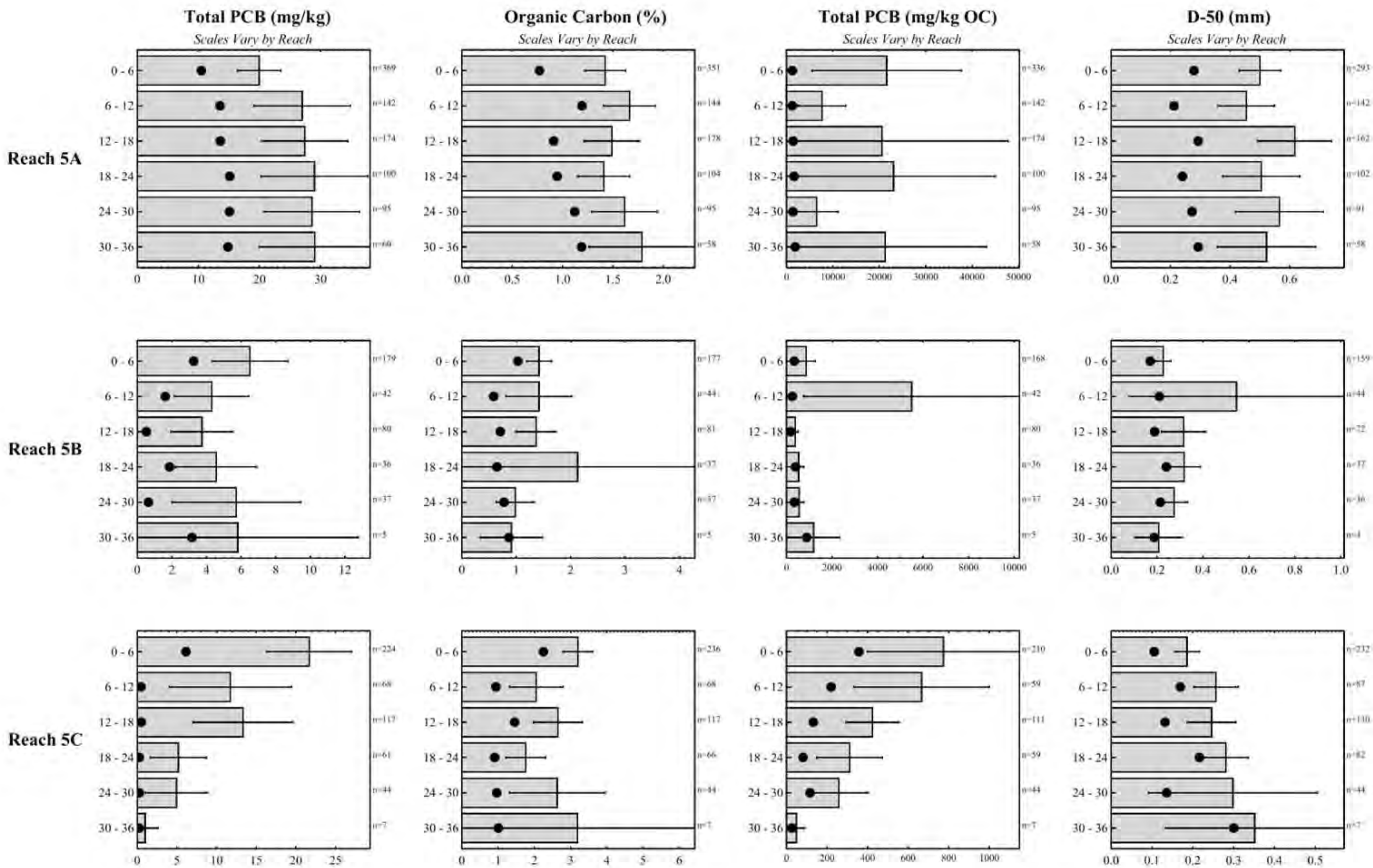

Figure 4-10a. Average sediment PCB, TOC, organic carbon-normalized PCB, and D-50 depth profiles by reach.

Notes: Data shown are 1998-2002 EPA and 1997-1998 GE data sets. Error bars represent 2 standard errors of the arithmetic mean. Points represent the median value.

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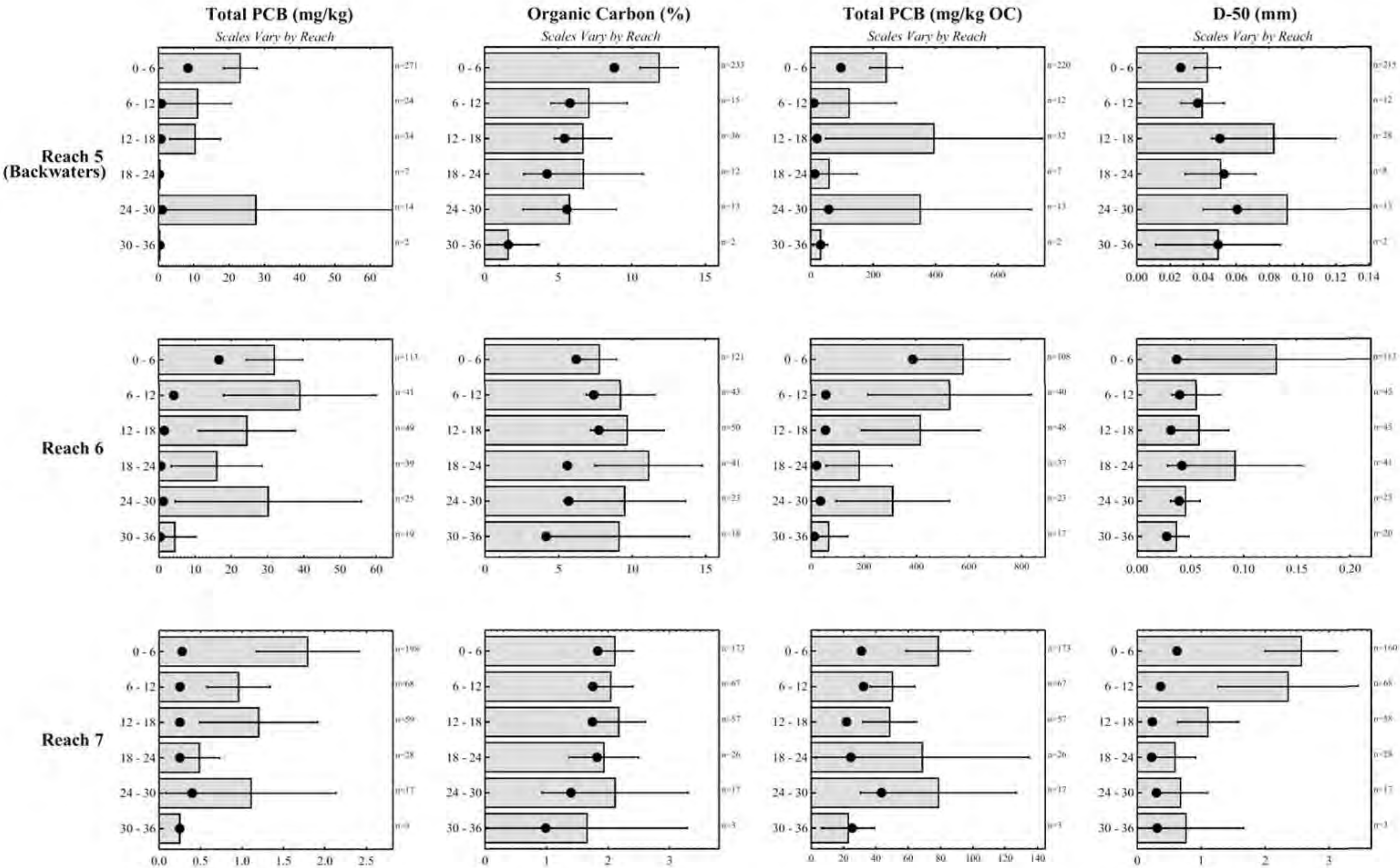

Figure 4-10b. Average sediment PCB, TOC, organic carbon-normalized PCB, and D-50 depth profiles by reach.

Notes: Data shown are 1998-2002 EPA and 1997-1998 GE data sets. Error bars represent 2 standard errors of the arithmetic mean. Points represent the median value.

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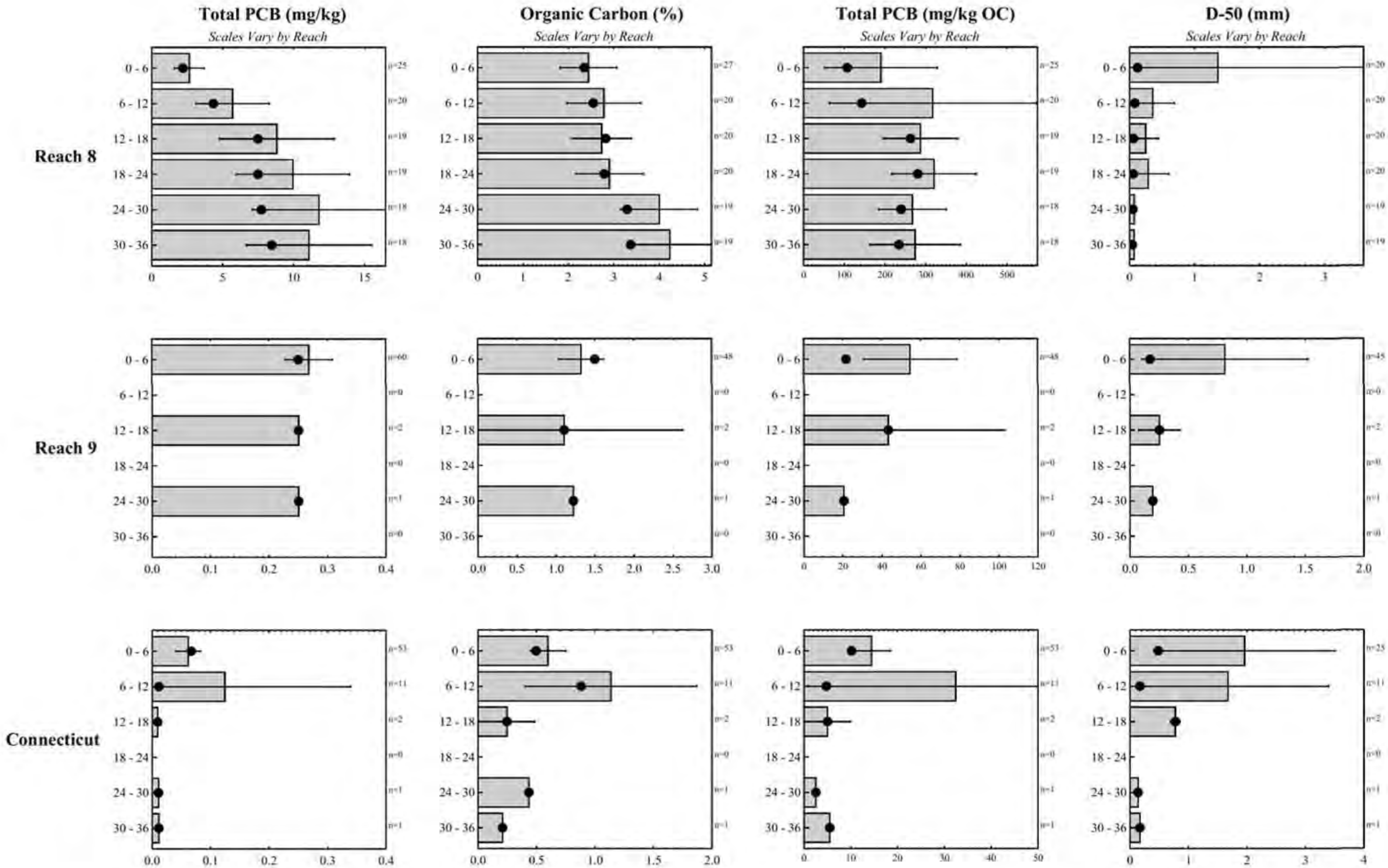

Figure 4-10c. Average sediment PCB, TOC, organic carbon-normalized PCB, and D-50 depth profiles by reach.

Notes: Data shown are 1998-2002 EPA and 1997-1998 GE data sets. Error bars represent 2 standard errors of the arithmetic mean. Points represent the median value.

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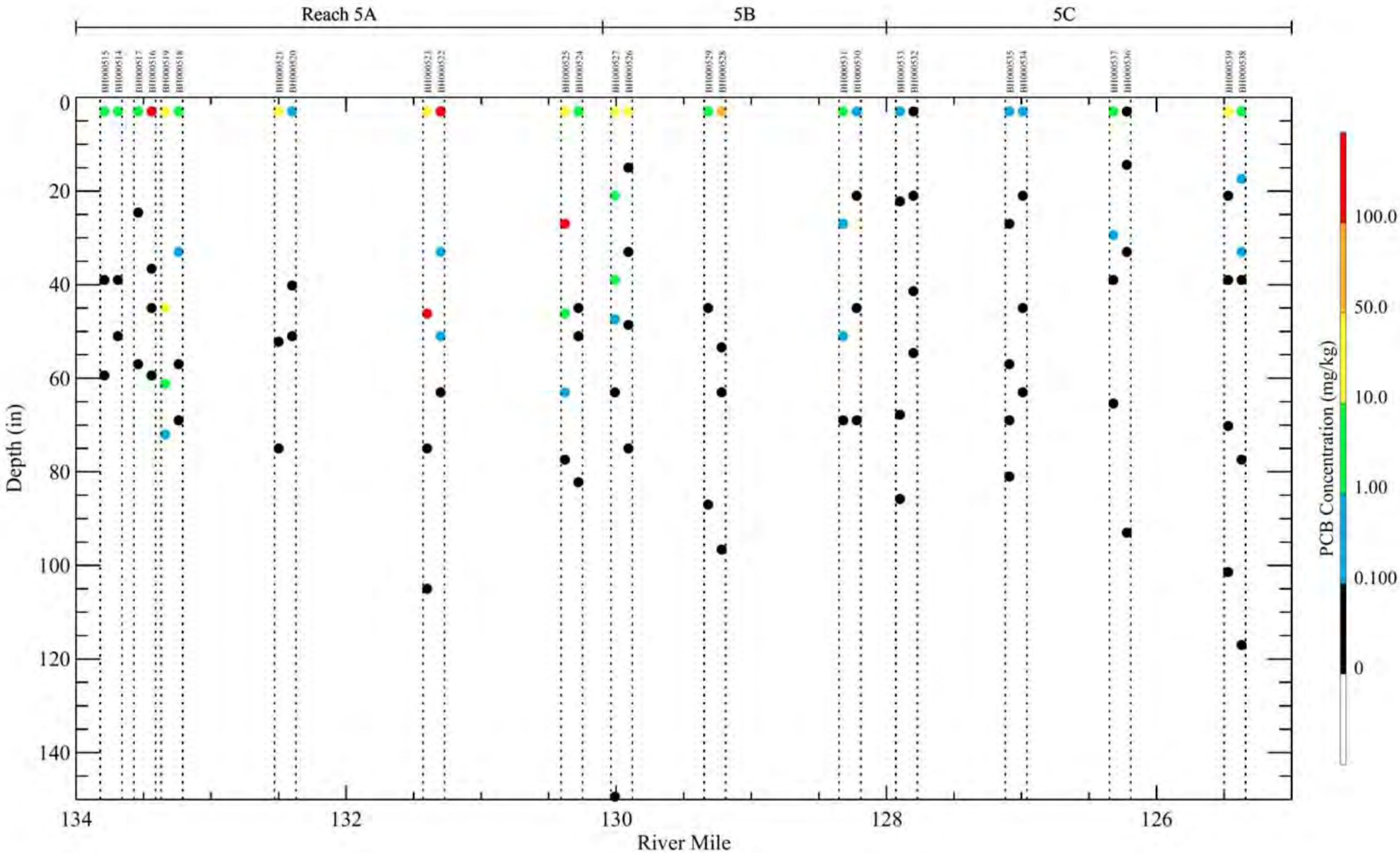

Figure 4-11. Profiles of PCB concentrations in 2001-2002 EPA Vertical Definition Cores.

Note: Two cores were collected at each location on each side of the channel, and have been offset in plot; Vertical dotted lines represent each core pair. Duplicate samples have been averaged.

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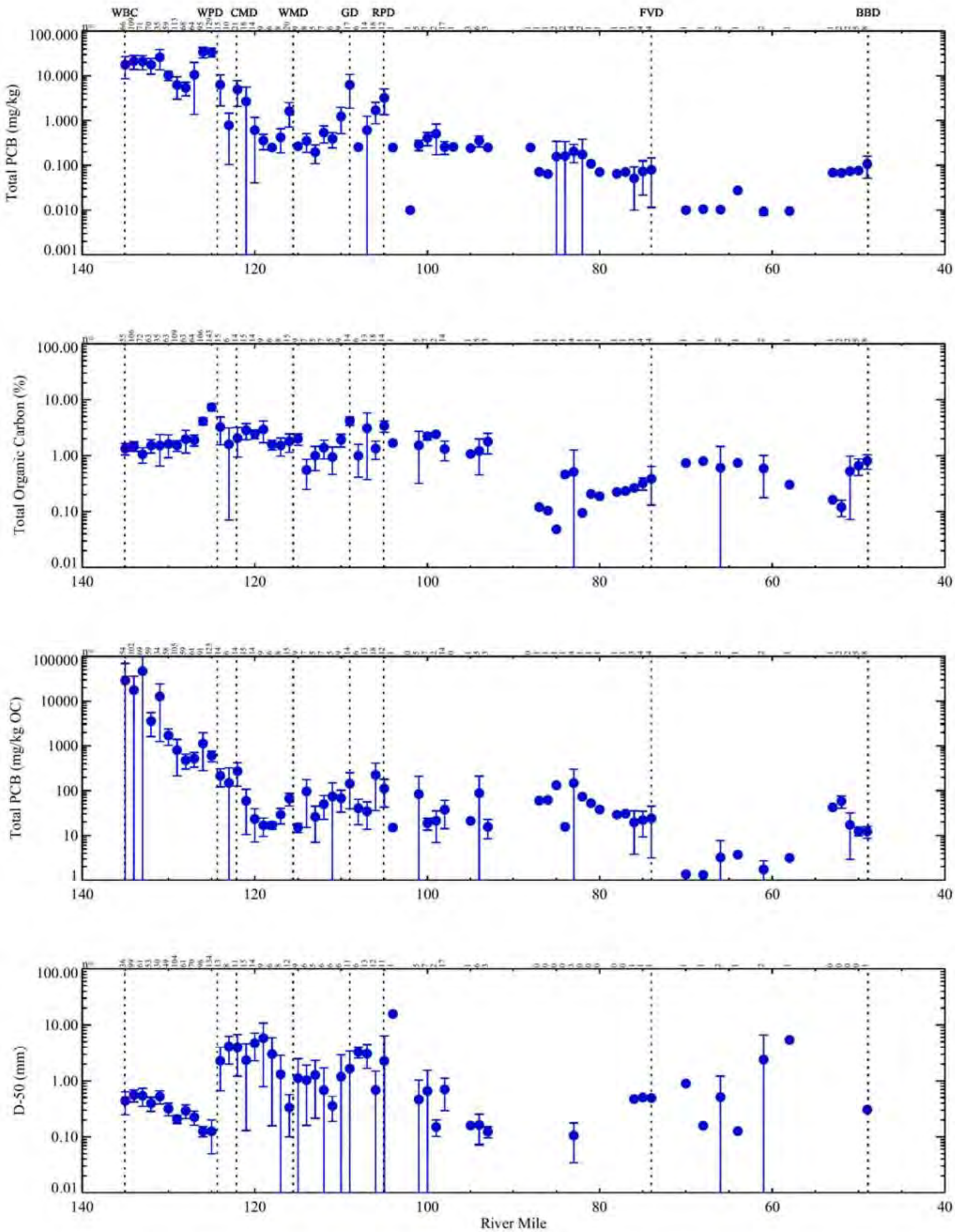

Figure 4-12. Spatial profiles of surface sediment (0-6") PCB, TOC, organic carbon-normalized PCB, and D-50 data from the Confluence to Bulls Bridge, CT.

Note: Data shown are 1998-2002 EPA and 1997-1998 GE data sets. Values shown are one-mile averages of the data. Error bars represent 2 standard errors of the mean.

Abbreviations: West Branch Confluence (WBC), Woods Pond Dam (WPD), Columbia Mill Dam (CMD), Willow Mill Dam (WMD), Glendale Dam (GD), Rising Pond Dam (RPD), Falls Village Dam (FVD), and Bulls Bridge Dam (BBD).

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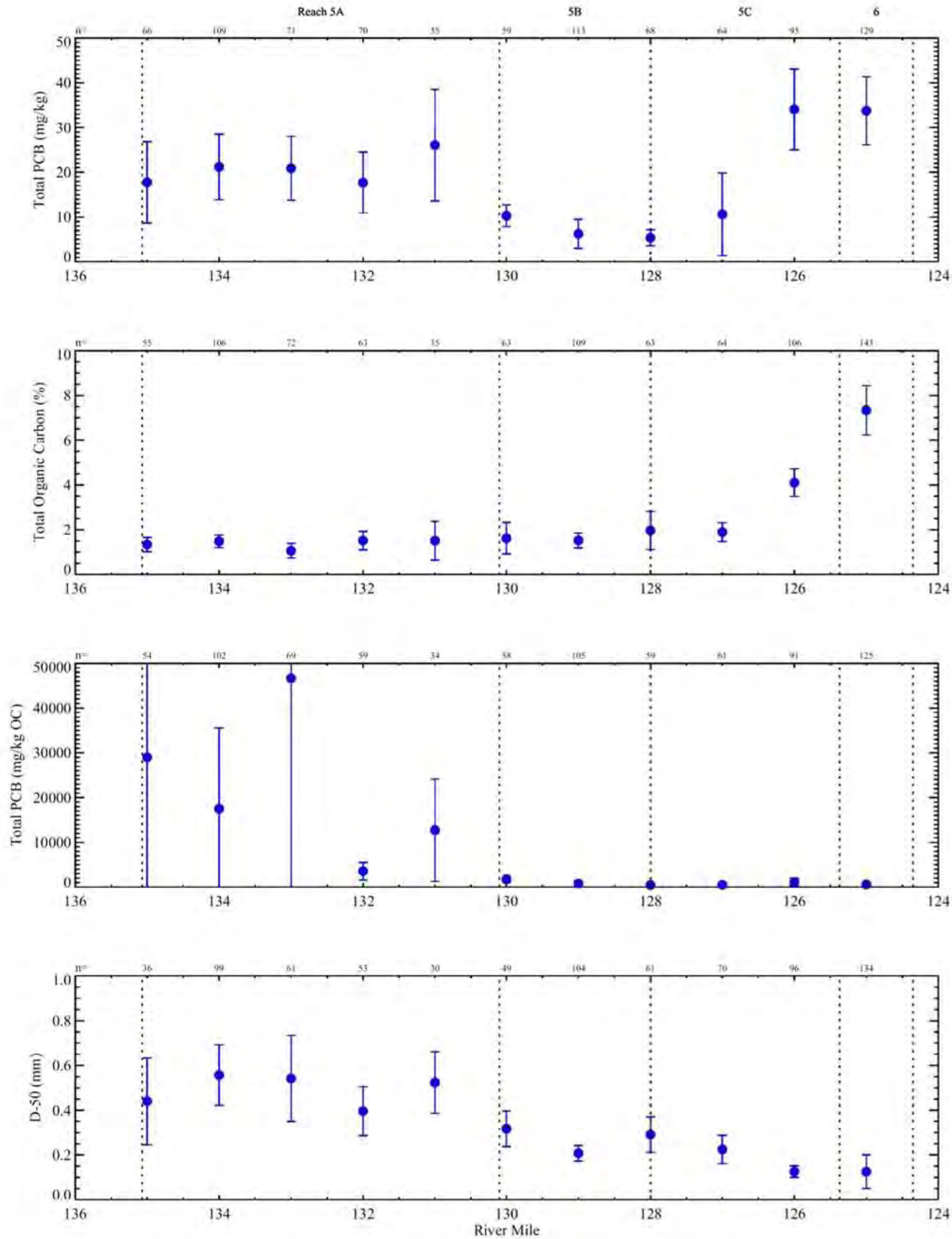

Figure 4-13. Spatial profiles of surface sediment (0-6") PCB, TOC, organic carbon-normalized PCB, and D-50 data from the Confluence to Woods Pond.

Note: Data shown are 1998-2002 EPA and 1997-1998 GE data sets. Values shown are one-mile averages of the data. Error bars represent 2 standard errors of the mean.

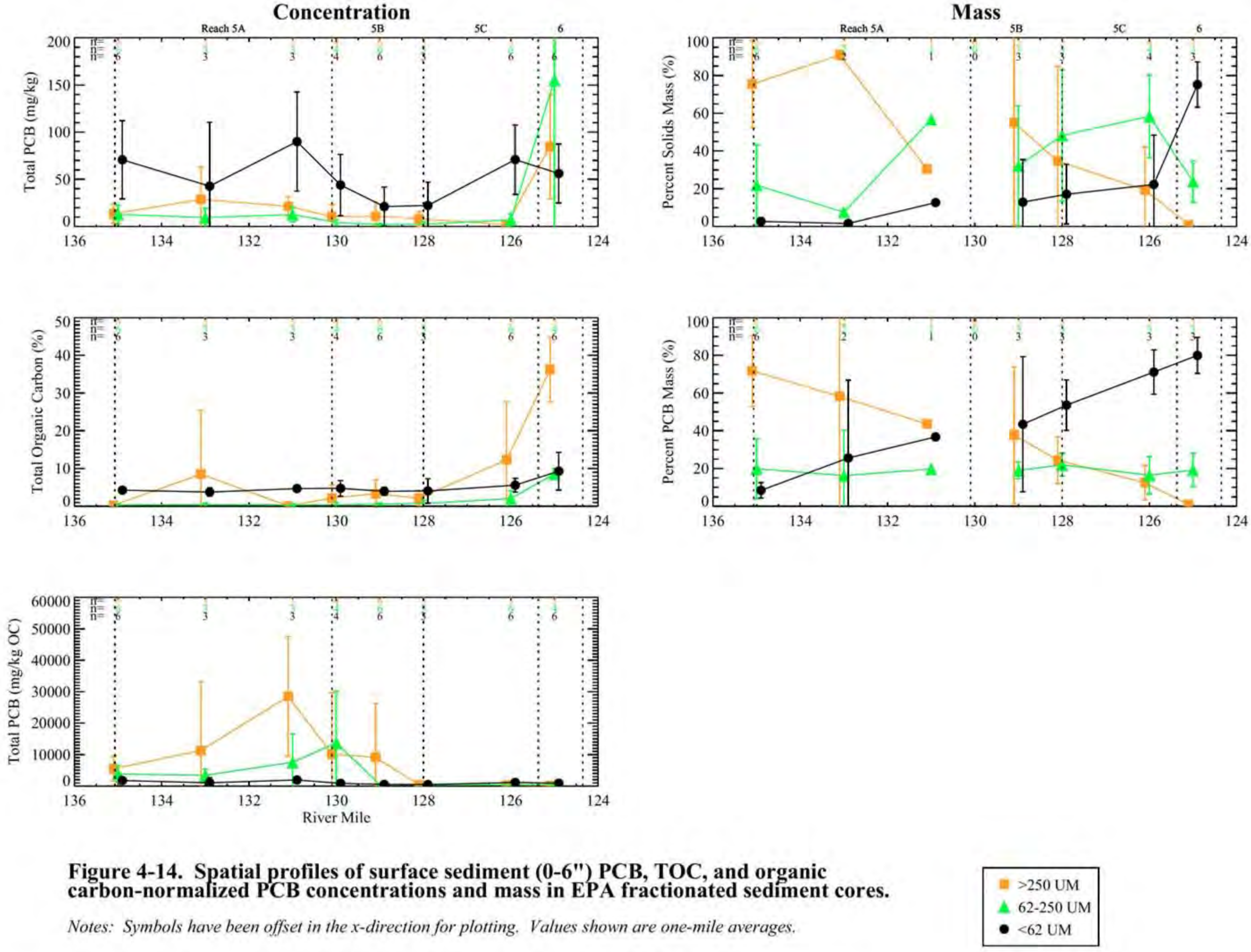

Figure 4-14. Spatial profiles of surface sediment (0-6") PCB, TOC, and organic carbon-normalized PCB concentrations and mass in EPA fractionated sediment cores.

Notes: Symbols have been offset in the x-direction for plotting. Values shown are one-mile averages.

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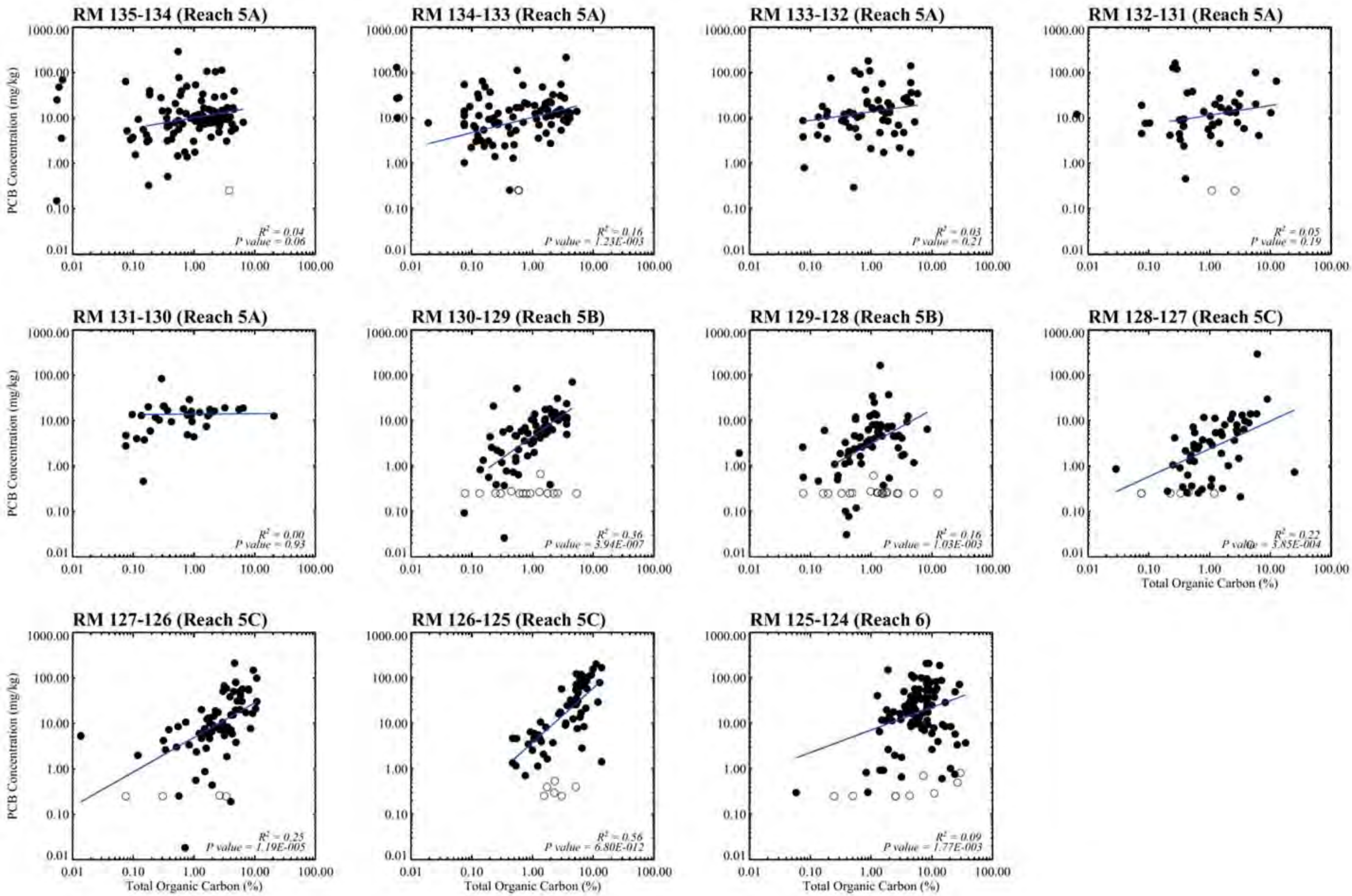

Figure 4-15. Relationship between PCB and TOC in surface (0-6") sediment.

Notes: Data shown are 1998-2002 EPA and 2001 EPA/GE partitioning data. Non-detect PCB and TOC samples plotted as open symbols at 1/2 MDL. Exclude non-detect PCB or TOC samples from regressions.

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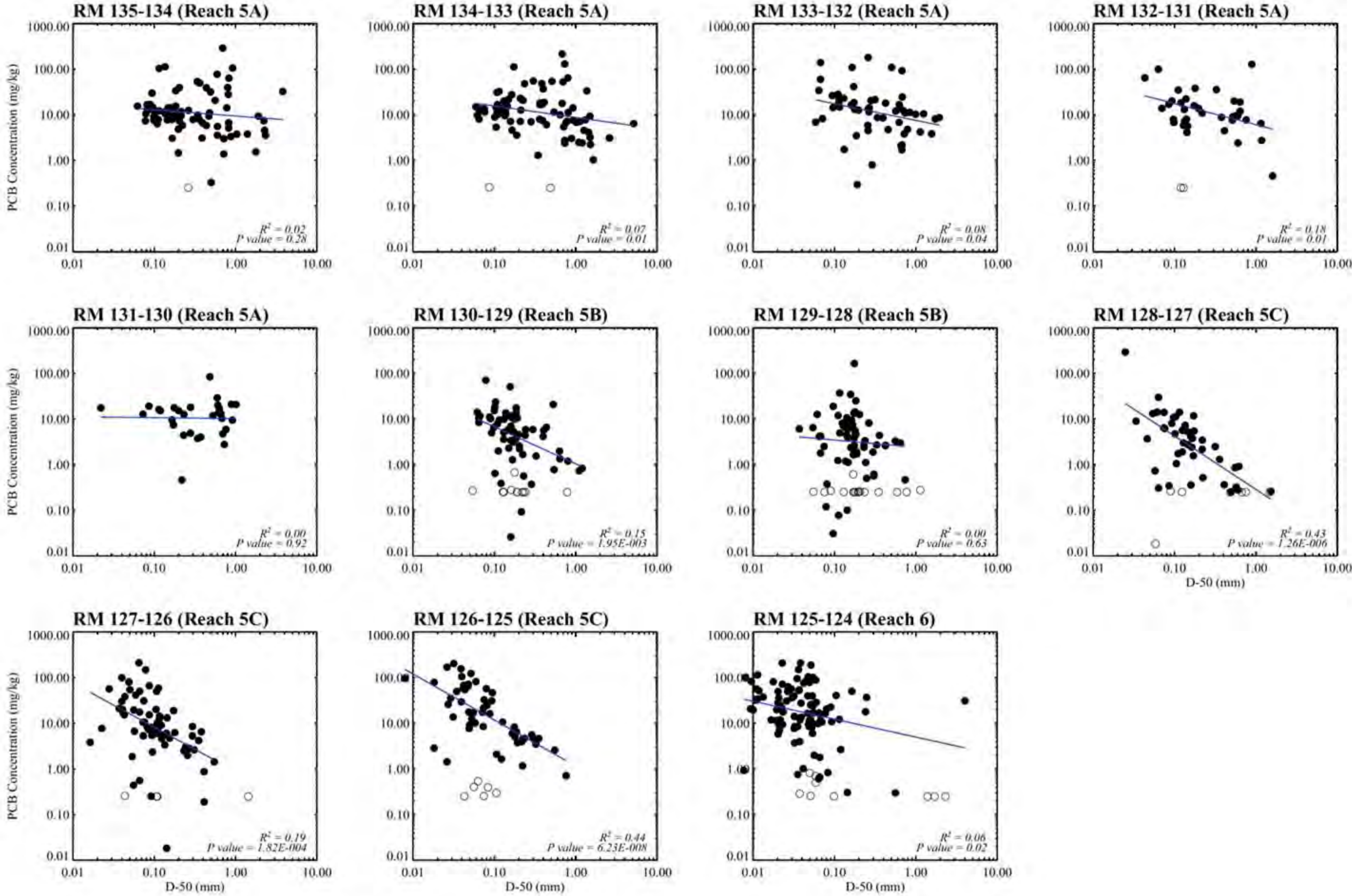

Figure 4-16. Relationship between PCB and D-50 in surface (0-6") sediment.

Notes: Data shown are 1998-2002 EPA and 2001 EPA/GE partitioning data. Non-detect PCB samples plotted as open symbols at 1/2 MDL and excluded from regressions.

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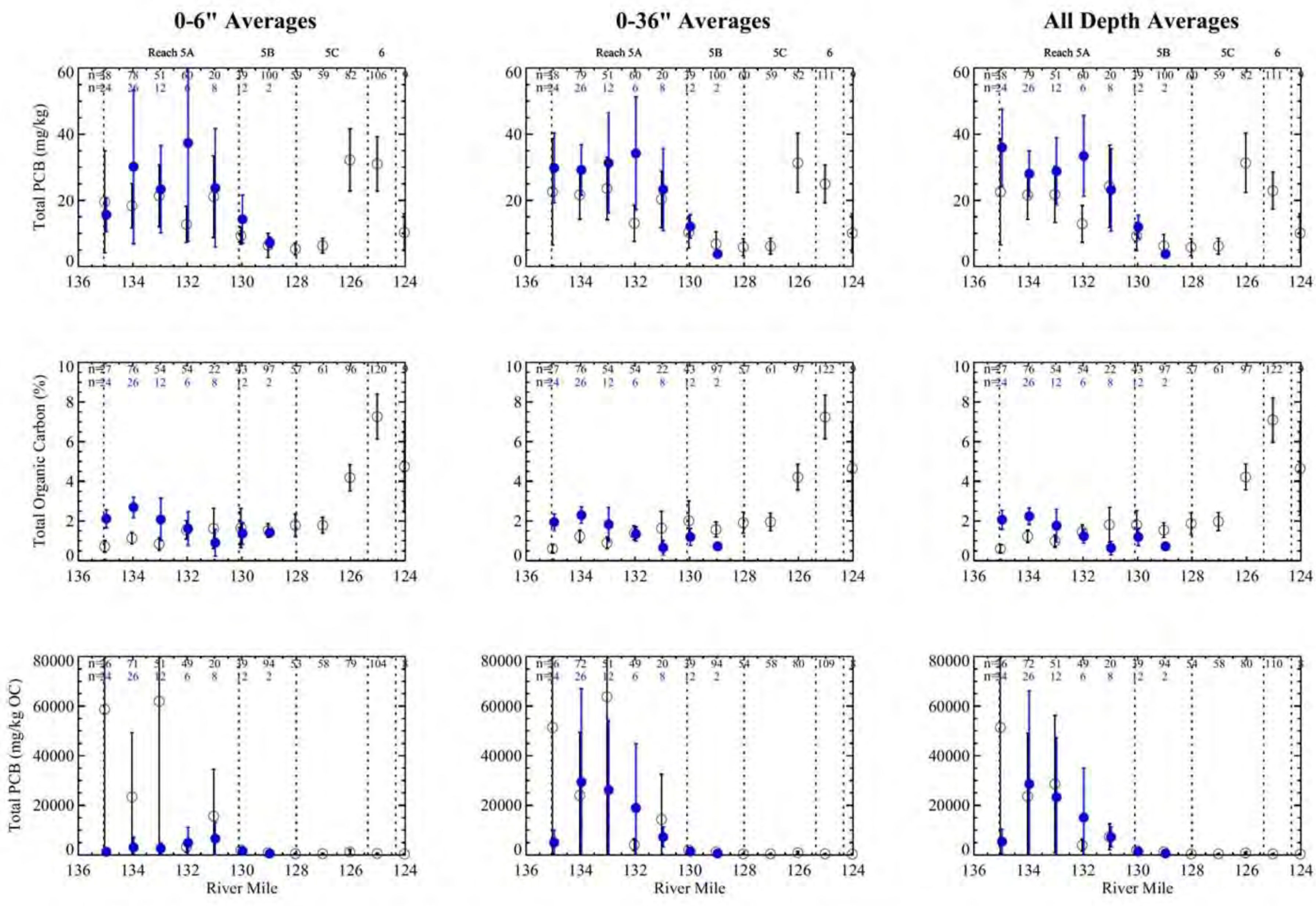

Figure 4-17. Spatial comparison of EPA aggrading bar and terrace surface sediment data with the remaining sediment data set.

Note: Data shown are one-mile averages. Error bars represent 2 standard errors of the mean. Numbers posted represent number of locations included in average, not sections.

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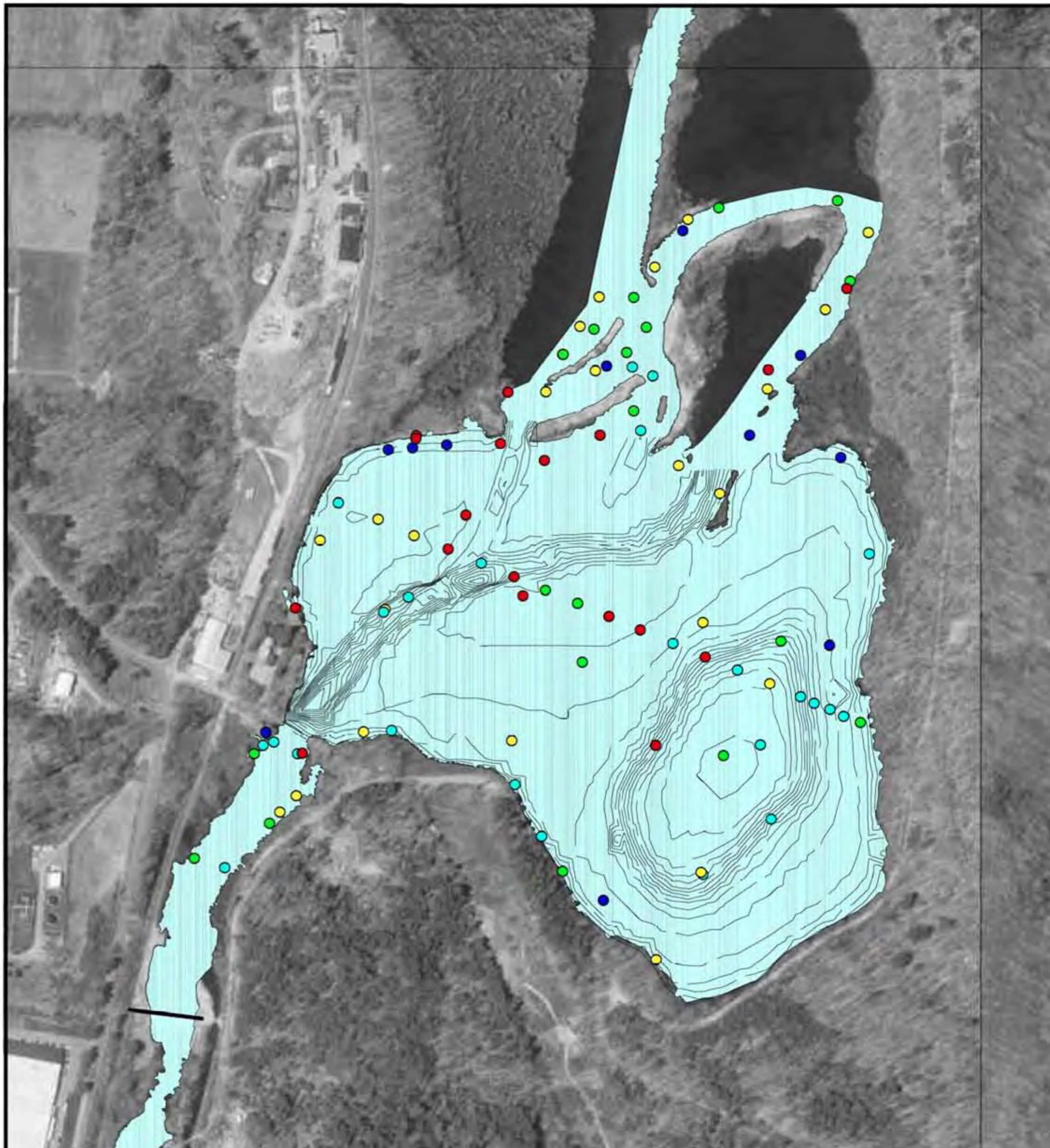

N

60 0 60 120 Meters

PCB Concentration (mg/kg)
0 - 5
5 - 10
10 - 20
20 - 50
50 +

Note:
Includes all surface (0 to 6 inches) sediment PCB data collected during the EPA Systematic (1999) and Discrete (1999 and 2002) sampling activities

10/21/02 SYR-D54-DJH
C:/20199072/20199g15.cdr

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HOUSATONIC RIVER - REST OF RIVER

RFI REPORT

PCB CONCENTRATION IN WOODS POND SURFACE SEDIMENT

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FIGURE
4-18

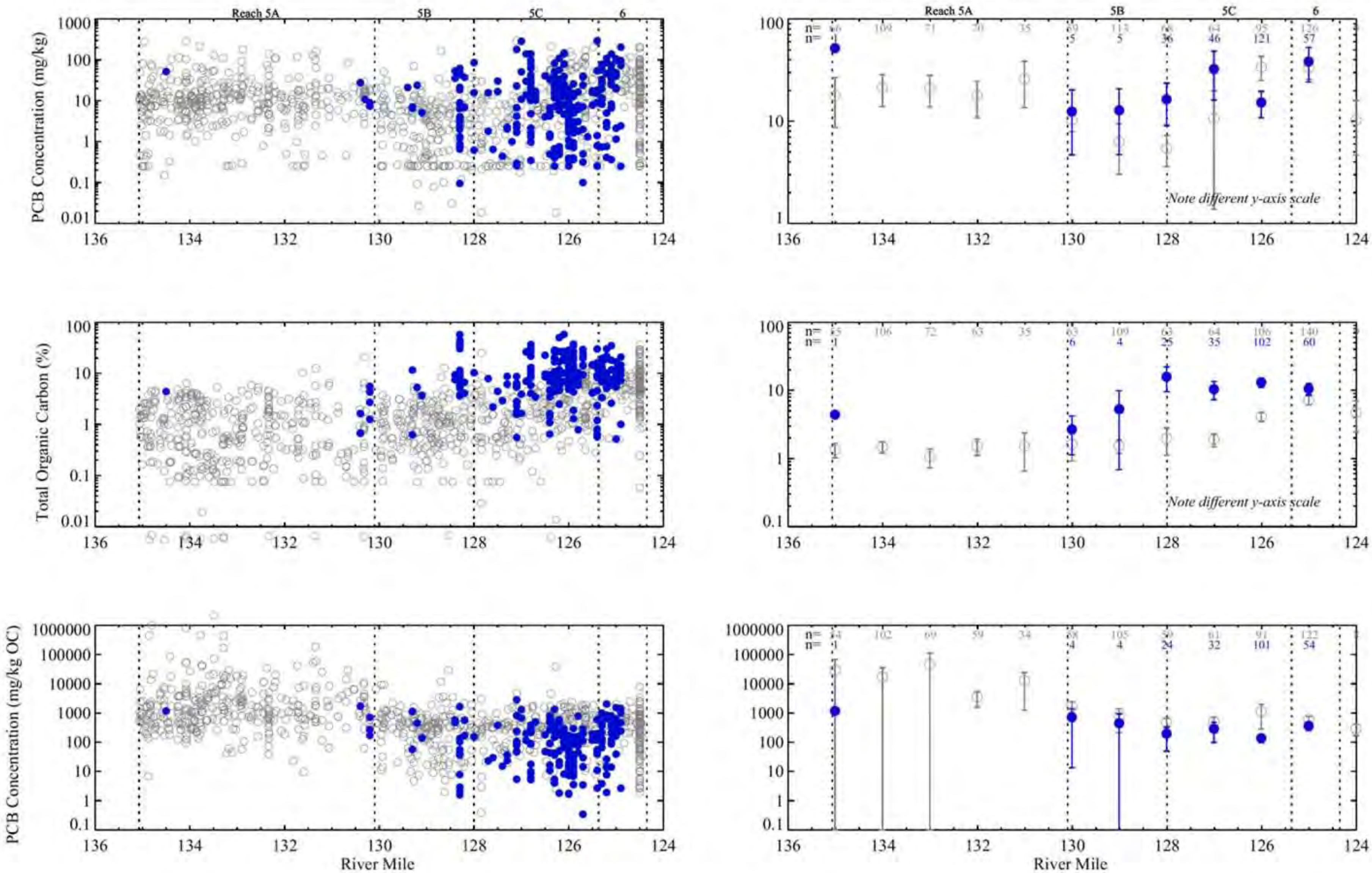

Figure 4-19. Spatial profiles of surface sediment (0-6") PCB, TOC, and organic carbon-normalized PCB concentrations in channel and backwater areas.

Note: Data shown are 1998-2002 EPA and 2001 EPA/GE partitioning data sets.

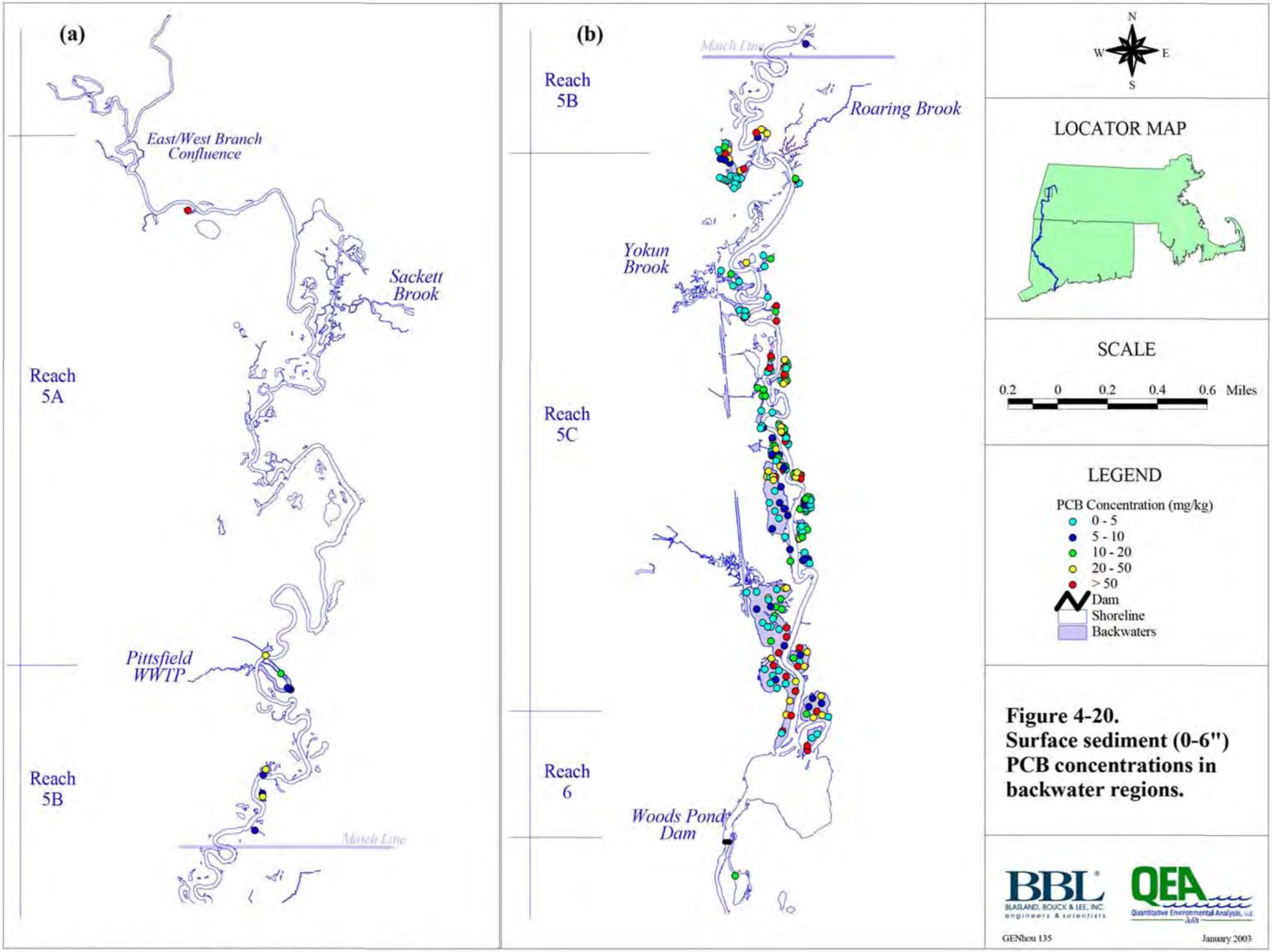

Figure 4-20. Surface sediment (0-6") PCB concentrations in backwater regions.

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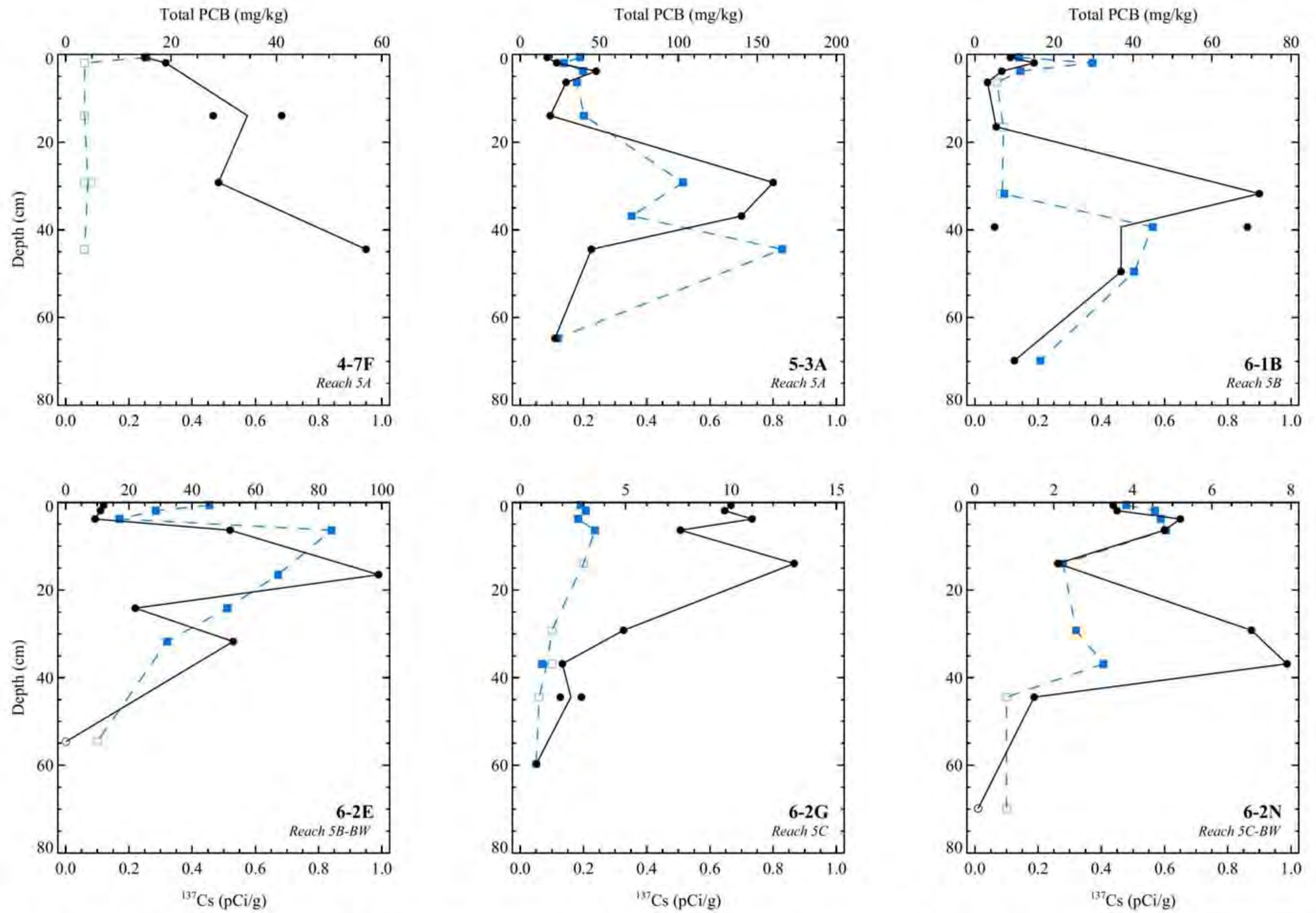

Figure 4-21a. Depth profiles of GE high resolution cores collected within Reach 5 during 1994 - 1995.

Note: Cesium-137 plots are all on the same scale; PCB scales vary by core. Line represents average of duplicate samples.

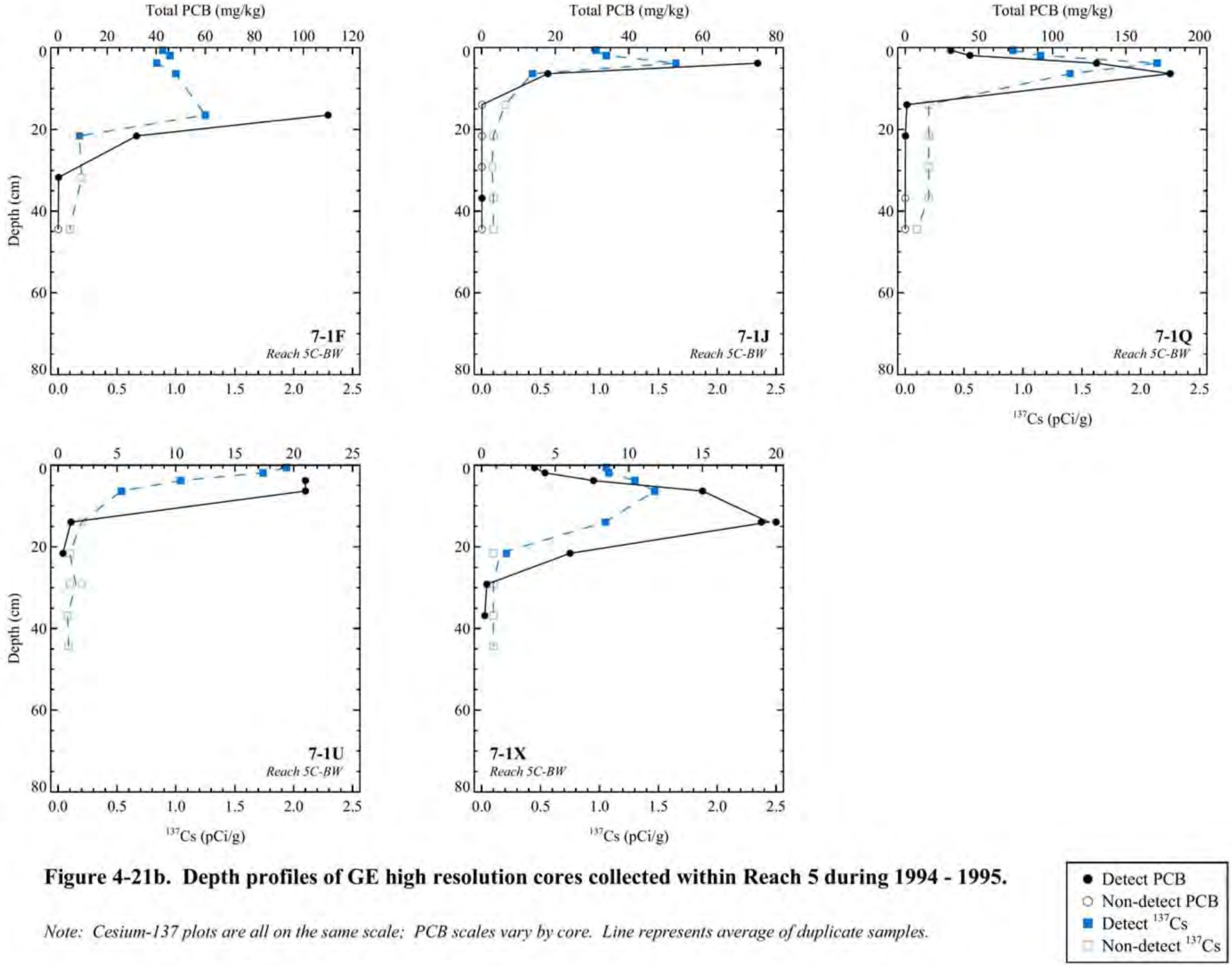

Figure 4-21b. Depth profiles of GE high resolution cores collected within Reach 5 during 1994 - 1995.

Note: Cesium-137 plots are all on the same scale; PCB scales vary by core. Line represents average of duplicate samples.

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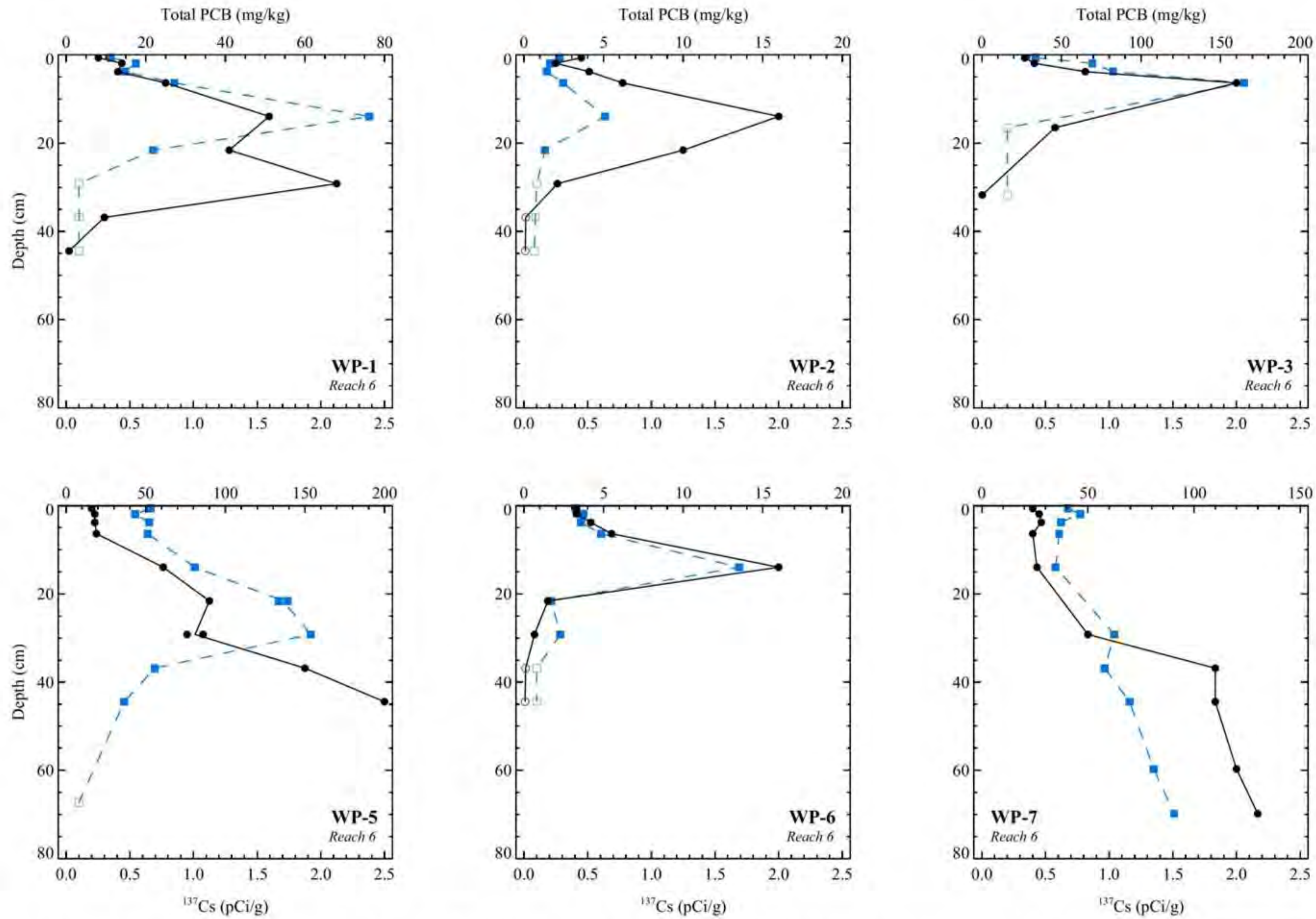

Figure 4-21c. Depth profiles of GE high resolution cores collected within Woods Pond during 1994 - 1995.

● Detect PCB
○ Non-detect PCB
■ Detect ^{137}Cs
□ Non-detect ^{137}Cs

Note: Cesium-137 plots are all on the same scale; PCB scales vary by core. Line represents average of duplicate samples.

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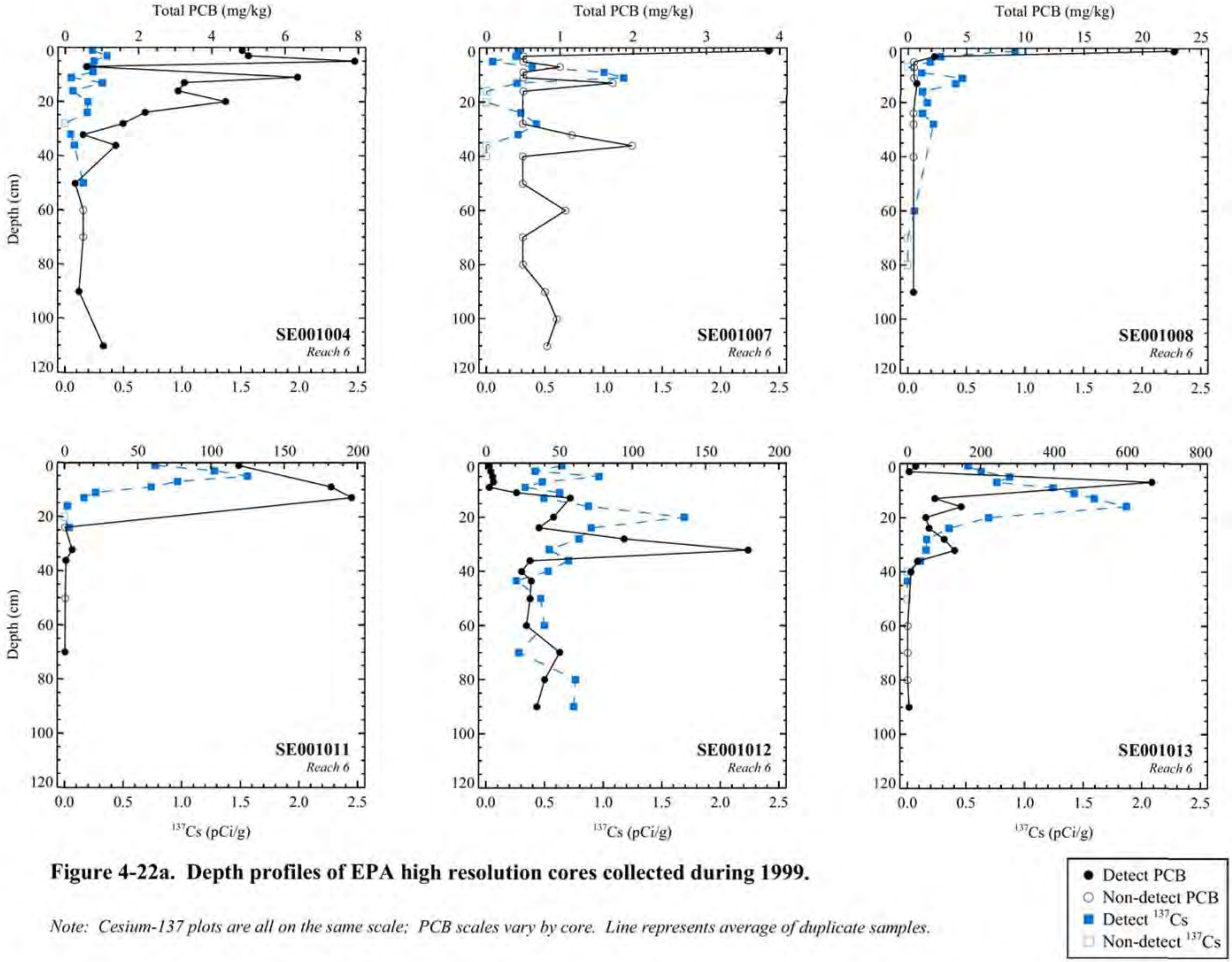

Figure 4-22a. Depth profiles of EPA high resolution cores collected during 1999.

Note: Cesium-137 plots are all on the same scale; PCB scales vary by core. Line represents average of duplicate samples.

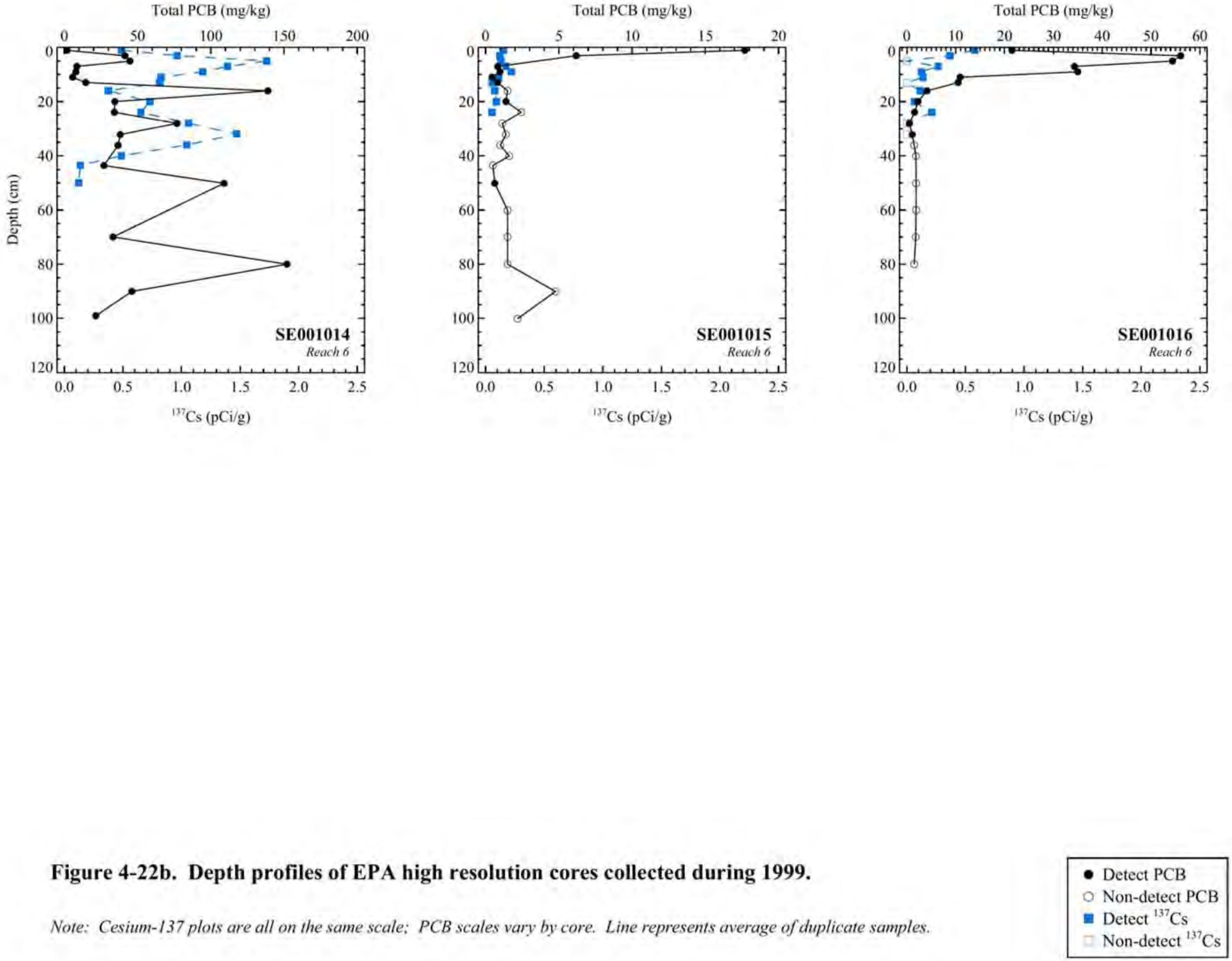

Figure 4-22b. Depth profiles of EPA high resolution cores collected during 1999.

Note: Cesium-137 plots are all on the same scale; PCB scales vary by core. Line represents average of duplicate samples.

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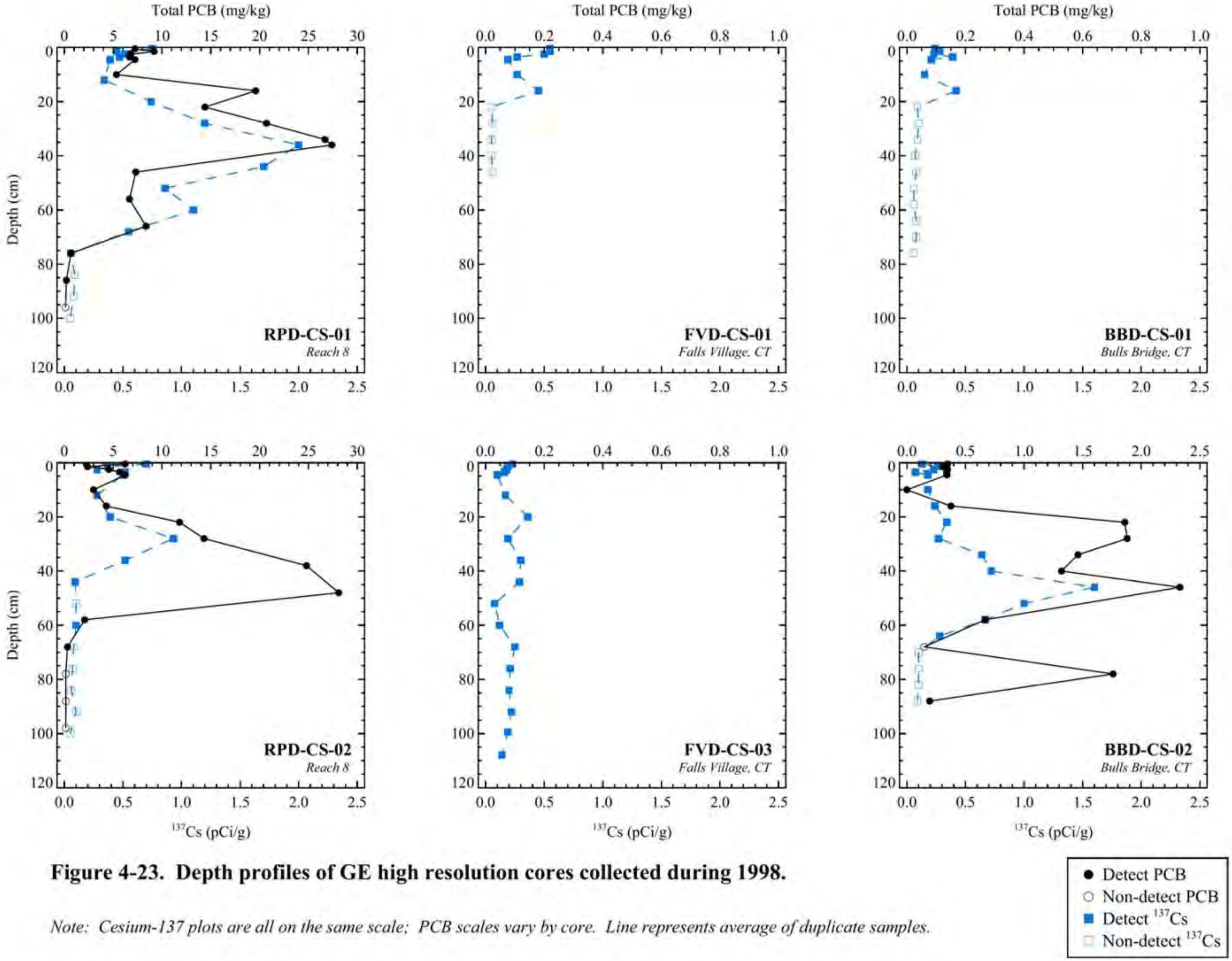

Figure 4-23. Depth profiles of GE high resolution cores collected during 1998.

Note: Cesium-137 plots are all on the same scale; PCB scales vary by core. Line represents average of duplicate samples.

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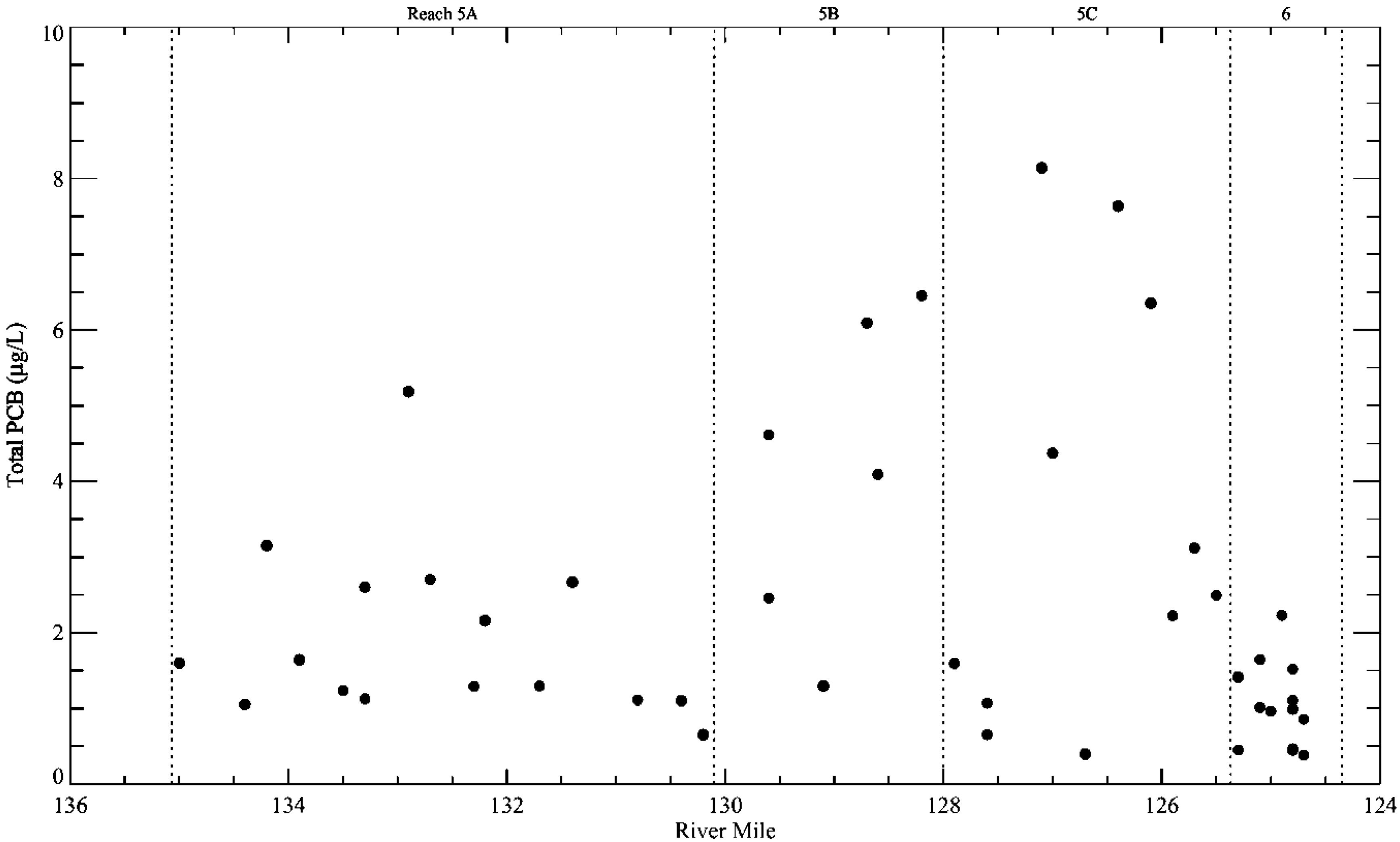

Figure 4-24. Spatial profile of 2001 EPA/GE porewater PCB data.

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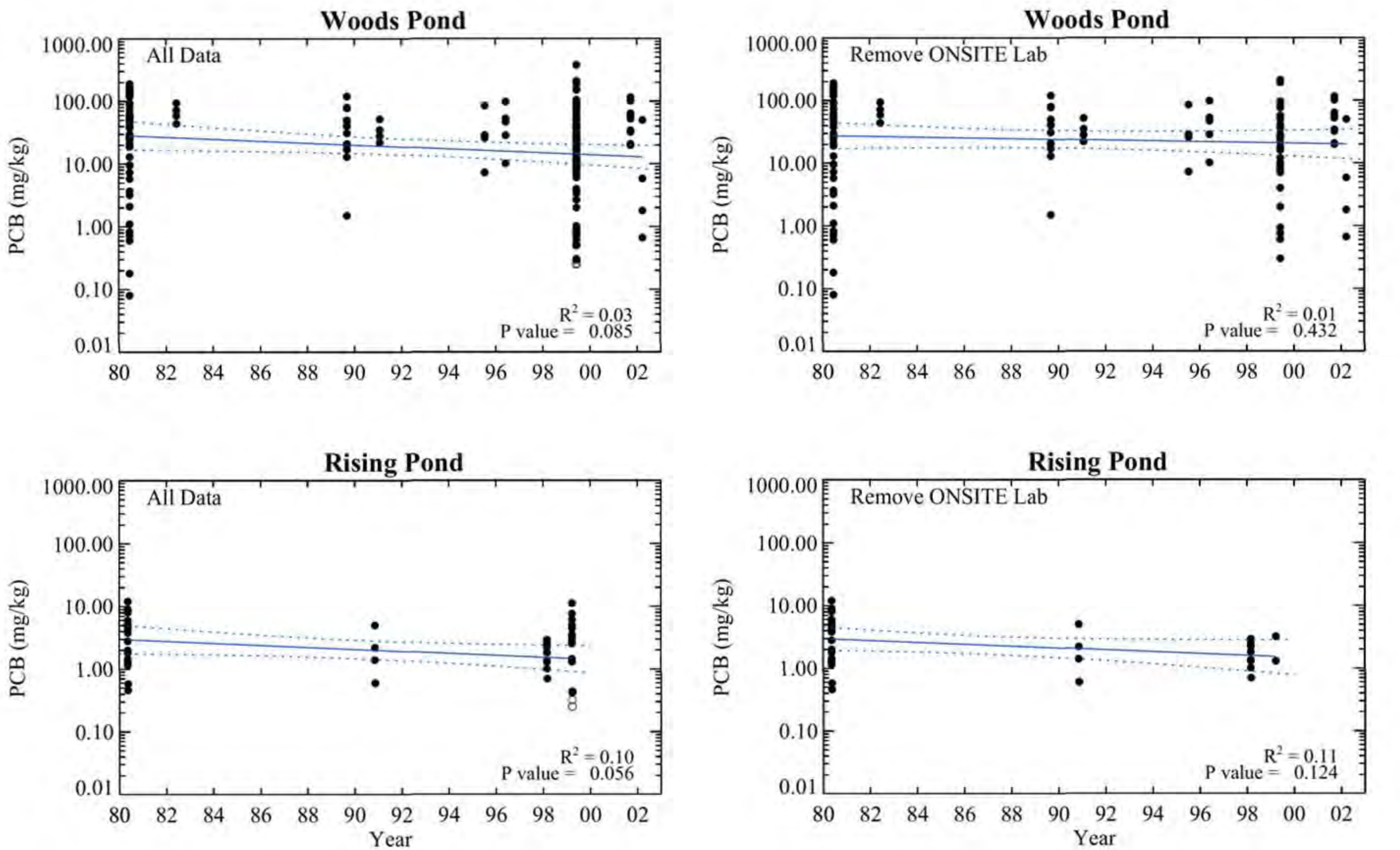

Figure 4-25. PCB temporal trend by reach for surface sediment (0-6") samples.

Notes: Data shown are 1998-2002 EPA and 1980-1998 GE data sets. Data binned by average date of each collection program. Dashed lines are 95% confidence intervals on regression lines.

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Thu Jul 17 15:24:47 2003

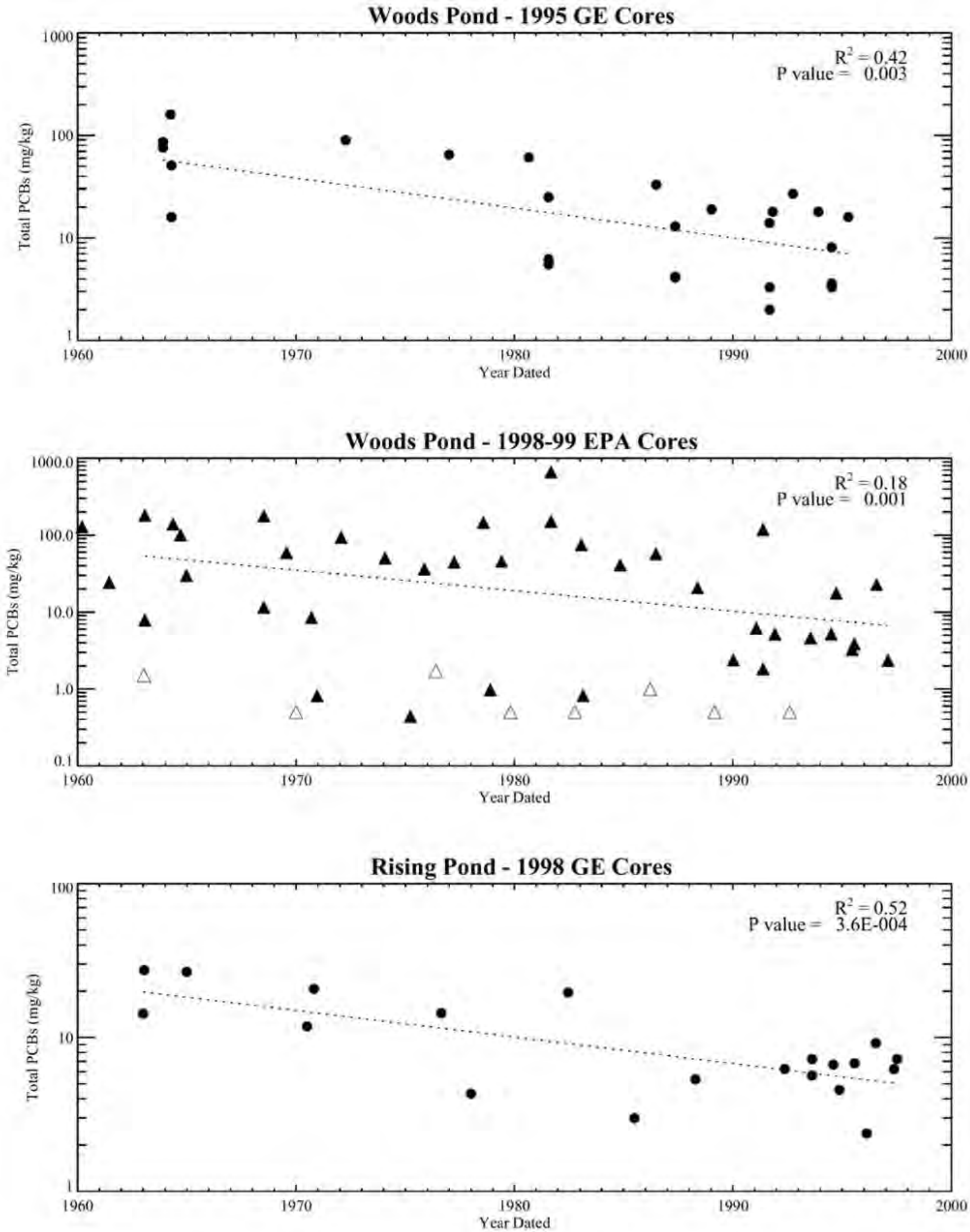

Figure 4-26. Temporal profile of sediment PCB concentrations in Woods Pond and Rising Pond estimated from dated high resolution cores.

Notes: Open symbols denote non-detect PCB data plotted at the MDL. Dating assumes Cs-137 peak in 1963 and constant deposition rate.Regression starts at 1963 and excludes non-detect PCBs.

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Fri Jun 27 16:09:15 2003

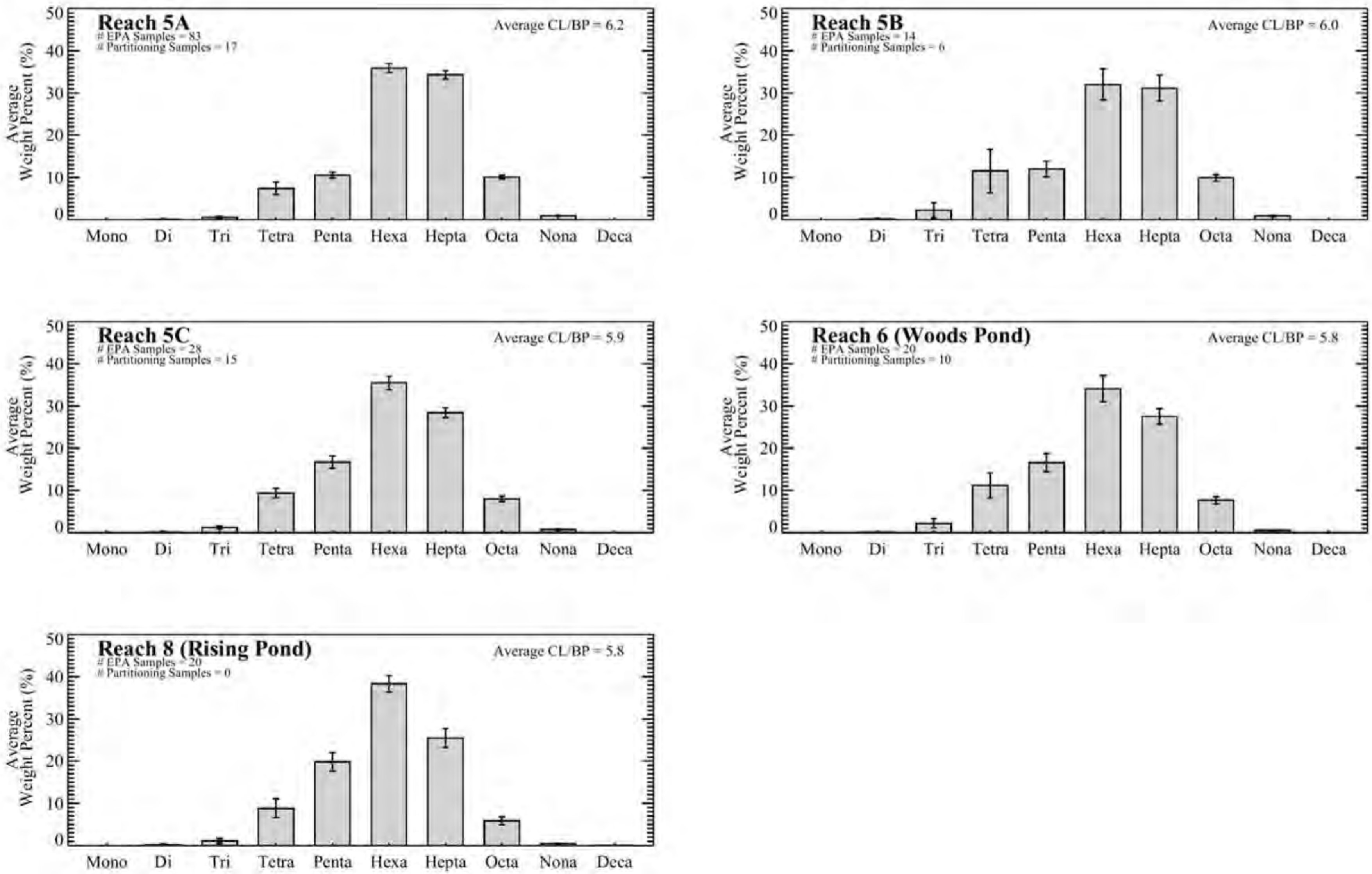

Figure 4-28. Average sediment PCB homolog distributions by reach.

Data sets included: 1998-2002 EPA and 2001 EPA/GE partitioning data.

Notes: Non-detect PCB congeners were set to 0. Low concentration (< 1 mg/kg) samples were omitted. Data for all depths included in averages. Error bars represent 2 standard errors of the mean.

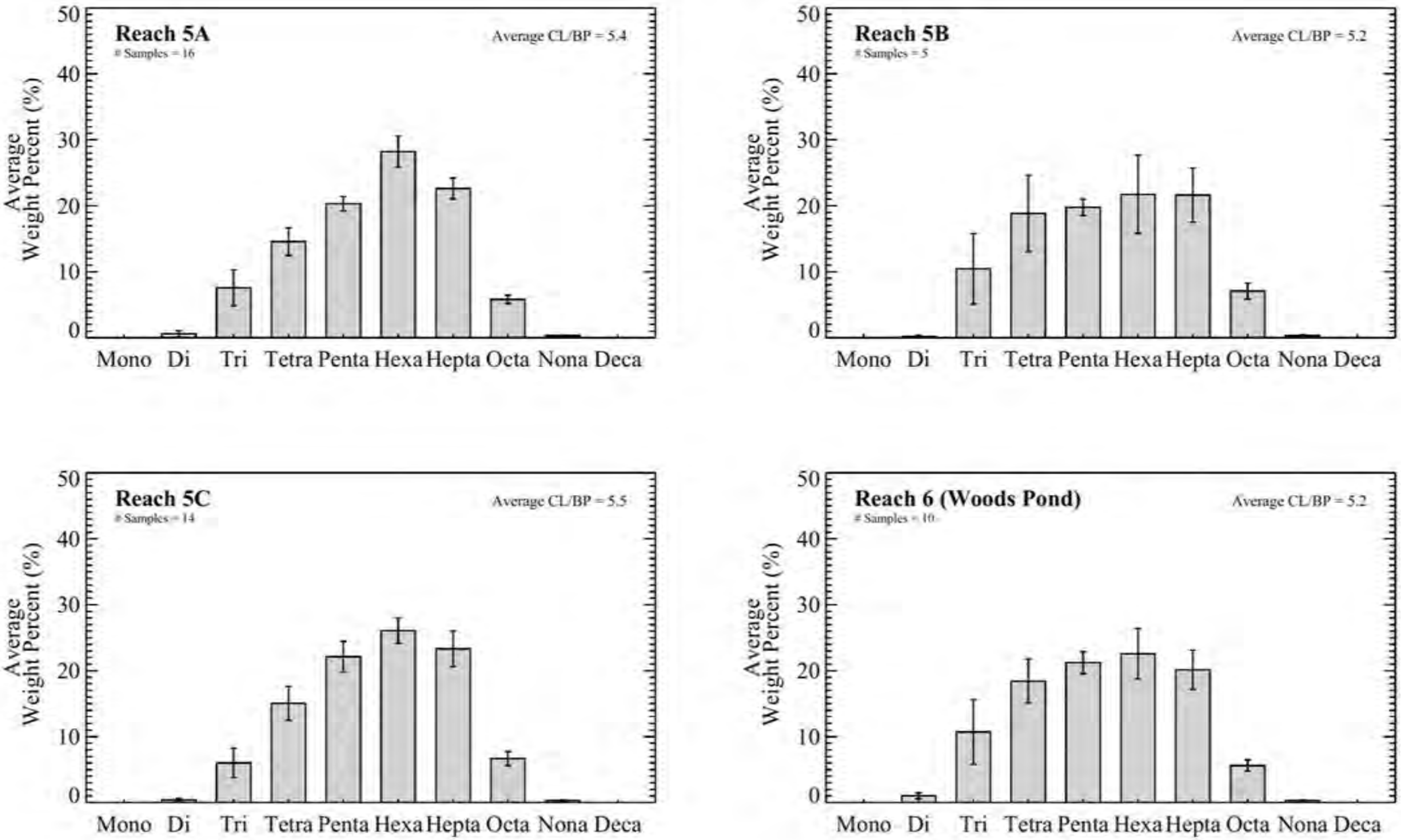

Figure 4-29. Average pore water PCB homolog distributions by reach.

Data sets included in average: 2001 EPA/GE partitioning data.

Note: Error bars represent 2 standard errors of the mean.

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Tue Jul 29 13:47:28 2003

Section 5

BLASAND, BOUCK & LEE, INC.
engineers & scientists

5. Riverbank and Floodplain Soil Investigations

5.1 General

Seasonal and annual high-flow events on the River cause periodic flooding of certain portions of the Rest of River area. During flooding events, PCBs and other water-borne chemical constituents may be transported onto and over the upper portions of the riverbanks and onto the floodplain (including vernal pools) and deposited in the soils. As this occurs, riverbank and floodplain soils may become contaminated with PCBs and other water-borne chemical constituents. Investigation of these areas is critical to developing a thorough understanding of the distribution and fate of PCBs and other constituents of the Rest of River area since floodplains of various widths border the approximately 50 miles of the Rest of River downstream of the Confluence to the Massachusetts/Connecticut border and beyond into Connecticut. A brief summary of the numerous studies conducted by GE and EPA is presented in Section 5.2, with additional details provided in Appendix A. In general, the primary objective of these investigations was to assess the nature and extent of PCBs and other constituents in the River's adjacent banks and floodplain soils. An important outcome of this evaluation is a more complete understanding of the spatial distribution of PCBs in adjacent soils and the factors influencing the observed spatial variations.

Section 5.3 summarizes the physical properties of floodplain and riverbank soils. Section 5.4 evaluates the nature and extent of PCBs in these soils, and Section 5.5 summarizes information for non-PCB constituents. Consistent with the requirements of the Reissued RCRA Permit, data obtained from areas that have been identified as Actual/Potential Lawns have been included in this evaluation.

5.2 Summary of Sampling and Analysis Activities

A number of studies have been conducted to characterize floodplain and riverbank soils adjacent to the Housatonic River. Each of the major studies is listed in Table 5-1, summarized briefly below, and discussed in greater detail in Appendix A.

5.2.1 1988 to 1998

In 1988 and 1989, on behalf of GE, BBL collected approximately 100 floodplain soil samples on the DeVos property located immediately south of New Lenox Road along the eastern bank of the River. Broader sampling of the floodplain on behalf of GE occurred from 1990-1992 as part of the MCP Phase II Investigation. Sampling was conducted along transects located from Coltsville to the Connecticut border, with 10 of the transects located downstream of the Confluence. Samples were collected along each transect in 6-inch depth increments, with more than 250 samples collected and analyzed for PCBs and percent solids.

Several additional floodplain soil sampling events were conducted between 1992 and 1994 by BBL on behalf of GE as part of MDEP-required activities to evaluate the need for STMs at specific properties within the floodplain. Floodplain soils in certain wildlife habitat and other areas between New Lenox Road and Woods Pond were also sampled. In 1994 and 1995, additional transect and some backwater sampling was conducted by BBL from the 10 existing transect locations between the Confluence and the Connecticut border, as well as from 12 additional transects. New transects were placed upstream of four existing dams located downstream of the Woods Pond Dam and at three other locations -- Stockbridge Golf Course, Searles Middle School, and the Sheffield Plain. Samples were collected in 6-inch depth increments and were analyzed for PCBs, percent solids, and TOC. More than 400 samples were collected during the 1994 and 1995 sampling events.

Sampling of two floodplain residential properties within the Rest of River area was also conducted in 1995 by BBL on behalf of GE. This investigation was expanded in 1997 and 1998, resulting in the collection of 360 additional samples from six other properties located between the Confluence and the Connecticut border.

5.2.2 1998 to Present

The most recent and extensive sampling of the Rest of River floodplain and riverbank soils was conducted by EPA as part of its SI. The sampling approach included the collection of samples from historical locations as well as additional locations and was generally conducted out to the 10-year floodplain. Thousands of systematic samples (collected at regularly spaced intervals) and discrete samples (focused on specific areas) were collected to address specific data quality objectives (Weston, 2000). Samples were generally collected in 6-inch depth increments between 0 and 30 inches, although a majority of the samples were from the top foot of soil. Samples deeper than 30 inches were also collected at some locations. Samples were analyzed for multiple parameters including PCBs; physical characteristics such as percent solids, grain size, and TOC; and Appendix IX constituents. EPA also collected soil data from vernal pools, which are poorly drained depressions in the floodplain that may become dry in summer. Most of these vernal pool samples (approximately 90%) were collected from the top 6 inches of soil and all were collected in Reaches 5 and 6. Finally, EPA conducted a meander survey and a toe pin study to assess bank erosion, which are discussed in Section 8.

5.2.3 Summary

In total, 6,317 floodplain, riverbank, and vernal pool soil samples have been collected to date by GE and EPA from more than 3,000 locations and analyzed for various chemical constituents. Of the 6,317 samples, 5,609 samples were defined as floodplain samples, 267 samples were defined as riverbank samples, and 441 were collected from vernal pools. Table 5-2 (below) summarizes the number of samples collected by sampling protocol (i.e., systematic or discrete) and subreach. Most of the samples (approximately 78%) contained in the database have been collected by EPA as part of its SI since 1998, and the majority of all samples collected are from locations within Reaches 5 and 7. There are no floodplain, riverbank or vernal pool soil data in the database from sample locations downstream of the Connecticut border; therefore, the discussions in this section focus on the portion of the River from the Confluence to the Massachusetts/Connecticut border. Riverbank soil samples were collected when distinct riverbanks were encountered during the floodplain sampling activities or for subsequent use in the risk assessments.

Table 5-2. Floodplain, Riverbank, and Vernal Pool Soils
Number of Discrete and Systematic Samples Collected – 1988-2002

Sampling Description	Reach 5A	Reach 5B	Reach 5C	Reach 6	Reach 7	Reach 8	Reach 9	Total
				Floodplain				
EPA Discrete	852	222	374	103	742	26	194	**2513**
EPA Systematic	344	209	589	46	618	0	0	**1806**
GE Discrete	219	128	6	16	189	24	0	**582**
GE Systematic	194	92	125	160	22	0	115	**708**
Floodplain Total	**1609**	**651**	**1094**	**325**	**1571**	**50**	**309**	**5609**
				Riverbank				
EPA Discrete	147	53	17	2	4	14	0	**237**
EPA Systematic	18	0	12	0	0	0	0	**30**
Riverbank Total	**165**	**53**	**29**	**2**	**4**	**14**	**0**	**267**
				Vernal Pool				
EPA Discrete	218	122	63	7	0	0	0	**410**
EPA Systematic	10	12	9	0	0	0	0	**31**
Vernal Pool Total	**228**	**134**	**72**	**7**	**0**	**0**	**0**	**441**

Notes:
1. All GE and EPA data from all depths are included.
2. Samples numbers do not include QC samples.

All soil PCB data and other relevant physical parameters are presented in tables in Appendix B, while figures in Appendix B that were developed by EPA show soil sample locations and associated PCB results. Summary statistics on all detected non-PCB constituents in floodplain, riverbank, and vernal pool soil samples are included in tables in Appendix C.

All soil data collected from the Rest of River area floodplain, riverbanks, and vernal pools are discussed and used to evaluate spatial trends and other relationships in this section of the RFI Report. This entire dataset is used for trend assessment because: 1) the dataset is relatively recent (soil data were mostly collected from 1990 and later); 2) floodplain soil is not as dynamic a medium as surface water or sediment and is not expected to change as much over time; and 3) the size of the floodplain area warrants the use of the broadest coverage of data available. Data from all three areas are first discussed in general, and then evaluated separately to assess the relative variability between the characteristics of the floodplain soils, riverbank soils, and vernal pool soils. For example, because their hydrologic conditions may differ from surrounding areas, soils sampled in vernal pools may have physical characteristics and PCB concentrations that are significantly different from those observed in floodplain or riverbank samples.

5.3 Physical Characteristics of Floodplain and Riverbank Soils

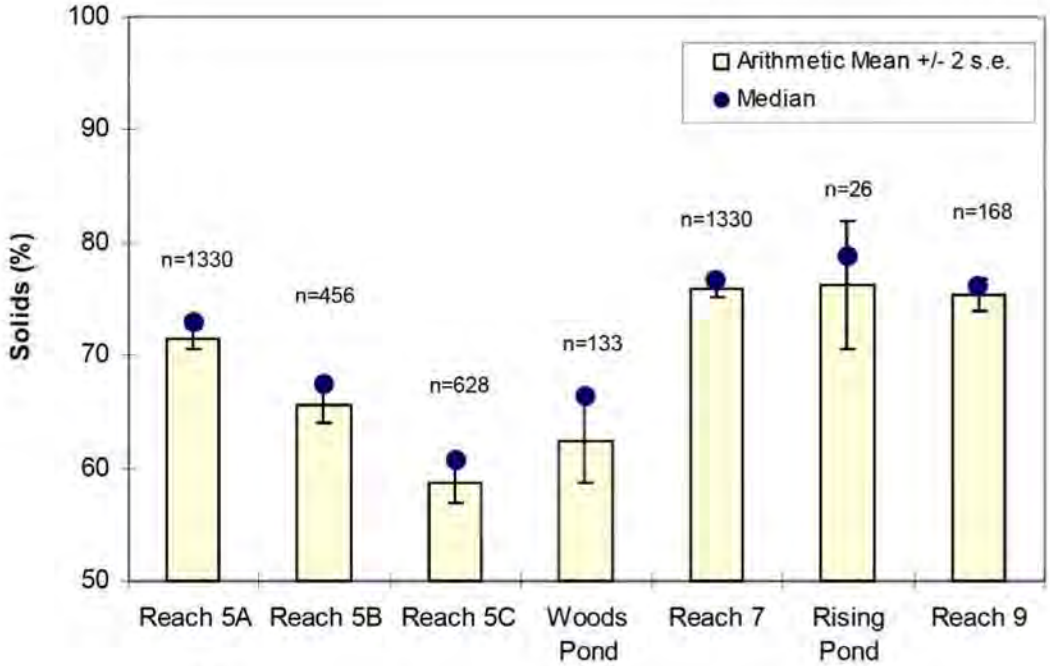
Certain physical properties of the floodplain, riverbank, and vernal pool soils, including solids content, TOC, and grain size distribution, were characterized through sample collection and analysis. These soil characteristics reflect conditions in the floodplain that either affect or may be associated with contaminant distribution. These parameters are often related to each other and may indicate differences in hydrologic conditions among floodplain areas (e.g., flooding frequency and duration, areas more prone to sediment deposition, etc.). For example, areas that are primarily depositional during periods of flooding would be more likely to contain finer particles potentially carried there from upstream sources. In areas where PCBs have been detected, these soil characteristics may correspond with and may serve as an indicator of PCB concentrations. Spatial variations may indicate differences in hydrologic and other mechanisms of transport that could account for differences in PCB content.

Results of analyses of data on the physical characteristics of the Rest of River floodplain, riverbank, and vernal pool soils are summarized by reach (including number of samples, ranges, arithmetic means and medians) in Tables 5-3 through 5-5 and are discussed below. The data from individual samples are included in Appendix B.

5.3.1 Percent Solids

A total of 4,071 floodplain, riverbank, and vernal pool soil samples collected between the Confluence and the Connecticut border were analyzed for percent solids. The majority of the percent solids data were for samples collected from Reaches 5 and 7, with floodplain soils comprising approximately 88% of all samples collected. A summary of the percent solids data is presented by reach in Table 5-3 and depicted on Figure 5-1 (below).

Figure 5-1. Floodplain, Riverbank, and Vernal Pool Soils - Percent Solids by Reach



Notes:
Includes all floodplain, riverbank, and vernal pool soil data collected by EPA and GE.
n = number of samples.

In summary, the percent solids reported for the floodplain, riverbank, and vernal pool soil samples range from less than 1% to 100%, with an overall average of 70%. As shown in Table 5-3, the average percent solids are lowest in Reaches 5C and 6, generally around 60%, compared with average percent solids of 66% to 76% reported for the other River reaches. The median percent solids are generally similar to the reach averages and in some cases slightly higher than the averages. In Reach 5, where all but six of the riverbank samples were collected and analyzed, the average percent solids reported for the riverbank and floodplain soil samples by subreach are similar to one another; as shown in Table 5-3, the averages for both floodplain and riverbank samples fall between 70% and 75% in Reaches 5A and 5B, and is 59% in Reach 5C.

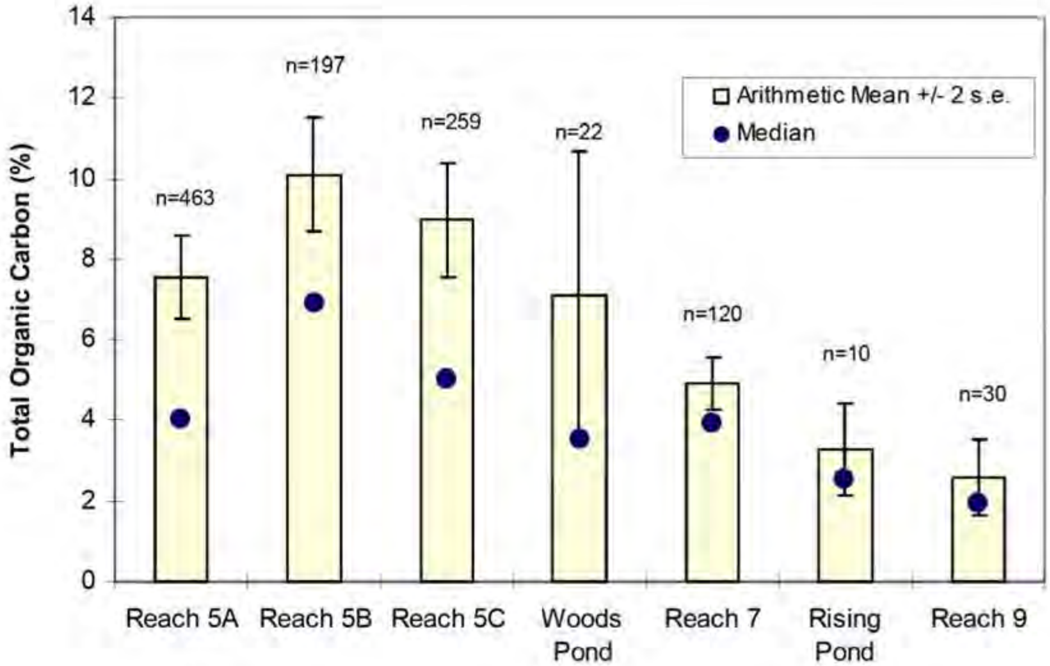
In Reaches 5A, 5B, and 5C, 316 vernal pool samples were analyzed for solids content; arithmetic mean percent solids values are 50%, 48%, and 49%, respectively (Table 5-3). These values are lower than values observed in the floodplain and riverbank samples from the same subreaches, where arithmetic mean percent solids values range from 59% in Reach 5C to 75% in Reach 5A. Only two vernal pool samples from Reach 6 were analyzed for percent solids; those results were 32% and 50%, which are both lower than the Reach 6 floodplain soil average percent solids of 63%.

5.3.2 Total Organic Carbon

A total of 1,101 floodplain, riverbank, and vernal pool soil samples collected between the Confluence and the Connecticut border were analyzed for TOC. A summary of the TOC data is presented by reach in Table 5-4 and on Figure 5-2 (below). As with percent solids, the majority of the TOC data were for samples collected from Reaches 5 and 7, with floodplain soils comprising approximately 64% of all samples collected.

In summary, TOC results reported for the floodplain, riverbank, and vernal pool soil samples ranged from non-detect to 90%. As shown in Table 5-4 and on Figure 5-2 (below), the soil TOC data are generally higher above Woods Pond Dam, where the average TOC values ranged from 7.1 to 10%, than downstream of Woods Pond, where the average TOC levels in the soils ranged from only 2.6 to 4.9%. Median values show a similar spatial trend, although the actual values are somewhat lower (ranging from 4.0 to 6.9% in Reach 5, 3.5% in Reach 6, and ranging from 2.0 to 3.9% downstream of Woods Pond)

Figure 5-2. Floodplain, Riverbank, and Vernal Pool Soils - TOC by Reach



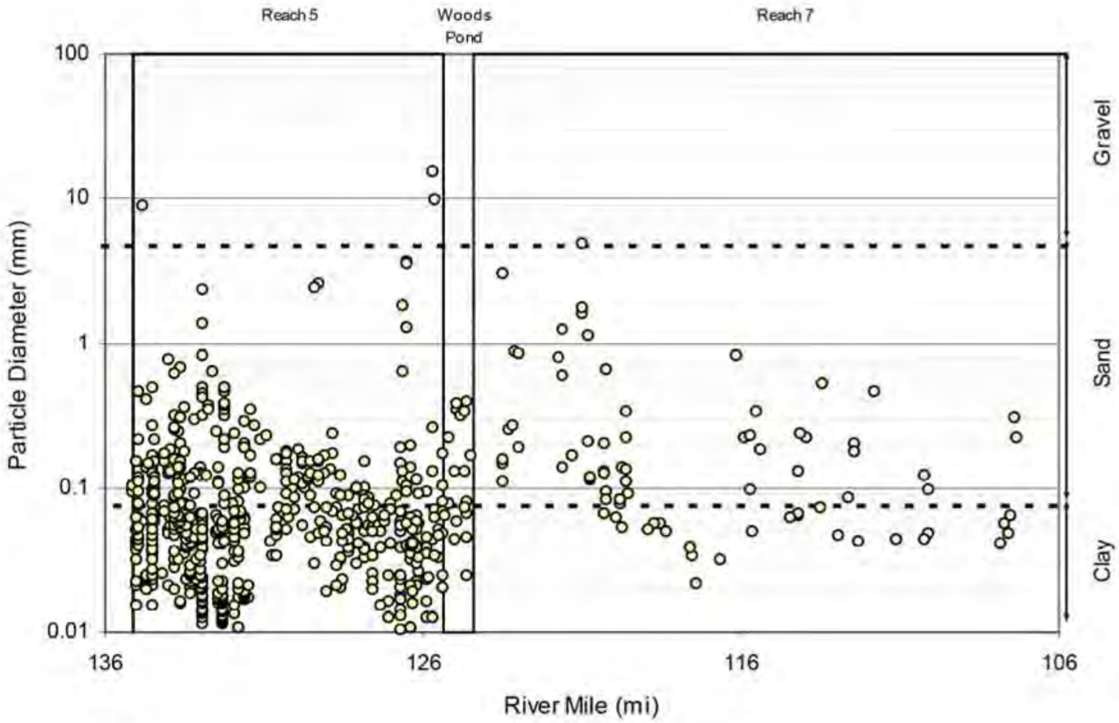
Notes:
Includes all floodplain, riverbank, and vernal pool soil data collected by EPA and GE.
n = number of samples.

All the riverbank samples that were analyzed for TOC were collected from Reach 5. Within Reach 5, average and median TOC concentrations in riverbank samples are lower overall than in floodplain samples (Table 5-4), particularly in Reach 5C, where the average TOC is 7.3% in the floodplain and only 3.3% in the riverbank soils. TOC concentrations in vernal pools are generally higher than levels observed in floodplain samples and riverbank samples. A total of 358 vernal pool samples from Reach 5 were analyzed for TOC; arithmetic mean TOC in the Reach 5 vernal pool samples ranges from 12% in Reach 5A to 15% in Reaches 5B and 5C (Table 5-4). These values compare with an arithmetic mean range of 4.3% to 7.3% in floodplain soils in Reach 5. The two vernal pool samples from Reach 6 that were analyzed for TOC yielded very high results of 24% and 35% TOC, compared to an average of 4.8% for the floodplain soils in Reach 6.

5.3.3 Grain Size Distribution

A total of 839 floodplain, riverbank, and vernal pool soil samples collected between the Confluence and the Connecticut border were analyzed for grain size. A summary of the grain size data is presented by reach in Table 5-5. The majority of samples collected for grain size analysis were from Reach 5, with floodplain soils comprising approximately 50% of all samples collected. Since few grain size soil data are available from Reaches 8 and 9, data patterns are discussed only for Reaches 5A, 5B, 5C, 6, and 7 (the Confluence to just above Rising Pond). Data show generally similar grain size distributions in floodplain soils among the reaches, with sand and silt representing the largest grain size fractions (Table 5-5). The finest grained soils were present in Reach 5C, where samples exhibited the highest percent silts and clays and lowest percent gravels or sands compared to other reaches. This pattern is illustrated on Figure 5-3 (below), which depicts the D-50 of floodplain, riverbank, and vernal pool soils with River mile, and shows a decreasing D-50 within Reach 5. These data are consistent with the percent solids and TOC data, and collectively suggest that the floodplain in Reach 5C is more depositional than in other reaches, resulting in the finer grained soil.

Figure 5-3. Floodplain, Riverbank, and Vernal Pool Soils – Median Grain Size (D-50) by River Mile



Notes:
Includes all GE and EPA floodplain, riverbank, and vernal pool data with an associated river mile.
Figure does not show four results collected on May 13 and 14, 1999 in Reach 9 (results all < 0.07 mm).
River miles were assigned in GIS based on the mile point (defined every 0.1mile between RM 144 and RM 105) that was geographically closest to each sampling location.

Grain size distribution data for floodplain, riverbank, and vernal pool soils are presented in Table 5-5. Comparison of the floodplain and riverbank data shows that riverbank soils generally contained more sand and less silt and clay particles in Reach 5 than did floodplain soils, although much less data exist from the riverbanks than from the floodplain, particularly in Reach 5C, where a sample size of 6 warrants cautious interpretation of the results. Percent sand values in floodplain soil in Reaches 5A and 5B have arithmetic means of 45% and 44%, respectively, compared to 59% to 63% in riverbank samples in these reaches. In Reach 5C, where percent sand values are generally lower than in Reaches 5A and 5B, the increase is from 31% sand in the floodplains to 41% in the riverbanks. Correspondingly, silt and clay fractions in riverbank samples are lower than in floodplain samples, although the difference is smallest in Reach 5C. Results overall indicate that the riverbank samples are sandier than adjacent floodplain soils. These results are expected, since riverbanks are exposed to a higher energy environment than the floodplain soil.

Vernal pool samples contain a much higher proportion of silt and clay than surrounding floodplain soils. Based on the results for the 357 vernal pool samples analyzed for grain size in Reaches 5 and 6 (Table 5-5), silt represented, on average, 57% to 76% of the vernal pool samples, compared to averages in the floodplain soils ranging from 38% (Reach 6) to 51% (Reach 5C). Conversely, percent sand comprised a lower fraction of vernal pool samples than in the floodplain and riverbank soils, with a range in the arithmetic means from 1.7% to 25% in vernal pool samples, compared to 31% to 49% in the floodplain soils.

5.3.4 Summary

In summary, there are some differences in floodplain, riverbank, and vernal pool soil physical properties, indicating the presence of spatial trends by River reach. Floodplain and riverbank soil percent solids within Reach 5 are lowest in Reach 5C, and Reach 5C floodplain samples have the highest organic carbon content and the highest proportion of silts and clays on average. The floodplain soil results generally indicate the presence of wetter, finer-grained soils in Reach 5C, which may be the result of a flatter, broader floodplain in this reach. The floodplain soils below Reach 6 tend to be drier and sandier, similar to Reach 5A. In Reach 5, riverbank soils tend to contain more sand and less organic carbon than the adjacent floodplain soils. Data on vernal pool soil characteristics from Reaches 5A, 5B, and 5C indicate that, as expected, wetter, finer-grained soils with higher organic content are present in vernal pools than generally occur in surrounding floodplain areas.

5.4 Nature and Extent of PCBs in Floodplain and Riverbank Soils

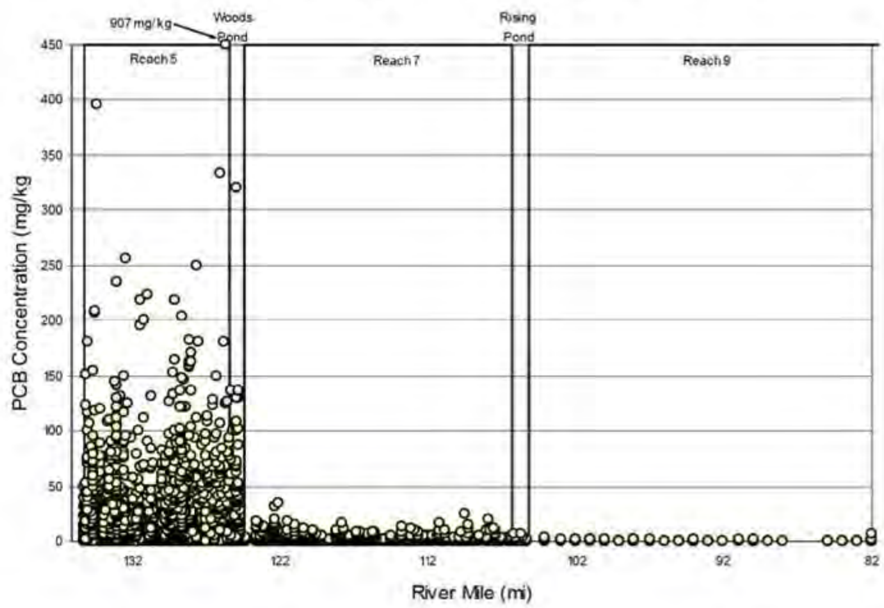
This section presents the data and findings of the floodplain, riverbank, and vernal pool soil investigations, including the nature and extent of PCBs detected in the floodplain and riverbank soils in the Rest of River from the Confluence to the Massachusetts/Connecticut border.

5.4.1 Overview

Of the 6,314 samples collected, a total of 6,233 floodplain, riverbank, and vernal pool samples have been analyzed for PCBs. Approximately 89% of these are floodplain samples; only 4% (237) are riverbank samples, and the remaining 7% are vernal pool soil samples. Statistical summaries of the total PCB results by subreach are presented in Table 5-6 and by reach and sampling depth in Table 5-7. The individual PCB results are presented along with select corresponding physical data in Appendix B.

Figure 5-4 (below) shows all soil PCB data (floodplain, riverbank, and vernal pools combined, all sample depths) by River mile. Overall, PCB concentrations decline with increasing distance downstream of the Confluence. The highest PCB concentrations occur in Reach 5 (maximum value of 907 mg/kg in Reach 5C in a sample from 2 feet to 2.5 feet below ground surface [bgs]). A sharp decrease in floodplain soil PCB concentration occurs downstream of Woods Pond, where the maximum single-sample value was 38 mg/kg in Reach 7 (in a sample from 3 feet to 3.5 feet bgs). Average values in Reaches 7, 8, and 9 at all sample depths are generally less than 3.0 mg/kg.

Figure 5-4. Total PCB Concentration by River Mile



Notes:
Includes all GE and EPA floodplain, riverbank, and vernal pool data with an associated river mile. River miles were assigned in GIS based on the mile point (defined every 0.1 mile between RM 144 and RM 105, and every 1.0 mile between RM 105 and RM 80) that was geographically closest to each sampling location.

Figure 5-4 also shows the high variability in PCB concentrations measured in floodplain, riverbank, and vernal pool soils in the Rest of River area. One of the objectives of the floodplain investigations was to evaluate other factors that affect the PCB concentrations observed in the floodplain. In the following subsections, PCB concentrations are discussed in relation to:

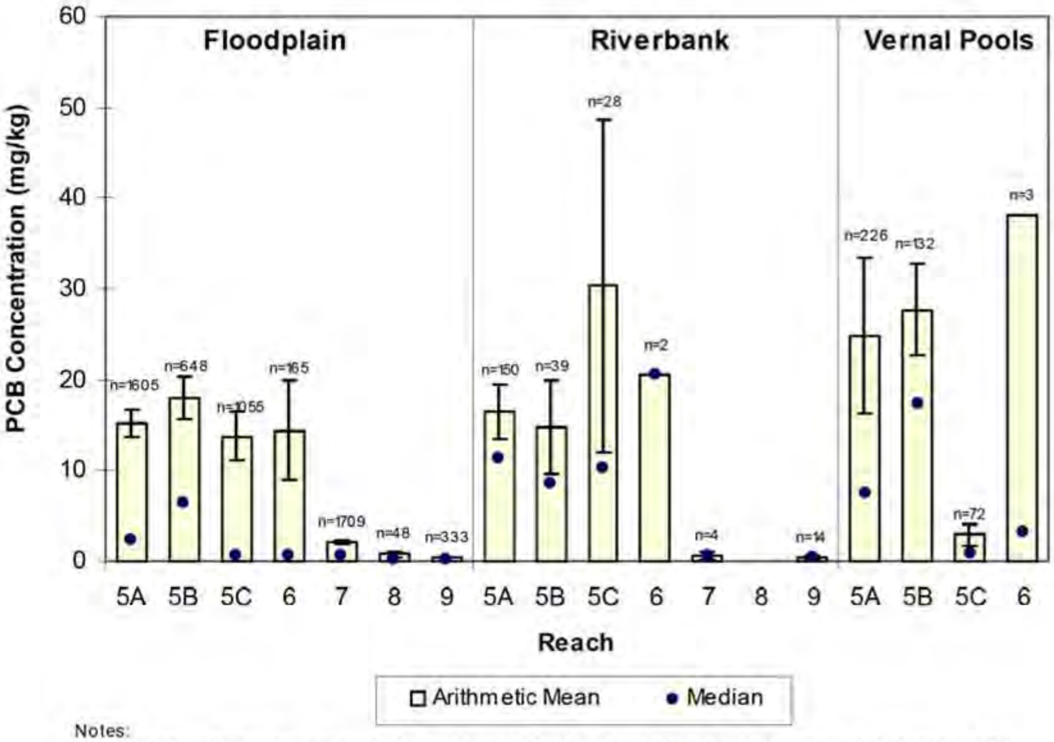
- Sample location and River reach;
- Sample depth internal;
- Lateral distance from the edge of water;
- Frequency of inundation due to flooding; and
- Physical characteristics of soils.

5.4.2 PCB Concentration by Reach

5.4.2.1 Floodplain Soil

The floodplain soil datasets by reach were evaluated to identify general spatial trends. As shown in Table 5-6, there is a large range in the number of samples collected from Reaches 5 through 9, with the total number of floodplain PCB samples in all reaches ranging from 48 in Reach 8 to 1,713 in Reach 7. However, general comparisons among reaches can be made. Arithmetic mean and median PCB concentrations are presented by reach on Figure 5-5 (below). As shown on that figure, the arithmetic means of PCB concentrations in floodplain soil are lowest in Reaches 8 and 9 (less than 1 mg/kg) and the mean concentration in Reach 7 is just over 2 mg/kg, compared to arithmetic means between 14 mg/kg and 19 mg/kg in Reaches 5 and 6. Aside from showing generally higher arithmetic mean PCB concentrations in Reaches 5A, 5B, 5C, and 6, Table 5-6 and Figure 5-5 also show that median PCB concentrations are much lower than the arithmetic means in these reaches, with values ranging from 0.60 mg/kg to 6.2 mg/kg.

Figure 5-5. Floodplain, Riverbank, and Vernal Pool Soils - Arithmetic Mean and Median PCB by Reach



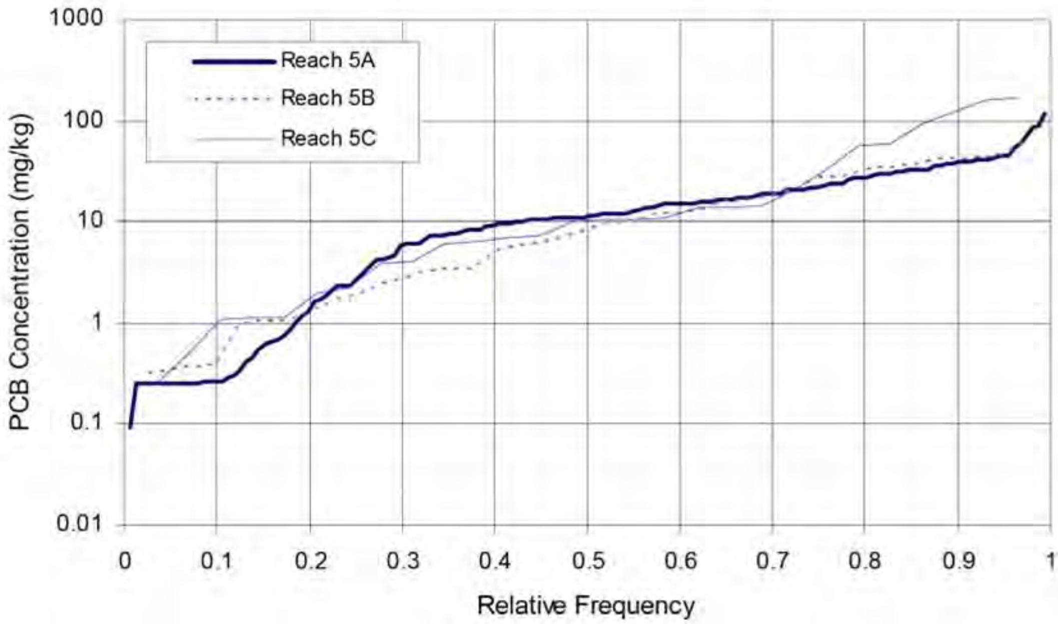
Notes:
Presents arithmetic mean and 2 standard errors for all EPA and GE floodplain, riverbank, and vernal pool soil PCB data.
n = number of samples.

5.4.2.2 Riverbank Soil

The majority (150 of 237, or 63%) of riverbank samples were collected in Reach 5A, with 67 samples collected from Reaches 5B and 5C and a total of 20 samples collected from Reaches 6, 7, and 9 (Table 5-6). In Reaches 7 and 9, the maximum observed PCB concentration in riverbank samples was 1.2 mg/kg. Within Reaches 5A, 5B, and 5C, where the majority of the riverbank samples were collected, most riverbank samples were collected from the 0- to 0.5-foot and 0.5- to 1-foot soil layers (Table 5-7). For these reaches, riverbank soil PCB concentrations ranged from non-detect to 171 mg/kg (reported at a depth of 0.5 to 1 foot in Reach 5C) (Table 5-7). Similar to floodplain soils, the median riverbank soil PCB concentrations are typically lower than the means.

Arithmetic mean and median PCB concentrations in riverbank samples are shown for all reaches on Figure 5-5 (above). In Reaches 5A and 5B, arithmetic means are similar to each other at 16 mg/kg and 15 mg/kg, respectively. The average riverbank value in Reach 5C is higher, at 30 mg/kg, in part reflecting an increase in the mean caused by the highest observed PCB concentration of the three subreaches. Median PCB concentrations for the three subreaches are lower and less variable, ranging from 8.6 mg/kg to 11 mg/kg. Frequency distributions of PCB results from all riverbank samples collected from Reaches 5A, 5B, and 5C (Figure 5-6, below) indicate that overall, the PCB concentrations of riverbank soils are generally similar in all three subreaches and follow similar distributions.

Figure 5-6. Frequency Distribution of PCBs in Reach 5 Riverbank Soils



Note:
Includes all GE and EPA riverbank soil data.

5.4.2.3 Vernal Pool Soil

Total PCB concentrations for all vernal pool samples analyzed for PCBs are presented by reach in Table 5-6 and on Figure 5-5 (above). A total of 433 samples collected from 411 locations within vernal pools in Reaches 5A, 5B, 5C, and 6 were analyzed for PCBs (queried as "VP" samples from the "Location Type" field in the November 2002 EPA database). These samples were most commonly collected from the surface sediment (over 90% within the upper 6 inches), although at four locations samples extended to a depth of 2.5 feet. No vernal pool samples were collected from Reaches 7, 8, or 9. Vernal pool sample locations are shown on Figure 5-7. Soil characteristics and PCB results are discussed below.

As shown in Table 5-6 and on Figure 5-5, average and median PCB concentrations in the vernal pool soils of Reach 5C are notably lower than those in Reaches 5A and 5B. (In Reach 6, the small sample size of 3 precludes any meaningful comparison.) Arithmetic mean concentrations for all samples from Reaches 5A and 5B are 25 and 28 mg/kg, respectively, compared to 2.9 mg/kg in Reach 5C (Table 5-7). The maximum PCB concentration measured in the surface soil layer of vernal pools in Reach 5C was only 26 mg/kg, compared to values of 874 mg/kg and 136 mg/kg in the surface layer of vernal pools in Reaches 5A and 5B, respectively. For all three reaches, median concentrations were considerably lower than the average concentrations.

5.4.2.4 Comparison of Floodplain, Riverbank, and Vernal Pool PCB Concentrations

Figure 5-5 (above) shows that in Reaches 5A and 5B, arithmetic mean PCB concentrations in riverbank and floodplain samples are similar, but the arithmetic mean in Reach 5C is considerably higher in riverbank than in floodplain samples. Median values are higher in riverbank than floodplain soils in all three subreaches, especially in Reaches 5A and 5C. In Reach 5C, this appears to be influenced in part by a large number of floodplain samples with less than 1 mg/kg PCB collected in the distal portions of the 10-year floodplain. The presence of higher concentrations of PCBs in riverbank soils than in floodplain soils reflects the riverbanks' greater proximity to the River and their consequent increased frequency of surface water contact. This lateral trend is discussed later in this section. By comparison, the vernal pools in Reaches 5A and 5B have higher average PCB concentrations than both the floodplain and the riverbank soils, with the opposite pattern observed in Reach 5C, where the average concentration in vernal pool soil is 4 to 10 times lower than in the floodplain or bank soils.

5.4.3 PCB Depth Distribution in Floodplain, Riverbank, and Vernal Pool Samples

Spatial trends in PCB concentration with depth were evaluated by compiling the floodplain, riverbank, and vernal pool soil results into 6-inch depth increments. Summaries of the floodplain, riverbank, and vernal pool total PCB results by subreach and sampling depth are provided in Table 5-7, and arithmetic and median values are plotted on Figures 5-8a through 5-8c for data from 6-inch depth intervals of the combined dataset. The number of samples collected and analyzed within each depth interval is highly variable; most samples were collected in 6-inch depth intervals from within the top 2.5 feet of floodplain soil, but at a few locations PCBs were detected at depths of several feet. (Note that total sample numbers may not be consistent between Tables 5-6 and 5-7 due to the depth weighting procedure. See Section 1.6 for details.)

In general, Figures 5-8a through 5-8c show that floodplain, riverbank, and vernal pool soil arithmetic means in Reaches 5A, 5B, 5C, and 6 exhibit considerable within-reach variability among depth intervals. The standard error bars on arithmetic means tend to be much larger for the deeper layers in Reach 5, due to the variability of PCB concentrations among a relatively small number of samples. The maximum PCB concentrations generally occur in the top 30 inches in all reaches (see Table 5-7).

Floodplain soils show the same general trends as all soil samples combined. As shown in Table 5-7, in Reaches 5A, 5B, and 5C, the highest PCB concentrations were generally detected in the top 30 inches, where the majority of samples were also collected. The highest averages in each of these reaches do not occur in the surface, but typically at or below a depth of 1 foot. In Reach 6, the highest average PCB concentrations in floodplain soils are contained in the uppermost 18 inches of soil, and decline steadily downward from the surface. PCB concentrations in soils in Reaches 7, 8, and 9 are considerably lower and more consistent among depths. In all cases, the medians are lower than the arithmetic means.

Riverbank soil samples were collected from Reaches 5, 6, 7, and 9 at depths of up to 2.5 feet; however, most samples were collected from the upper two 6-inch intervals (i.e., the top foot) in Reach 5A. Although the dataset for deeper soil intervals is relatively limited, the data indicate that PCBs were detected in nearly all depth intervals collected from all reaches, with the maximum PCB concentrations occurring within the top foot (Table 5-7).

The vernal pool data are also very limited at depths greater than 6 inches. Table 5-7 shows that most (over 90%) of the vernal pool data are from the 0- to 0.5-foot depth interval of soil. The limited available data suggest that PCBs in the vernal pools are highest in the upper 6 inches of soil, and generally decrease with depth.

A more detailed discussion of PCB results by reach and depth interval for 6-inch depth interval data summarized in Table 5-7 is presented below.

5.4.3.1 Reach 5

A total of 3,249 floodplain soil samples were collected from Reach 5 at depths of up to 9.5 feet and analyzed for PCBs. PCB concentrations reported for samples collected in this reach ranged from non-detect to 907 mg/kg (which was measured in the 2- to 2.5-foot interval in Reach 5C). Arithmetic mean PCB concentrations are generally similar among the most sampled depth intervals, except in Reach 5C where the mean increases with depth to the 2.5- to 3-foot interval. Median values are generally much lower than the means.

A total of 204 riverbank samples were collected from Reach 5 at depths of up to 2.5 feet for PCB analysis, with more than 60% of the samples being collected from the upper 1-foot depth interval within Reach 5A. The maximum single-sample PCB concentrations for each subreach were found in the 6- to 12-inch depth increment, but the average and median concentrations are variable among depths. The average PCB concentrations in the top foot (0- to 6-inch and 6- to 12-inch depths) are higher in Reach 5C than in Reaches 5A and 5B. However, the median values are fairly consistent among reaches.

Of the 430 samples collected from vernal pools and analyzed for PCB, 93% were collected from the uppermost 6-inch increment. Within that surface layer, average PCB concentrations are highest in Reaches 5A and 5B, and lowest downstream of Woods Pond. Limited data below 6 inches suggest that PCB concentrations in vernal pool soils generally decrease with depth. Similar to the other soil sample datasets, the medians are lower than the arithmetic averages.

5.4.3.2 Reach 6

In Reach 6, a total of 162 floodplain soil samples were collected and analyzed for PCBs to a depth of up to 2.5 feet. PCB concentrations reported for samples collected from this reach ranged from non-detect to 321 mg/kg (which was measured in the 0- to 0.5-foot interval). Arithmetic mean PCB concentrations in Reach 6 floodplain soil depth interval samples decrease with depth from a high of 19 mg/kg in the 0- to 0.5-foot interval to 1.4 mg/kg in the 2- to 2.5-foot interval. This pattern is also generally reflected in median PCB concentrations.

Two riverbank soil samples were collected in Reach 6: one from the 0- to 0.5-foot interval with a PCB detection of 24 mg/kg, and the second from the 0.5- to 1-foot interval with a PCB detection of 17 mg/kg. Three vernal pool samples were collected, all from the 0- to 0.5-foot interval, at three locations within Reach 6, with PCB concentrations of 2.3, 3.2, and 109 mg/kg. Given the lack of data from other depths, no vertical delineation of PCBs in the Reach 6 vernal pools could be performed.

5.4.3.3 Reaches 7 through 9

A total of 2,090 floodplain soil samples were collected from Reaches 7, 8, and 9, with the majority of samples collected in the top 2.5 feet within Reach 7. As shown in Table 5-7, PCB concentrations in Reach 7 floodplain soils are much lower than in Reaches 5 and 6, and no depth-related PCB concentration trends are observed. Individual PCB concentrations reported for samples collected from Reach 7 ranged from non-detect to 38 mg/kg (which was measured in the 0- to 0.5-foot interval and 3.0- to 3.5-foot interval, respectively). In Reaches 8 and 9, most data were from the top two 6-inch intervals only and PCB concentrations were generally below 1 mg/kg (approximately 97% and 91% of all floodplain soil samples were below 1 mg/kg in Reaches 8 and 9, respectively). Median PCB concentrations in all these reaches are consistently lower than the arithmetic means.

Eighteen riverbank soil samples were collected in Reaches 7 and 9 for PCB analysis, with nearly all samples being collected within the top foot. Due to the small number of samples collected within each reach, no discernible spatial relationship can be seen. However, reported PCB concentrations were generally less than 1 mg/kg.

No vernal pool samples were collected downstream of Woods Pond.

5.4.4 Lateral PCB Distribution from Edge of Water Outward

The lateral distribution of PCBs in the surface soil of the floodplain was evaluated by characterizing the distance from the River's edge corresponding to PCB concentration. ArcView GIS was used to calculate the nearest distance of each floodplain, vernal pool, and riverbank sample (surface [0 to 6 inches] and subsurface) from the edge of water. While variability will be introduced by samples adjacent to the river in a bend, the general utility of this analysis is maintained relative to the varying horizontal extent of the 1 ppm isopleth along the River.

The relationship between PCB concentrations in riverbank, floodplain, and vernal pool soil and distance from the river is shown for each reach in Figures 5-9 and 5-10. These graphs show that although there is considerable variability in the data, there is a general trend of declining PCB concentrations as distance from the river channel increases.

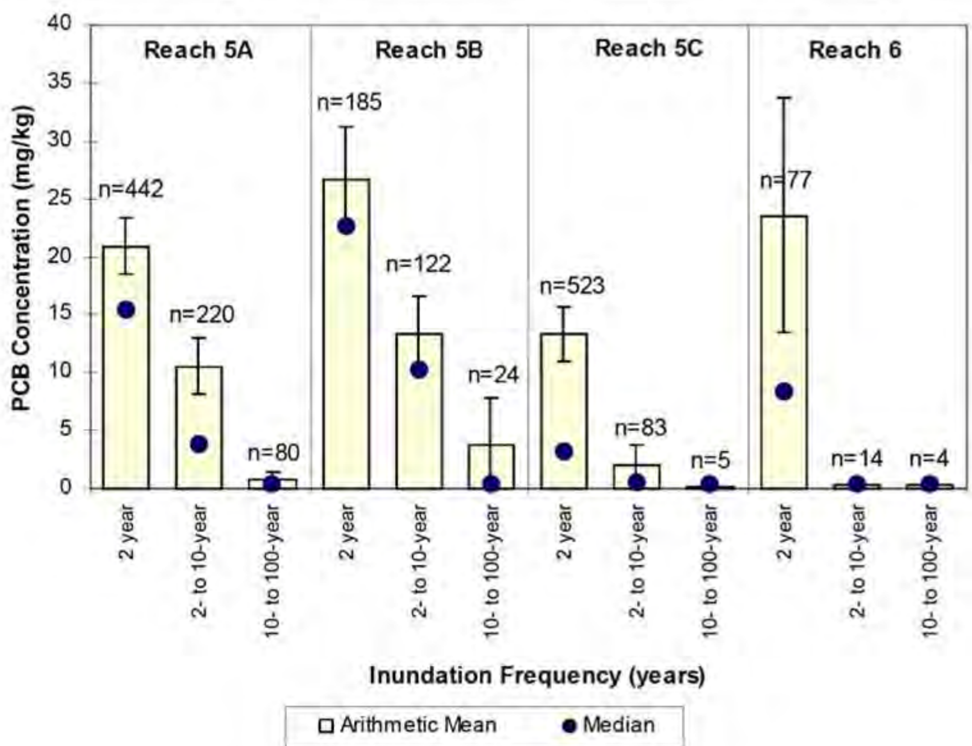
5.4.5 Inundation Frequency

Flood frequency is an additional factor that may help explain the spatial distribution of PCBs in floodplain soils. The objective of this analysis was to account for changing topography within the floodplain area. To perform this analysis, soil PCB concentrations were related to estimates of the flood frequency at each sample location in Reaches 5 and 6. This analysis was limited to Reaches 5 and 6 due to higher PCB concentrations present in these reaches, the relatively shorter distance of these reaches (as compared to Reaches 7 and 9), and the complexity of the information needed for this analysis. In addition, the detailed photogrammetric topography necessary for the resolution of this analysis was available only for Reaches 5 and 6. Digital elevation data, sample geographic coordinates, and a HEC-2 hydraulic model were used to relate River flow data to estimated flood frequency at each sample location. All sample locations between the Confluence and Woods Pond Dam were assigned to one of three inundation frequency categories: 2-year, 2- to 10-year, and 10- to 100-year. The 2-year and 2- to 10-year floodplain isoplethes were generated using surface water profiles predicted by the HEC-2 model. The 10- to 100-year floodplain isopleth was established based on FEMA flood mapping. The estimated 2-year, 2-

to 10-year, and 10- to 100-year floodplain areas are shown on Figure 5-11. For the purposes of this analysis, only floodplain and riverbank soil data were examined, as the vernal pools are inundated at a greater frequency and for longer durations than the other soils.

Next, the average and median total PCB concentrations in floodplain and riverbank surface soil samples were calculated for samples in each flood-frequency category in Reaches 5A, 5B, 5C, and 6. Surface soils are examined, as opposed to soils at depth, since the observed PCB concentrations can be assumed to be indicative of more recent deposition during inundation. Results are plotted on Figure 5-12 (below). As depicted on Figure 5-12, data show that in all reaches examined, the highest PCB concentrations are found within the 2-year floodplain, with progressively lower concentrations occurring in the 2- to 10-year and 10- to 100-year floodplain categories. Only a few samples collected from outside the 2- to 10-year floodplain had detectable PCB levels.

Figure 5-12. Floodplain and Riverbank Surface Soils - PCB by Reach and Inundation Frequency



Notes:
Includes all GE and EPA surficial (0-to 6-inch depth interval) floodplain and riverbank soil data.
Does not include vernal pool data
The 2-year and the 2- to 10-year floodplain isopleths were generated using surface water profiles predicted by the HEC-2 model. The 10- to 100-year floodplain isopleth was established based on FEMA flood mapping.

In Reach 5A, arithmetic mean surficial PCB concentrations decrease from 21 mg/kg in the 2-year floodplain to 11 mg/kg in the 2- to 10-year floodplain. Beyond the 10-year floodplain, the arithmetic means are less than 1 mg/kg. In Reach 5B, PCB concentrations decrease from 27 mg/kg in the 2-year floodplain category to approximately 13 mg/kg in the 2- to 10-year floodplain category and to 3.7 mg/kg or lower in less frequently inundated floodplain. The mean PCB concentration of 3.7 mg/kg in the surface of the 10- to 100-year floodplain in this reach is due to a few high PCB detections skewing the result, as evidenced by the low median value (0.25 mg/kg). In fact, over 50% of PCB concentrations in the surface soils in the Reach 5B 10- to 100-year floodplain were non-detect and over 80% of results were less than 1 mg/kg. In Reaches 5C and 6, average PCB concentrations in the surface quickly drop to levels at or below 1 mg/kg outside of the 2-year inundation frequency. Overall, these results are consistent with the evaluation of the lateral distribution of PCB concentrations as a function of distance from river's edge, and support the conclusion that floodplain soil PCB concentrations generally decrease with distance from the river's edge.

5.4.6 Comparison of Soil PCB Concentrations to Previously Defined 1 mg/kg PCB Isopleth

Prior investigations of the Rest of River area resulted in the development of an approximate 1 mg/kg PCB isopleth for the floodplain in Reaches 5 and 6, which generally corresponds to the 10-year floodplain. The development of this isopleth is discussed in the 1996 RFI Report (BBL, 1996). The previously defined 1 mg/kg PCB isopleth is depicted on Figure 5-13. Since that time, a considerable amount of additional soil PCB data has been generated from these reaches. Analysis of the current dataset shows that most samples with PCB concentrations greater than 1 mg/kg fall within the previously defined isopleth, thus confirming the findings of the 1996 RFI Report. Of the approximately 1,990 surficial floodplain and riverbank soil samples collected in Reaches 5 and 6 for PCB analysis, only 42 samples (2%) had PCB detections above 1 mg/kg in areas outside the predicted 1 mg/kg isopleth. At these locations, PCB concentrations greater than 1 mg/kg were not detected in the subsurface samples. By contrast, more than 730 surface soil samples collected from the top one-foot interval <u>within</u> the 1 mg/kg isopleth showed PCB concentrations less than 1 mg/kg. Again, for the purposes of this analysis, only floodplain and riverbank soil data were examined since the 1 mg/kg isopleth was based on elevation at which a certain area was flooded by the River (vs. an area of standing water) and the vernal pools are inundated at a greater frequency and for longer durations than the other soils.

5.4.7 Soil Characteristics Affecting PCB Concentrations

Relationships between PCB concentrations and soil characteristics in reaches with more abundant data were also evaluated. Because PCBs have a stronger affinity for organic carbon and finer-grained soil or sediment particles such as silt and clay, positive relationships among PCB concentration, organic carbon content, and the fractions of silt and clay would be expected. Also, because higher solids content is usually associated with sandier soils containing less organic carbon, a negative relationship between PCB concentration and percent solids is commonly observed.

5.4.7.1 TOC

All floodplain, riverbank, and vernal pool soil PCB and TOC data are plotted, by reach, on Figures 5-14a through 5-14c. As evidenced in these figures, there is a statistically significant ($p < 0.05$) positive relationship between PCB concentrations and TOC in soils in Reaches 5A, 5B, 5C, 6, and 8, where the percent TOC explains between 14 and 50% of the variability observed in the PCB data (i.e., r^2 values range from 0.14 to 0.50). Within these reaches, the highest PCB concentrations generally correspond to elevated TOC. In Reach 5, where most of the soil data were collected, the vernal pool data generally fall in the higher end of the TOC range (although they show variable PCB concentrations), and floodplain soil data comprise most of the lower TOC and PCB values (see Figure 5-14a). No statistically significant relationships were observed between PCB concentration and TOC in Reach 7 and 9 soils.

5.4.7.2 Percent Solids

All floodplain, riverbank, and vernal pool PCB and percent solids data are shown by reach on Figures 5-15a through 5-15c. As observed on those figures, there is an inverse relationship between PCB concentration and percent solids in floodplain soils in each reach and all are statistically significant ($p < 0.05$) except in Reach 9. The strongest relationship is observed in Reach 6, where percent solids account for 67% of the variability in the PCB data (r^2 value = 0.67). Weaker relationships between PCB concentrations and percent solids are apparent in Reaches 5A and 5C, where elevated PCB concentrations occur in both high and low percent solids, although in both reaches, non-detections are less common in soils with very low percent solids.

5.5 Analysis of PCB Aroclor and Homolog Composition

5.5.1 PCB Aroclors

Individual PCB Aroclors were quantified in a subset of the 6,492 total PCB samples (including quality control [QC] samples). A summary of the quantified PCB Aroclors by reach is presented in Table 5-8, below. The PCBs detected in Housatonic River floodplain, riverbank, and vernal pool soils were predominantly quantified as Aroclor 1260. Overall, approximately 96% of the detected PCBs were quantified as Aroclor 1260. The remainder of the detected PCBs were quantified mostly as Aroclor 1254 (quantified as approximately 4% of the total detected PCBs). PCB Aroclors 1242 and 1248 were typically quantified at levels of less than 0.1% of the total PCBs.

Table 5-8. Floodplain, Riverbank, and Vernal Pool Soils - PCB Aroclor Composition Percent of Total PCBs

Reach	N	Average Quantitation at Each Location (%)			
		Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Reach 5A	1998	0.0	< 0.1	5.8	94
Reach 5B	699	0.0	< 0.1	2.9	97
Reach 5C	1302	< 0.1	< 0.1	2.6	97
Reach 6	177	0.0	0.0	3.0	97
Reach 7	1805	0.1	0.2	4.6	95
Reach 8	51	0.0	0.0	0.7	99
Reach 9	363	0.0	0.0	3.6	96

Note:
Includes all EPA and GE riverbank, floodplain, and vernal pool soil data (1988-2002) with detectable PCB including QA/QC samples.

5.5.2 PCB Homolog Composition

Individual PCB homolog groups were quantified in 160 floodplain, riverbank, and vernal pool soil samples collected by EPA between 1999 and 2002 from Reaches 5, 6, 7, and 9 and analyzed for PCB congeners. The average homolog proportions of total PCB concentration for all these samples and individual reaches are summarized on Figure 5-16. Results show a relatively consistent homolog composition in all reaches. Hexachlorobiphenyls are consistently the most abundant homolog, followed by heptachlorobiphenyls. In Reaches 5 and 6, pentachlorobiphenyls are slightly more abundant than octachlorobiphenyls on average. In Reaches 7 and 9, octachlorobiphenyls slightly exceed pentachlorobiphenyls. Similar to the PCB Aroclor results discussed above, the average PCB homolog composition shows that the PCB mixture in floodplain, riverbank, and vernal pool soils is most similar to Aroclor 1260.

5.6 PCB Mass in Floodplain, Riverbank, and Vernal Pool Soils

The PCB mass within the floodplain soil of the Rest of River area was estimated using the physical data (surface area, soil depth, and percent solids) and analytical data (dry-weight PCB concentrations) collected during the 1998-2002 sediment sampling activities. As discussed in Section 4.7, PCB mass estimates tend to be highly uncertain due to different methods of calculating mass, the spatial variability of both the physical and chemical characteristics of soil, the density and distribution of available data, the inherent need to extrapolate the representativeness of available data over large volumes of soil, and the compounding effect of combining all these uncertainties in the resulting mass estimates. In consideration of these factors, ranges of mass estimates are presented rather than a single value. As in the Section 4 calculations of sediment PCB mass, variations in the bulk density and PCB concentrations were estimated by two standard errors, and mass was calculated using the upper and lower limits of both factors. Mass estimates for the Housatonic River floodplain were generated for Reaches 5 through 9. The following assumptions and procedures were applied:

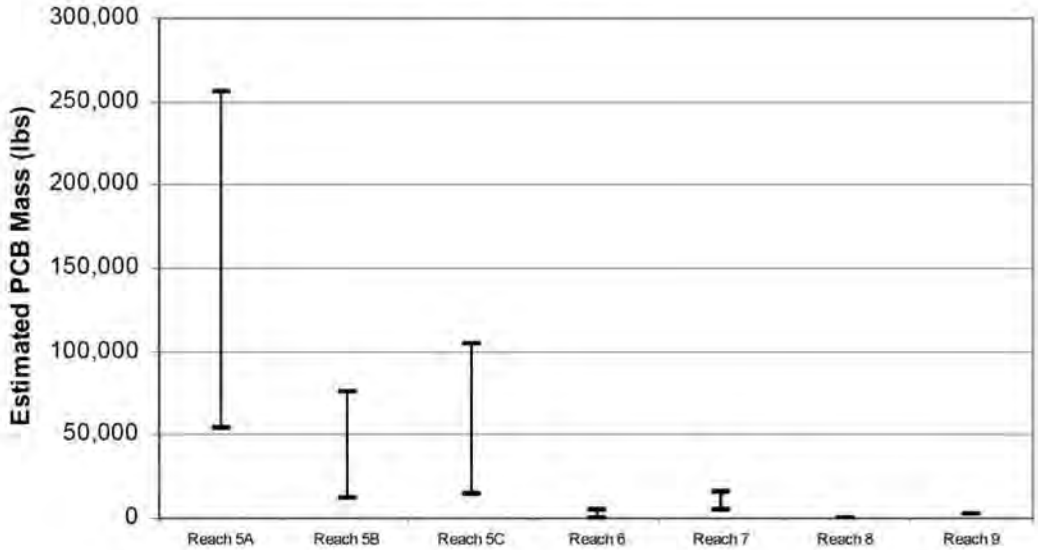
- Floodplain surface areas in Reaches 5 and 6 were split into proximal and distal floodplain areas. The proximal area is defined as the floodplain area along the riverbank extending 50 feet into the floodplain perpendicular to the channel. The distal area represents the area extending from the proximal area to the 1 mg/kg isopleth. The proximal/distal area designation was made due to the observed higher PCB concentrations closer to the riverbank. Separate mass estimates were made for the proximal and distal floodplains in these reaches.

- PCB mass in Reaches 7, 8, and 9 were calculated only for proximal areas in these reaches, since the 1 mg/kg isopleth line is not established in these reaches and PCB concentrations in these reaches outside 50 feet from the River are generally low (greater than 60% of PCB results less than 1 mg/kg).
- In these calculations, all data from floodplain, riverbank, and vernal pool samples were used.
- Due to the lack of site-specific bulk density data, bulk density was estimated from site-specific percent solids data.

To estimate the PCB mass in these floodplain reaches and capture some of the observed differences in PCB concentration with depth, PCB mass was calculated for 6-inch depths within each reach to the vertical extent to which PCBs were detected. The first step in the calculation of the reach-specific PCB mass was to estimate the area over which PCBs were distributed. To facilitate this calculation, the percentage of PCBs detected within each depth interval was assumed to be representative of the fraction of the soil that contains PCBs. For example, if PCBs were detected in 96% of samples collected from the top 6 inches of floodplain soil in Reach 5A, then 96% of the 121-acre surface area of that floodplain reach was assumed to contain PCB mass, resulting in an area of 116 acres (i.e., 121 acres x 0.96 = 116 acres). This calculation was conducted for each 6-inch depth interval at which PCBs were detected and, for Reaches 5 and 6, for both the distal and proximal areas of the floodplain. After determining these areas, the volume of PCB-containing soil was determined as the product of the depth (i.e., 6 inches) and the estimated area over which PCB were detected. Corresponding with the calculated PCB-containing soil volume for each sediment depth interval, an upper and lower PCB concentration within each 6-inch depth increment was estimated as the reach-wide arithmetic mean of detected PCB concentration results plus and minus two standard errors. Similar upper and lower bounds were determined for reach-wide bulk density, estimated from percent solids data (see Table 5-9).

The PCB mass in each reach-specific depth interval was then estimated as the product of the PCB-containing soil volume, the upper and lower PCB concentrations, and the upper and lower sediment bulk density (estimated from percent solids data) within the specific reach and depth interval (see Table 5-9). The total PCB mass within the reach was calculated as the sum of those calculated for the individual depth intervals. Based on the calculation methods described above, the calculated ranges of PCB mass (in lbs of PCBs) are shown, per reach, in Table 5-9 and on Figure 5-17 (below), and are also summarized in Table 5-10 (below).

Figure 5-17. Estimated PCB Mass in Housatonic River Floodplain Soil



Note:
Mass estimates reflect the use of plus and minus two standard errors on reach-wide average PCB concentration and bulk density in calculations.

As can be seen, by far the greatest estimated mass of PCBs in the floodplain soils is present in Reach 5, with the majority residing in Reach 5A. The ranges of PCB mass shown above are the upper and lower bounds based on uncertainty in both the PCB and bulk density. When summed for the entire floodplain from the Confluence to the Connecticut border, these estimates produce an overall range of approximately 89,000 lbs to 460,000 lbs of PCBs, as shown in Table 5-10. Within Reach 5A, the estimated PCB mass is approximately evenly divided between the proximal and distal floodplain areas, while in the other reaches, the great majority of the estimated PCB mass (over 85%) is within the proximal floodplain areas (see Table 5-9).

Table 5-10. PCB Mass in Floodplain Soils

Reach	Range (lbs)		
Reach 5A	54,000	-	255,000
Reach 5B	12,300	-	76,000
Reach 5C	14,000	-	105,000
Reach 6	350	-	4,800
Reach 7	5,300	-	15,000
Reach 8	30	-	90
Reach 9	2,400	-	2,800
Rounded Total:	**89,000**	**-**	**460,000**

Note:

1. Total mass by reach is rounded sum of proximal and distal area estimates.
2. See Table 5-9 for detailed results by reach and area.

The large range of PCB mass estimates highlights the uncertainty inherent in the calculations. If the upper and lower bounds on PCB and bulk density are assessed separately, different estimates of PCB mass are calculated. If the PCB arithmetic mean of detected PCBs is used and the density is varied, the overall range of PCB mass is 240,000 lbs to 250,000 lbs. On the other hand, if a reach-wide arithmetic mean bulk-density value is used for each reach and PCBs are varied, the overall range of PCB mass is estimated to be 89,000 lbs to 460,000 lbs. The observed differences in the PCB mass estimated by varying these reach-specific values further demonstrate the uncertainties associated with the estimation of PCB mass.

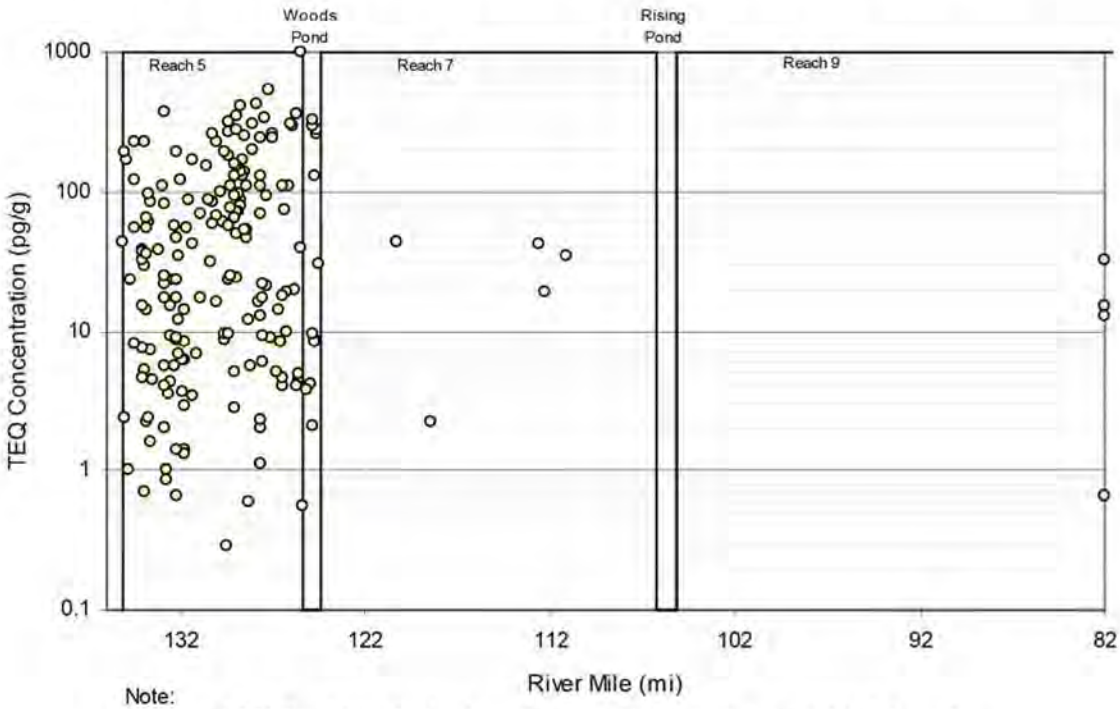
5.7 Nature and Extent of Other Constituents in Floodplain, Riverbank, and Vernal Pool Soils

The majority of the floodplain, riverbank, and vernal pool soil samples were analyzed for PCBs (6,233 out of 6,314 samples collected). In addition to the PCB analyses discussed in the previous subsections, analyses for non-PCB constituents were performed on a smaller subset of the floodplain, riverbank, and vernal pool soil samples. The other constituents analyzed for included SVOCs, pesticides, herbicides, PCDDs/PCDFs, cyanide, sulfide, and metals. Information on the frequency of detection of these constituents in floodplain and riverbank soils, as well as summary statistics on concentrations, are included in Appendix C.

As discussed in Section 2.6, EPA has advised GE that, based on EPA's human health and ecological screening evaluations, the non-PCB constituents, other than potentially PCDDs/PCDFs, are not key constituents of concern in the Rest of River. As a result, the extent of these constituents in the Rest of River floodplain and riverbank soils will not be evaluated further, except for a brief discussion of PCDD/PCDF compounds.

For PCDDs/PCDFs, review of the data indicates detection of a number of PCDD/PCDF compounds in floodplain soils. To evaluate these data further, a TEQ concentration was calculated for each sample using the TEFs published by the WHO and representing non-detected compounds as one-half the analytical detection limit. TEQ values calculated for the subset of floodplain, riverbank, and vernal pool soil samples analyzed for PCDDs/PCDFs range from 0.29 pg/g (within Reach 5B) to 990 pg/g (within Reach 5C). Arithmetic mean TEQ values (considering floodplain, riverbank, and vernal pool data combined) range from 15 pg/g (within Reach 9) to 122 pg/g (within Reach 5B). TEQ values are plotted by River mile on Figure 5-18 (below). These TEQ values show considerable variability within reaches, but are generally higher above Woods Pond and are lower in the few available samples downstream of Woods Pond Dam.

Figure 5-18. TEQ Concentration in the Housatonic River Floodplain



Note:
Includes all EPA floodplain, riverbank, and vernal pool data with an associated river mile.

5.8 Summary

Considerable spatial variability in floodplain, riverbank, and vernal pool soil PCB concentrations exists within the Rest of River area. Much of the variability can be accounted for by a number of factors. Several relevant findings are summarized below.

Overall, average and median floodplain, riverbank, and vernal pool soil PCB concentrations are highest within Reach 5, while average and median PCB concentrations all are much lower in Reaches 7, 8, and 9. Median PCB concentrations are consistently lower than the averages.

Within Reach 5, several factors may account for the observed spatial distribution of PCBs. Riverbank soils tend to contain higher average PCB concentrations than floodplain soils due in part to the increased contact that riverbanks have with surface water. Similarly, average PCB concentrations in floodplain soils tend to be highest in areas that are closer to the River and that are flooded more frequently. For example, average and median surface soil PCB concentrations within Reach 5 are highest in the 2-year floodplain and decrease progressively in the 2- to 10-year and 10- to 100-year floodplains. Floodplain data also indicate that large areas of the 2- to 10-year floodplain located away from the riverbank contain little or no detectable PCBs.

PCB concentrations vary with soil properties. In general, within a given reach, the highest PCB concentrations typically occur in samples containing lower percent solids, larger proportions of silts and clays, and higher organic carbon content. Data from vernal pools generally show that wetter, finer-grained, more organic soils occur at these locations than in the surrounding floodplain. Average PCB concentrations in vernal pools in Reaches 5A and 5B are also higher than those in floodplain and riverbank soils within the same reaches. However, the opposite is true in Reach 5C.

As with the PCB mass estimates for sediments, estimates of PCB mass in the floodplain soils in the Rest of River area consist of large ranges, reflecting the uncertainties in the methods, data used, and calculations. These estimates of PCB mass in the Rest of River floodplain soils have resulted in an overall range of 89,000 lbs to 460,000 lbs of PCBs.

Other chemical constituents were also detected in floodplain, riverbank, and vernal pool samples, but are not the focus of this RFI Report, except for a brief discussion of PCDDs/PCDFs. For PCDDs/PCDFs, TEQ values range up to 990 pg/g (less than 1 μg/kg) and show higher values above Woods Pond than downstream of Woods Pond.

Section 5 Tables

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Table 5-1
Floodplain and Riverbank Soils
Summary of Sampling Activities/Investigations

Year	Lead Organization	Description and Purpose	No. of Locations/ Samples Collected	Analytical Parameters	Report Citation
1988 – 1989	GE/BBL	DeVos Property Sampling – Select sampling of the DeVos property in Lenox, MA to determine the presence of PCBs.	52 / 104	PCBs	BBEPC, Dec. 1991
1990	GE/BBL	MCP Phase II Investigation – Sampling of 10 transects within the Rest of River designated FP2 through FP11 to provide a representation of the PCBs present.	114 / 227	PCBs	BBEPC, Dec. 1991
1992	GE/BBL	MCP Phase II Investigation – Additional sampling at 2 of the original 10 transects (FP2 and FP7) to better define the extent of PCBs at these locations.	9 / 36	PCBs, TOC	BBEPC, Aug. 1992
1992 – 1994	GE/BBL	Floodplain Property Analysis – Conducted as part of MDEP-required activities to evaluate the need for short-term measures (STMs) at specific floodplain properties.	16 parcels / 89	PCBs, TOC	BBEPC, Oct. 1992; BBEPC, Feb. 1993; BBL, 1994
1994 – 1995	GE/BBL	Supplemental Phase II/RFI Investigation – Sampling at existing (10) and new (12) transects (22 total transects) to further define the horizontal and vertical extent of PCBs in floodplain soils downstream of the GE facility.	153 / 432	PCBs, TOC	BBL, 1996
1995	GE/BBL	Supplemental Phase II/RFI Investigation – Additional sampling at residential properties to define the extent of PCBs in floodplain soils.	2 parcels / 24	PCBs, TOC	BBL, 1996
1997 - 1998	GE/BBL	Additional sampling at floodplain properties to further define the extent of PCBs in floodplain soils.	6 parcels / 361	PCBs	---
1998 - 2002	USEPA/ Weston	USEPA Supplemental Investigation – Sampling to define the nature and extent of the soil contamination in the Housatonic River and associated floodplain by PCBs and other contaminants and to further delineate pathways of contaminant migration.	2,537 / 4,572	PCBs, TOC, Appendix IX (approx. 10% of samples)	---

Notes:
1. Only major sampling events are summarized.
2. Sample numbers do not include QC samples.

Table 5-3
Floodplain, Riverbank, and Vernal Pool Soils
Solids Content by Reach (%) -- 1998-2002

All Data (Floodplain, Riverbank, and Vernal Pools)							
Sampling Location	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	1330	73	71	72	70	0.030	100
Reach 5B	456	67	66	67	64	14	99
Reach 5C	628	61	59	60	57	8.1	99
Reach 6	133	66	62	66	59	9.3	97
Reach 7	1330	77	76	77	75	14	100
Reach 8	26	79	76	82	70	41	100
Reach 9	168	76	75	77	74	32	96
Floodplain							
Sampling Location	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	1019	76	75	76	74	0	100
Reach 5B	342	72	70	72	69	14	99
Reach 5C	563	61	59	61	58	8	99
Reach 6	131	67	63	67	59	9	97
Reach 7	1326	77	76	77	75	14	100
Reach 8	26	79	76	82	70	41	100
Reach 9	166	76	76	77	74	32	96
Riverbank							
Sampling Location	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	140	72	72	74	71	52	100
Reach 5B	14	75	73	78	68	54	92
Reach 5C	20	58	59	65	54	40	82
Reach 6	--	--	--	--	--	--	--
Reach 7	4	61	60	84	36	37	82
Reach 8	--	--	--	--	--	--	--
Reach 9	2	61	61	NA	NA	57	65
Vernal Pools							
Sampling Location	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	171	53	50	53	48	6	94
Reach 5B	100	49	48	50	46	16	80
Reach 5C	45	47	49	55	43	13	96
Reach 6	2	41	41	NA	NA	32	50
Reach 7	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--

Notes:

1. All EPA data from all depths are included.
2. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
3. Duplicate samples were averaged.
4. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).
5. -- No data collected.
6. All EPA data queried as "VP" samples from the "Location Type" field in the November 2002 EPA database from all depths are included as vernal pool samples.

Table 5-4
Floodplain, Riverbank, and Vernal Pool Soils
Total Organic Carbon (TOC) by Reach (%) -- 1992-2002

All Data (Floodplain, Riverbank, and Vernal Pool)								
Sampling Location	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	463	96	4.0	7.5	8.6	6.5	ND	90
Reach 5B	197	98	6.9	10	12	8.7	ND	51
Reach 5C	259	97	5.0	9.0	10	7.6	ND	78
Reach 6	22	100	3.5	7.1	11	3.5	1.4	35
Reach 7	120	100	3.9	4.9	5.6	4.2	1.0	25
Reach 8	10	100	2.6	3.3	4.4	2.2	1.6	6.9
Reach 9	30	100	2.0	2.6	3.5	1.6	0.56	15
Floodplain								
Sampling Location	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	243	96	2.6	4.3	5.3	3.3	ND	90
Reach 5B	85	96	2.7	4.8	6.2	3.3	ND	48
Reach 5C	192	99	4.3	7.3	8.5	6.1	ND	45
Reach 6	20	100	3.4	4.8	6.7	3.0	1.4	16
Reach 7	120	100	3.9	4.9	5.6	4.2	1.0	25
Reach 8	10	100	2.6	3.3	4.4	2.2	1.6	6.9
Reach 9	30	100	2.0	2.6	3.5	1.6	0.56	15
Riverbank								
Sampling Location	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	30	100	2.3	2.7	3.2	2.2	0.72	7.0
Reach 5B	5	100	2.3	2.4	3.3	1.5	1.3	3.9
Reach 5C	6	83	3.2	3.3	5.1	1.5	ND	5.8
Reach 6	--	--	--	--	--	--	--	--
Reach 7	--	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--	--
Vernal Pools								
Sampling Location	Number of Samples	Detection Frequency (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	190	95	8.8	12	14	10	ND	85
Reach 5B	107	100	13	15	17	13	1.6	51
Reach 5C	61	93	9.4	15	19	10	ND	78
Reach 6	2	100	30	30	NA	NA	24	35
Reach 7	--	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--	--

Notes:

1. All GE and EPA data from all depths are included.
2. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
3. Duplicate samples were averaged.
4. ND = Not Detected.
5. -- No data collected.
6. All EPA data queried as "VP" samples from the "Location Type" field in the November 2002 EPA database from all depths are included as vernal pool samples.
7. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).

Table 5-5
Floodplain, Riverbank, and Vernal Pool Soils
Grain Size by Reach (%) -- 1998-2001

All Data (Floodplain, Riverbank, and Vernal Pools)							
Sampling Location	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Percent Clay							
Reach 5A	366	11	13	14	12	0	40
Reach 5B	174	14	14	15	13	1.2	42
Reach 5C	199	13	15	16	13	1.5	41
Reach 6	18	9.3	13	17	8.5	3.0	29
Reach 7	78	8.0	8.5	9.7	7.4	0.70	27
Reach 8	--	--	--	--	--	--	--
Reach 9	4	9.5	10	13	7.4	7.5	14
Percent Gravel							
Reach 5A	366	0	2.0	2.6	1.4	0	63
Reach 5B	174	0	0.83	1.5	0.15	0	36
Reach 5C	199	0	2.4	3.7	1.2	0	62
Reach 6	18	0.80	7.9	14	1.9	0	36
Reach 7	78	1.4	9.0	12	6.3	0	50
Reach 8	--	--	--	--	--	--	--
Reach 9	4	0	0	0	0	0	0
Percent Sand							
Reach 5A	366	34	36	39	34	0	93
Reach 5B	174	23	31	35	28	0	85
Reach 5C	199	28	30	32	27	0	87
Reach 6	18	36	31	42	20	0.10	78
Reach 7	78	51	49	54	45	13	90
Reach 8	--	--	--	--	--	--	--
Reach 9	4	26	26	40	12	8.7	43
Percent Silt							
Reach 5A	366	54	49	51	47	4.0	97
Reach 5B	174	60	54	57	51	11	88
Reach 5C	199	57	53	56	51	3.1	89
Reach 6	18	48	49	60	37	16	95
Reach 7	78	30	33	37	29	2.1	73
Reach 8	--	--	--	--	--	--	--
Reach 9	4	65	64	77	51	48	77

Table 5-5
Floodplain, Riverbank, and Vernal Pool Soils
Grain Size by Reach (%) -- 1998-2001

Floodplain							
Sampling Location	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Percent Clay							
Reach 5A	142	7.2	8.6	9.6	7.7	0.0	39.0
Reach 5B	50	7.6	10.0	12.0	7.8	1.2	42.0
Reach 5C	132	13.0	14.0	16.0	13.0	1.5	40.0
Reach 6	13	7.1	9.0	12.0	6.4	3.0	20.0
Reach 7	78	8.0	8.5	9.7	7.4	0.7	27.0
Reach 8	--	--	--	--	--	--	--
Reach 9	4	9.5	10.0	13.0	7.4	7.5	14.0
Percent Gravel							
Reach 5A	142	0.0	2.9	3.8	1.9	0.0	29.0
Reach 5B	50	0.0	2.5	4.8	0.2	0.0	36.0
Reach 5C	132	0.0	3.2	5.0	1.4	0.0	62.0
Reach 6	13	2.2	11.0	19.0	3.2	0.0	36.0
Reach 7	78	3.0	9.0	12.0	6.3	0.0	50.0
Reach 8	--	--	--	--	--	--	--
Reach 9	4	0.0	0.0	0.0	0.0	0.0	0.0
Percent Sand							
Reach 5A	142	44.0	45.0	49.0	42.0	2.4	93.0
Reach 5B	50	43.0	44.0	51.0	38.0	8.3	85.0
Reach 5C	132	29.0	31.0	34.0	28.0	0.0	71.0
Reach 6	13	42.0	42.0	51.0	33.0	13.0	78.0
Reach 7	78	51.0	49.0	54.0	45.0	13.0	90.0
Reach 8	--	--	--	--	--	--	--
Reach 9	4	26.0	26.0	40.0	12.0	8.7	43.0
Percent Silt							
Reach 5A	142	43.0	43.0	47.0	40.0	4.0	79.0
Reach 5B	50	46.0	43.0	49.0	38.0	11.0	74.0
Reach 5C	132	57.0	51.0	54.0	49.0	3.1	79.0
Reach 6	13	31.0	38.0	48.0	28.0	16.0	68.0
Reach 7	78	30.0	33.0	37.0	29.0	2.1	73.0
Reach 8	--	--	--	--	--	--	--
Reach 9	4	65.0	64.0	77.0	51.0	48.0	77.0

Table 5-5
Floodplain, Riverbank, and Vernal Pool Soils
Grain Size by Reach (%) -- 1998-2001

Riverbank							
Sampling Location	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Percent Clay							
Reach 5A	38	4.9	7.1	8.7	5.4	1.0	23.0
Reach 5B	19	5.4	6.7	8.3	5.2	4.0	16.0
Reach 5C	6	8.3	9.1	13.0	5.5	4.3	17.0
Reach 6	--	--	--	--	--	--	--
Reach 7	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--
Percent Gravel							
Reach 5A	38	0.0	1.9	5.2	< 0	0.0	63.0
Reach 5B	19	0.0	0.0	0.0	0.0	0.0	0.0
Reach 5C	6	0.0	1.2	3.1	< 0	0.0	6.1
Reach 6	--	--	--	--	--	--	--
Reach 7	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--
Percent Sand							
Reach 5A	38	64	59	65	53	14	83
Reach 5B	19	67	63	71	56	32	83
Reach 5C	6	46	41	55	27	13	58
Reach 6	--	--	--	--	--	--	--
Reach 7	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--
Percent Silt							
Reach 5A	38	26.0	32.0	37.0	27.0	4.3	73.0
Reach 5B	19	27.0	30.0	36.0	24.0	12.0	53.0
Reach 5C	6	47.0	49.0	61.0	37.0	32.0	70.0
Reach 6	--	--	--	--	--	--	--
Reach 7	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--

Table 5-5
Floodplain, Riverbank, and Vernal Pool Soils
Grain Size by Reach (%) -- 1998-2001

Vernal Pools							
Sampling Location	Number of Samples	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Percent Clay							
Reach 5A	186	17.0	17.0	18.0	16.0	1.5	40.0
Reach 5B	105	17.0	17.0	19.0	16.0	4.4	37.0
Reach 5C	61	15.0	16.0	18.0	14.0	2.6	41.0
Reach 6	5	26.0	22.0	31.0	13.0	5.0	29.0
Reach 7	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--
Percent Gravel							
Reach 5A	186	0.0	1.4	2.0	0.7	0.0	35.0
Reach 5B	105	0.0	0.2	0.3	0.1	0.0	3.9
Reach 5C	61	0.0	1.0	1.7	0.4	0.0	14.0
Reach 6	5	0.0	0.0	0.1	< 0	0.0	0.1
Reach 7	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--
Percent Sand							
Reach 5A	186	19.0	24.0	27.0	22.0	0.0	89.0
Reach 5B	105	15.0	19.0	22.0	16.0	0.0	76.0
Reach 5C	61	22.0	25.0	31.0	19.0	0.0	87.0
Reach 6	5	0.1	1.7	3.8	< 0	0.1	5.1
Reach 7	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--
Percent Silt							
Reach 5A	186	62.0	57.0	60.0	55.0	5.7	97.0
Reach 5B	105	65.0	63.0	65.0	61.0	19.0	88.0
Reach 5C	61	58.0	58.0	62.0	53.0	9.3	89.0
Reach 6	5	73.0	76.0	86.0	67.0	68.0	95.0
Reach 7	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--

Notes:

1. All EPA data from all depths are included.
2. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
3. Duplicate samples were averaged.
4. -- No data collected.
5. All EPA data queried as "VP" samples from the "Location Type" field in the November 2002 EPA database from all depths are included as vernal pool samples.

Table 5-6
Floodplain[1], Riverbank, and Vernal Pool Soils
Total PCB by Reach (mg/kg) -- 1988-2002

All Soils (Floodplain, Riverbank, and Vernal Pools								
Sampling Location	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	1981	77	3.5	16	18	15	ND	874
Reach 5B	819	83	8.2	19	21	17	ND	230
Reach 5C	1155	64	0.73	14	16	11	ND	907
Reach 6	170	62	0.60	15	20	9.4	ND	321
Reach 7	1713	67	0.57	2.1	2.3	1.9	ND	38
Reach 8	48	69	0.27	0.80	1.2	0.43	ND	6.0
Reach 9	347	56	0.25	0.42	0.48	0.36	ND	6.3
Floodplain Soils								
Sampling Location	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	1605	75	2.3	15	17	14	ND	395
Reach 5B	648	80	6.4	18	20	16	ND	230
Reach 5C	1055	64	0.70	14	16	11	ND	907
Reach 6	165	61	0.55	14	20	8.9	ND	321
Reach 7	1709	67	0.57	2.1	2.3	1.9	ND	38
Reach 8	48	69	0.27	0.80	1.2	0.43	ND	6.0
Reach 9	333	55	0.25	0.42	0.48	0.35	ND	6.3
Riverbank Soils								
Sampling Location	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	150	89	11	16	19	13	ND	117
Reach 5B	39	90	8.6	15	20	9.6	ND	62
Reach 5C	28	96	10	30	49	12	ND	171
Reach 6	2	100	21	21	NA	NA	9.8	25
Reach 7	4	75	0.60	0.64	1.0	0.26	ND	1.1
Reach 8	--	--	--	--	--	--	--	--
Reach 9	14	71	0.34	0.48	0.65	0.32	ND	1.2
Vernal Pools								
Sampling Location	Number of Samples	Detection Frequency (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A	226	84	7.5	25	33	16	ND	874
Reach 5B	132	95	17	28	33	23.0	ND	136
Reach 5C	72	53	0.77	2.9	4.1	1.7	ND	26
Reach 6	3	100	3.2	38	109	< 0	2.3	109
Reach 7	--	--	--	--	--	--	--	--
Reach 8	--	--	--	--	--	--	--	--
Reach 9	--	--	--	--	--	--	--	--

Notes:

1. All GE and EPA data from all depths are included.
2. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
3. Duplicate samples were averaged.
4. ND = Not Detected.
5. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).
6. -- No data collected.
7. All EPA data from queried as "VP" samples from the "Location Type" field in the November 2002 EPA database from all depths are included as vernal pool samples.

Table 5-7
Floodplain, Riverbank, and Vernal Pool Soils
Total PCB Data by Reach and Depth (mg/kg) -- 1988-2002

All Soils (Floodplain, Riverbank, and Vernal Pools)								
Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP								
0-6	1092	84	6.1	17	19	15	ND	874
6-12	500	64	0.67	12	14	9.8	ND	209
12-18	140	75	1.6	24	33	15	ND	395
18-24	42	62	0.31	21	37	4.7	ND	199
24-30	116	67	0.71	17	25	9.2	ND	257
30-36	22	73	0.50	12	22	1.6	ND	98.1
36-42	13	77	0.78	14	27	0.89	ND	68.8
42-48	11	82	0.33	11	20	1.7	ND	39.0
48-54	9	100	0.35	7.3	18	< 0	0.090	48.0
54-60	6	100	7.2	30	74	< 0	0.082	140
60-66	6	83	13	36	81	< 0	ND	140
66-72	2	100	7.1	7.1	NA	NA	2.2	12.0
72-78	3	67	5.8	7.9	19	< 0	ND	18.0
78-84	4	25	0.0060	14	43	< 0	ND	57.0
84-90	5	80	33	37	71	2.0	ND	88.0
108-114	1	0	NA	ND	NA	NA	ND	ND
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence								
0-6	486	88	12	21	24	19	ND	230
6-12	115	78	0	17	22	12	ND	164
12-18	55	78	3.5	23	34	12	ND	204
18-24	7	100	13	26	62	< 0	0.18	130
24-30	51	61	0.65	13	23	2.2	ND	219
30-36	6	100	8.2	20	45	< 0	0.28	83.0
36-42	6	100	1.2	13	36	< 0	0.30	71.0
42-48	5	80	0.55	2.1	4.5	< 0	ND	6.40
48-54	5	80	0.13	0.51	1.0	< 0	ND	1.30
54-60	5	60	0.032	0.38	0.81	< 0	ND	1.00
60-66	1	100	NA	1.7	NA	NA	1.7	1.70
66-72	1	0	NA	ND	NA	NA	ND	ND
72-78	2	0	0.010	ND	NA	NA	ND	ND
78-84	3	0	0	ND	0	0	ND	ND
84-90	1	100	NA	0.11	NA	NA	0.11	0.110
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond								
0-6	704	67	0.90	11	13	9.1	ND	334
6-12	239	55	0.37	13	18	8.6	ND	249
12-18	85	62	1.1	20	29	12	ND	220
18-24	13	62	0.28	26	70	< 0	ND	280
24-30	75	57	0.45	33	61	5.5	ND	907
30-36	4	100	3.1	34	98	< 0	0.30	130
36-42	2	100	0.57	0.57	NA	NA	0.29	0.840
42-48	3	100	0.40	2.8	7.6	< 0	0.25	7.60
48-54	4	75	7.7	14	33	< 0	ND	41.0
54-60	4	75	0.12	3.8	11	< 0	ND	15.0
60-66	2	50	0.21	0.21	NA	NA	ND	0.420
66-72	1	0	NA	ND	NA	NA	ND	ND
72-78	1	0	NA	ND	NA	NA	ND	ND
78-84	1	0	NA	ND	NA	NA	ND	ND
84-90	4	25	0.012	0.015	0.022	0.0073	ND	0.025
90-96	1	0	NA	ND	NA	NA	ND	ND

Table 5-7
Floodplain, Riverbank, and Vernal Pool Soils
Total PCB Data by Reach and Depth (mg/kg) -- 1988-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 6 - Woods Pond								
0-6	101	71	1.1	19	28	11	ND	321
6-12	18	50	0.41	14	29	< 0	ND	130
12-18	24	50	0.29	12	24	< 0	ND	137
24-30	24	38	0.25	1.4	3.0	< 0	ND	19.9
Reach 7 - Woods Pond Dam to Rising Pond								
0-6	751	79	1.1	2.4	2.7	2.1	ND	38.0
6-12	396	67	0.40	1.9	2.3	1.6	ND	28.9
12-18	246	57	0.49	2.2	2.7	1.7	ND	27.8
18-24	36	81	1.2	4.2	6.5	1.9	ND	22.0
24-30	216	43	0.25	1.3	1.8	0.88	ND	34.3
30-36	23	74	0.37	1.3	2.6	< 0	ND	15.1
36-42	23	48	0.091	2.8	6.2	< 0	ND	37.5
42-48	11	45	0.063	0.69	1.6	< 0	ND	5.34
48-54	7	14	0.065	0.16	0.37	< 0	ND	0.774
54-60	2	50	1.5	1.5	NA	NA	ND	2.96
60-66	2	50	0.16	0.16	NA	NA	ND	0.249
Reach 8 - Rising Pond								
0-6	23	74	0.25	1.0	1.7	0.35	ND	6.00
6-12	22	59	0.25	0.63	1.0	0.23	ND	3.90
12-18	1	100	NA	0.39	NA	NA	0.39	0.390
18-24	1	100	NA	0.39	NA	NA	0.39	0.390
24-30	1	100	NA	0.39	NA	NA	0.39	0.390
Reach 9 - Downstream of Rising Pond Dam to Connecticut Border								
0-6	167	62	0.26	0.38	0.43	0.32	ND	1.70
6-12	167	51	0.25	0.45	0.55	0.34	ND	6.32
12-18	4	100	1.5	1.7	3.4	< 0	0.14	3.70
18-24	4	25	0.25	0.27	0.62	< 0	ND	0.770
24-30	3	0	0.024	ND	0	0	ND	ND
30-36	2	0	0.023	ND	NA	NA	ND	ND
Floodplain Soils								
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP								
0-6	817	83	4.9	15	17	13	ND	235
6-12	432	61	0.50	11	14	8.9	ND	209
12-18	132	74	1.5	24	33	15	ND	395
18-24	42	62	0.30	21	37	4.7	ND	199
24-30	108	67	0.60	17	26	8.6	ND	257
30-36	22	73	0.50	12	22	1.6	ND	98
36-42	13	77	0.78	14	27	0.89	ND	69
42-48	11	82	0.33	11	20	1.7	ND	39
48-54	9	100	0.35	7.3	18	< 0	0.090	48
54-60	6	100	7.2	30	74	< 0	0.082	140
60-66	6	83	13	36	81	< 0	ND	140
66-72	2	100	7.1	7.1	NA	NA	2.2	12
72-78	3	67	5.8	7.9	19	< 0	ND	18
78-84	4	25	0.011	14	43	< 0	ND	57
84-90	5	80	33	37	71	2.0	ND	88
108-114	1	0	NA	ND	NA	NA	NA	NA

Table 5-7
Floodplain, Riverbank, and Vernal Pool Soils
Total PCB Data by Reach and Depth (mg/kg) -- 1988-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence								
0-6	347	85	10	19	22	17	ND	230
6-12	94	76	4.5	17	23	11	ND	164
12-18	54	78	3.3	23	34	12	ND	204
18-24	7	100	13	26	62	< 0	0.18	130
24-30	50	60	0.61	13	24	2.3	ND	219
30-36	6	100	8.2	20	45	< 0	0.28	83
36-42	6	100	1.2	13	36	< 0	0.30	71
42-48	5	80	0.55	2.1	4.5	< 0	ND	6.4
48-54	5	80	0.13	0.51	1.0	< 0	ND	1.3
54-60	5	60	0.032	0.38	0.81	< 0	ND	1.0
60-66	1	100	NA	1.7	NA	NA	NA	NA
66-72	1	0	NA	ND	NA	NA	NA	NA
72-78	2	0	NA	ND	NA	NA	ND	NA
78-84	3	0	NA	ND	NA	NA	ND	NA
84-90	1	100	NA	0.11	NA	NA	NA	NA
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond								
0-6	628	68	0.95	11	13	9.3	ND	334
6-12	231	54	0.36	13	17	8.2	ND	249
12-18	80	60	0.86	21	30	12	ND	220
18-24	13	62	0.28	26	70	< 0	ND	280
24-30	70	57	0.41	32	62	3.0	ND	907
30-36	4	100	3.1	34	98	< 0	0.30	130
36-42	2	100	0.57	0.57	NA	NA	0.29	0.84
42-48	3	100	0.40	2.8	7.6	< 0	0.25	7.6
48-54	4	75	7.7	14	33	< 0	ND	41
54-60	4	75	0.12	3.8	11	< 0	ND	15
60-66	2	50	0.21	0.21	NA	NA	ND	0.42
66-72	1	0	NA	ND	NA	NA	NA	NA
72-78	1	0	NA	ND	NA	NA	NA	NA
78-84	1	0	NA	ND	NA	NA	NA	NA
84-90	4	25	0.012	0.015	0.022	0.0073	ND	0.025
90-96	1	0	NA	ND	NA	NA	NA	NA
Reach 6 - Woods Pond								
0-6	97	70	1.0	19	27	11	ND	321
6-12	17	47	0.32	14	30	< 0	ND	130
12-18	24	50	0.29	12	24	< 0	ND	137
24-30	24	38	0.25	1.4	3.0	< 0	ND	20
Reach 7 - Woods Pond Dam to Rising Pond								
0-6	749	79	1.1	2.4	2.7	2.1	ND	38
6-12	394	67	0.40	1.9	2.3	1.6	ND	29
12-18	246	57	0.47	2.2	2.7	1.7	ND	28
18-24	36	81	1.2	4.2	6.5	1.9	ND	22
24-30	216	43	0.25	1.3	1.8	0.88	ND	34
30-36	23	74	0.37	1.3	2.6	< 0	ND	15
36-42	23	48	0.091	2.8	6.2	< 0	ND	38
42-48	11	45	0.063	0.69	1.6	< 0	ND	5.3
48-54	7	14	0.065	0.16	0.37	< 0	ND	0.77
54-60	2	50	1.5	1.5	NA	NA	ND	3.0
60-66	2	50	0.16	0.16	NA	NA	ND	0.25

Table 5-7
Floodplain, Riverbank, and Vernal Pool Soils
Total PCB Data by Reach and Depth (mg/kg) -- 1988-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 8 - Rising Pond								
0-6	23	74	0.25	1.0	1.7	0.35	ND	6.0
6-12	22	59	0.25	0.63	1.0	0.23	ND	3.9
12-18	1	100	NA	0.39	NA	NA	NA	NA
18-24	1	100	NA	0.39	NA	NA	NA	NA
24-30	1	100	NA	0.39	NA	NA	NA	NA
Reach 9 - Rising Pond Dam to Connecticut Border								
0-6	161	61	0.25	0.38	0.43	0.32	ND	1.7
6-12	161	50	0.25	0.44	0.55	0.33	ND	6.3
12-18	3	100	2.6	2.1	4.3	0.042	0.14	3.7
18-24	3	33	0.024	0.27	0.77	< 0	ND	0.77
24-30	3	0	NA	ND	NA	NA	ND	NA
30-36	2	0	NA	ND	NA	NA	ND	NA
Riverbank Soils								
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP								
0-6	69	96	12	14	17	11	ND	71
6-12	61	82	11	17	22	11	ND	117
12-18	6	83	13	16	30	3.2	ND	40
24-30	6	83	5.0	25	55	< 0	ND	86
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence								
0-6	18	89	6.0	11	16	5.3	ND	36
6-12	18	89	6.5	19	29	9.7	ND	62
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond								
0-6	13	100	11	28	53	3.5	2.3	163
6-12	5	100	11	44	109	< 0	1.2	171
12-18	4	100	8.7	9.9	18	1.6	1.1	21
24-30	4	75	47	54	118	< 0	ND	123
Reach 6 - Woods Pond								
0-6	1	100	NA	24	NA	NA	NA	NA
6-12	1	100	NA	17	NA	NA	NA	NA
Reach 7 - Woods Pond Dam to Rising Pond								
0-6	2	100	0.60	0.60	NA	NA	0.44	0.76
6-12	2	50	0.68	0.68	NA	NA	ND	1.1
Reach 9 - Rising Pond Dam to Connecticut Border								
0-6	6	67	0.29	0.39	0.56	0.21	ND	0.80
6-12	6	83	0.54	0.63	0.95	0.32	ND	1.2
12-18	1	100	NA	0.36	NA	NA	NA	NA
18-24	1	0	NA	ND	NA	NA	NA	NA
Vernal Pools								
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP								
0-6	206	83	9.0	26	35	17	ND	874
6-12	7	71	2.3	8.3	18	< 0	ND	33
12-18	2	100	27	27	NA	NA	7.8	46
24-30	2	50	0.85	0.85	NA	NA	ND	1.1
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence								
0-6	121	94	19	28	34	23	ND	136
6-12	3	100	12	13	17	8.5	9.4	17
12-18	1	100	NA	9.9	NA	NA	NA	NA
24-30	1	100	NA	0.81	NA	NA	NA	NA

Table 5-7
Floodplain, Riverbank, and Vernal Pool Soils
Total PCB Data by Reach and Depth (mg/kg) -- 1988-2002

Depth Interval (inch)	Number of Samples	Frequency of Detection (%)	Median	Arithmetic Mean	+2 Standard Errors	-2 Standard Errors	Minimum	Maximum
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond								
0-6	63	51	0.78	3.2	4.5	1.8	ND	26
6-12	3	67	0.45	0.82	1.8	< 0	ND	1.8
12-18	1	100	NA	0.87	NA	NA	NA	NA
24-30	1	0	NA	ND	NA	NA	NA	NA
Reach 6 - Woods Pond								
0-6	3	100	3.2	38	109	< 0	2.3	109

Notes:
1. All GE and EPA data are included.
2. Non-detected values were assigned a value of one-half the detection limit prior to calculation.
3. Duplicate samples were averaged.
4. Data were depth-weighted (as necessary) to provide representative and comparable values for 6-inch increments (e.g., 0-6, 6-12, etc.)
5. ND = Not Detected.
6. NA = Analysis not conducted due to sample size (n<3) and/or frequency of detection (0%).
7. -- No data collected.
8. All EPA data queried as "VP" samples from the "Location Type" field in the November 2002 EPA database are included as vernal pool samples.

Table 5-9
Summary of Housatonic River Floodplain Soil PCB Mass Estimate

Total Area (acre)	Depth (inch)	Number of Detected Samples[1]	Bulk Density[2] (g/cm^3)		Depth Weighted PCB[3] (mg/kg)		Percent Detected	Area[4] (acre)	PCB Mass[5] (lbs)	
			+2 Std Error	-2 Std Error	+2 Std Error	-2 Std Error			+2 Std Error	-2 Std Error
Reach 5A - Confluence of the East and West Branch of the Housatonic River to Upstream of the WWTP										
					Proximal Floodplain[6]					
121	0-6	277	1.4	1.4	29	22	96	116	6,550	4,903
	6-12	141	1.4	1.4	34	22	85	104	6,702	4,321
	12-18	52	1.4	1.4	56	21	85	103	11,256	4,054
	18-24	13	1.4	1.4	93	9	81	98	17,645	1,754
	24-30	47	1.4	1.4	48	17	78	95	8,759	3,038
	30-36	10	1.4	1.4	39	0	71	87	6,437	0
	36-42	7	1.4	1.4	39	0	78	94	7,184	0
	42-48	6	1.4	1.4	25	1.7	75	91	4,351	289
	48-54	6	1.4	1.4	6.8	0	100	121	1,586	0
	54-60	5	1.4	1.4	86	0	100	121	20,063	0
	60-66	4	1.4	1.4	114	0	80	97	21,428	0
	66-72	1	1.4	1.4	2.2	2.2	100	121	515	502
	72-78	1	1.4	1.4	18	18	50	61	2,106	2,054
	78-84	1	1.4	1.4	57	57	25	30	3,334	3,252
	84-90	4	1.4	1.4	84	7.9	80	97	15,652	1,442
	Total								**133,567**	**25,608**
					Distal Floodplain[7]					
204	0-6	587	1.4	1.4	23	15	86	176	7,691	5,139
	6-12	156	1.4	1.4	17	8.5	66	135	4,408	2,157
	12-18	50	1.4	1.4	41	12	74	150	11,861	3,511
	18-24	12	1.4	1.4	44	0	60	122	10,293	0
	24-30	30	1.4	1.4	32	0	63	127	7,979	0
	30-36	6	1.4	1.4	29	0	86	175	9,658	0
	36-42	3	1.4	1.4	46	0	100	204	17,902	0
	42-48	3	1.4	1.4	39	0	100	204	15,344	0
	48-54	3	1.4	1.4	48	0	100	204	18,885	0
	54-60	1	1.4	1.4	23	23	100	204	9,049	8,825
	60-66	1	1.4	1.4	4.6	4.6	100	204	1,810	1,765
	66-72	1	1.4	1.4	12	12	100	204	4,721	4,605
	72-78	1	1.4	1.4	5.8	5.8	100	204	2,282	2,226
	Total								**121,883**	**28,227**
								Reach Total	**255,450**	**53,835**

Table 5-9
Summary of Housatonic River Floodplain Soil PCB Mass Estimate

Total Area (acre)	Depth (inch)	Number of Detected Samples[1]	Bulk Density[2] (g/cm³)		Depth Weighted PCB[3] (mg/kg)		Percent Detected	Area[4] (acre)	PCB Mass[5] (lbs)	
			+2 Std Error	-2 Std Error	+2 Std Error	-2 Std Error			+2 Std Error	-2 Std Error
Reach 5B - Downstream of WWTP to Upstream of the Roaring Brook Confluence										
					Proximal Floodplain[6]					
92	0-6	147	1.3	1.2	29	21	95	88	4,589	3,052
	6-12	45	1.3	1.2	31	18	92	85	4,699	2,464
	12-18	26	1.3	1.2	56	19	90	83	8,251	2,576
	18-24	4	1.3	1.2	99	0	100	92	16,379	0
	24-30	23	1.3	1.2	49	4.6	82	76	6,604	575
	30-36	4	1.3	1.2	64	0	100	92	10,605	0
	36-42	3	1.3	1.2	71	0	100	92	11,705	0
	42-48	3	1.3	1.2	6.4	0	100	92	1,056	0
	48-54	2	1.3	1.2	1.5	0.85	67	61	159	87
	54-60	3	1.3	1.2	1.2	0.022	75	69	149	2
	60-66	1	1.3	1.2	1.7	1.7	100	92	280	260
	84-90	1	1.3	1.2	0.11	0.11	100	92	18	17
	Total								**64,496**	**9,033**
					Distal Floodplain[7]					
53	0-6	254	1.3	1.2	29	22	89	48	2,506	1,731
	6-12	38	1.3	1.2	34	12.2	84	45	2,758	913
	12-18	16	1.3	1.2	35	0	67	36	2,243	0
	18-24	3	1.3	1.2	26	0	100	53	2,503	0
	24-30	8	1.3	1.2	6.4	0.83	38	20	235	28
	30-36	2	1.3	1.2	10	5.4	100	53	976	479
	36-42	3	1.3	1.2	3.2	0	100	53	303	0
	42-48	1	1.3	1.2	3.2	3.2	50	27	153	142
	48-54	2	1.3	1.2	0.14	0.12	100	53	13	10
	Total								**11,690**	**3,303**
								Reach Total	**76,186**	**12,336**

Table 5-9
Summary of Housatonic River Floodplain Soil PCB Mass Estimate

Total Area (acre)	Depth (inch)	Number of Detected Samples[1]	Bulk Density[2] (g/cm^3)		Depth Weighted PCB[3] (mg/kg)		Percent Detected	Area[4] (acre)	PCB Mass[5] (lbs)	
			+2 Std Error	-2 Std Error	+2 Std Error	-2 Std Error			+2 Std Error	-2 Std Error
Reach 5C - Upstream of Roaring Brook Confluence to Headwaters of Woods Pond										
					Proximal Floodplain[6]					
164	0-6	221	0.98	0.91	28	18	97	158	5,915	3,533
	6-12	73	0.98	0.91	47	23	84	138	8,804	3,931
	12-18	44	0.98	0.91	53	24	83	136	9,808	4,106
	18-24	7	0.98	0.91	128	0	88	143	24,716	0
	24-30	39	0.98	0.91	115	12	76	125	19,440	1,846
	30-36	4	0.98	0.91	98	0	100	164	21,699	0
	36-42	2	0.98	0.91	1.1	0.015	100	164	247	3
	42-48	3	0.98	0.91	7.6	0	100	164	1,681	0
	48-54	3	0.98	0.91	42.6	0	75	123	7,062	0
	54-60	3	0.98	0.91	15	0	75	123	2,489	0
	60-66	1	0.98	0.91	0.42	0.42	50	82	46	43
	84-90	1	0.98	0.91	0.025	0.025	25	41	1	1
	Total								**101,908**	**13,464**
					Distal Floodplain[7]					
91	0-6	220	0.98	0.91	14	9	66	60	1,140	642
	6-12	47	0.98	0.91	19	3.8	59	54	1,368	258
	12-18	8	0.98	0.91	4.0	0.84	32	29	158	31
	18-24	1	0.98	0.91	0.13	0.13	100	91	16	15
	24-30	4	0.98	0.91	3.5	0.17	19	17	81	4
	Total								**2,763**	**950**
								Reach Total	**104,672**	**14,413**

Table 5-9
Summary of Housatonic River Floodplain Soil PCB Mass Estimate

Total Area (acre)	Depth (inch)	Number of Detected Samples[1]	Bulk Density[2] (g/cm³)		Depth Weighted PCB[3] (mg/kg)		Percent Detected	Area[4] (acre)	PCB Mass[5] (lbs)	
			+2 Std Error	-2 Std Error	+2 Std Error	-2 Std Error			+2 Std Error	-2 Std Error
Reach 6 - Woods Pond										
					Proximal Floodplain[6]					
22	0-6	58	1.1	0.93	29	14	82	18	816	311
	6-12	7	1.1	0.93	68	0	70	15	1,652	0
	12-18	9	1.1	0.93	59	0	75	16	1,537	10
	24-30	8	1.1	0.93	8.4	0	62	14	178	0
	Total								4,183	321
					Distal Floodplain[7]					
5	0-6	14	1.1	0.93	97	6.2	70	3	530	27
	6-12	2	1.1	0.93	25	0	29	1	57	0
	12-18	3	1.1	0.93	14	0	43	2	45	0
	18-24	1	1.1	0.93	0.59	0.59	17	1	1	1
	Total								634	28
								Reach Total	4,817	349
Reach 7 - Woods Pond Dam to Rising Pond										
					Proximal Floodplain[6]					
239	0-6	331	1.5	1.4	3.6	2.7	84	201	1,486	1,031
	6-12	165	1.5	1.4	4.1	2.7	76	182	1,503	948
	12-18	98	1.5	1.4	5.2	3.1	66	158	1,684	950
	18-24	25	1.5	1.4	9.0	2.8	78	187	3,398	1,014
	24-30	68	1.5	1.4	4.7	2.1	54	130	1,238	529
	30-36	16	1.5	1.4	3.6	0.014	80	191	1,401	5
	36-42	11	1.5	1.4	13	0	50	119	3,047	0
	42-48	5	1.5	1.4	3.4	0	45	109	748	0
	48-54	1	1.5	1.4	0.77	0.77	14	34	54	51
	54-60	1	1.5	1.4	3.0	3.0	50	119	717	682
	60-66	1	1.5	1.4	0.25	0.25	50	119	60	57
	Total								15,336	5,267
								Reach Total	15,336	5,267

Table 5-9
Summary of Housatonic River Floodplain Soil PCB Mass Estimate

Total Area (acre)	Depth (inch)	Number of Detected Samples[1]	Bulk Density[2] (g/cm³)		Depth Weighted PCB[3] (mg/kg)		Percent Detected	Area[4] (acre)	PCB Mass[5] (lbs)	
			+2 Std Error	-2 Std Error	+2 Std Error	-2 Std Error			+2 Std Error	-2 Std Error
Reach 8 - Rising Pond										
					Proximal Floodplain[6]					
10	0-6	13	1.7	1.2	2.4	0.34	72	7	40	4
	6-12	11	1.7	1.2	1.7	0.25	58	6	22	2
	12-18	1	1.7	1.2	0.39	0.39	100	10	9	7
	18-24	1	1.7	1.2	0.39	0.39	100	10	9	7
	24-30	1	1.7	1.2	0.39	0.39	100	10	9	7
	Total								88	26
								Reach Total	88	26
Reach 9 - Rising Pond Dam to Connecticut Border										
					Proximal Floodplain[6]					
311	0-6	62	1.5	1.4	0.72	0.51	63	197	287	188
	6-12	58	1.5	1.4	1.1	0.59	57	179	390	198
	12-18	1	1.5	1.4	2.6	2.6	100	311	1,643	1,524
	18-24	1	1.5	1.4	0.77	0.77	100	311	487	451
	Total								2,807	2,362
								Reach Total	2,807	2,362
								Proximal River Total	322,386	56,082
								Distal River Total	136,970	32,508
								River Total	459,356	88,589

Notes:

1. Number of samples with detectable concentrations of PCB.
2. The upper and lower bound for the bulk density was calculated from median percent solids for each reach using the following relationship:
   Bulk Density (g dry/cm3) = (Ds x Average Percent Solids +/- 2 Std Err) / (Ds-((Ds-Dw) * Average Percent Solids +/- 2 Std Err))
   where:
   Ds = density of solids (g/cm3) = 2.65 g/cm3, and
   Dw = density of water (g/cm3) = 1.00 g/cm3.
3. Two standard errors of the arithmetic mean of detected PCB concentrations.
4. Area prorated by percentage of detections (i.e., Total Area*% detected).
5. The upper bound PCB mass estimate is determined as the product of the arithmetic mean of detected PCB plus 2 standard errors, the reach-wide arithmetic mean bulk density plus 2 standard errors, and the "PCB-containing volume." Conversely, the lower bound PCB mass estimate is determined as the product of the arithmetic mean of detected PCB minus 2 standard errors, the reach-wide arithmetic mean bulk density minus 2 standard errors, and the "PCB-containing volume."
6. Proximal floodplain area comprises the area along the reach riverbank extending into the floodplain 50 feet perpendicular to the channel.
7. Distal floodplain area defined as the floodplain area outside the proximal area extending to the 1 ppm isopleth.
8. Includes all GE and EPA data. Data were depth-weighted (as necessary) to provide representative and comparable values for 6-inch increments (e.g., 0-6, 6-12, etc.)

Section 5 Figures

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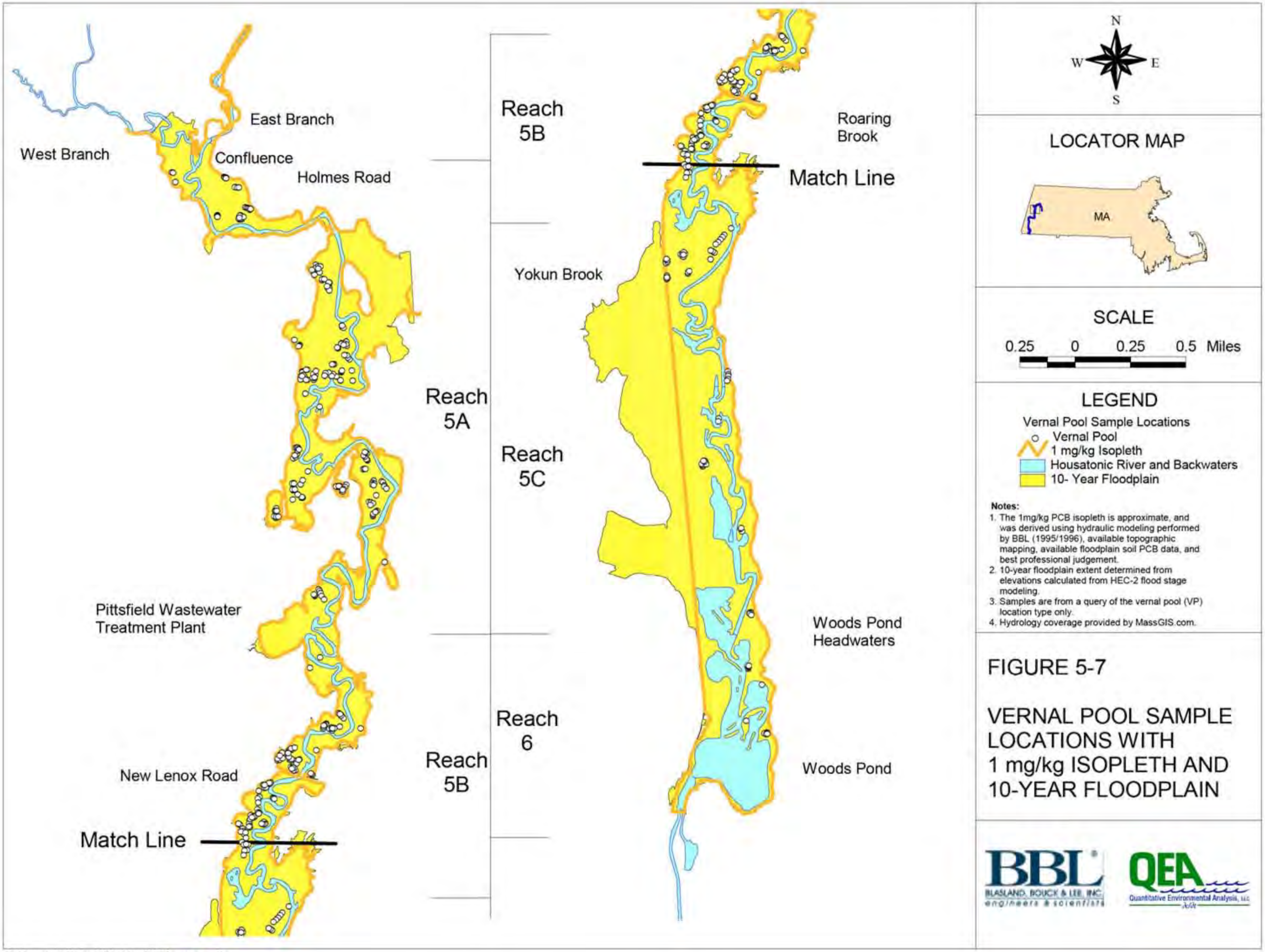

FIGURE 5-7

VERNAL POOL SAMPLE LOCATIONS WITH 1 mg/kg ISOPLETH AND 10-YEAR FLOODPLAIN

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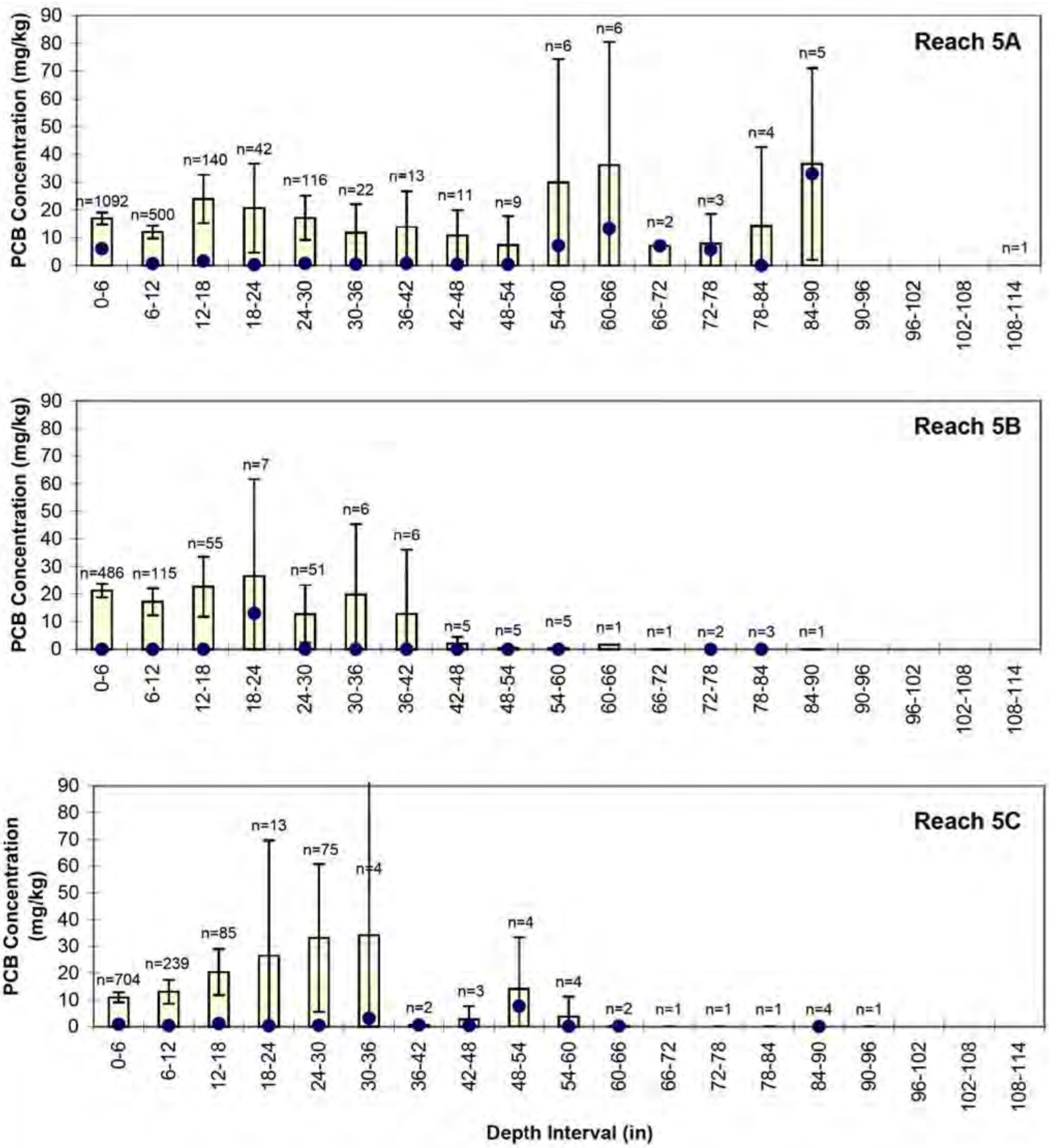

□ Arithmetic Mean

● Median

Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data.

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FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOILS PCB CONCENTRATION BY REACH AND DEPTH

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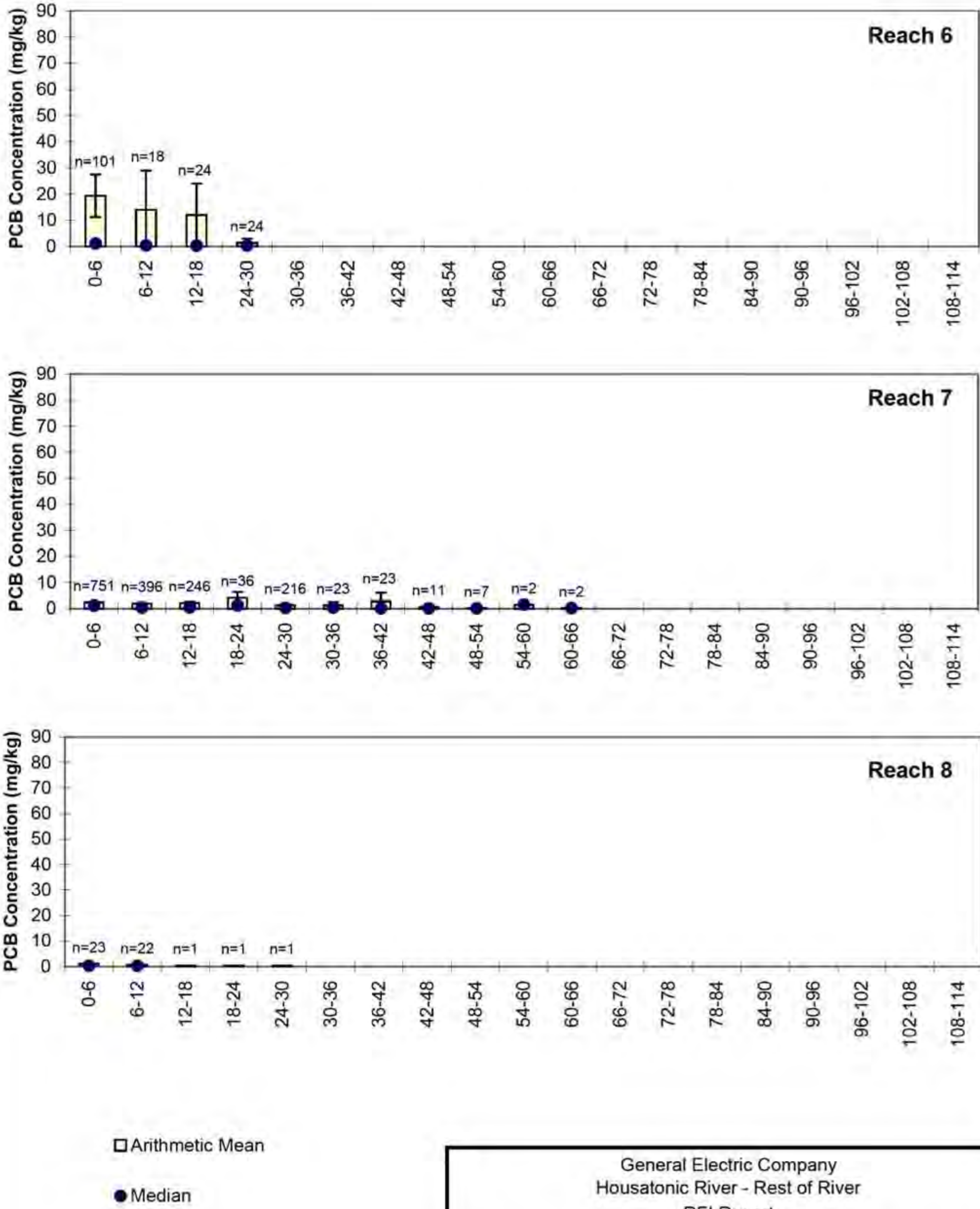
FIGURE
5-8a

V:\GE_Housatonic_Rest_of_River\Reports and Presentations\RFI Report - July Final\Figures\Section 5\Figure 5-8.xls



Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data.

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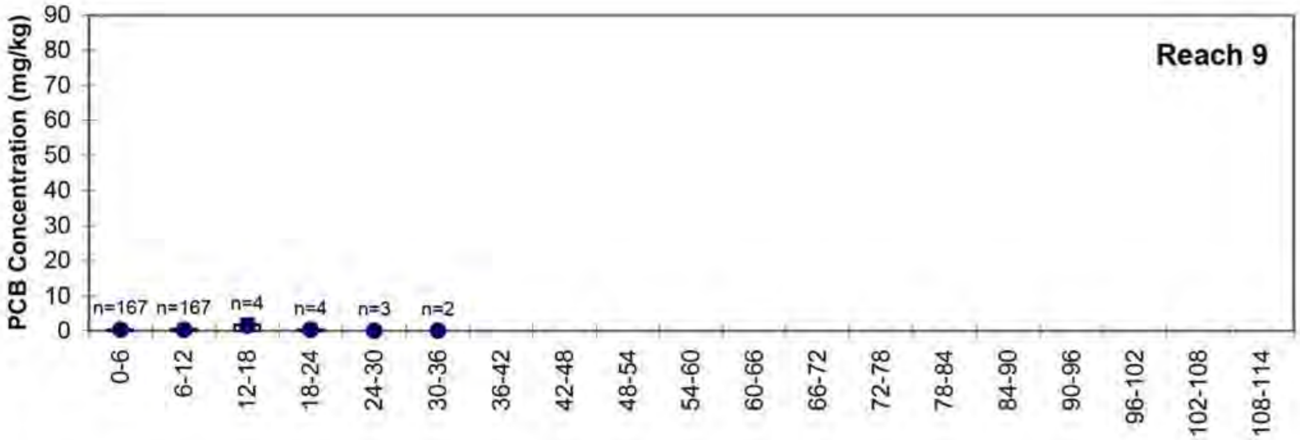
FIGURE 5-8b



□ Arithmetic Mean

● Median

Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data.

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FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOILS PCB CONCENTRATION BY REACH AND DEPTH

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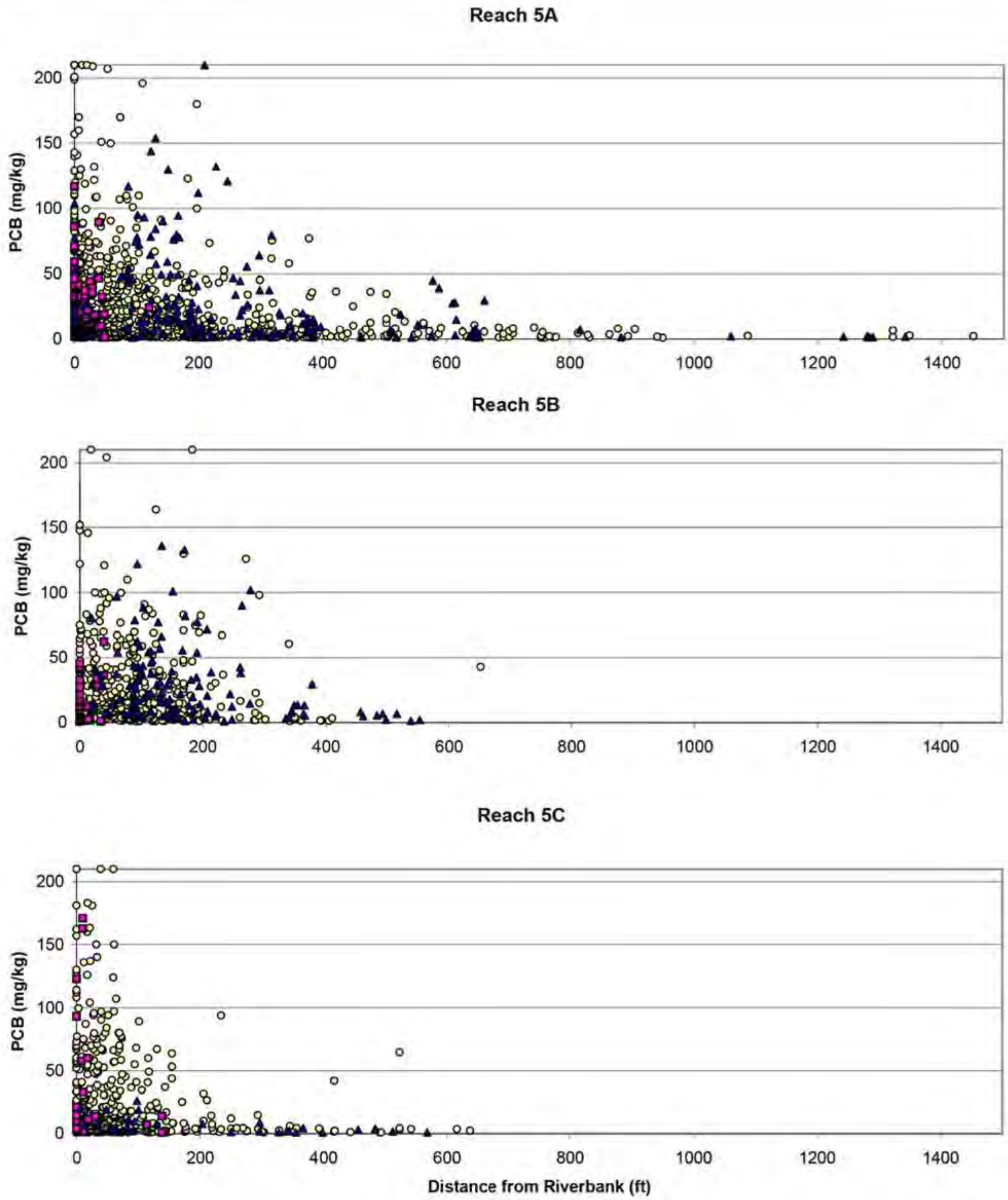
FIGURE 5-8c



LEGEND

- ○ Floodplain
- ■ Riverbank
- ▲ Vernal Pool

Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data greater than 1 mg/kg
4. Non detect values are shown as 1/2 the detection limit.
5. Values greater than 210 mg/kg are shown at 210 mg/kg

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PCB CONCENTRATION BY DISTANCE FROM RIVERBANK IN HOUSATONIC RIVER FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOIL - REACH 5

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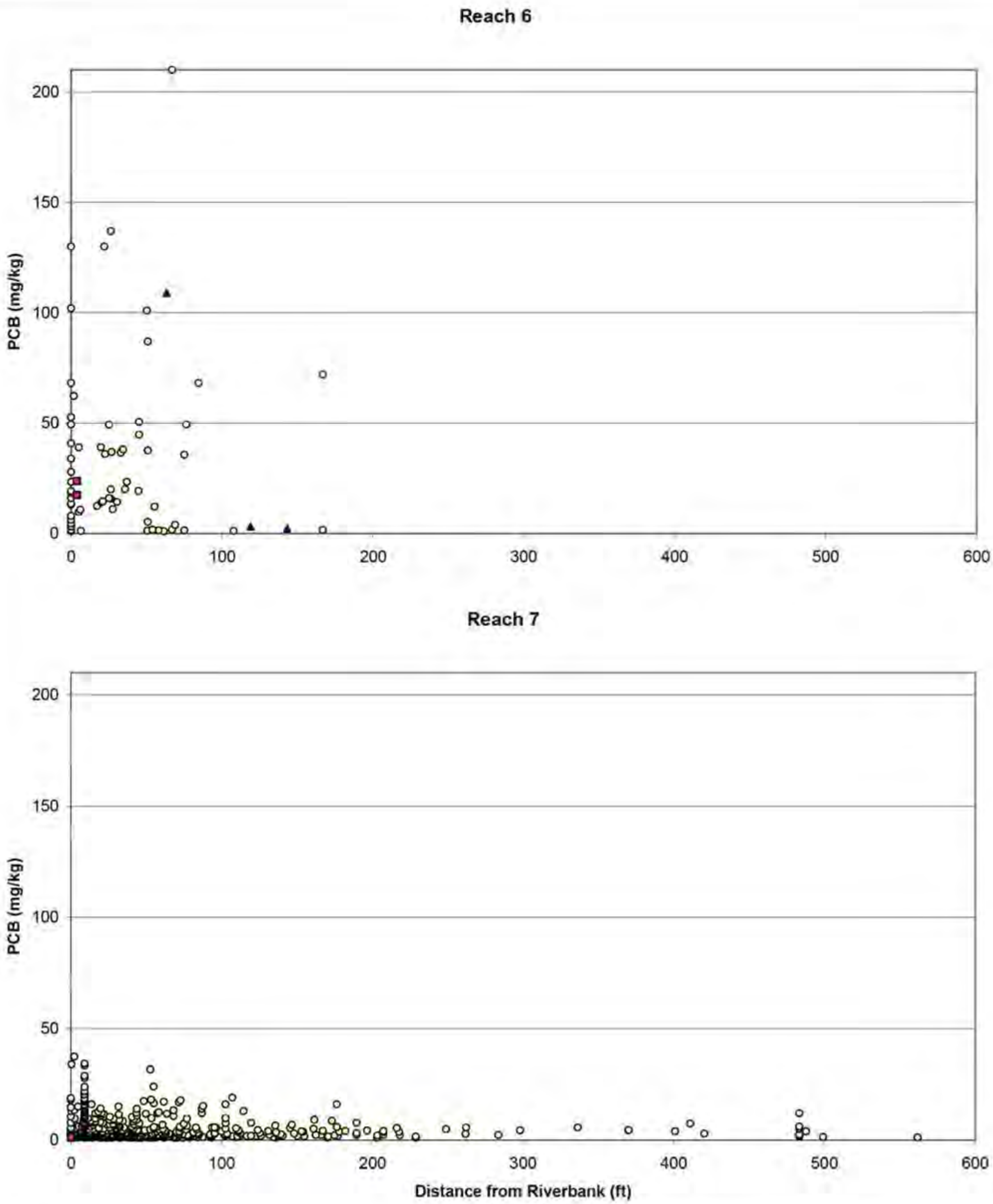
FIGURE
5-9

V:\GE_Housatonic_Rest_of_River\Reports and Presentations\RFI Report - Sept Final\Figures 5-9,5-10.xls



LEGEND

- ○ Floodplain
- ■ Riverbank
- ▲ Vernal Pool

Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data greater than 1 mg/kg
4. Non detect values are shown as 1/2 the detection limit.
5. Values greater than 210 mg/kg are shown at 210 mg/kg

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PCB CONCENTRATION BY DISTANCE FROM RIVERBANK IN HOUSATONIC RIVER FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOIL - REACHES 6 AND 7

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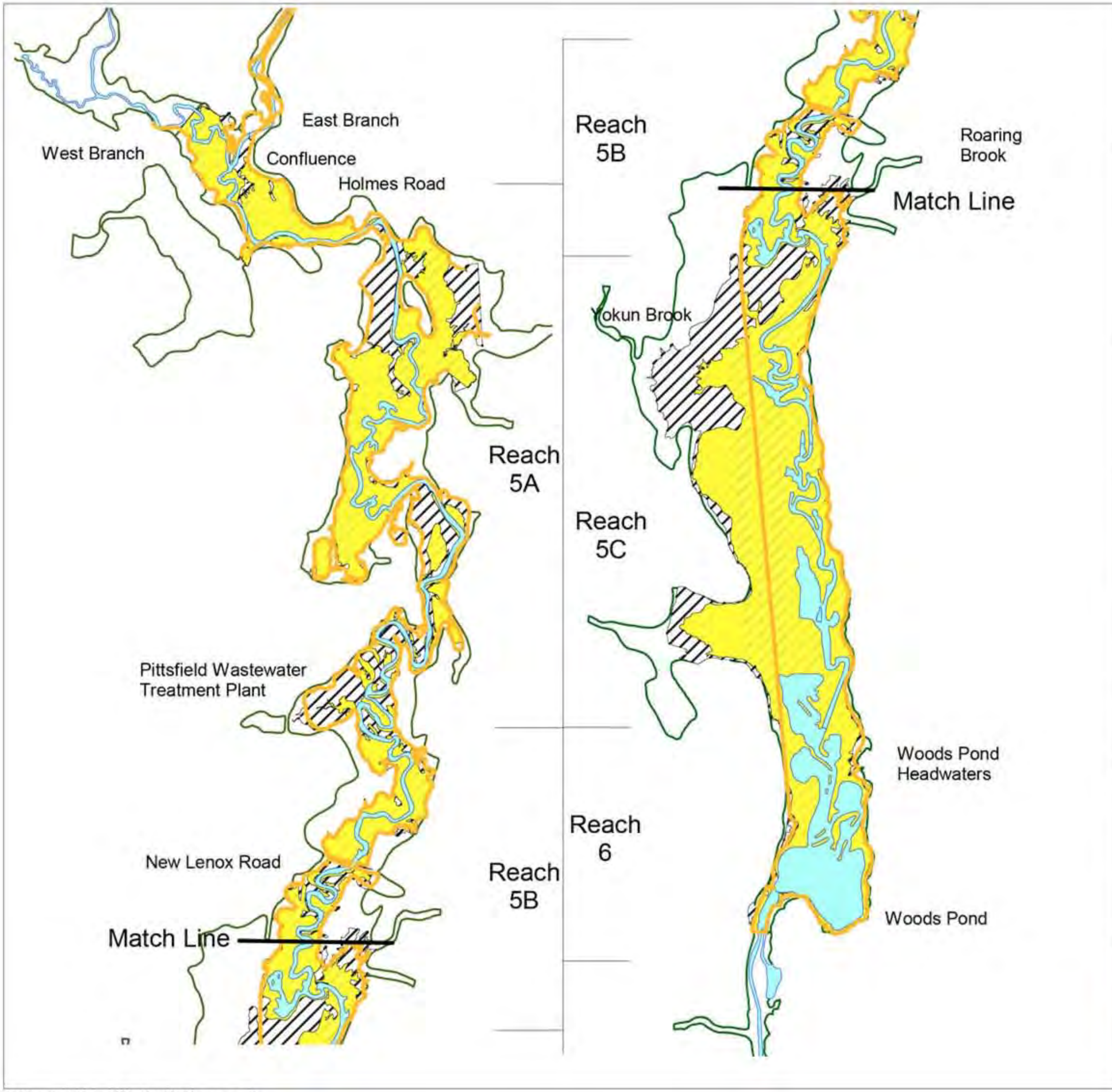
FIGURE
5-10



N
W E
S

LOCATOR MAP

SCALE

0.25 0 0.25 0.5 Miles

LEGEND

- 1 mg/kg PCB Isopleth
- Housatonic River and Backwaters
- 2- Year Floodplain
- 10- Year Floodplain
- 100- Year Floodplain

Notes:

1. The 1mg/kg PCB isopleth is approximate, and was derived using hydraulic modeling performed by BBL (1995/1996), available topographic mapping, available floodplain soil PCB data, and best professional judgement.
2. 2- and 10-year floodplain extent determined from elevations calculated from HEC-2 flood stage modeling.
3. 100-year floodplain coverage provided by FEMA (Q3 Flood data).
4. Hydrology coverage provided by MassGIS.com.

FIGURE 5-11

HOUSATONIC RIVER 2-, 10-, AND 100 -YEAR FLOODPLAINS

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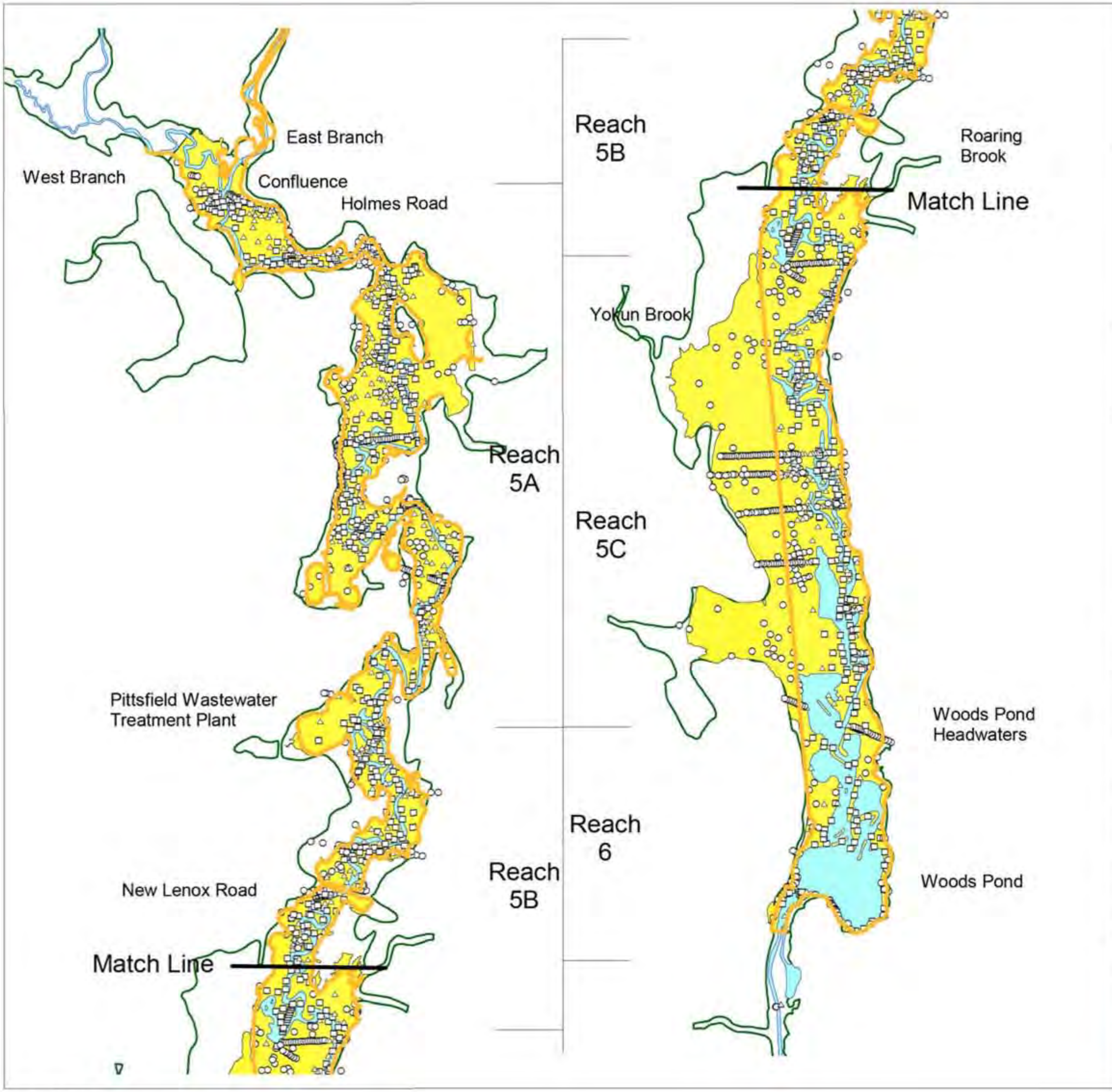
QEA Quantitative Environmental Analysis, LLC



LOCATOR MAP

SCALE

0.25 0 0.25 0.5 Miles

LEGEND

Surface PCB Concentrations

- ○ < 1.0 ppm
- △ 1.0 - 10 ppm
- □ > 10 ppm
- 1 mg/kg Isopleth
- Housatonic River and Backwaters
- 10-Year Floodplain
- 100-Year Floodplain

Notes:

1. The 1mg/kg PCB isopleth is approximate, and was derived using hydraulic modeling performed by BBL (1995/1996), available topographic mapping, available floodplain soil PCB data, and best professional judgement.
2. 10-year floodplain extent determined from elevations calculated from HEC-2 flood stage modeling.
3. 100-year floodplain coverage provided by FEMA (Q3 Flood data).
4. Hydrology coverage provided by MassGIS.com.
5. Includes all GE and EPA surficial floodplain and riverbank soil data. Does not include vernal pool data.

FIGURE 5-13

SURFACE SOIL (0-6 inches) PCB CONCENTRATIONS WITH 1 mg/kg ISOPLETH AND 10- AND 100-YEAR FLOODPLAINS

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QEA Quantitative Environmental Analysis, LLC

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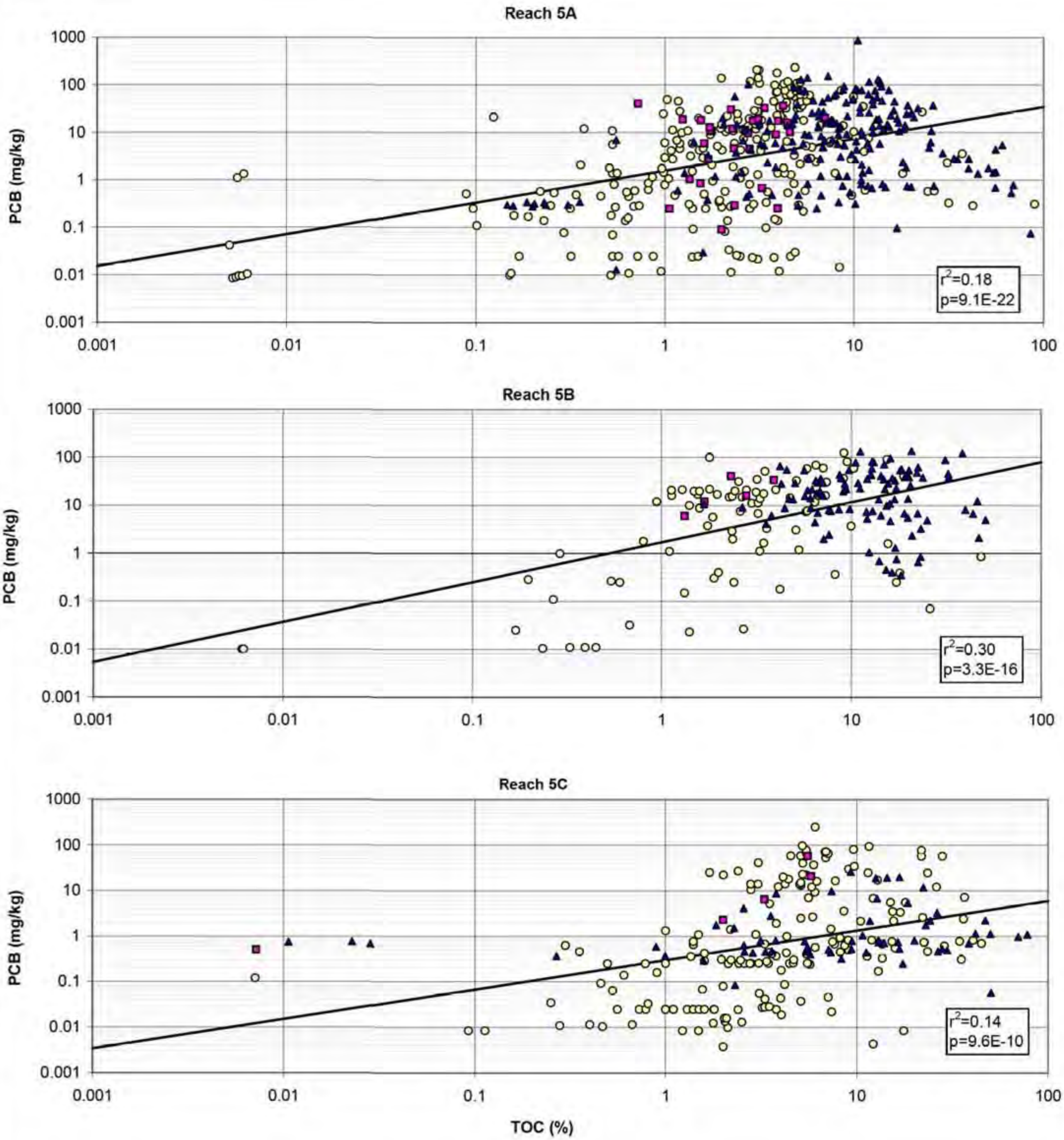
Housatonic Q:\HousatonicRiver\APRs\MassRFIFigures.apr - tbr



LEGEND

- ○ Floodplain
- ■ Riverbank
- ▲ Vernal Pool

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RELATIONSHIP OF PCB CONCENTRATION AND TOTAL ORGANIC CARBON IN HOUSATONIC RIVER FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOIL

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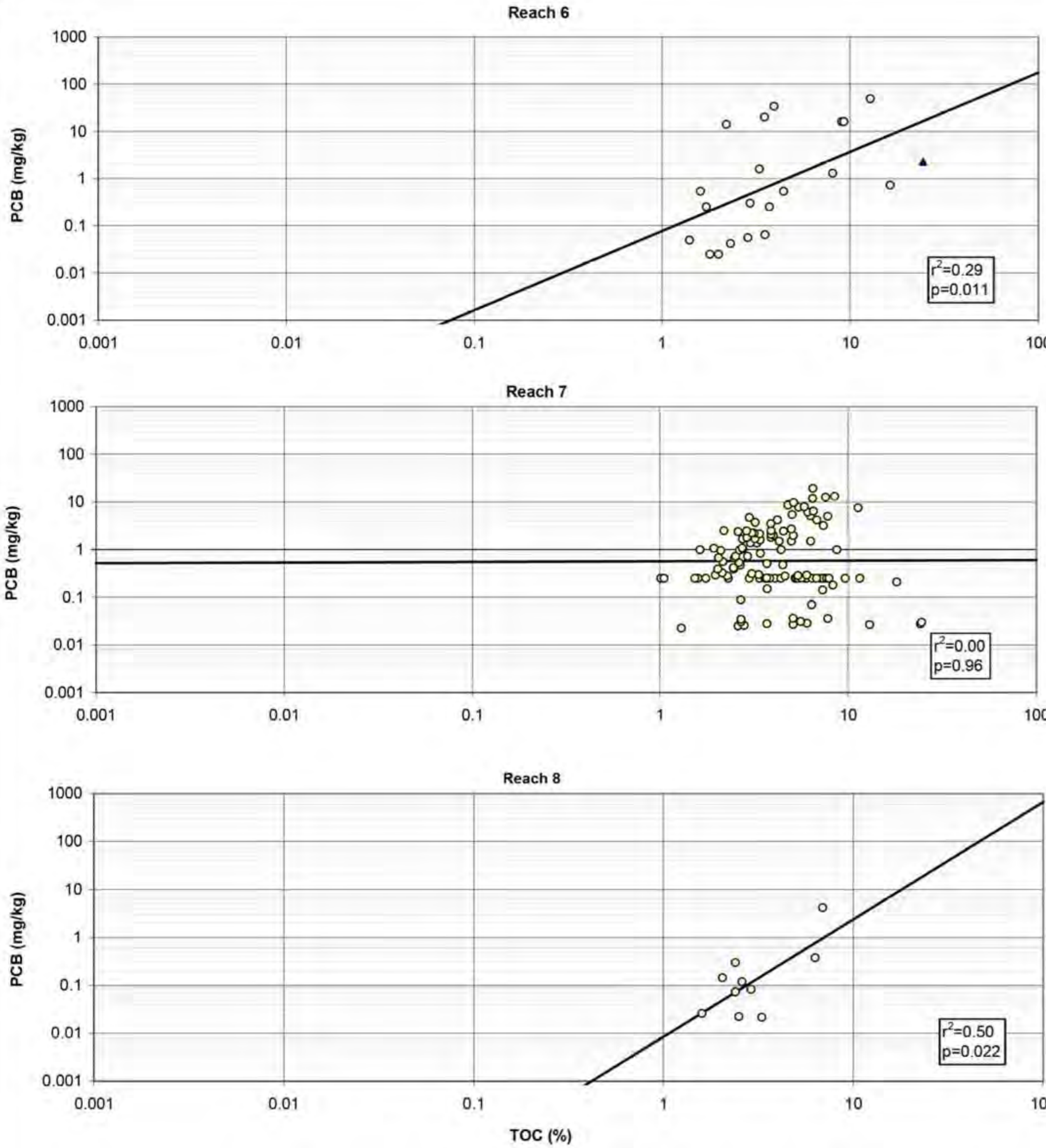
FIGURE 5-14a

Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data.
4. Non detect values are shown as 1/2 the detection limit.



Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data.
4. Non detect values are shown as 1/2 the detection limit.

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RELATIONSHIP OF PCB CONCENTRATION AND TOTAL ORGANIC CARBON IN HOUSATONIC RIVER FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOIL

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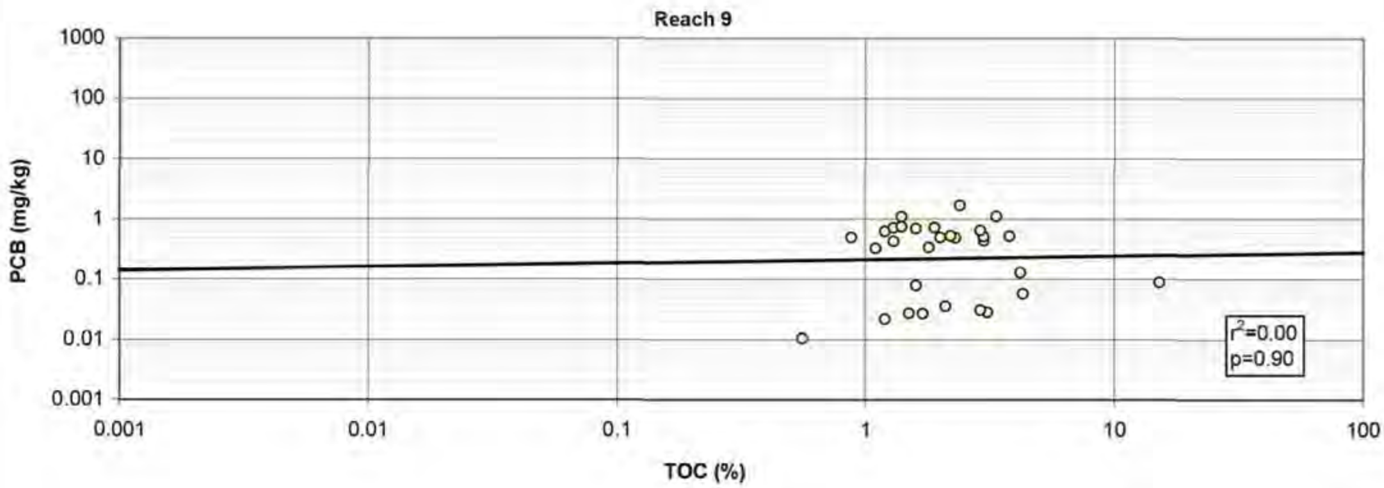
FIGURE 5-14b



Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data.
4. Non detect values are shown as 1/2 the detection limit.

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RELATIONSHIP OF PCB CONCENTRATION AND TOTAL ORGANIC CARBON IN HOUSATONIC RIVER FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOIL

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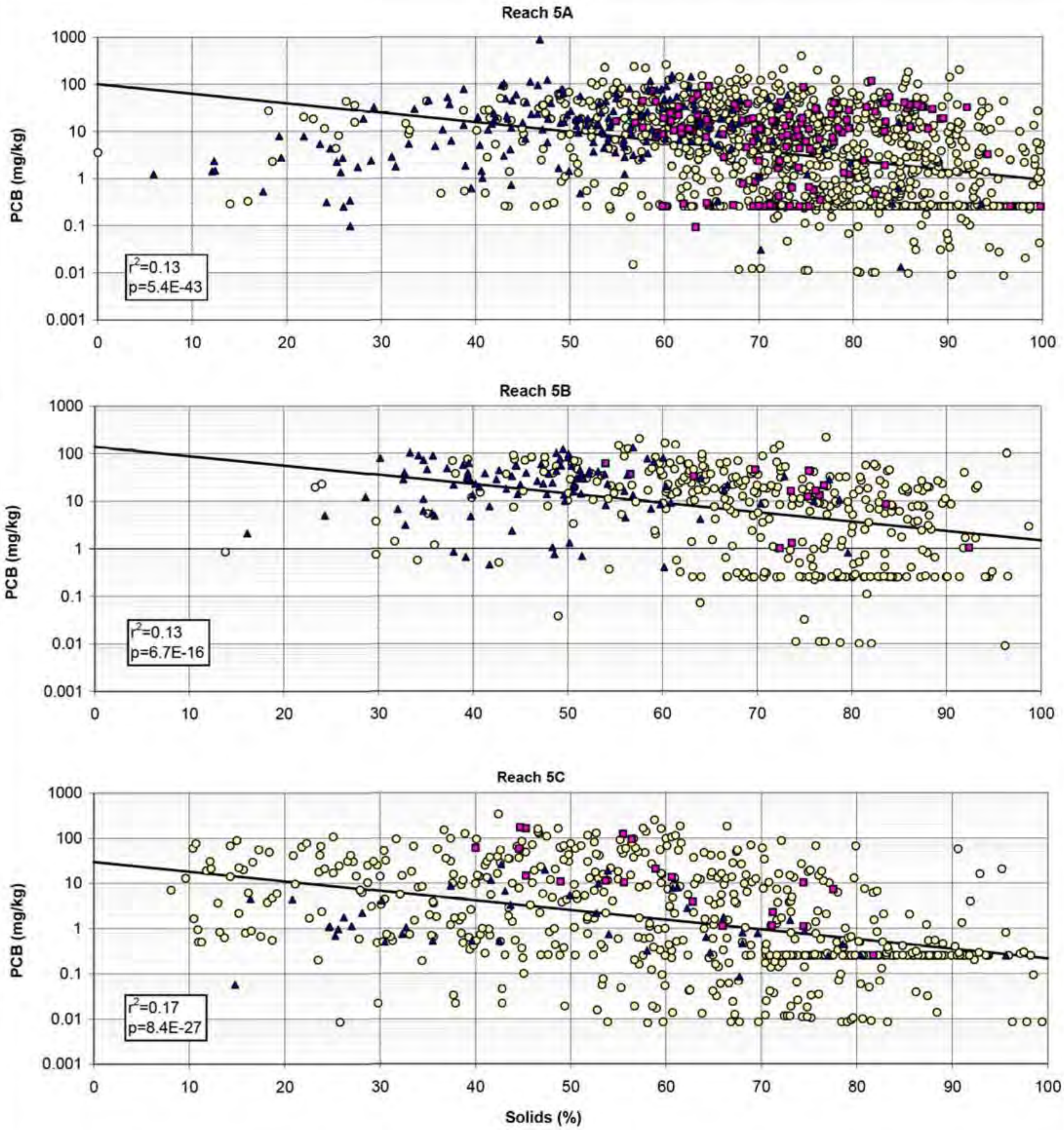
FIGURE
5-14c



LEGEND

- ○ Floodplain
- ■ Riverbank
- ▲ Vernal Pool

Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data.
4. Non detect values are shown as 1/2 the detection limit.

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RELATIONSHIP OF PCB CONCENTRATION AND PERCENT SOLIDS IN HOUSATONIC RIVER FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOIL

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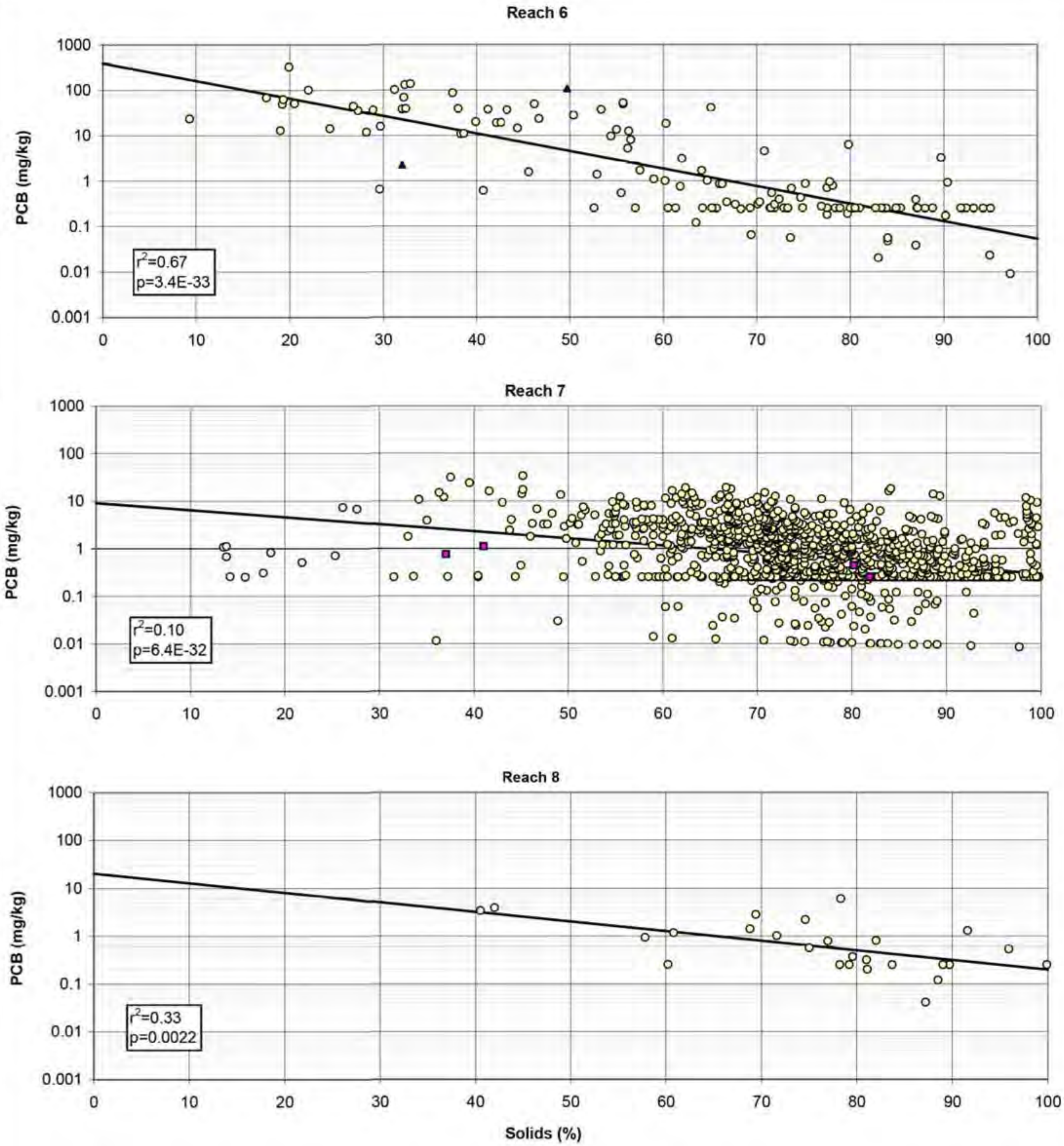
FIGURE 5-15a



Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data.
4. Non detect values are shown as 1/2 the detection limit.

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RELATIONSHIP OF PCB CONCENTRATION AND PERCENT SOLIDS IN HOUSATONIC RIVER FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOIL

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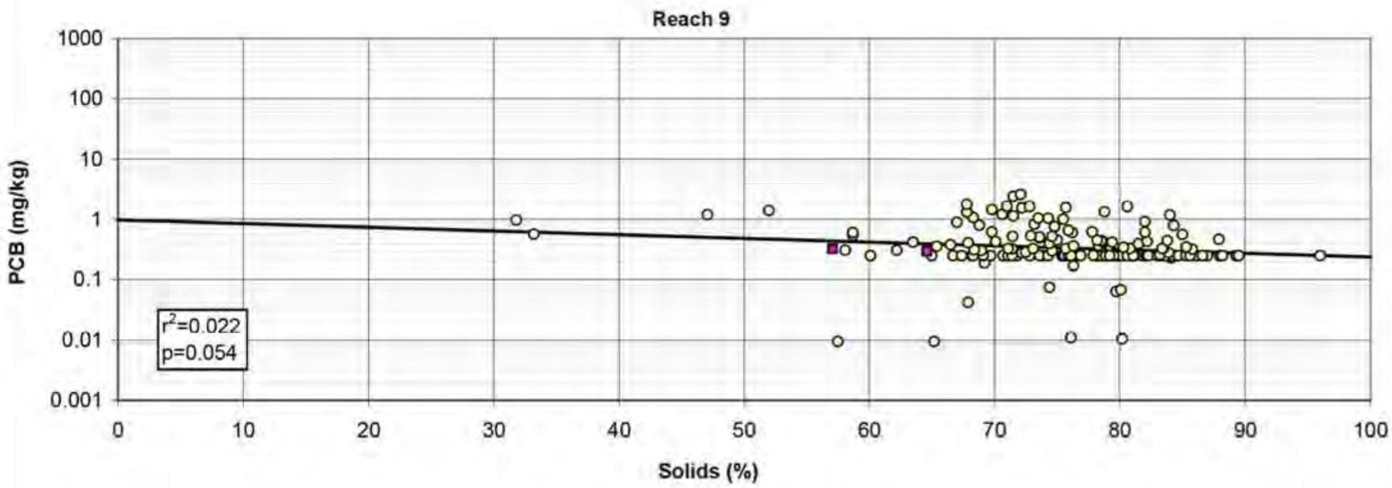
FIGURE
5-15b



Notes:
1. PCB = polychlorinated biphenyls.
2. mg/kg = milligrams per kilogram.
3. Includes all GE and EPA data.
4. Non detect values are shown as 1/2 the detection limit.

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RELATIONSHIP OF PCB CONCENTRATION AND PERCENT SOLIDS IN HOUSATONIC RIVER FLOODPLAIN, RIVERBANK, AND VERNAL POOL SOIL

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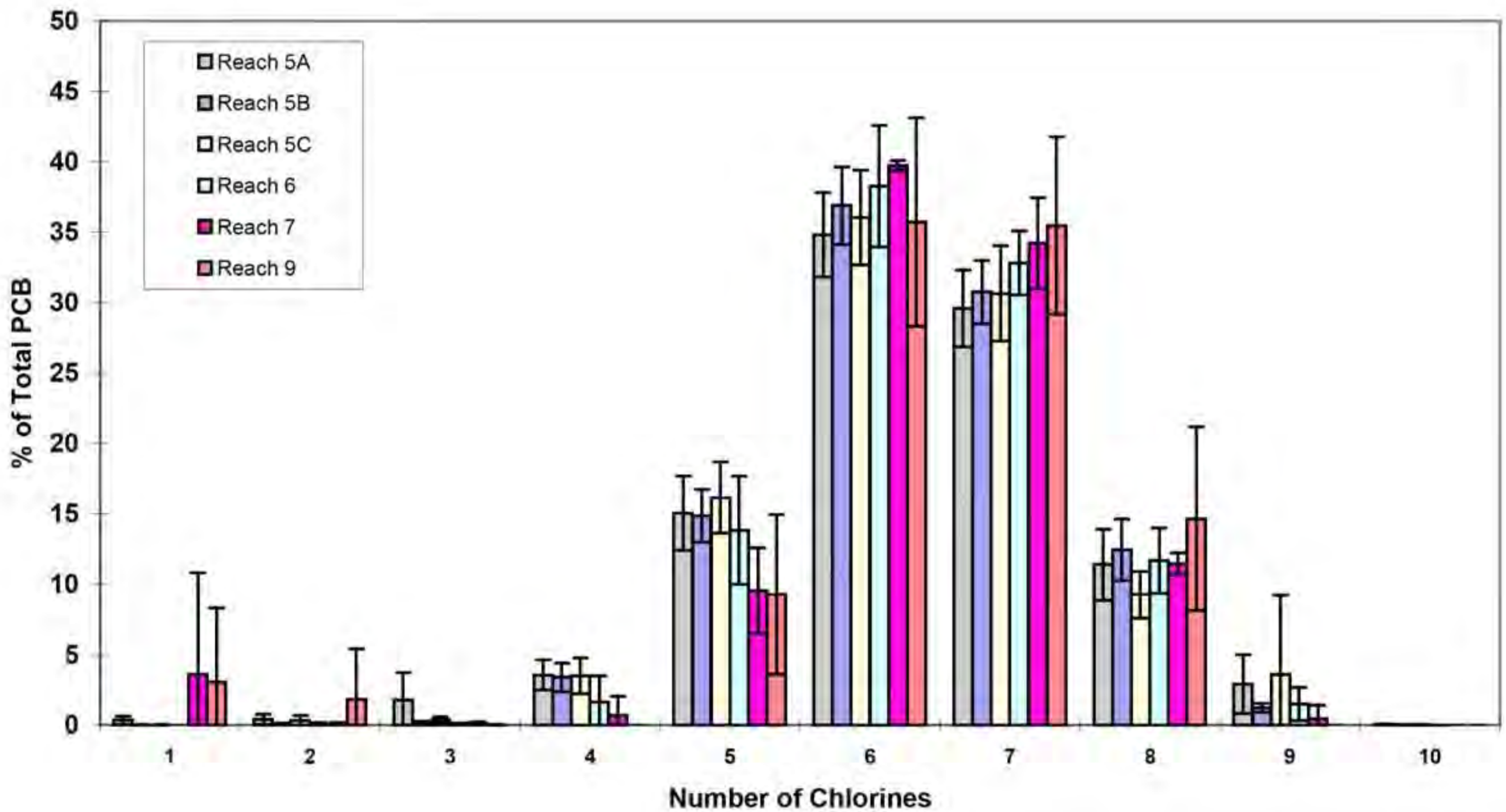
FIGURE 5-15c



Notes:
Presents arithmetic mean +/- 2 standard errors.
Includes all EPA homolog data.
Percentage based upon individual homolog divided by the sum of all homologs in a sample.

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FLOODPLAIN,RIVERBANK, AND VERNAL POOL SOIL AVERAGE PCB HOMOLOG DISTRIBUTION BY REACH

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FIGURE 5-16